

Report on development indicator evaluation in
electricity sector in Lao PDR

(Program evaluation analysis)

March 2013

**Japan International Cooperation Agency
Laos Office**

Abbreviations and Acronyms

ADB	Asian Development Bank
ASEAN	Association of Southeast Asian Nations
AusAID	Australian Agency for International Development
BOL	Bank of the Lao PDR
BOP	Balance of Payment
CA	Concession Agreement
DAC	Development Assistance Committee
DEB (MEM)	Department of Energy Business
DEM (MEM)	Department of Energy Management
DEPD (MEM)	Department of Energy Promotion and Development
DEPP (MEM)	Department of Energy Policy and Planning
DOE	Department of Energy (Philippines)
DSM	Demand Side Management
DSR	Debt Service Ratio
EDL	Electricité du Lao PDR
EDL-Gen	EDL-Generation Public Company
EGAT	Electricity Generating Authority of Thailand
EIA (1)	Environmental Impact Assessment
EIA (2)	Energy Information Administration (U.S.)
EPDP	Power Development Plan of EDL (EDL-PDP)
EPPO	Energy Policy and Planning Office (Ministry of Energy, Thailand)
ERAV	Electricity Regulatory Authority of Vietnam
ERC	Energy Regulatory Commission (The Philippines)
ESCO	Energy Service Company
ESIA	Environmental and Social Impact Assessment
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GMS	Greater Mekong Sub-region
GOL	The Government of the Lao People's Democratic Republic
HAPUA	Head of ASEAN Power Utilities/Authorities
HHI	Herfindal-Hitshman index
IDA	International Development Agency
IE	Institute of Energy (Vietnam)
IMF	International Monetary Fund
IPO	Initial Public Offering
IPP	Independent Power Producer

IPP (d)	IPP for domestic supply
IPP (e)	IPP for export
IREP	Institute of Renewable Energy and Promotion
IRR	Internal Rate of Return
ISPM	Improvement of Power Sector Management
JICA	Japan International Cooperation Agency
LDC	Least Developed Country
LEPTS	Lao Electric Power Technical Standard
LHSE	Lao Holding State Enterprise
LRMC	Long Run Marginal Cost
MAF	Ministry of Agriculture and Forestry
MDGs	Millennium Development Goals
MEA	Metropolitan Electricity Authority of Thailand
MEM	Ministry of Energy and Mines
MEMR	Ministry of Energy and Mineral Resources (Indonesia)
MIC	Ministry of Industry and Commerce
MOE	Ministry of Energy
MOF	Ministry of Finance
MOIT	Ministry of Industry and Trade (Vietnam)
MONRE	Ministry of Natural Resources and Environment
MOU	Memorandum of Understanding
MPI	Ministry of Planning and Investment
MPWT	Ministry of Public Work and Transportation
NERI	National Economic Research Institute
NPC	National Power Corporation (of the Philippines)
NSEDP	National Socio-Economic Development Plan
NPDP	National Power Development Plan
NPEP	National Poverty Eradication Program
ODA	Official Development Assistance
PDA	Project Development Agreement
PDP	Power Development Plan
PEA	Provincial Electricity Authority of Thailand
PPP (1)	Public and Private Partnership
PPP (2)	Purchasing Power Purity
RE	Renewable energy
RESD	Renewable Energy Development Strategy
REP	Rural Electrification Project (World Bank)
ROA	Return on Asset

ROE	Return on Equity
SAIDI	System Average Interruption Duration Index
SAIFI	System Average Interruption Frequency Index
SEA	Strategic Environmental Assessment
SPC	Special Purpose Company
SPP	Small Power Producer (Thailand)
TA	Technical Assistance
TNB	Tenaga National Berhad (of Malaysia)
TOU	Time of use
UN	The United Nations
WB	The World Bank
WDI	World Development Indicators
WREA	Water Resource and Environment Administration

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Executive Summary

1 Characteristics of Electricity Industry in Lao PDR

Lao PDR is blessed with rivers that have a large water volume. Lao PDR electricity, called the “battery of Indochina”, is an important export along with minerals. However, 80% of the supply capacity is produced by IPPs that carry out exports. Even though there is enough supply to meet domestic demand, they have to export a certain amount to international off-takers such as Thailand’s EGAT under the PPA contract.

In 2010, state-operated power company EDL separated its generation department from the main company as EDL-Gen. By doing so, EDL has become the single buyer. It is said that the objective behind this was to attract foreign investments in its generation department.

As a part of the electricity sector of Lao PDR, LHSE was founded as the investment company under the control of the Ministry of Finance. Through this company, investments to IPPs (SPC such as Nam Theun 2) are made.

2 Main Problems of the Lao PDR electricity sector

The main problems of the Lao PDR electricity sector can be categorized as follows: 1) Stable power supply for domestic consumers, 2) contribution to domestic economy, and 3) environment.

1) Stable power supply for domestic consumers

1-1) Energy security problem

As for energy security, there is a risk regarding dependence of national revenue on the export of hydro electric power. The significant part of the government revenue is comprised of royalties from hydro electric power and various taxes. Even though hydro electric power has a high supply capacity, imported electricity provided for 66% of domestic demand in March 2012. And it increases as domestic demand increases.

1-2) Problems of governance concerning investment promotion

The following items ([a] to [c]) are problems concerning investment promotion:

a) Problems concerning governance of the electricity sector

Problems include insufficient governance of the electricity sector (policy making/regulation on energy/electricity sector, etc.) and a lack of business administrative skills in electric companies (financial security/organization management of human resources/maintenance and management capability).

Solicited IPP bidding (single buyers formulate long-term power supply development plans and decide the development period of entering COD [Commercial Operation Date], scale and fuel of IPPs) is not prepared.

b) Uneven access to domestic and international transmission

Since EDL doesn’t have the financial capacity to install international transmission lines for export by themselves, IPPs have no choice but to arrange it by themselves. For example, even though it is economically efficient for Nam Ngum 3 and Nam Ngiep 1 to use the transmission lines constructed by Nam Ngum 2 (connecting Navon sub-station and the border), it is still under negotiation concerning a wheeling charge. As can be seen from this example, the transmission line is not neutral, and new domestic and foreign entrants cannot access it.

c) Various data are undeveloped

Various statistical data, procedures to collect data and updates, which are the basis of energy policymaking, water resources, and energy saving policy, are

underdeveloped. For example, data (power export amount(kWh), value (US\$)) registered by each ministry are not consistent (such as electricity export volume).

1-3) Problems concerning EDL's financial independence

EDL's financial problems are converted to off-taker risks that inhibit investment promotion. This is due to imports from neighboring countries, high purchasing price from EDL-Gen, and high transmission and distribution losses. Sales and profit per employee are lower compared to the utility companies in the neighboring countries. Electricity tariffs are set below the LRMC cost, although there is no direct subsidy. Although there is a cross-subsidy that makes the tariff structure non-cost reflective.

The electricity tariff is also affecting the financial independence of EDL significantly. The following 3 points are the main problems.

a) No set-up of peak / off-peak (TOU)

Although there is a peak tariff set for export and import of electricity, there is no peak tariff for domestic usage. Due to lack of TOU (Time of Use) tariffs, the run-of-river type of hydroelectric generation has a cost advantage, which makes the optimum usage of water resources difficult. The introduction of meters that are suitable for hourly measuring is necessary which have already been introduced in Thailand, Malaysia, and Philippines.

b) Electricity tariff structure does not reflect cost of sales for respective segments

There is no direct subsidy to the electricity sector but a cross-subsidy exists.

c) Only energy charge is set

The electricity tariffs consist only of an energy charge and are not divided into a basic charge and an energy charge. In Southeast Asia, Cambodia is another country with an electricity tariff containing only an energy charge.

1-4) Problems concerning international balance of payments

Foreign exchange reserves are only two months, and the significant import of electricity during the dry seasons is also affecting this problem.

2) Contribution to national economy

2-1) Poverty reduction

The difference in the diffusion ratio and availability of electricity between rural and urban areas, including Vientiane, creates an economic disparity due to the deficiency of domestic electricity supply, undeveloped transmission lines, and low electrification ratio in local and mountainous regions.

2-2) Effective usage of water resources

Comprehensive plan for optimum for utilization of water resources including hydroelectric power, irrigation, and flood prevention is not coordinated among ministries.

2-3) Development of manufacturing industry

In order to deal with rapid domestic demand increase, EDL also has to import from neighboring countries including Thailand. EDL's profit becomes negative (cost loss margin back spread).

3) Consideration of the environment

Stricter investment regulations are lowering profitability of hydro electric power. Therefore, due diligence during F/S (Feasibility Study) becomes unsuitable after starting business.

Increase in coal generation will contribute to adjusting to the changing load more in a flexible way during the dry season, thus contributing to energy security. On the other hand, there is a risk of increasing CO₂ emission.

Considering problems above, we conducted Cross-SWOT analysis to provide solution for addressing current situation.

		External factors	
		Opportunity	Threat
Internal factors	Strength	<ul style="list-style-type: none"> •Rapid increase in power demand in neighboring countries (Thailand, Myanmar, Vietnam, China) (O1) • Increase in labor costs in Asian countries (O2) •Enlarged domestic power demand (O3) 	<ul style="list-style-type: none"> •Growth of neighboring economies (T1) •Revision of power purchase contract between EDL and GAT (Thai) (Thailand's energy policy (T2)
	Weakness	<ul style="list-style-type: none"> •Low cost generation from abundant water resource (S1) •Low labor cost (S2) •Abundant mineral resources (S3) 	<ul style="list-style-type: none"> •Attract electricity consuming industries (S1, S2) •Reinforce coal generation and aim at domestic and foreign peak demand during the dry season (S3, O1) •Attract labor intensive industry (S2, O2)
		<ul style="list-style-type: none"> •Undeveloped distribution line (W1) •Weak financial structure of EDL (W2) •Budget deficit (W3) •Low population(W4) •Underdeveloped system accepting investment(W5) 	<ul style="list-style-type: none"> •Transmission lines to be completed (W1, O1, O3) •Revision of electricity tariff (W2, O1, O2) •Enlargement of hydroelectric power export (W3, O1) •Early development of system accepting investment (W5,O1)

Source: Created by H. Nagayama, Kyoto University

Fig. Cross-SWOT figure about electricity industry in Lao PDR

3 Verification of relevance and effectiveness of proposed electricity development indicators

The relevance of DAC5 items is a degree of consistency between development aid and target group, counter country, donor's priority, along with policy and purposes. The effectiveness is a scale to measure the achievement degree of the development aid's goal. To achieve the goal of the program, drawing out the program outcome is necessary, and to achieve the program outcome, program output, which shows the direct effect of the projects on the indicators, is also necessary.

3.1 Verification of relevance

“The program” has to be consistent with Japan's basic policy (main goal) of assistance for Lao PDR (to help Lao PDR achieve MDGs and escape from LDC), and contributes to “support for improving domestic gap of access to electricity and electricity export through expanding safe and stable electricity supply” in the economic and social infrastructure maintenance, one of the Japan's emphasized areas (medium goals).

In the relationship to Japan's task guides <Energy supply>, the following four main tasks are addressed.

Task 1: Stable power supply to ensure sustainable economical development (formulation of comprehensive energy policy, drawing up energy development plan, construction and generation and maintenance of transmission and distribution facilities, drawing up electricity technical standard, and technical experts in electricity field)

Task 2: Promotion of rural electrification from the viewpoint of human security

Task 3: Design of electricity sector reform

Task 4: Energy supply with environment consideration

To satisfy the aforementioned Task 1, Japan has prepared basic data in Lao PDR's power and energy field through “Data Collection Study on Energy Sector in Lao PDR (2012)”. Through “Project Improvement of the Government Mechanism for Sustainable Power Development Planning (finishing in 2013)”, JICA is preparing for full-scale aid for policymaking of the National Power Development Plan.

Lao-Electric Power Technical Standard is prepared through the “Improvement of Power Sector Management (IPSM, 2013)”.

Throughout these projects, technical experts in the power field in the country were trained.

In Task 2 and 4, JICA is promoting rural electrification and energy supply with environmental consideration under “Technological aid for small sized hydropower development potential (Hydropower plan research)”.

Relevant to the Lao government's policy, the program goal of <Enlarged supply of stable, sustainable and effective electricity for realization of socio-economic development> is the basic policy among the nation's 7th National Socio-Economic Development Plan (2010-2015). The specific to the electricity sector of NSEDP are as follows:

- ① Extend distribution lines and increase electrification ratio through rural electrification by off-grid types of generation
- ② To fulfill the growing need of electricity, reinforce domestic supply power
- ③ Adjust EDL's administration according to commercial principles

However, the following project outcomes were considered

- i) Stable power supply
- ii) Contribution to domestic economy
- iii) Consideration of environment

It seems appropriate to change the program goal to < Enlarged supply of stable, sustainable and effective electricity for enhancement of GDP through realization of socio-economic development>.

Due to the change of this goal setting, the goal of this project should conform to the 7th Socio-Economical Development Plan (2010-2015). The goals of this plan are to “maintain economic growth in a stable and progressive manner at more than 8% per year (GDP per capita estimation for 2015 is about US\$ 1,700 per person per year at current prices), achieve MDGs (including poverty reduction) and parity with ASEAN Community by 2015, acquire modern technologies and infrastructure, and establish a diverse economic foundation to move the country out of its Least Developed Country status in 2020.”

3.2 Verification of effectiveness

3-2-1) Consistency between the program goal and program outcome (socioeconomic activity)

The program outcome, including energy security, contribution to nation's economy, and environmental consideration, meets the consistency when the effectiveness and relevance were verified. Energy security, investment promotion, EDL's financial independence and contribution to international balance of payments through export should be realized by a stable supply of electricity. Industrial and agricultural production increase through supply of domestic cheap electricity and utilization of water resources, contributing in turn to the national economy by reducing economic disparity and poverty. However, environmental considerations, including management of CO₂ and optional utilization of water resources, have to be considered to achieve the program's goal.

3-2-2) Consistency between program outcome and program output

As the result of the program output, the program outcome can be achieved. Thus consistency between them is valid.

Output 1: Reinforcement of electricity administrative management capacity contributes to stable power supply through restructuring the power sector (including establishment of independent electricity regulatory authority). Especially, the formulation of a comprehensive electricity development policy directly provides a significant impact on the power supply plan of EDL-Gen, IPP (d) and IPP (e). Strengthening of the regulatory framework enhances investment in the electricity sector through improvement of EDL's financial strength and investment promotion and enhances power supply capacity through utilization of water resources.

Output 2: Power facilities contribute to a stable power supply by forming the physical facilities. However, if formation of electricity facilities doesn't match the consideration of the environment, a balanced development of the country cannot be expected. Electricity facilities contribute to a stable power supply through power generation, transmission and distribution, enhancement of supply capacity in rural electrification, reduction of transmission and distribution loss, and more efficient power transmission and distribution by connecting with GMS.

Output 3: Enhancement of business administration capability for the electricity business undertakers (EDL, EDL-Gen and IPPs) contributes to a stable power supply by structuring efficient entities. Financial and planning capacity, organization management capacity, and project implementation and supervision capacity can lead to reinforcement of EDL's financial strength through improvement of EDL's business management capacity.

As for contribution to a development strategy (way of thinking about indicators), there are only two numerical goals: electrification ratio and renewable energy introduction ratio. However, through program evaluation analysis in the "Development indicator analysis

on Lao PDR electricity sector program”, we have set indicators (including qualitative value) for output and outcome which led to a clearer relationship between the two. In the future, monitoring and business enforcement of development strategy indicators for goal achievement becomes necessary under cooperation with other donors.

3-2-3) Cooperation with World Bank Group, ADB

As for the cooperation with World Bank Group and ADB, it is hard to say that the scenario for cooperative program goal achievement is appropriately set because the number of staff organization, investment fund, and promotion of project differ between these facilities, including JICA. In order to bring consistency to the program, close cooperative communication with other aid facilities is necessary in planning and enforcing items. For example,

- 1). For effective utilization maintenance of water resources, World Bank’s “Water resources law maintenance project” and “Valley maintenance/ modeling aid project” and JICA’s “National power development plan (planned enforcement item)”
- 2). For reinforcement in order to promote investment, World Bank’s “IPP contract maintenance project” and JICA’s “Electricity sector governance reinforcement project”
- 3). For aid to small hydropower projects, World Bank’s small hydropower private investment promotion, ADB’s small hydropower F/S aid and JICA’s “Electricity sector governance reinforcement projects”

3.3 Revision of output indicator items

The following indicators were added to the original set of indicators from the viewpoint of effectiveness

Output 1: Reinforcement of electricity administrative management capability

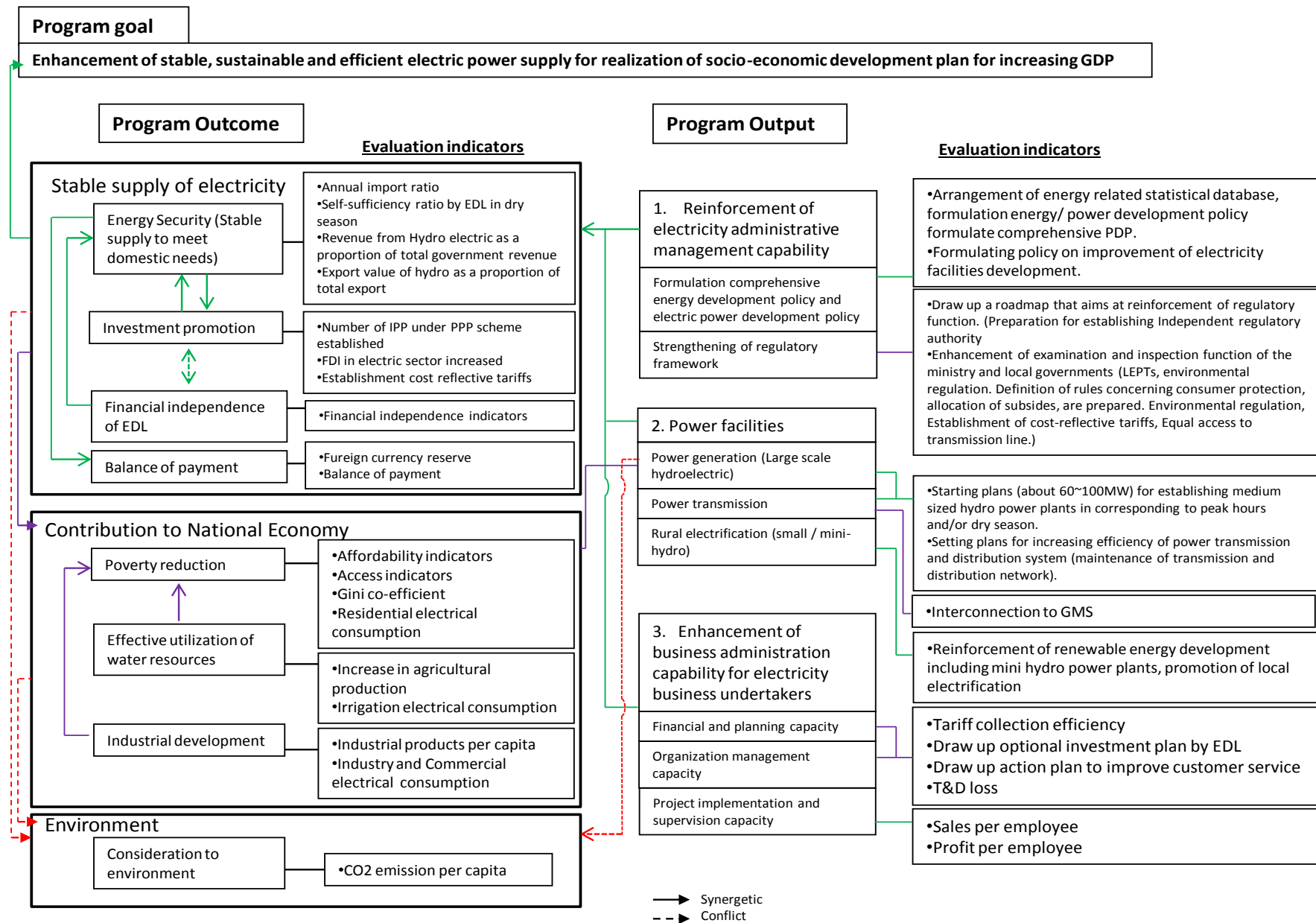
Establishment of independent regulatory committee, introduction of cost-reflective tariffs, development with economical balance, and environmental regulations with consideration for balanced growth with economy

Output 2: Power facilities

Small to medium sized (60-100MW) hydropower generation facilities to adjust to peak hours, added

Output 3: Enhancement of business administration capability of electricity business undertakers

Reductions of transmission and distribution loss, enhancement of tariff collection ratio were added. Sales per employees, and profit per employees were also added for numerical target for improved business administration of EDL.



Source: Created by Kyoto University, Nagayama

Summary Figure: Verification of relevance and efficacy

4 Proposal of development indicator for the project

4.1 Approach to development indicator

In this project, we have come up with indicators for program's goal, then indicators for the three outcomes and lastly indicators for outputs, which can be gained through achievement of project under the "Electricity Maintenance program" of Lao PDR made by JICA.

Furthermore, the indicators used in the project were evaluated separately from four viewpoints: 1) accessibility, 2) comparability, 3) verifiability, and 4) relationship between outcome and output. Also, specific situations and problems of Lao PDR were considered.

- 1). As for accessibility, some statistical data are not provided by Lao PDR. For example, the electricity export value of 2011 is 75.97 million dollars according to the Lao Central Bank's official statistics. However, according to the data used by NERI, it is 280 million dollars. According to MEM's annual report (2011-2012), it is 435 million dollars. The problem is that data, which should be captured by the customs office, are not well captured.
- 2). For comparability, criteria are easier to compare between Lao PDR and the benchmarked neighboring countries. Since the WDI and EIA data are appropriate for international comparison, we used them if they are available.
- 3). For verifiability, we have considered if the same data would be accessible for future monitoring. For example, there is a limit concerning obtaining data about the amount of imported electricity. NERI cannot make the right estimation for this amount. This is because, depending on the transmission and distribution line's installation, the imported amount from Vietnam, China, and Thailand may change.
- 4). For relevance of outcome, output indicators if it is mutually irrelevant and exclusive, it is practically not a meaningful indicator. Indicators qualitative viewpoint were also considered.

For constructing the development indicators, making a definition of each policy's achievement becomes necessary.

Stable Supply of Electricity, Energy Security, Access, Fiscal Dependence of the sector and Affordability were defined as follows:

- Stable Supply of Electricity: "Enlarge electricity export and improve contribution to national revenues" and "Enlarge power supply for domestic consumers, provide low cost electricity to domestic industries and people, and develop new industries".
- Energy Security: "Decrease the imported electricity ration during the dry season in Lao PDR, where hydropower consists 99% of the generation. Also, decrease export ratio and the percentage of hydropower generation in national revenue". For this purpose, increase coal-fired generation to curb imported electricity in the dry season. Through strengthening bargaining power in negotiating with neighboring countries, and through improving added value of electricity export, net import will be reduced.
- Access: "The proportion of consumers which have reasonably uninterrupted usage of electricity supply to potential consumers".
- Fiscal Dependence of the EDL: "The financial support from the government or cross-subsidy among different customer classes is minimal. In order to attract investment, EDL should have strong financial capabilities as off-takers. For this aim, electricity prices have to be raised to match cost".
- Affordability: 'The proportion of electricity-related expenditure to amounts payable for electricity.'

In this project, program goal, program outcome, and program output were evaluated under accessibility, comparability, and verifiability.

Program Goal

The program goal was “Enhancement of stable, sustainable and efficient electric power supply for realization of socio-economic development plan for increasing GDP”, and indicators are GDP per capita and Power consumption per capita (kWh).

In Lao PDR, it is expected that electricity exports occupy a large share of all exports. If support for the electricity industry is made effectively and increases domestic electricity supply and export, and reduces import, it is expected that the GDP will be increased as shown in simple macro economies for $Y = (C: \text{Consumption}) + (I: \text{Private investment}) + (G: \text{Government expenditure}) + (EX: \text{Export}) + (IM: \text{Import})$.

Summary Figure Indicators of Program Goal

		Unit	Source	Data		
				2010 ~ 2015	2015 ~ 2020	2020 ~ 2025
Enhancement of stable, sustainable and efficient electric power supply for realization of socio-economic development plan	GDP per capita(2011) (2000 constant price)	USD	WDI	591(Laos) 737(Vietnam)	< Benchmark > 1206(Indonesia) 1413(Philippines)	< Benchmark > 2699 (Thailand)
	Power consumption per capita (kWh)	kWh	WDI	357 (Laos)	640 (Indonesia) 140 (Philippines) 1034(Vietnam)	2243 (Thailand)

Program Outcome (Influence to social activity)

In program outcome (contribution to society) stable i) stable power supply, ii) contribution to domestic economy and iii) environment consideration was adopted.

Summary Figure Indicators of Program Outcome

Stable supply of electricity

	Unit	Source	Data			
			2010~2015	2015~2020	2020~2025	
Energy Security (Stable supply to meet domestic needs)	Annual import ratio	%	MEM	45% (2012 Average)		
	Import ratio by EDL in dry season	%	MEM	66% (March 2012)		
	Export value of hydro as a proportion to total export	%	BOL/IMF	10.5%(2010) 27%(2013); IMF projection		
	Share of coal (domestic supply) to total domestic supply	%	PDP2012	0%	4%(2015)Hongsa(100MW/2,356 MW)	
	Share of hydropower as a proportion to Total government revenue	%	IMF / MEM annual report	4.4%(2010)	5.2%(2016)	
	RE ratio (Solar + Wind + Small hydro + Solid waste + Biomass / Biogass + Geothermal)	%	PDP2012 RESQ2011) WDI	0.18% (2011)	RESQ RE: 243MW (2020)	30% of Total energy consumption by 2025 RESQ RE: 728MW (2025) <Benchmark: Mwh Base> Vietnam 0.1% (2010) Malaysia 1.02% (2010) Indonesia 5.6% (2010) Thailand 2.1% (2010) Philippines 14.8% (2010)
	HHI		WDI MEM	Laos(2011) 9,869	<Benchmark> Thailand (2010) 5966	<Benchmark> Philippines 2,474(2010) Indonesia 2,717(2010) Vietnam 4,411(2010) Malaysia 2,282(2010)
	Green Energy (RE + Hydro + Gas)		WDI MEM	99.5% (2011)		<Benchmark: MWh Base> Vietnam 75% (2010) Malaysia 62.69% (2010) Indonesia 39.6% (2010) Thailand 80.4% (2010) Philippines 55.1% (2010)
	Energy intensity Total Primary Energy Consumption per dollar of GDP	EIA	Btu per Year 2005 U.S.D (Market Exchange Rates)	Laos 10,832(2010)		<Benchmark> Thailand (2010) 20,585 Philippines (2010) 9,283 Malaysia (2010) 17,392 Indonesia (2010) 16,049 Vietnam (2010) 25,108
	Number of IPP projects under PPP scheme established	%	MEM	(Xekatom, NT2)		
FDI in Electric Sector / Total FDI	value / FF	MPI	0.72% (2011)			
Domestic investment in Electric Sector	value / FF	MPI				
Share of IPP(e) / Total capacity	%	MEM (PDP 2010-2020)	15% (2011)		13% (2020)	
Share of IPP(d) / Total capacity	%	MEM (PDP 2010-2020)	31% (2011)		76% (2020) <Benchmark> Philippines 55.1% Vietnam 75%	
Financial Independence	Self-Financing Ratio = Operating Cash Flow less Debt Service / Capital Investment (%)	%	EDL	0.07 (2010) 0.06(2011)		Target>30%(WB covenants)
	ROA = Profit before income taxes / Total Assets	%	EDL	1.35 (2010)	<Benchmark> 7.7% (2011:EGAT)	
	ROE = Net profit / Total Equity	%	EDL	1.58 (2010)	<Benchmark> 12.2% (2011:EGAT)	
	Debt to equity ratio	Ratio	EDL	0.64(2010) 1.3 (2011)	<Benchmark> EGAT 0.59 (2011)	Target<1.5(WB covenants)
	Profit ratio	%	EDL	5.09 (2010)	<Benchmark> 7.3% (2011:EGAT)	
	Debt service coverage ratio	%	EDL	1.21 (2011)		Target> 1.5(WB covenants)
	Estimated Government Subsidy for residential customers @ 150kwh	US AID	US cents/kwh	Laos 0	<Benchmark> Thailand 8.8 Philippines 0 Malaysia 4.51 Indonesia 8.38	
	Estimated Average Set (Cost of sale) for residential customers @ 150kwh	"Implementation Completion and results report of the Rural Electrification program" (2012)	US cents/kwh	EDL/Cost of supply 959k/kWh (11.9 US cents / kWh) (2009) 946k/kWh (11.8 US cents / kWh) (2010) 976k/kWh (12.2 US cents / kWh) (2011)	<Benchmark> Thailand 19.18 Philippines 19.84 Indonesia 15.61 Malaysia 15.25	
	LRMC / Average Tariff : ratio	Ratio	World Bank (Tariff study) Merako (2012)	LRMC/Average tariff = 1.02 (Average tariff (2011) 647 k/kWh LRMC 661k/kWh (Distribution LV before loss)) <Benchmark: Merako(2012)> Merako(Philippines) 1 Malaysia 1.56 Thailand 1.58 Korea 2.05 Taiwan 2.16 Indonesia 1.98	<1	<1
	Subsidy/Average Electricity Tariff	Ratio	EDL / USAID	Laos(0), Only In-kind	<Benchmark> Thailand 0.85 Indonesia 1.16 Malaysia 0.42	<Benchmark> Philippines 0
Establishment of cost reflective tariffs	Ratio of Industrial users to residential user	JETRO (2012)	Laos (1.05)	<Benchmark> Thailand 1.33 Indonesia 1	<Benchmark> Philippines 0.6 Malaysia 0.86 Vietnam 0.84	
Receivable Turnover Period (day)	Days	Annual Report	85(2.3%)	45(1.2%);Target	EGAT(7days)	

Source: Created by H. Nagayama, Kyoto University

Contribution to national economy

		Unit	Source	Data				
				2010~2015	2015~2020	2020~2025		
Poverty reduction	Affordability : Income Improvement	Income Affordability = Cost of Subsistence Electricity / Poverty Income Level (%)	% months Total Urban Rural	WB(2013)	97.716 kip/month household			
	Access	Household Access = Households with a Commercial Connection / Total Households	%	EDL	78.53%(2011)	<Benchmark> 86.8% (2010: Thailand)	<Benchmark> 97.3 (2010: Vietnam) 90%(by 2010: gov's target)	
		Village Access = Communities with Commercial Supply / Total Communities	%	EDL	68.99%(2011)			
	Gini-index			Index	WDI	Laos 0.36(2008) <Benchmark> Thailand 0.4(2009) Indonesia 0.34(2005) Vietnam 0.36(2008)		
	Residential electrical consumption			GWh	Electricity Statistics 2011	1,004,074(2011)		
Effective utilization of water resources	Agriculture value added (constant 2000 US\$)		USD	WDI	178(2010)	<Vietnam> 130(2010) <Philippine> 165(2010) <Indonesia> 155(2010)	<Thailand> 205(2010) <Malaysia> 400(2010)	
	Irrigation electrical consumption		GWh	Electricity Statistics 2011	46,185(2011)			
Industrial development	Industry value added (constant 2000US\$)		USD	WDI	183(2010)	<Vietnam> 336(2010) <Philippine> 461(2010) <Indonesia> 496(2010)	<Thailand> 1203 <Malaysia> 2177	
	Industry and commercial electrical consumption		GWh	Electricity Statistics 2011	584,087(Industry:2011) 598,738(Commercial:2011)			

Source: Created by H. Nagayama, Kyoto University

Environment

		Unit	Source	Data		
				2010~2015	2015~2020	2020~2025
Consideration to environment	CO2 emission kg per 2000US\$ of GDP	kg per 2000 US\$ per GDP	WDI	0.57 (2009)	<Philippines> 0.6 (2009) <Thailand> 3.91 (2009)	<Vietnam> 2.4 (2009) <Thailand> 1.6 (2009) <Indonesia> 1.7 (2009) <Malaysia> 1.4 (2009)
Consideration to environment	CO2 emission metric ton per capita	metric ton per capita	WDI	0.29 (2009)		<Vietnam> 3.9 (2009) <Indonesia> 7.1 (2009) <Malaysia> 1.9 (2009)

Source: Created by H. Nagayama, Kyoto University

Program Output

In Program Output, reinforcement of electricity administrative management capability, maintenance of electricity facilities and improvement of business administrative abilities of electricity business undertakers were chosen.

Summary Figure Indicators of Program Output

			Unit	Source	Data			
					2010~2015	2015~2020	2020~2025	
Reinforcement of electricity administrative management capability	Support of review of energy development policy and electric power development policy	Arrangement of energy related statistical database			Can collect data by dispatching staff	Can collect through internet Man dated to submit energy consumption data	Data collection activities are institutionalized	
		Energy power development policy formulating comprehensive PDP			Preparation for NPDP	Institutionalized NPDP	Integration to GSM framework	
		Formulating policy on improvement of electricity facilities development			Unsolicited bidding system	Preparation for Solicited bidding system	Solicited bidding system is institutionalized	
	Strengthening of regulatory framework	Draw up a roadmap that aims at reinforcement of regulatory function			Preparation for establishing Independent regulatory authority	Establishment of Independent regulatory authority	Financial of Independent regulatory authority is property	
		Enhancement of examination and inspection function of the ministry and local governments	Environmental regulation			Environmental regulation which do not hinder FDI	Environmental regulation which do not hinder FDI	Environmental regulation which do not hinder FDI
			Establishment of cost-reflective tariffs Ratio of Industrial (over 5MW)to residential (150kWh-) price		JETRO (2012)	1.05 Vientiane	<Benchmark> BKK 1.33 Manila 0.6 JKL 1 KL 0.86 Hanoi 0.84	
			LEPTS			LEPTS are institutionalized	LEPTS are institutionalized	LEPTS are institutionalized
			Definition of rules			Definition of rules concerning consumer protection, allocation of subsidies are prepared	Definition of rules concerning consumer protection, allocation of subsidies are prepared	Definition of rules concerning consumer protection, allocation of subsidies are prepared
			Equal access to transmission line			Equal access to transmission line is guaranteed	Equal access to transmission line is guaranteed	Equal access to transmission line is guaranteed
Electricity station facilities	Power generation (Large scale hydroelectric)	Starting plans (about 60-100MW) for establishing medium sized hydro power plants corresponding to peak hours and /or dry season	MW	Statistic year book 2011 PDP 2012	527 MW(2011)	2356MW(2015)	8265MW(2020)	
	Power transmission	Setting plans for increasing efficiency of power transmission and distribution system (maintenance of transmission and distribution network)	Transmission and distribution losses(system losses) %	EDL WDI MEM(The Strategy Plan) PDP (2010-2020)	Transmission loss 33% + Distribution loss 10.78% →13.78% (2010)	14.24% (2015) <Benchmark> Vietnam (10%) Indonesia (9.4%) Philippines (11.5%)	12.68% (2020) <Benchmark> Japan (4.4%) Thailand (6.3%)	
			Interconnection to GSM km		Statistic year book 2011	Bilateral transaction 3342km (115KV)	Multilateral transaction	Integration to competitive market
	Rural electrification (small / mini-hydro)	Reinforcement of renewable energy development including mini hydro power plants, promotion of local electrification (Relation)	MW	REDS (2011 Oct)	13MW (2011)	140MW (2015)	243MW (2020) 728MW (2025)	
Enhancement of business administration capability for electricity business undertakers	Financial and planning capacity				Preparation for NPDP	NPDP Institutionalized	Update NPDP by themselves	
	Organization management capacity	Tariff collection efficiency (unpaid ratio)	%	EDL	2.2%(2011)		<Benchmark> EGAT (7days)	
		Accounts receivable turn over periods	day	EDL	85days(2010)			
		Draw up optional investment plan by EDL			Preparation for NPDP	NPDP Institutionalized	Integration to GSM framework	
		Draw up action plan to improve customer service			# of new customer visits increased # new tariff system offered	# of new customer visits increased # new tariff system offered	# of new customer visits increased # new tariff system offered	
	Project implementation and supervision capacity	Sales per employee = sales / number of employee	USD	EDL, annual report	59,539 (2010)	<Benchmark> PLN (2011) 487,115 TNB (2011)	<Benchmark> EGAT(2011) 526,720	
		Net profit per employee	USD	EDL, annual report	2,962 (2010)	<Benchmark> PLN (2011) 16,845 TNB (2011) 5,790	<Benchmark> EGAT (2011) 38,527	

Source: Created by Kyoto University Nagayama

4.3 Conclusions for electricity development indicators

We have constructed indicators that are related to aid for the developing country's electricity sector with Lao PDR. Affordability, access and energy security have been given as indicators related to the electricity sector so far. In this report, we initially have set three steps for indicator settings from the viewpoint of aid for developing countries. The indicators are Program goal, Program outcome and Program output.

The Program goal is to interlock with the development plan of both aiding country and counter-aiding country.

The Program output is something that was directly affected by aid project; the program outcome is goal, which is achieved through program output.

The maxims we have learnt throughout this study about electricity indicator construction are as follows:

To construct indicators under unique circumstances of the country and make clear definitions for respective indicators

To prioritize in time the achievement of indicator goals

To add qualitative indicators

To monitor while focusing on the interrelation between indicators with different steps

5. Preparation to institutionalize a national electricity development indicator

5.1 Preparation for setting a national electricity development indicator

The important theme for Lao PDR in the future is to share the goals with donors.

The following steps are necessary.

- 1) Prioritize policies among different policy goals (e.g., improving EDL's financial status and promotion of local electrification, which mutually works in the opposite direction/ raising of electricity tariffs based on the cost).
- 2) Clearly make definitions of indicators to suit to policy goals. For example, as for energy security, the definition varies from country to country; thus, the definition of energy security by Lao PDR is necessary.
- 3) Carry out benchmark comparison for each indicator in other countries with consideration of Lao PDR's economic developmental stage and review the goal settings.
- 4) Take a multi-sector approach, including MEM (Ministry of Energy and Mines), MAF (Ministry of Agriculture and Forestry), MPWT (Ministry of Public Work and Transportation), MPI (Ministry of Planning and Investment), MOF (Ministry of Finance), EDL, EDL-gen and IPPs.

5.2 Steps for setting national electricity development indicators

The following approach for the preparation of setting electricity development indicators and updates is proposed.

- STEP1) Agree on a list of desirable indicators with Lao governments
- STEP2) Confirm consistency of published indicators and seek for the necessary but missing data (e.g., collect latest country reports on energy sector, including ones written in Lao PDR language; confirm consistency among various data sources about import value, etc.)
- STEP3) Make inventory of missing data (e.g., SAIFI, SAIDI)
- STEP4) Examine accessibility of data available
- STEP5) Make several economic development scenario under cooperation with NERI and make relevant target (e.g., example of Thailand: Jutamane, M and S, Kumar [2012])
- STEP6) Agree on appropriate indicator with Lao governments
- STEP7) Review, maintain and update periodically and confirm the outcomes of the policy (e.g., Case of Mexico: Claudia, et al [2012])

5.3 Electricity sector industry organization

In order to set up an organization to make the aforementioned development indicators and to continuously monitor, reform of current organization is necessary.

The current setup of the Lao PDR electricity industry is single buying. Thus the role sharing is similar to Thailand and Indonesia, which also adopts single buyers. The model that falls between the Thailand model and the Vietnam model is preferred. DEPP should be in charge of policy and international relations including GMS and ASEAN like NEPO in Thailand. The DEM and DEP function is to be transferred to an independent regulatory committee. Regulatory institutions can be affiliated with MEM at first (e.g., ERAV of Vietnam), but should be targeted at political and financial independence in the end.

Such a foundation of independent regulatory institutions is also necessary to address the current EDL's financial status. The current organizations of MEM, DEM, DEB, IREP and Prime Minister's Office that hold permission authority for electricity business could be integrated into independent regulatory authority.

6. JICA's role in electricity maintenance program

JICA's role in program goal and program outcome in electricity infrastructure improvement is not direct. However, in program output, JICA, World Bank, and ADB's demarcation is relatively easy to carry out. In order to elevate the program outcome effect, it is recommended that World Bank and ADB create a regulatory outline while JICA is in charge of skill training.

Report on development indicator evaluation in the electricity sector in Lao PDR

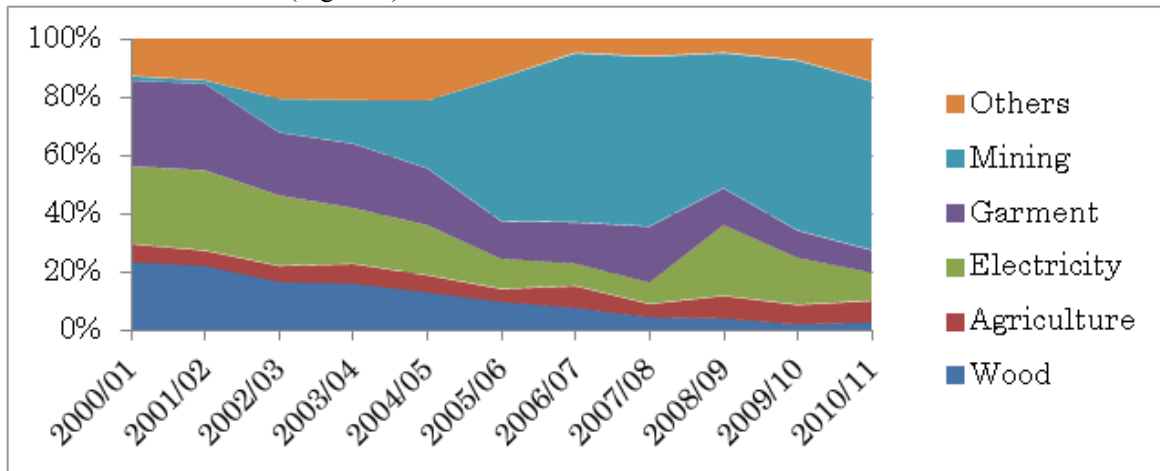
1. Characteristics of electricity industry in Lao PDR

We will be discussing the major characteristics and problems of electricity industry in Lao PDR, on which establishment of electricity development indicator is based.

1.1 Characteristics of industrial structure

1.1.1 Structure of export and import

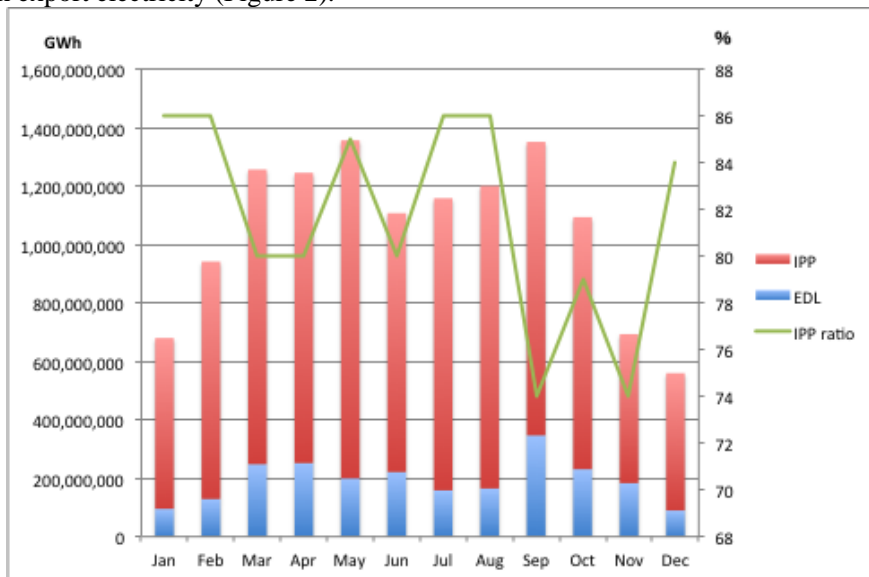
As Lao PDR has plenty of rivers with large amount of water, electricity also is a major export comparable to mineral resources. Therefore, Lao PDR is called “the battery of Indochina” (Figure 1).



Source: NERI (2013)

Figure 1: Transition in export structure in Lao PDR

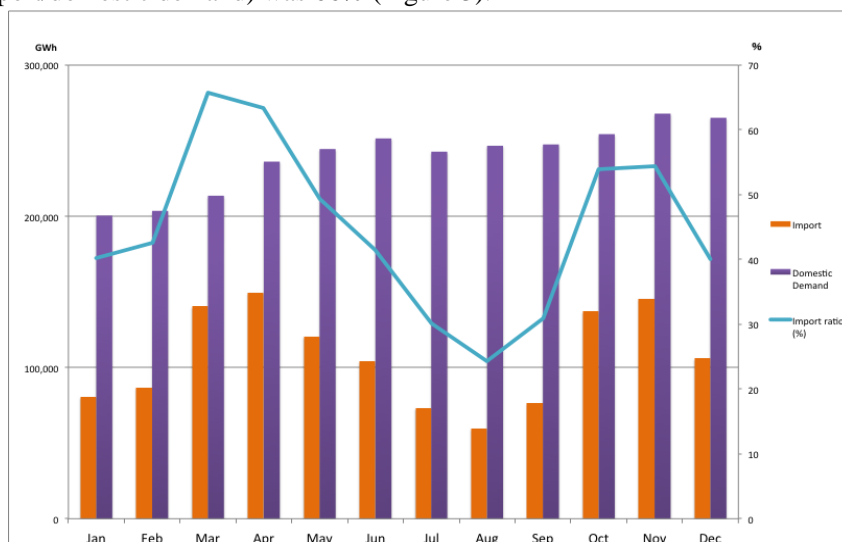
As shown in the diagram below, about 80% of total electricity is supplied by IPPs, which export electricity (Figure 2).



Source: Created from data supplied by MEM

Figure 2: IPP ratio in total electricity generation in 2012

Although Lao PDR can supply enough electricity for domestic demand, Lao PDR has to export a large part of the generated electricity because of PPA agreements signed with foreign off-takers such as EGAT in Thailand. A monthly distribution shows that in the dry season, the import ratio is large. In March 2012 (the dry season in Lao PDR), the import ratio (import/domestic demand) was 66% (Figure 3).

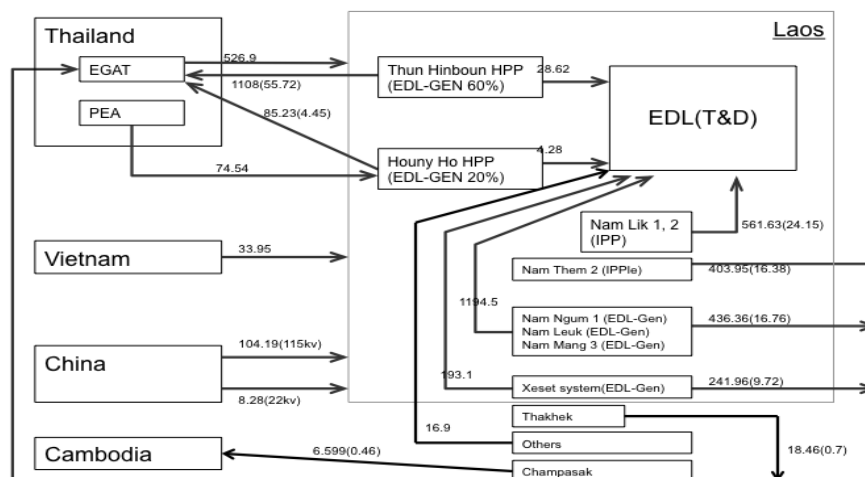


Note1: In export data, Nam Liki-2 is omitted
 Note2: Import ratio (%) = Import / Domestic demand
 Source: MEM

Figure 3: Monthly import ratio in 2012

Furthermore, since domestic transmission lines are not fully installed, EDL imports electricity from Vietnam, China, and Thailand.

<2011>



Note1: GWh, the unit of number in parentheses is million US\$
 Note2: Others: EDL: Nam Dung, Nam Ko, Nam Ngay
 EDL-GEN shared with IPP: Theun Hinboun, Houay Ho, Nam Lik 1, 2
 Note3: Import is done by EDL

Source: Created from document of MEM and EDL

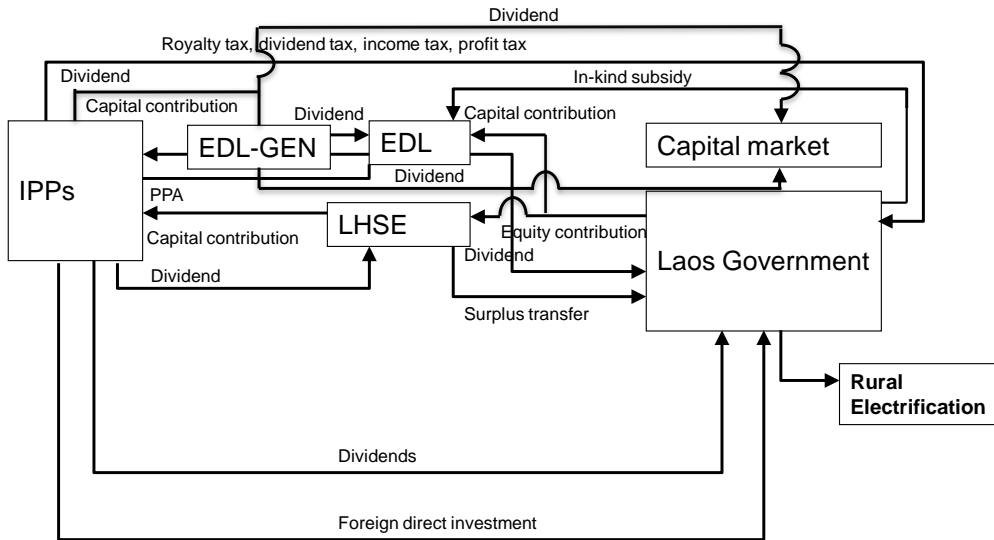
Figure 4: The situation of electricity export and import in Lao PDR (2011)

1.1.2 Structure of sector organization

In 2010, the generation sector has been separated as EDL-Gen from EDL, which made EDL a single buyer.

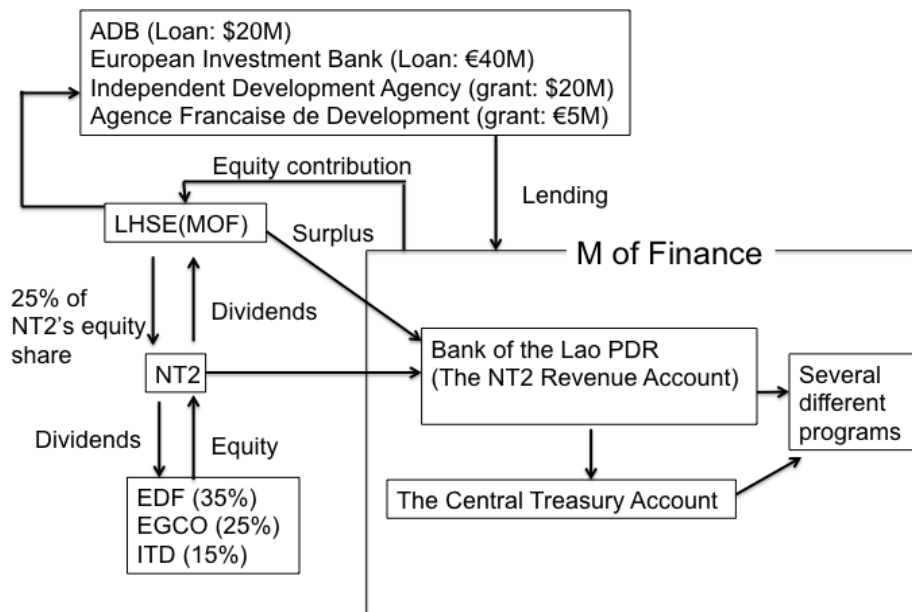
Another characteristic of the electricity sector in Lao PDR is that LHSE was established as a government (under the control of the Ministry of Finance) corporation other than EDL, through which the investment for IPPs of SPC (Special Purpose Company) such as Nam Theun 2 is made (Figure 5).

International Balance of payment flow



Source: Created from each kind of document

Figure 5: Financial flow of Lao government, EDL, IPP and others

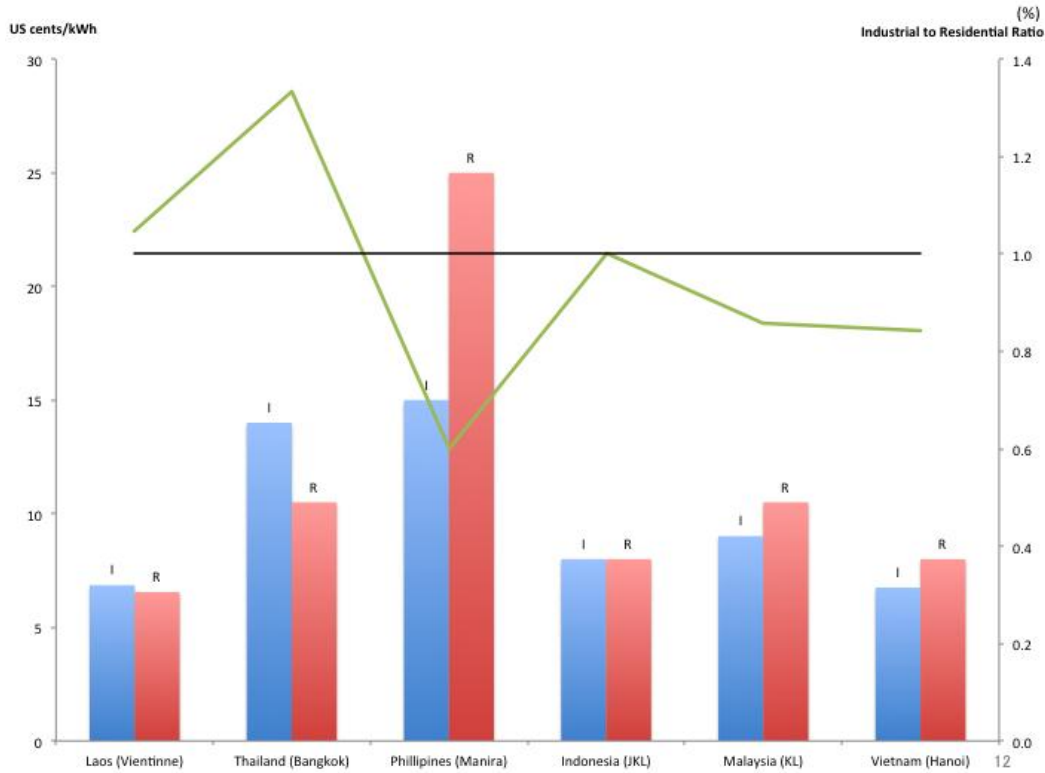


Source: Created from ADB "Sector Assistance Evaluation for the Energy Sector in Lao PDR" (2012)

Figure 6: Composition of Nam Theun 2 Project

1.1.3 International comparison in major indicators

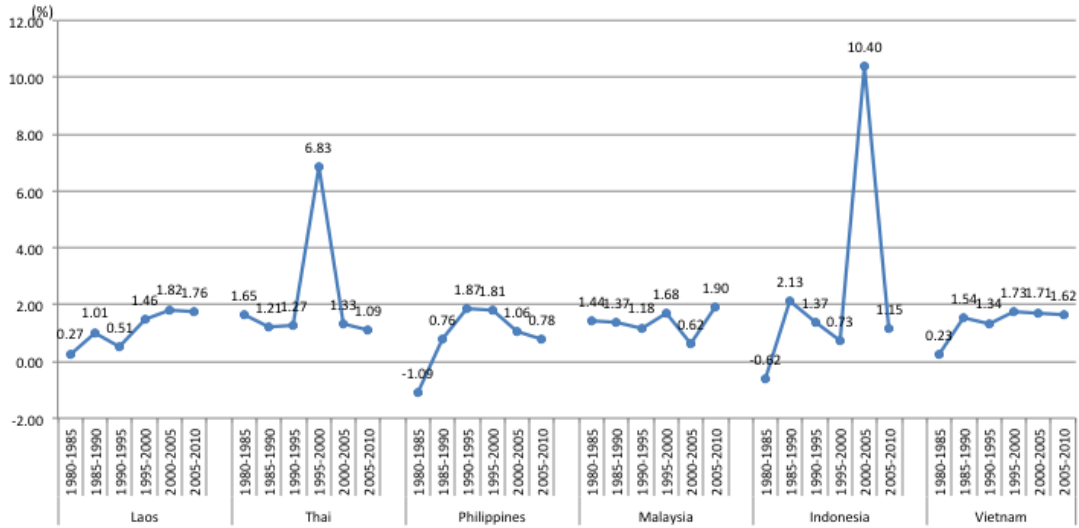
It is important to set a cost-reflective tariff in order to ensure stable financial resources and strengthen the financial base of EDL as off-takers. Although Lao PDR's government does not offer direct subsidy as does the Philippines, there is a problem in its cross-subsidy. By offering a direct subsidy to electric companies, Indonesia, Thailand and Vietnam prevent electricity rates from increasing for the sake of their residents.



Note : I=Industrial
R=Residential
The polygonal line stands for Industrial to Residential Ratio
Source: JETRO (2012)

Figure 7: Industrial to Residential Ratio in Asian countries

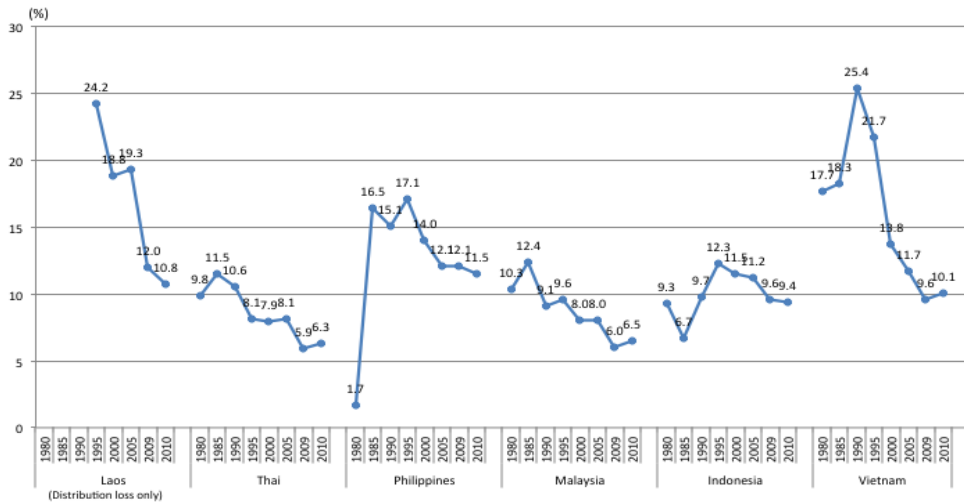
Like other Asian countries, Lao PDR has experienced a rapid increase in domestic demand for electricity.



Note: High elasticity of Thailand and Indonesia during 1995-2005 is largely because of Asian currency crisis
 Source: Electricity consumption EIA GDP: WDI

Figure 8: Elasticity of Electricity Consumption to GDP

In EDL, the loss in distribution is decreasing. However, compared with Thailand, EDL still has room for improving the loss ratio.

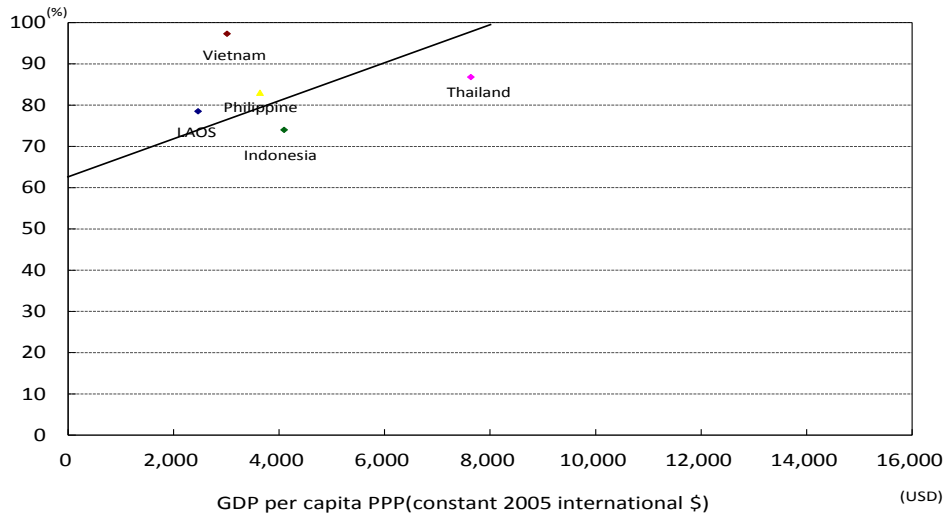


Note: Lao PDR figure captures only distribution loss
 Source: Lao PDR (EDL), other country (WDI)

Figure 9: Transmission and Distribution loss (%)

The figure below shows the correlation between GDP per capita PPP and household access.

$$\text{Household Access (\%)} = \frac{\text{Households with a Commercial Connection (B)}}{\text{Total Households (C)}}$$

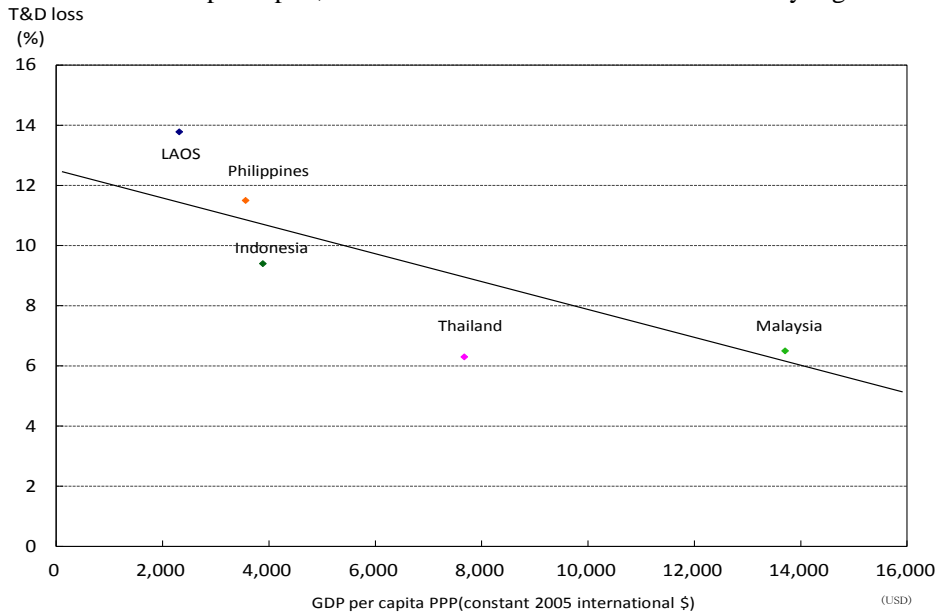


Note: Household Access = Households with a Commercial Connection / Total Households
 GDP per capita PPP (constant international): WDI

Source: Household Access: EDL, JICA, PLN 2010: Lao PDR, Indonesia, The Philippine 2011: Thailand, Vietnam

Figure 10: Household Access (%) vs. GDP per capita (PPP)

In terms of GDP per capita, household access in Lao PDR is relatively high.

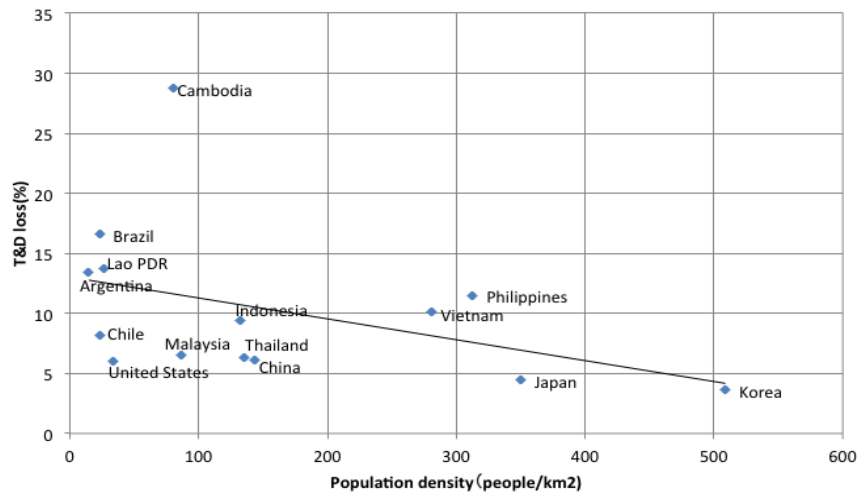


Source: T&D loss (Lao PDR : EDL, others: WDI) : 2010

GDP per capita PPP (constant international): WDI

Figure 11: T&D loss vs. GDP per capita PPP

As per capita GDP increases, T&D loss tends to decrease. However, in areas with low density of population, T&D loss tends to be high, which partly produces a high T&D loss in Lao PDR.



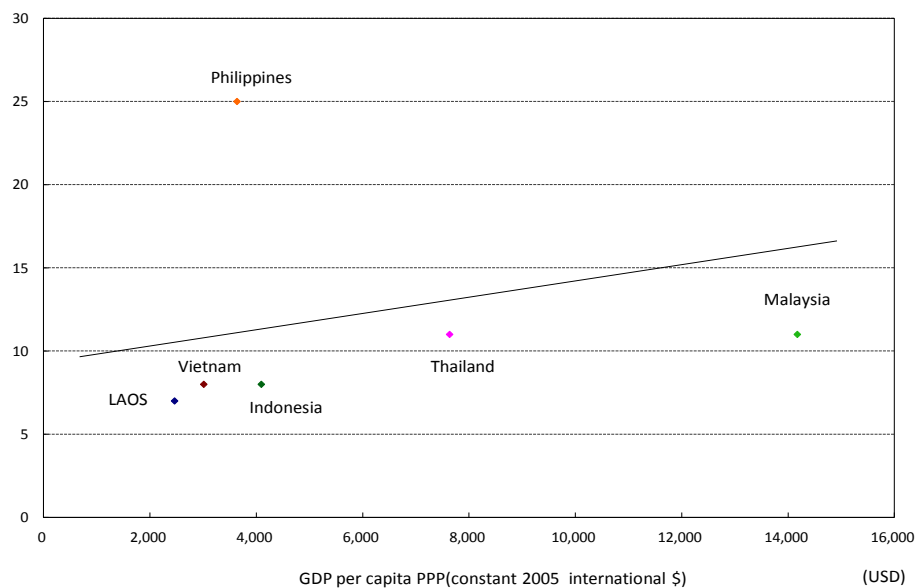
Source: T&D loss(2010) : WDI, Lao PDR(EDL), Population Density: WDI

Figure 12: T&D loss (%) vs. Population density (people/km2)

GDP per capita PPP and residential tariff are correlated. Economic growth needs the electric tariff to rise.

Average residential tariff April/2012

(US cents/kwh)



Source: Average residential tariff : JETRO April, 2012 WDI

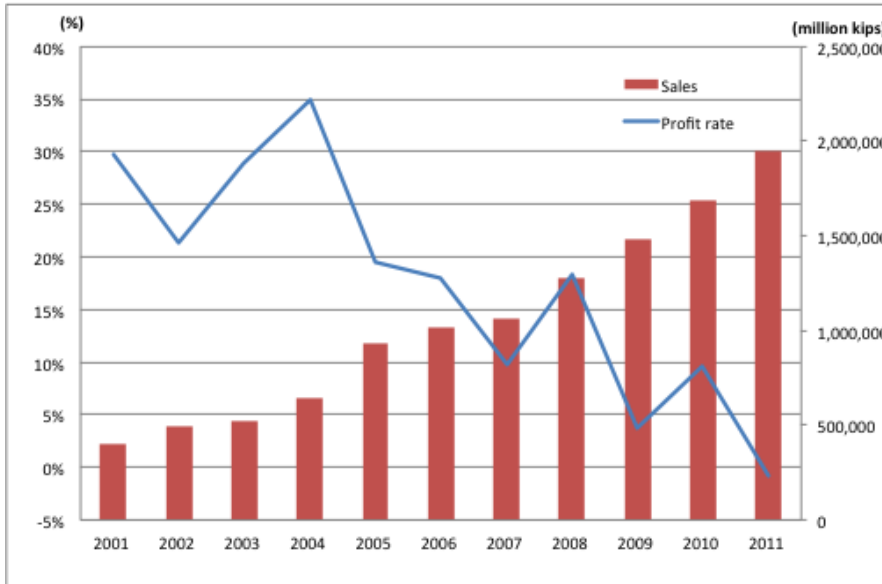
GDP per capita PPP (constant international \$): 2011 WDI

Figure 13: Average residential tariff vs. GDP per capita PPP

1.1.4 Financial analysis on EDL

1.1.4.1 Shift in business performance of EDL

EDL's sales have been continuously increasing since 2001, but the profit rate has been decreasing year by year. This is probably because of investment in low-profit power transmission and distribution, and power loss of transmission and distribution. In particular, purchase of electricity from EDL-Gen since 2011 and expansion of import from Thailand has made EDL's financial situation worse.

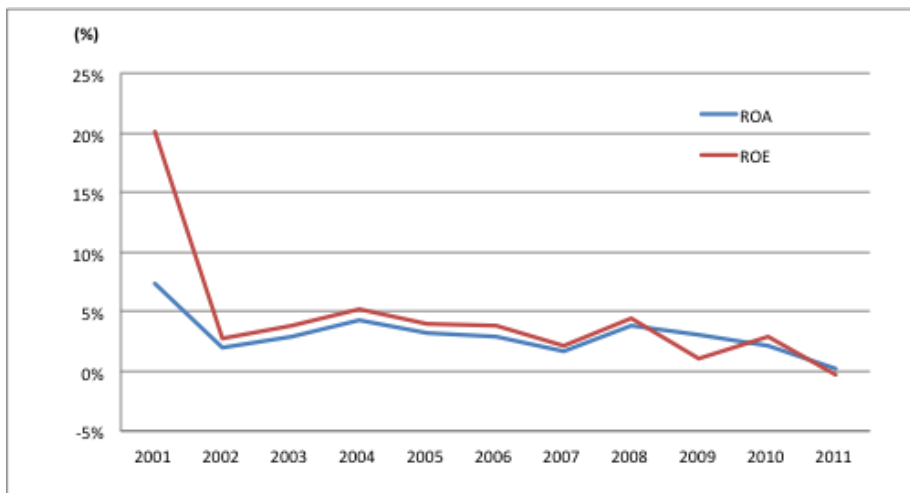


Note: EDL-GEN was separated in 2010

Source: annual reports of EDL and electric power companies of each country

Fig. 14: Transition in sales and profit rate of EDL

Both ROA and ROE have decreased since 2008

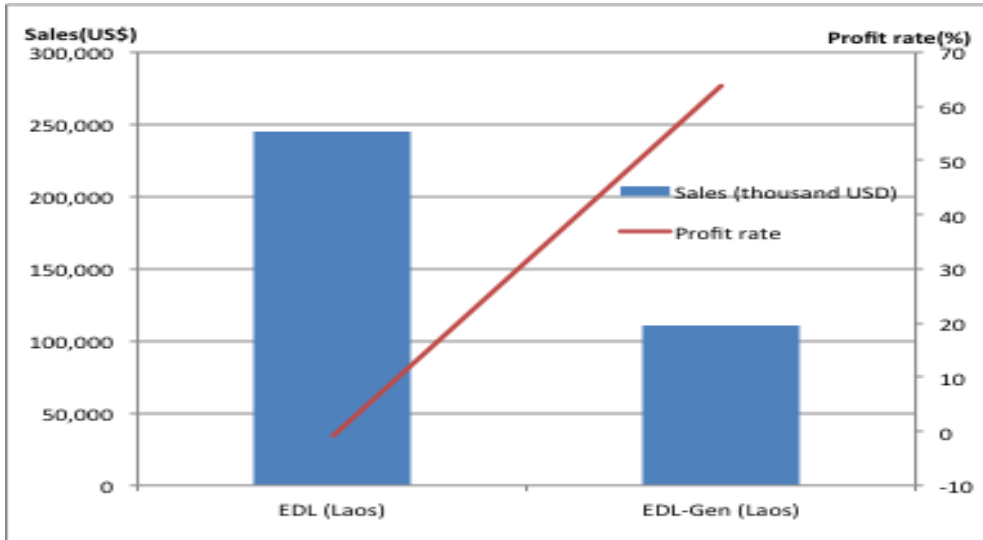


Source: annual reports of EDL and electric power companies of each country

Fig. 15 Transition in ROA and ROE of EDL

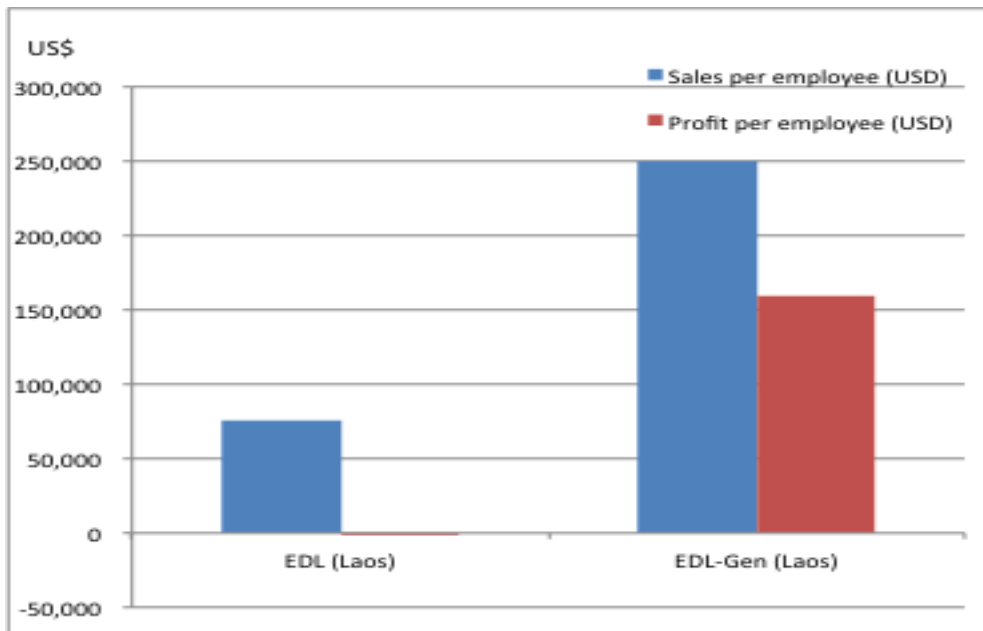
EDL-GEN separated in 2010 as a high-profit company with more than a 60% of profit rate (Figures 16 and 17). EDL has 75% of EDL-GEN's shares.

One of EDL-GEN's policies is to make costs less than 40% of total revenue. Therefore, profit (net profit – income of investment on IPP) is more than 60% of all the revenue (income from selling electricity to EDL + other profits + exchange rate gains; no less than 13% in IRR).



Source: Excerpt from EDL and EDI-Gen Annual Report

Fig 16: Comparison in sales and profit rate between EDL and EDL-Gen (2011)



Source: Excerpt from EDL and EDI-Gen Annual Report

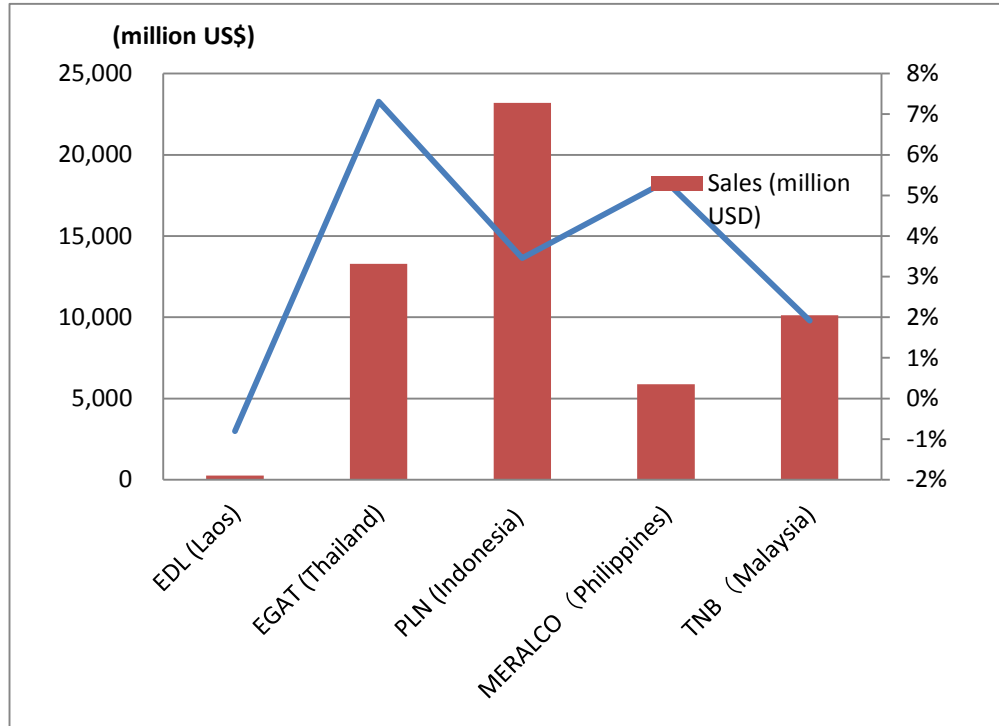
Fig 17: Sales and profit of EDL and EDL-Gen per person (2011)

1.1.4.2 Comparison of EDL and Asian electricity companies

EDL and other Asian electricity companies were compared by using financial data in 2011.

Sales and profit scale are small compared to other Asian countries due to the Laotian economy and population (Figure 18-1).

Net profit, ROA and ROE are low, and problems of financial structure are likely to be a big constraint of completion of IPP (d)(domestic IPP), compared to EDL, a power transmission and distribution company.

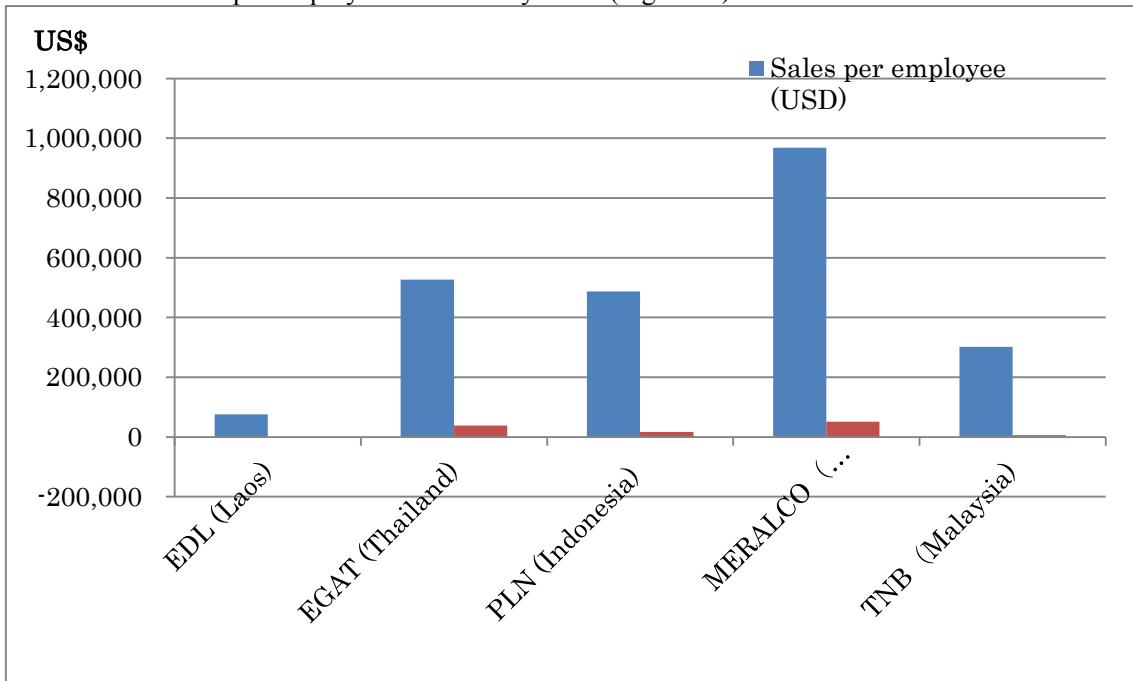


Note: EDL is an entity of transmission and distribution, EGAT is that of power generation and transmission, PLN is that of generation, transmission and distribution, MERALCO is that of distribution and TNB is that of generation, transmission and distribution.

Source: Annual report of each company

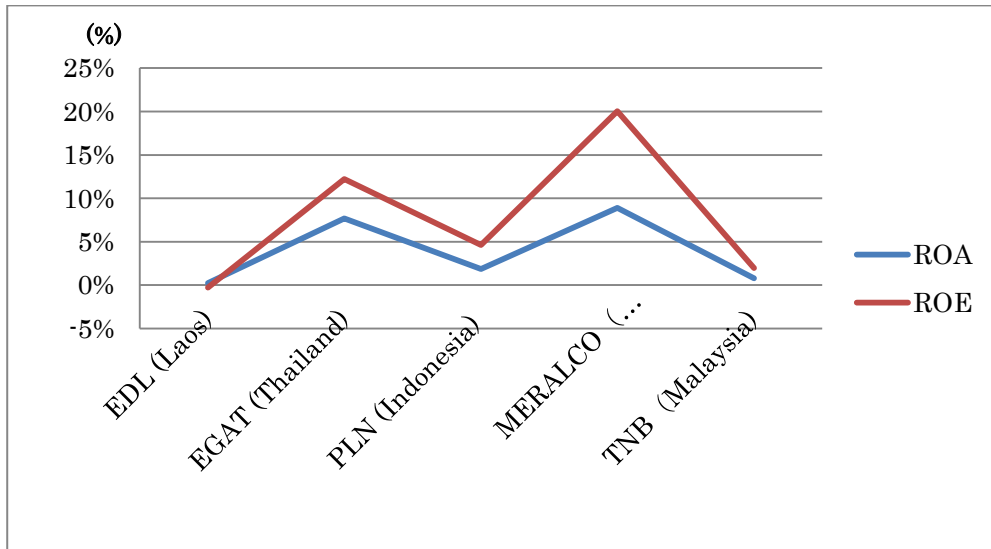
Fig 18-1 Comparison in sales and profit of Asian electricity companies (2011)

EDL's sales per employee are also very small (Fig. 18-2).



Source: Annual report of each company

Fig. 18-2: Comparison in sales and profit per person of Asian electricity companies (2011)



Source: Annual report of each company

Fig. 19: Comparison in ROA and ROE of Asian electricity companies (2011)

3 Main Problems of the Lao PDR electricity sector

The main problems of the Lao PDR electricity sector can be categorized as follows: 1) Stable power supply for domestic consumers, 2) contribution to domestic economy, and 3) environment.

1) Stable power supply for domestic consumers

1-1) Energy security problem

As for energy security, there is a risk regarding dependence of national revenue on the export of hydro electric power. The significant part of the government revenue is comprised of royalties from hydropower and various taxes. Even though hydro electric power has a high supply capacity, imported electricity provided for 66% of domestic demand in March 2012. And it increases as domestic demand increases.

1-2) Problems of governance concerning investment promotion

The following items (a) to c)) are problems concerning investment promotion:

a) Problems concerning governance of the electricity sector

Problems include insufficient governance of the electricity sector (policy making/regulation on energy/electricity sector, etc.) and a lack of business administrative skills in electric companies (financial security/organization management of human resources/maintenance and management capability).

Solicited IPP bidding (single buyers formulate long-term power supply development plans and decide the development period of entering COD [Commercial Operation Date], scale and fuel of IPPs) is not prepared.

b) Uneven access to domestic and international transmission

Since EDL doesn't have the financial capacity to install international transmission lines for export by themselves, IPPs have no choice but to arrange it by themselves. For example, even though it is economically efficient for Nam Ngum 3 and Nam Ngiep 1 to use the transmission lines constructed by Nam Ngum 2 (connecting Navon sub-station and the border), it is still under negotiation concerning a wheeling charge. As can be seen from this example, the transmission line is not neutral, and new domestic and foreign entrants cannot access it.

c) Various data are undeveloped

Various statistical data, procedures to collect data and updates, which are the basis of energy policymaking, water resources, and energy saving policy, are underdeveloped. For example, data (power export amount (kWh), value (US\$)) registered by each ministry are not consistent (such as electricity export volume).

1-3) Problems concerning EDL's financial independence

EDL's financial problems are converted to off-taker risks of EDL that inhibit investment promotion. This is due to imports from neighboring countries, high purchasing price from EDL-Gen, which is under the controlled by the Lao government, and high transmission and distribution losses. Sales and profit per employee are lower compared to the utility companies in neighboring countries. Electricity tariffs are set below the LRMC cost. Although there is no direct subsidy, there is a cross-subsidy that makes the tariff structure non-cost reflective.

The electricity tariff is also affecting the financial independence of EDL significantly. The following 3 points are the main problems.

a) No set-up of peak / off-peak (TOU)

Although there is a peak tariff set for export and import of electricity, there is no peak tariff for domestic usage. Due to lack of TOU (Time of Use) tariffs, the run-of-river type of hydroelectric generation has a cost advantage, which makes the optimum usage of water resources difficult. The introduction of meters that are suitable for hourly measuring is necessary which have already been introduced in Thailand, Malaysia, and Philippines.

b) Electricity tariff structure does not reflect cost of sales for respective segments

There is no direct subsidy to the electricity sector but a cross-subsidy exists.

c) Only energy charge is set

The electricity tariffs consist only of an energy charge and are not divided into a basic charge and an energy charge. In Southeast Asia, Cambodia is another country with an electricity tariff containing only an energy charge.

1-4) Problems concerning international balance of payments

Foreign exchange reserves are only two months, and the significant import of electricity during the dry seasons is also affecting this problem.

2) Contribution to national economy

2-1) Poverty reduction

The difference in the diffusion ratio and availability of electricity between rural and urban areas, including Vientiane, creates an economic disparity due to the deficiency of domestic electricity supply, undeveloped transmission lines, and low electrification ratio in local and mountainous regions.

2-2) Effective usage of water resources

Comprehensive plan for optimum utilization of water resources including hydroelectric power, irrigation, and flood prevention is not formulated among ministries.

2-3) Development of manufacturing industry

In order to deal with rapid domestic demand increase, EDL also has to import from neighboring countries including Thailand. EDL's profit becomes negative (cost loss margin back spread).

3) Consideration of the environment

Stricter investment regulations are lowering profitability of hydro electric power. Therefore, due diligence during F/S (Feasibility Study) becomes unsuitable after starting business.

Increase in coal generation will contribute to adjusting to the changing load more in a flexible way during the dry season, thus contributing to energy security. On the other hand, there is a risk of increasing CO₂ emission.

Considering problems above, we conducted Cross-SWOT analysis to provide solutions for addressing current situation.

		External factors	
		Opportunity	Threat
Internal factors	Strength	<ul style="list-style-type: none"> •Rapid increase in power demand in neighboring countries (Thailand, Myanmar, Vietnam, China) (O1) • Increase in labor costs in Asian countries (O2) •Enlarged domestic power demand (O3) 	<ul style="list-style-type: none"> •Growth of neighboring economies (T1) •Revision of power purchase contract between EDL and GAT (Thai) (Thailand's energy policy (T2)
	Weakness	<ul style="list-style-type: none"> •Low cost generation from abundant water resource (S1) •Low labor cost (S2) •Abundant mineral resources (S3) 	<ul style="list-style-type: none"> •Attract electricity consuming industries (S1, S2) •Reinforce coal generation and aim at domestic and foreign peak demand during the dry season (S3, O1) •Attract labor intensive industry (S2, O2)
		<ul style="list-style-type: none"> •Undeveloped distribution line (W1) •Weak financial structure of EDL (W2) •Budget deficit (W3) •Low population(W4) •Underdeveloped system accepting investment(W5) 	<ul style="list-style-type: none"> •Increase hydro generation with reservoir to add high added value to hydroelectric power generation (S1, T2) •Strategic alliance with neighboring economies (S1,S2,S3,T1)

Source: Created by H. Nagayama, Kyoto University

Fig. 20 Cross-SWOT analysis in Lao PDR

1.4 Overall evaluation electricity sector performance in Lao PDR

The Fig.21 describes evaluation of Lao's electric sector performance. Only introduction of IPP (e) and electrification ratio shows good performance. Many problems of government still remains to be solved.

Fig. 21 Evaluation on performance of electricity sector in Lao PDR (As of March, 2012)

	Items	Contexts in Laos in 2012 (if any)	Current assessment
Power generation	Single Buyer of IPP(d)→fair participation of wholesale market Unsolicited IPP	Transparent IPP procedure easy to understand for investors, no post-changes in tax system. Transparent choices of agencies	△ Power generation and transmission are separated by law (though not completely), and entry is fair, but the procedures are opaque Solicited IPP
	IPP(d) rises smoothly Unsolicited IPP	Transparent IPP procedure easy to understand for investors, no post-changes in tax system. Transparent choices of agencies	○ Solicited IPP
	Enough power generation facilities corresponding to increasing demand are built		△ Net import resulted from export obligation (Supply capability is sufficient)
	Market control power is alleviated		- N/A : too early to discuss a single buyer system
	The suitable minimal cost concerning water operation	Most suitable water operation (dams and irrigation) has to be considered	× The developers who win the first contracts are not always good at utilizing water
Power transmission	Fair access to the transmission grid		× IPP faces a challenge regarding its neutrality concerning the transmission lines it has constructed (ADB adjusts interests and supports acquisition)
	Neutrality of transmission grid (more transparent shipping trust)		- N/A
	Clear transmission fee design investing on system enhancement and system planning method		- N/A
	Power exchange among GMS are institutionalized	Single buyer of GMS →wholesale competition	△ Only between 2 countries. GMS is under discussion
	Good financial situation of single buyers (because investment on power generation is promoted)	Financial situation of EDL	× Has cash flow been improved by China's 70 billion yen loan? Will the project of PDP2010-2020I be achieved according to the plan?
	Effort to reduce power transmission loss		△ Reduction of loss rate by half, mainly in non-technical losses, supported by World Bank
	Effort to reduce power blackout ratio		× Indicators like SAIFI and SAIDI to be constructed following completion of central dispatch center
Power distribution/retailing service	Options to provide power for customers	Retailers other than EDL appear	× No movement
	The poor and remote areas can access electricity		○ P2P is functioning and the electrification rate is improving, supported by World Bank
	Effort to reduce power distribution loss		△ Reduction of loss rate by half, mainly in non-technical losses, supported by World Bank
	Cost-reflective tariff structure	No subsidy	× In order to abolish cross-subsidies, it's necessary to raise the electric power tariff and income of the total EDL
	Effort to improve customer service is done	EDL has made an effort towards customer service	× No competition because of EDL's supply monopoly
Regulatory governance	Establishment of independent regulatory agencies both financially and politically	Departments and agencies in MEM	× No movement
	Definition of rules concerning consumer protection, allocation of subsidies are prepared		subsidies are in-kind, no regulations based on consumer protection
Environmental regulation	Environmental regulation not to inhibit investment promotion, but to improve welfare of residents in the areas	Harmony with investment promotion is necessary	× Regulation becomes stricter year by year and IPP's business condition declines
Energy saving	Energy saving plan is created and enforced	Creation and update of energy data base, labeling, DSM, consumer enlightenment, ESCO, spread of LED lamps	△ ADB attempts to describe the overall view of energy efficiency

Note ○: Performed well
 △: partially performed
 ×: No progress

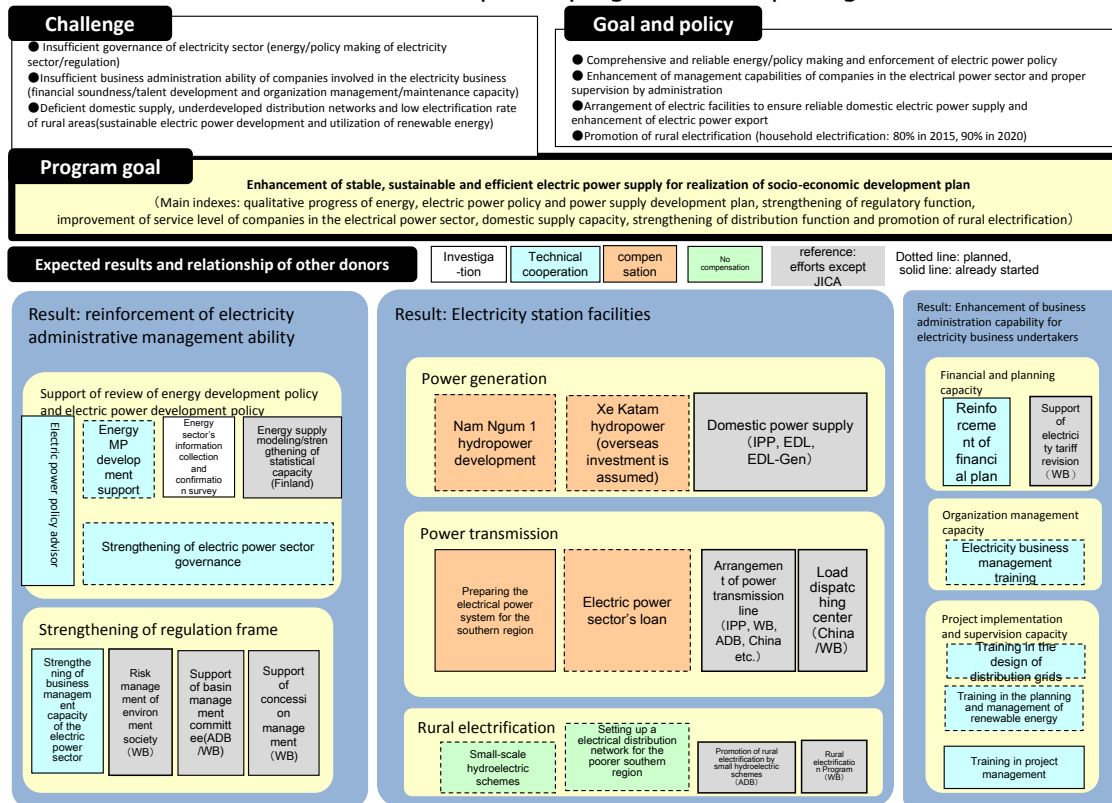
Source: Created by Kyoto University Nagayama

2. Previous JICA's program on electricity development indicators of Lao PDR

JICA has proposed the "Electric Power Development program" in 2012.

The summary is as follows: (Figure 22).

Laos "Electric Power Development program": concept diagram (draft)

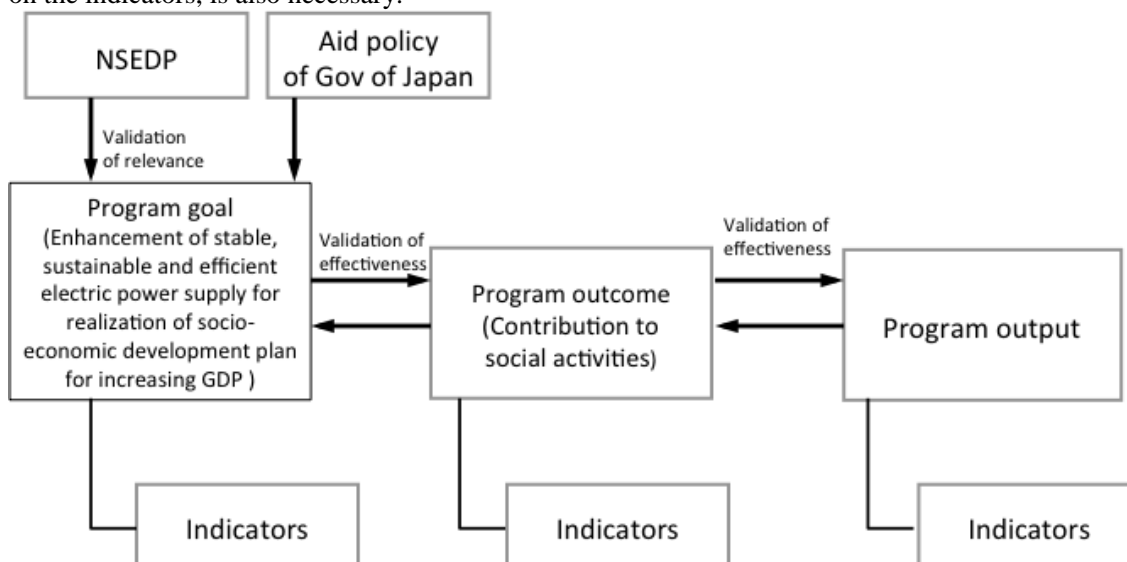


Source : JICA

Fig. 22 Conceptual diagram of 'Electric Power Development Program

3. Verification of relevance and effectiveness of proposed electricity development indicators

The relevance of DAC5 items is a degree of consistency between development aid and target group, counter country, donor’s priority, along with policy and purposes. The effectiveness is a scale to measure the achievement degree of the development aid’s goal. To achieve the goal of the program, drawing out the program outcome is necessary, and to achieve the program outcome, program output, which shows the direct effect of the projects on the indicators, is also necessary.



Source: Created by Kyoto University Nagayama

Fig. 23. Validation procedure of the program

3.1 Verification of relevance

“The program” has to be consistent with Japan’s basic policy (main goal) of assistance for Lao PDR (to help Lao PDR achieve MDGs and escape from LDC), and contributes to “support for improving domestic gap of access to electricity and electricity export through expanding safe and stable electricity supply” in the economic and social infrastructure maintenance, one of the Japan’s emphasized areas (medium goals).

In the relationship to Japan’s task guides <Energy supply>, the following four main tasks are addressed.

- Task 1: Stable power supply to ensure sustainable economical development (formulation of comprehensive energy policy, drawing up energy development plan, construction and generation and maintenance of transmission and distribution facilities, drawing up electricity technical standard, and technical experts in electricity field)
- Task 2: Promotion of rural electrification from the viewpoint of human security
- Task 3: Design of electricity sector reform
- Task 4: Energy supply with environment consideration

To satisfy the aforementioned Task 1, Japan has prepared basic data in Lao PDR’s power and energy field through “Data Collection Study on Energy Sector in Lao PDR (2012)”. Through “Project Improvement of the Government Mechanism for Sustainable Power Development Planning (to be completed in 2013)”, JICA is preparing for full-scale aid for policymaking of the National Power Development Plan.

Lao-Electric Power Technical Standard is prepared through the “Improvement of Power Sector Management (IPSM, 2013)”.

Throughout these projects, technical experts in the power field in the country were trained.

In Task 2 and 4, JICA is promoting rural electrification and energy supply with

environmental consideration under "Technological aid for small sized hydropower development potential (Hydropower plan research)".

Relevant to the Lao government's policy, the program goal of <Enlarged supply of stable, sustainable and effective electricity for realization of socio-economic development> is the basic policy among the nation's 7th National Socio-Economic Development Plan (2010-2015). The specific to the electricity sector of NSEDP are as follows:

- ① Extend distribution lines and increase electrification ratio through rural electrification by off-grid types of generation
- ② To fulfill the growing need of electricity, reinforce domestic supply power
- ③ Adjust EDL's administration according to commercial principles

However, the following project outcomes were considered

- i) Stable power supply
- ii) Contribution to domestic economy
- iii) Consideration of environment

It seems appropriate to change the program goal to < Enlarged supply of stable, sustainable and effective electricity for enhancement of GDP through realization of socio-economic development>.

Due to the change of this goal setting, the goal of this project should conform to the 7th Socio-Economical Development Plan (2010-2015). The goals of this plan are to "maintain economic growth in a stable and progressive manner at more than 8% per year (GDP per capita estimation for 2015 is about US\$ 1,700 per person per year at current prices), achieve MDGs (including poverty reduction) and parity with ASEAN Community by 2015, acquire modern technologies and infrastructure, and establish a diverse economic foundation to move the country out of its Least Developed Country status in 2020."

3.2 Verification of effectiveness

3-2-1) Consistency between the program goal and program outcome (socioeconomic activity)

The program outcome, including energy security, contribution to nation's economy, and environmental consideration, meets the consistency when the effectiveness and relevance were verified. Energy security, investment promotion, EDL's financial independence and contribution to international balance of payments through export should be realized by a stable supply of electricity. Industrial and agricultural production increase through supply of domestic cheap electricity and utilization of water resources, contributing in turn to the national economy by reducing economic disparity and poverty. However, environmental considerations, including management of CO₂ and optional utilization of water resources, have to be considered to achieve the program's goal.

3-2-2) Consistency between program outcome and program output

As the result of the program output, the program outcome can be achieved. Thus consistency between them is valid.

Output1: Reinforcement of electricity administrative management capacity contributes to stable power supply through restructuring the power sector (including establishment of independent electricity regulatory authority). Especially, the formulation of a comprehensive electricity development policy directly provides a significant impact on the power supply plan of EDL-Gen, IPP (d) and IPP (e). Strengthening of the regulatory framework enhances investment in the electricity sector through improvement of EDL's financial strength and investment promotion and enhances

power supply capacity through utilization of water resources.

Output2: Output 2: Power facilities contribute to a stable power supply by forming the physical facilities. However, if formation of electricity facilities doesn't match the consideration of the environment, a balanced development of the country cannot be expected. Electricity facilities contribute to a stable power supply through power generation, transmission and distribution, enhancement of supply capacity in rural electrification, reduction of transmission and distribution loss, and more efficient power transmission and distribution by connecting with GMS.

Output3: Enhancement of business administration capability for the electricity business undertakers (EDL, EDL-Gen and IPPs) contributes to a stable power supply by structuring efficient entities. Financial and planning capacity, organization management capacity, and project implementation and supervision capacity can lead to reinforcement of EDL's financial strength through improvement of EDL's business management capacity.

As for contribution to a development strategy (way of thinking about indicators), there are only two numerical goals: electrification ratio and renewable energy introduction ratio. However, through program evaluation analysis in the "Development indicator analysis on Lao PDR electricity sector program", we have set indicators (including qualitative value) for output and outcome which led to a clearer relationship between the two. In the future, monitoring and business enforcement of development strategy indicators for goal achievement becomes necessary under cooperation with other in donors.

3-2-3) Cooperation with the World Bank Group, ADB

As for the cooperation with the World Bank Group and ADB, it is hard to say that the scenario for cooperative program goal achievement is appropriately set because the number of staff organization, investment fund, and promotion of project differ between these facilities, including JICA. In order to bring consistency to the program, close cooperative communication with other aid facilities is necessary in planning and enforcing items. For example,

- 1). For effective utilization maintenance of water resources, World Bank's "Water resources law maintenance project" and "Valley maintenance/ modeling aid project" and JICA's "National power development plan (planned enforcement item)"
- 2). For reinforcement in order to promote investment, World Bank's "IPP contract maintenance project" and JICA's "Electricity sector governance reinforcement project"
- 3). For aid to small hydropower projects, World Bank's small hydropower private investment promotion, ADB's small hydropower F/S aid and JICA's "Electricity sector governance reinforcement projects"

3.3 Revision of output indicator items

The following indicators were added to the original set of indicators from the viewpoint of effectiveness

Output1: Reinforcement of electricity administrative management capability

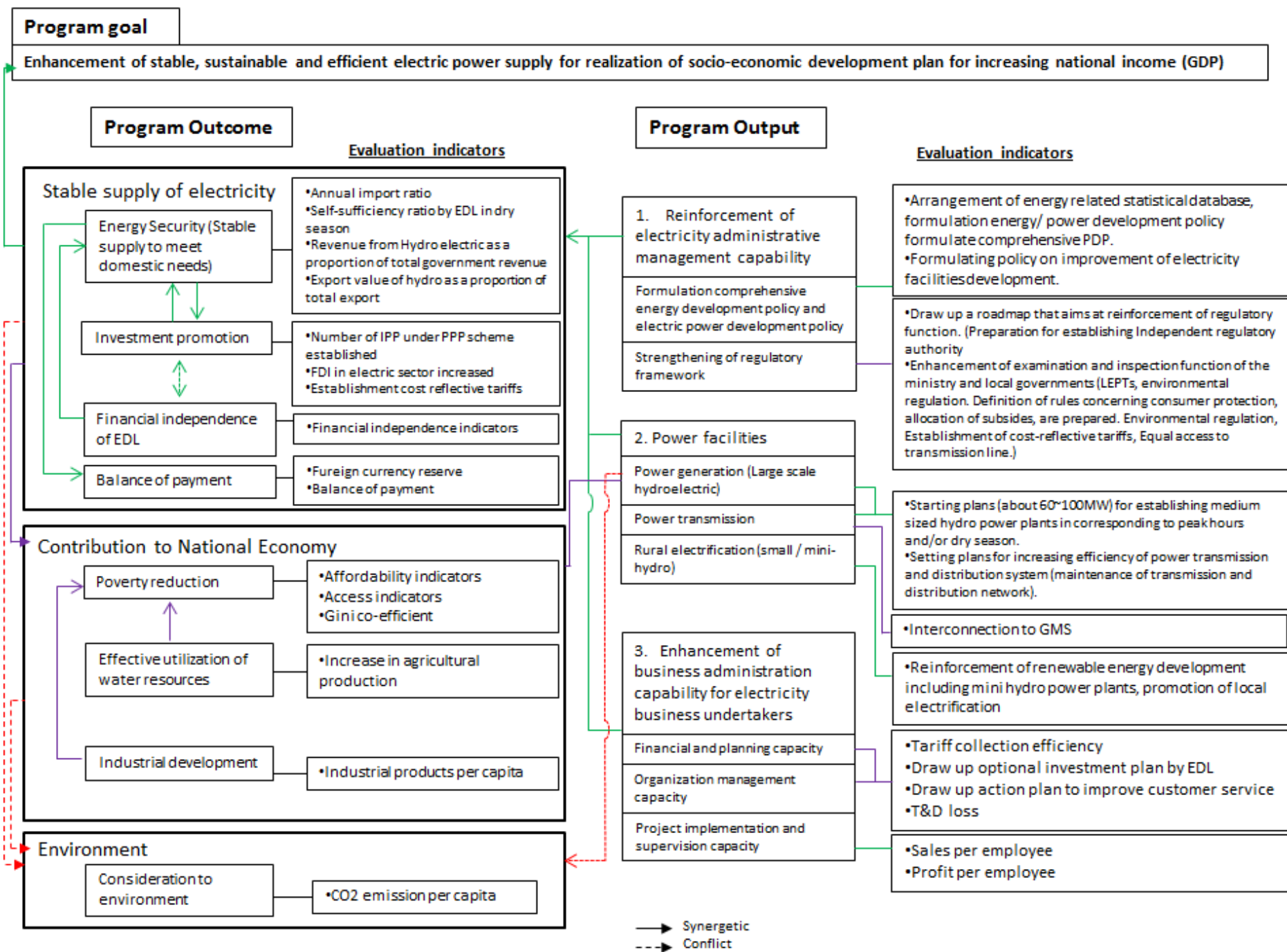
Establishment of independent regulatory committee, introduction of cost-reflective tariffs, development with economical balance, and environmental regulations with consideration for balanced growth with economy

Output2: Power facilities

Small to medium sized (60-100MW) hydropower generation facilities to adjust to peak hours, added

Output3: Enhancement of business administration capability of electricity business undertakers

Reductions of transmission and distribution loss, enhancement of tariff collection ratio were added. Sales per employees, and profit per employees were also added for numerical target for improved business administration of EDL.



Source : Created by JICA provided materials

Fig. 24 Validation of adequacy and effectiveness of this program

4. Suggestion on electricity development indicator

4.1 Prior research on electricity development indicator

Comprehensive indicators of energy and electric power are created by the IAEA (2005). ADB/IBIC/WB (2005) designed 37 energy indicators concerning the Asian infrastructure arrangement.

Grubb et al. (2006) proposed a numerically calculable indicator including the HHI (Herfindahl-Hirschman Index).

Konstantiuns et al. (2008) arranged developers of methodologies and a sustainable energy policy indicator and gives appropriateness, completeness, and flexibility as criteria of choice of a sustainable indicator. They provide realistic description, transparency, simplicity, and ability of comparison as appropriateness. They provide technical and scientific adequacy and international acknowledgement as completeness. They provide easy calculation, existence of quality data, ability to map changes, and easy connection with other models as necessary indicators of flexibility. Also, they set energy indicators such as security of energy supply, competitive energy market, and environmental protection.

Bert et al. (2009) arrange the 4-part classification initially made by APERC (2007) from a viewpoint of long-term SOS (Security of Supply): Availability (elements relating to geological existence), accessibility (geopolitical elements), affordability (economical elements), acceptability (environmental and societal elements). Resource estimates, reserves to production ratios, diversity indices, import dependence, political stability, the energy price, mean variance portfolio theory, share of zero-carbon fuels, market liquidity and demand-side indicators were simple indicators of energy security. They give indicators such as Shannon index based, the IEA's energy security index, supply-demand index, willingness to pay, and oil vulnerability index as aggregated indicators of energy security.

Jutamane and Kumar (2012) looked at indicators from the viewpoint of a nation's security. The same paper, focused on Thailand's security, set indicators, and monitored for 45 years from 1986 to 2030. They constructed three scenarios—"High economic growth and least cost option (HEGR & LC)", "Low carbon society (LCS)", and "Current Policy (CP)"—and presented additional policies (e.g., energy saving) that might become necessary in each circumstances.

Claudia, et al (2012) looked at Mexico's energy related policies and sustainability indicators. The sustainability indicators are more comprehensive than eight indicators (Autarky¹, Robustness², Productivity³, Electricity coverage⁴, Coverage of basic energy needs⁵, Relative purity⁶, Renewable energy sources⁷, Depletion fuels⁸) The sustainability indicators were used to compare 1990 and 2008, and as a result 2008 was less sustainable than 1990.

As research on the electricity sector performance indicators, Jamasb et al. (2004) developed about 150 indicators that represent a wide range in "Core Indicators for Determinants and Performance of Electricity Sector in Developing Countries".

Jamasb et al. (2004) propose to evaluate indicators based on following points: 1) comparability, consistency and measurability; 2) relevance to policymaking and sensitivity to policy change; 3) cost and benefits of different forms of data collection methods; 4) tradeoffs that are implicit in the choice of data sources; and 5) core

¹ Autarky: Energy supply for a long-term period would be guaranteed by own resources.

² Robustness: Economy vulnerability in relation to related foreign changes to energy sector.

³ Energy Productivity: The inverse of energy intensity.

⁴ Electricity Coverage: The share of dwelling with electricity on the national territory.

⁵ Coverage of basic energy needs: Final energy consumption of residential sector x transportation efficiency given by the energy economic information system from Latin-American Energy Organization

⁶ Relative Purity in the use of energy: Carbon dioxide emissions

⁷ Renewable energy sources: The share of renewable energy source in relation to national energy consumption

⁸ Deletion of fossil funnels quotient between oils reserves and gross annual oil production.

indicators to be accepted globally, making international comparison possible, and effectively proposing strategies to be used for developing countries' communities to aid the developing countries effectively.

In the same report, it is said that having the following properties are ideal for electricity sector indicators (Jamasp et al. (2004)).

- be closely connected with aid organizations' objectives in the power sector
- be suitable for cross-country comparison
- have generally accepted conventions and be relatively easy to measure
- be consistent in definition, measurement method and data assembly (should be comparable over time)
- be available at realistic and reasonable levels of cost and effort
- be reliable and ideally, cross-checked

4.2 Suggestion on development indicators

4.2.1 Approach to development indicator

In this project, we have come up with indicators for program's goal, then indicators for the three outcomes and lastly indicators for outputs, which can be gained through achievement of project under the "Electricity Maintenance program" of Lao PDR made by JICA.

Furthermore, the indicators used in the project were evaluated separately from four viewpoints: 1) accessibility, 2) comparability, 3) verifiability, and 4) relationship between outcome and output. Also, specific situations and problems of Lao PDR were considered.

- 1) As for accessibility, some statistical data are not provided by Lao PDR. For example, the electricity export value of 2011 is 75.97 million dollars according to the Lao Central Bank's official statistics. However, according to the data used by NERI, it is 280 million dollars. According to MEM's annual report (2011-2012), it is 435 million dollars. The problem is that data, which should be captured by the customs office, are not well captured.
- 2) For comparability, criteria are easier to compare between Lao PDR and the benchmarked neighboring countries. Since the WDI and EIA data are appropriate for international comparison, we used them if they are available.
- 3) For verifiability, we have considered if the same data would be accessible for future monitoring. For example, there is a limit concerning obtaining data about the amount of imported electricity. NERI cannot make the right estimation for this amount. This is because, depending on the transmission and distribution line's installation, the imported amount from Vietnam, China, and Thailand may change.
- 4) For relevance of outcome, output indicators if it is mutually irrelevant and exclusive, it is practically not a meaningful indicator. Indicators qualitative viewpoint were also considered.

In this project, each item's indicators were chosen according to the following steps.

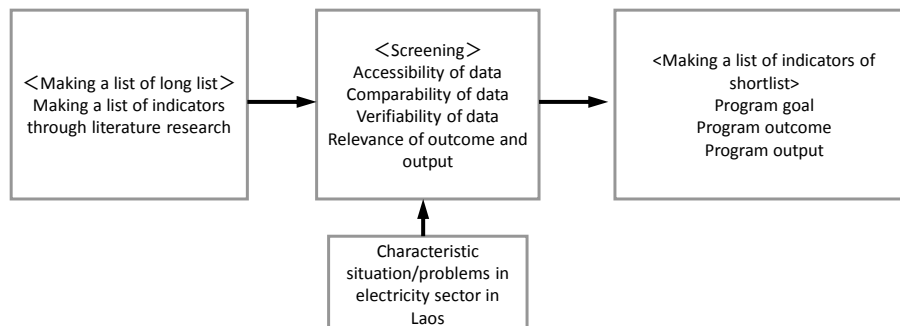


Fig. 25 Process in selecting electricity development indicators

For constructing the development indicators, making a definition of each policy's achievement becomes necessary.

Stable Supply of Electricity, Energy Security, Access, Fiscal Dependence of the sector and Affordability were defined as follows:

- Stable Supply of Electricity: “Enlarge electricity export and improve contribution to national revenues” and “Enlarge power supply for domestic consumers, provide low cost electricity to domestic industries and people, and develop new industries”.
- Energy Security: “Decrease the imported electricity ration during the dry season in Lao PDR, where hydropower consists 99% of the generation. Also, decrease export ratio and the percentage of hydropower generation in national revenue”. For this purpose, increase coal-fired generation to curb imported electricity in the dry season. Through strengthening bargaining power in negotiating with neighboring countries, and through improving added value of electricity export, net import will be reduced.
- Access: “The proportion of consumers which have reasonably uninterrupted usage of electricity supply to potential consumers”.
- Fiscal Dependence of the EDL: “The financial support from the government or cross-subsidy among different customer classes is minimal. In order to attract investment, EDL should have strong financial capabilities as off-takers. For this aim, electricity prices have to be raised to match cost”.
- Affordability: ‘The proportion of electricity-related expenditure to amounts payable for electricity.’

4.2.2 Adoption of indicators in the present operation

In this project, program goal, program outcome, and program output were evaluated under accessibility, comparability, and verifiability. (For details of evaluation for each indicator, see reference document 5)

4.2.2.1 Program goal

The program goal was “Enhancement of stable, sustainable and efficient electric power supply for realization of socio-economic development plan for increasing GDP”, and indicators are GDP per capita and Power consumption per capita (kWh).

In Lao PDR, it is expected that electricity exports occupy a large share of all exports. If support for the electricity industry is made effectively and increases domestic electricity supply and export, and reduces import, it is expected that the GDP will be increased as shown in simple macro economies for $Y = (C: \text{Consumption}) + (I: \text{Private investment}) + (G: \text{Government expenditure}) + (EX: \text{Export}) + (IM: \text{Import})$.

Figure 26 Indicators in program goal

	Unit	Source	Data		
			2010 ~ 2015	2015 ~ 2020	2020 ~ 2025
Enhancement of stable, sustainable and efficient electric power supply for realization of socio-economic development plan	GDP per capita(2011) (2000 constant price)	USD	WDI 591(Laos) 737(Vietnam)	< Benchmark > 1206(Indonesia) 1413(Philippines)	< Benchmark > 2699 (Thailand)
	Power consumption per capita (kWh)	kWh	WDI 357 (Laos)	640 (Indonesia) 140 (Philippines) 1034(Vietnam)	2243 (Thailand)

Source: Created by Kyoto University Nagayama

4.2.2.2. Program outcome (Influence on social activities)

Program outcome (contribution to society) adopts 3 topics: i) stable electricity supply, ii) contribution to domestic economy, and iii) contribution to the environment.

i) In the stable electricity supply, we prepare three categories as energy security, investment promotion, and financial independence.

For energy security, we adopt the indicator below;

- Annual import ratio
- Import ratio by EDL in dry season
- Export value of hydro as a proportion to total export
- Share of coal (domestic supply) to total domestic supply
- Share of hydropower as a proportion to total government revenue
- HHI (Herfindal = Hitshman index)⁹
- RE ratio (RE = (geothermal + solar + wind + small hydro + solid waste + biomass/biogas))
- Green Energy = (RE + hydro + natural gas))
- Energy Intensity – Total Primary Energy Consumption per Dollar of GDP

Grubb et al. (2006) adopted the Herfindal=Hitshman index (HHI) to measure the diversity in energy resources..The results of the measurement of electricity HHI are 9869 in Lao PDR, 5966 in Thailand, 4411 in Vietnam, 2717 in Indonesia, 2474 in the Philippines, and 2282 in Malaysia, which shows that Lao PDR' number is high in Asian 6 countries and Lao PDR excessively depends on hydropower generation. (Reference figure 2)

According to EGAT PDP 2010, Thailand has benchmarks for import restriction from Neighboring Countries (EGAT PDP2010, p11) Maximum share of the power import over the system's generating capacity must not exceed the following percentages:

- Total import from 1 country - 13%
- Total import from 2 countries - 25%
- Total import from 3 countries - 33%
- Total import from 4 countries - 38%

For investment promotion,

- Number of IPP projects under PPP scheme established
- FDI in Electric Sector
- Debt equity ratio (= Debt to Equity)
- Share of IPP(e) / Total capacity

⁹ HHI stands for Herfindahl-Hirschman Index, which is the summation of squared market share of each company. This can be used to measure the extent of market concentration. The bigger the index is, the more tight the oligopoly is, and on the other hand, the smaller the index is, the more intense the competition by many companies is.

- Share of IPP(d) / Total capacity
However, there are some restrictions on data availability, For example, data in real FDI amount cannot be obtained, because only data available is approval basis.

For financial independence,

- Self-Financing Ratio = Operating Cash Flow less Debt Service / Capital Investment (%)
- ROA=Profit before income taxes / Total Assets
- ROE = Net profit / Total Equity
- Debt ratio = Total Liabilities / Total Equity and Liabilities
- Profit ratio = Net profit / Total revenue
- Debt service ratio
- LLRMC / Average Tariff : ratio
- Subsidy/Average Electricity Tariff
- Establishment of cost reflective tariffs (Ratio of industrial users to residential users)
- Receivable Turnover Period (day)

are adopted as indicators.

The reason why financial independence is categorized under outcome rather than output is that EDL performance is affected not only by EDL's efforts for improving management, but by other factors, such as electricity tariff setting, the wholesale purchase price settled between EDL-GEN (which is under the control of Lao government), and import from neighboring countries including Thailand.

According to the Tariff study update project (Final Report, 2009) of IDA (International Development Agency), LRMC (from 2007 to 2016; before loss; Add thought level) is 661 kip/kWh in low voltage level, 534 kip/kWh in transmission level and 448 kip/kWh in generation level. According to the report, the cost of service is higher than LRMC and, in order to ensure a profit rate for 5% of pure fixed assets, the electricity charge needs to be 1270 kip/kWh on average in 2016. (in 2011, the tariff was 647 kip/kWh, and even "New electricity tariff table" (published in September 3rd, 2012 by MEM) says the average tariff will be 700 kip/kWh in 2016).

"Implementation Completion and results report of the Rural Electrification program" (2012) from the World Bank makes the cost of supply 959kip/kWh (11.9 US cents / kWh) (2009) , 946kip/kWh (11.8 US cents / kWh) (2010) and 976kip/kWh (12.2 US cents / kWh) (2011) based on EDL tariff plan (2012).

The World Bank and the IDA (2011) set three covenants: Self-financing ratio > 30%, Debt equity ratio < 1.5, and Debt service ratio > 1.5. (At the conversation of World Bank and IFC on March 26th in 2013, it was confirmed that covenants had not changed.)

The reason for long accounts receivable turnover, 85 days (2.3%), is because of institutions concerning electricity rate payment of governmental organizations and irrigation facilities. The target is to shorten the turnover into 45 days (2.2%) by making Ministry of Finance (MOF) pay EDL directly.

For contribution to the national economy, we adopt poverty reduction, utilization of water resource, and industrial development.

For poverty reduction, affordability, accessibility and Gini-coefficient are adopted.

However, no related data available for affordability, we tried to collect reference data. According to Department of Statistics report (2007/2008), the electricity consumption of a household is 1.5% (33,200 kip/month/household) of total household consumption under the title of "Water and electricity." In urban areas, the rate is 2.2% (65,300 kip/month/household), and in rural areas, for Access to Road, 1/1% (21,000 kip/month/household), and for Without Access to Road, 0.4% (6,200 kip/month/household). As the only benchmark, we can cite the "People to People" project promoted by EDL and World Bank which gives 7 million kip (85 US\$) for households when they newly connect

electricity distribution lines, and in which households which used the support need to prove their ability to repay 20 thousand kips a month.

In the World Bank report “Implementation completion and results report of the rural electrification program (2013)”, WTP (willingness to pay) is listed as 97,716 kip / month household.

The Lao Institute for Renewable energy conducts interviews about Willingness to Pay in villages where the NGO (Non-Governmental Organizations) is doing a project. From the result, in the electrification project by kerosene, the payback is 60,000-80,000 kip/month/household, and in the project by Pico water or solar, 18,000-30,000 kips/month/household.

For accessibility, we adopt indicators below;

● Household Access (%) = Households with a Commercial Connection / Total Households

● Village Access (%) = Communities with Commercial Supply / Total Communities

For utilization of water resources,

● Agriculture value added (constant 2000 US\$)

For benchmarks in industrial development,

● Industry value added (constant 2000US\$)

are adopted.

For improvement in national balance of payments,

● Import of electricity as a proportion to total import

● Export of electricity as a proportion to total export

are adopted.

When national revenue increases through electricity exports, the amount of money used for capital expenditure increases and the whole country benefits.

The DSR (Debt Service Ratio: the interest and principal payments ratio to export) is 2.3%, which is good relative to neighbor countries such as Vietnam and Cambodia. However, foreign currency exchange reserves are for two months. As Lao PDR needs foreign currency exchange reserves for at least 4 months, efforts to reduce electricity imports and expand electricity exports are necessary.

For the environment,

● CO₂ emission kg per 2000US\$ of GDP

● CO₂ emission metric ton per capita

are adopted.

There are other candidate indicators related to the environment other than CO₂ (a factor of climate change), such as air quality, water quality, soil quality, and forest/biodiversity (Grubb et al., 2006; IAEA, 2005). However, data in Lao PDR other than CO₂ are difficult to obtain.

Figure 27 Indicators of program outcome

Stable supply of electricity

	Unit	Source	Data			
			2010~2015	2015~2020	2020~2025	
Energy Security (Stable supply to meet domestic needs)	Annual import ratio	%	MEM	45% (2012 Average)		
	Import ratio by EDL in dry season	%	MEM	66% (March 2012)		
	Export value of hydro as a proportion to total export	%	BOL/IMF	10.5%(2010) 27%(2013); IMF projection		
	Share of coal (domestic supply) to total domestic supply	%	PDP2012	0%	4%(2015)Hongsai(100MW/2,356 MW)	
	Share of hydropower as a proportion to Total government revenue	%	IMF / MEM annual report	4.4%(2010)	5.2%(2016)	
	RE ratio (Solar + Wind + Small hydro + Solid waste + Biomass / Biogas + Geothermal)	%	PDP2012 RES2011 WDI	0.18% (2011)	RES2011 RE: 243MW (2020)	30% of Total energy consumption by 2025 RES2011 RE: 728MW (2025) <Benchmark: Mwh Base> Vietnam 0.1% (2010) Malaysia 1.02% (2010) Indonesia 5.6% (2010) Thailand 2.1% (2010) Philippines 14.8% (2010)
	HHI		WDI MEM	Laos(2011) 9,869	<Benchmark> Thailand (2010) 5966	<Benchmark> Philippines 2,474(2010) Indonesia 2,717(2010) Vietnam 4,411(2010) Malaysia 2,282(2010)
Green Energy (RE + Hydro + Gas)		WDI MEM	99.5% (2011)		<Benchmark: MWh Base> Vietnam 75% (2010) Malaysia 62.69% (2010) Indonesia 39.6% (2010) Thailand 80.4% (2010) Philippines 55.1% (2010)	
Energy intensity	ELA	Btu per Year	Laos		<Benchmark>	
Investment promotion	Number of IPP projects under PPP scheme established	%	MEM	Xekatom, NT2		
	FDI in Electric Sector / Total FDI	value / FF	MPI	0.72% (2011)		
	Domestic investment in Electric Sector	value / FF	MPI			
	Share of IPP(e) / Total capacity	%	MEM (PDP 2010-2020)	15% (2011)		13% (2020)
Share of IPP(d) / Total capacity	%	MEM (PDP 2010-2020)	31% (2011)		76% (2020) <Benchmark> Philippines 55.1% Vietnam 75%	
Financial Independence	Self-Financing Ratio = Operating Cash Flow less Debt Service / Capital Investment (%)	%	EDL	0.07 (2010) 0.06(2011)		Target>30%(WB covenants)
	ROA = Profit before income taxes / Total Assets	%	EDL	1.35 (2010)	<Benchmark> 7.7% (2011)EGAT	
	ROE = Net profit / Total Equity	%	EDL	1.58 (2010)	<Benchmark> 12.2% (2011)EGAT	
	Debt to equity ratio	Ratio	EDL	0.64(2010) 1.3 (2011)	<Benchmark> EGAT 0.59 (2011)	Target<1.5(WB covenants)
	Profit ratio	%	EDL	5.09 (2010)	<Benchmark> 7.3% (2011)EGAT	
	Service coverage ratio	%	EDL	1.21 (2011)		Target> 1.5(WB covenants)
	Estimated Government Subsidy for residential customers @ 150kwh	US AID	US cents/kwh	Laos 0	<Benchmark> Thailand 8.8 Philippines 0 Malaysia 4.51 Indonesia 8.38	
	Estimated Average Set (Cost of sale) for residential customers @ 150kwh	"Implementation Completion and results report of the Rural Electrification program" (2012)	US cents/kwh	EDL/ Cost of supply 959kip/kWh (11.9 US cents / kWh) (2009) 946kip/kWh (11.8 US cents / kWh) (2010) 976kip/kWh (12.2 US cents / kWh) (2011)	<Benchmark> Thailand 19.18 Philippines 19.84 Indonesia 15.61 Malaysia 15.25	
	LRMC / Average Tariff : ratio	Ratio	World Bank (Tariff study) Merako (2012)	LRMC/Average tariff = 1.02 (Average tariff (2011) 647 kip/kWh) LRMC 661kip/kWh (Distribution LV before loss) <Benchmark: Merako(2012)> Merako(Philippines) 1 Malaysia 1.56 Thailand 1.58 Korea 2.05 Taiwan 2.16 Indonesia 1.98	<1	<1
	Subsidy/Average Electricity Tariff	Ratio	EDL/USAID	Laos(0), Only In-kind	<Benchmark> Thailand 0.85 Indonesia 1.16 Malaysia 0.42	<Benchmark> Philippines 0
Establishment of cost reflective tariffs	Ratio of Industrial users to residential user	JETRO (2012)	Laos (1.05)	<Benchmark> Thailand 1.33 Indonesia 1	<Benchmark> Philippines 0.6 Malaysia 0.86 Vietnam 0.84	
Receivable Turnover Period (day)	Days	Annual Report	85(2.3%)	45(1.2%)/Target	EGAT(7days)	

Source: Created by Kyoto University Nagayama

Contribution to national economy

			Unit	Source	Data		
					2010~2015	2015~2020	2020~2025
Poverty reduction	Affordability : Income Improvement	Income Affordability = Cost of Subsistence Electricity / Poverty Income Level (%)	% months Total Urban Rural	WB(2013)	97.716 kip/month household		
	Access	Household Access = Households with a Commercial Connection / Total Households	%	EDL	78.53%(2011)	<Benchmark> 86.8% (2010: Thailand)	<Benchmark> 97.3 (2010: Vietnam) 90%(by 2010: gov's target)
		Village Access = Communities with Commercial Supply / Total Communities	%	EDL	68.99%(2011)		
	Gini-index		Index	WDI	Laos 0.36(2008) <Benchmark> Thailand 0.4(2009) Indonesia 0.34(2005) Vietnam 0.36(2008)		
	Residential electrical consumption		GWh	Electricity Statistics 2011	1,004,074(2011)		
Effective utilization of water resources	Agriculture value added (constant 2000 US\$)		USD	WDI	178(2010)	<Vietnam> 130(2010) <Philippine> 165(2010) <Indonesia> 155(2010)	<Thailand> 205(2010) <Malaysia> 400(2010)
	Irrigation electrical consumption		GWh	Electricity Statistics 2011	46,185(2011)		
Industrial development	Industry value added (constant 2000US\$)		USD	WDI	183(2010)	<Vietnam> 336(2010) <Philippine> 461(2010) <Indonesia> 496(2010)	<Thailand> 1203 <Malaysia> 2177
	Industry and commercial electrical consumption		GWh	Electricity Statistics 2011	584,087(Industry:2011) 598,738(Commercial:2011)		

Source: Created by Kyoto University Nagayama

Environment

			Unit	Source	Data		
					2010~2015	2015~2020	2020~2025
Consideration to environment	CO2 emission kg per 2000US\$ of GDP		kg per 2000 US\$ per GDP	WDI	0.57 (2009)	<Philippines> 0.6 (2009) <Thailand> 3.91 (2009)	<Vietnam> 2.4 (2009) <Thailand> 1.6 (2009) <Indonesia> 1.7 (2009) <Malaysia> 1.4 (2009)
Consideration to environment	CO2 emission metric ton per capita		metric ton per capita	WDI	0.29 (2009)		<Vietnam> 3.9 (2009) <Indonesia> 7.1 (2009) <Malaysia> 1.9 (2009)

Source: Created by Kyoto University Nagayama

4.2.2.3 Program Output

Program output includes reinforcement of electricity administrative management ability, maintenance of electricity facilities, and enhancement of business administrative ability of electricity business undertakers.

- i) About reinforcement of electricity administrative management ability
 - Arrangement of energy related statistical database
 - Energy/power development policy formulating comprehensive PDP
 - Formulating policy on improvement of electricity facilities development
 - Draw up a roadmap that aims at reinforcement of regulatory function
 - Enhancement of examination and inspection function of the ministry and local governments

Environmental regulation, LEPTS, Definition of rules concerning consumer protection, allocation of subsidies are prepared, Equal access to transmission line were listed.
- ii) About maintenance of electricity facilities
 - Starting plans (about 60~100MW) for establishing medium sized hydro power plants corresponding to peak hours and/or dry season
 - Setting plans for increasing efficiency of power transmission and distribution system (maintenance of transmission and distribution network)
T&D loss, Interconnection to GMS, km(extension of distribution lines) were listed.
 - Reinforcement of renewable energy development including mini hydro power plants, promotion of local electrification
- iii) About enhancement of business administrative capability of electricity business undertakers
 - Draw up optional investment plan by EDL for Financial and planning capacity,
 - Organization management capacity

Tariff collection efficiency (unpaid ratio), Accounts receivable turn over periods, Draw up optional investment plan by EDL and Draw up action plan to improve customer service are listed.
Sales per employee / Net profit per employee for Project implementation and supervision capacity are listed.

Figure 28 Indicators of program output

			Unit	Source	Data			
					2010~2015	2015~2020	2020~2025	
Reinforcement of electricity administrative management capability	Support of review of energy development policy and electric power development policy	Arrangement of energy related statistical database			Can collect data by dispatching staff	Can collect through internet Man dated to submit energy consumption data	Data collection activities are institutionalized	
		Energy · power development policy formulating comprehensive PDP			Preparation for NPDP	Institutionalized NPDP	Integration to GSM framework	
		Formulating policy on improvement of electricity facilities development			Unsolicited bidding system	Preparation for Solicited bidding system	Solicited bidding system is institutionalized	
	Strengthening of regulatory framework	Draw up a roadmap that aims at reinforcement of regulatory function			Preparation for establishing Independent regulatory authority	Establishment of Independent regulatory authority	Financial of Independent regulatory authority is property	
		Enhancement of examination and inspection function of the ministry and local governments	Environmental regulation			Environmental regulation which do not hinder FDI	Environmental regulation which do not hinder FDI	Environmental regulation which do not hinder FDI
			Establishment of cost-reflective tariffs Ratio of Industrial (over 5MW)to residential (150kWh-) price		JETRO (2012)	1.05 Vientiane	<Benchmark>-BKK 1.33 Manila 0.6 JKL 1 KL 0.86 Hanoi 0.84	
			LEPTS			LEPTS are institutionalized	LEPTS are institutionalized	LEPTS are institutionalized
			Definition of rules			Definition of rules concerning consumer protection, allocation of subsidies are prepared	Definition of rules concerning consumer protection, allocation of subsidies are prepared	Definition of rules concerning consumer protection, allocation of subsidies are prepared
			Equal access to transmission line			Equal access to transmission line is guaranteed	Equal access to transmission line is guaranteed	Equal access to transmission line is guaranteed
Electricity station facilities	Power generation (Large scale hydroelectric)	Starting plans (about 60-100MW) for establishing medium sized hydro power plants corresponding to peak hours and /or dry season	MW	Statistic year book 2011 PDP 2012	527 MW(2011)	2356MW (2015)	8265MW (2020)	
	Power transmission	Setting plans for increasing efficiency of power transmission and distribution system (maintenance of transmission and distribution network)	Transmission and distribution losses(system losses) %	EDL WDI MEM(The Strategy Plan) PDP (2010-2020)	Transmission loss 33% + Distribution loss 10.78% →13.78% (2010)	14.24% (2015) <Benchmark> Vietnam (10%) Indonesia (9.4%) Philippines (11.5%)	12.68% (2020) <Benchmark> Japan (4.4%) Thailand (6.3%)	
			Interconnection to GSM		Bilateral transaction	Multilateral transaction	Integration to competitive market	
			km	Statistic year book 2011	3342km (115KV)			
	Rural electrification (small / mini-hydro)	Reinforcement of renewable energy development including mini hydro power plants, promotion of local electrification (Relation)	MW	REDS (2011 Oct)	13MW (2011)	140MW (2015)	243MW (2020) 728MW (2025)	
Enhancement of business administration capability for electricity business undertakers	Financial and planning capacity				Preparation for NPDP	NPDP Institutionalized	Update NPDP by themselves	
	Organization management capacity	Tariff collection efficiency (unpaid ratio)	%	EDL	2.2%(2011)		<Benchmark> EGAT (7days)	
		Accounts receivable turn over periods	day	EDL	85days(2010)			
		Draw up optional investment plan by EDL			Preparation for NPDP	NPDP Institutionalized	Integration to GSM framework	
	Project implementation and supervision capacity	Sales per employee = sales / number of employee	USD	EDL, annual report	59,539 (2010)	<Benchmark> PLN (2011) 487,115 TNB (2011)	<Benchmark> EGAT(2011) 526,720	
								Net profit per employee

Source: Created by Kyoto University Nagayama

Other indicators to look at electricity sector performance comprehensively

- "Blackout ratio / SAIDI / SAIFI
Duration of Outage (SAIDI) = Total Duration of Forced Outage per Year / Total number of Customers (Hours Forced Outage per Customer per Year)."
- Reserve Margin = (Available generation capacity (MW) – Historical Peak Load (MW)) / Historical Peak Load (MW). (%)
- Labor Productivity = No of Customers / Employee
- Average Plant Load Factor = Total Annual Generation Output (MWh) / 8760(hr)* Installed Capacity (MW)
- Consumption Density = Annual Energy Sales / Total length system distribution network (MWh/km)
- "Electricity of electricity consumption to GDP = Δ in Electricity consumption \div Δ in GDP"

However, among the aforementioned indicators, data for SAIDI, SAIFAI, Reserve Margin are currently unobtainable.

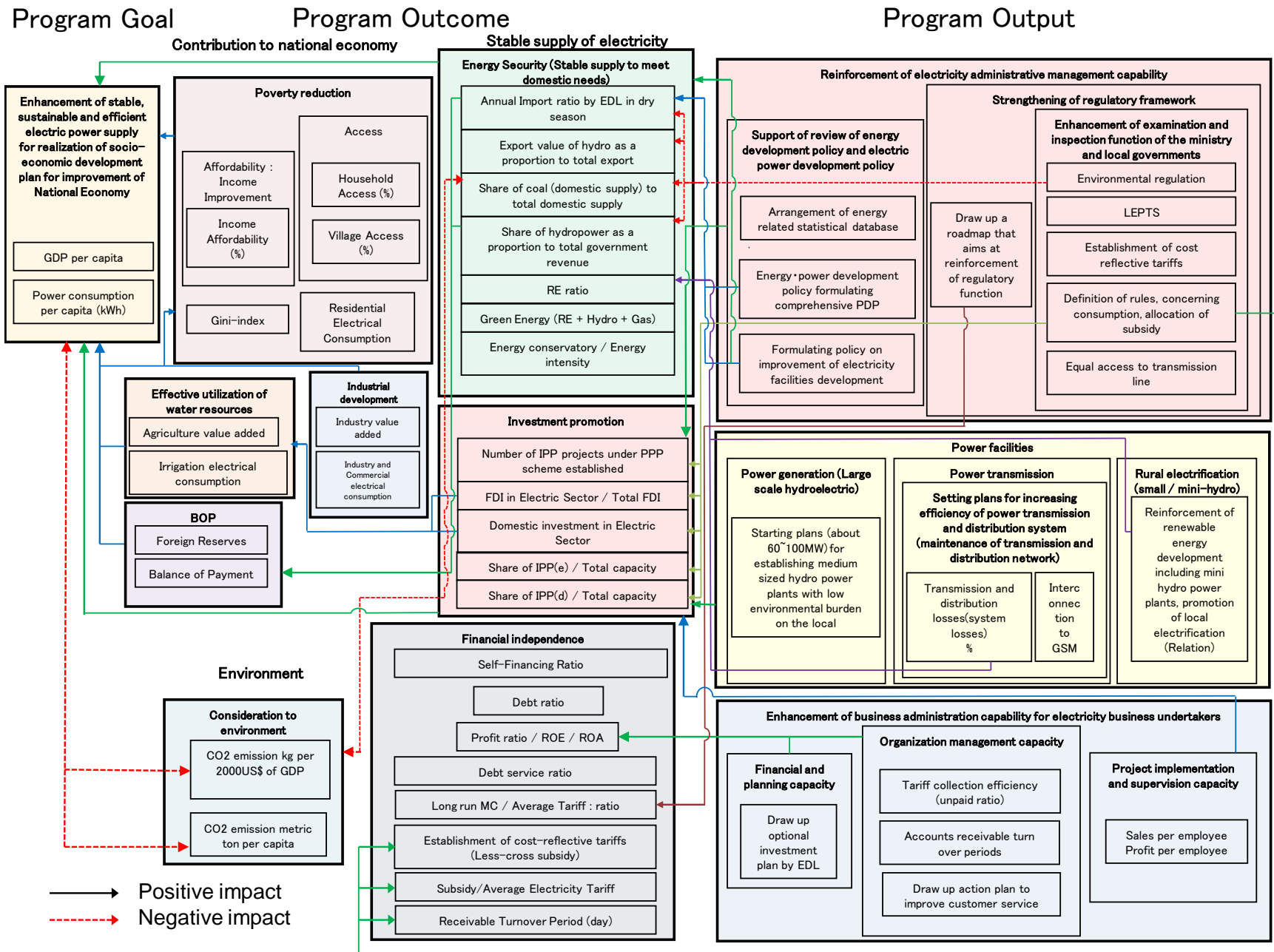
Figure 29 Indicators to look at electricity sector comprehensively

		Unit	Source	Data		
Sector Performance				2010~2011	2015~2020	2020~2025
1	Blackout ratio / SAIDI / SAIFI Duration of Outage (SAIDI) = Total Duration of Forced Outage per Year / Total number of Customers (Hours Forced Outage per Customer per Year).	Hours Forced Outage per Customer per Year		No data	No data	No data
2	Reserve Margin = (Available generation capacity (MW) – Historical Peak Load (MW)) / Historical Peak Load (MW). (%)	% MW MW				
3	Labor Productivity = No of Customers / Employee		EDL	226.6(HH/employee)		
4	Average Plant Load Factor = Total Annual Generation Output (MWh) / 8,780(hr)* Installed Capacity (MW)	MWh MW				
5	Consumption Density = Annual Energy Sales / Total length system distribution network (MWh/km)	MWh/km				
6	Electricity of electricity consumption to GDP = $\frac{\Delta \text{in Electricity consumption}}{\Delta \text{in GDP}}$		EDL WDI EIA	1.76 (2000-20005) <Benchmark> Thailand 1.09 (2000-2005) Philippines 0.78 (2000-2005) Indonesia 1.15 (2000-2005) Malaysia 1.9 (2000-2005) Vietnam 1.12 (2000-2005)		

Source: Created by Kyoto University Nagayama

4.2.3 Impact among electricity indicators

The impact flow among electricity development indicators are as shown in Figure 17.



Note RE = geothermal + solar + wind + small hydro + solid waste + biomass/biogas
 Source: Created by Kyoto University Nagayama, from JICA documents

Figure 30 Impact flow among electricity development indicators

4.3 Conclusions for electricity development indicators

We have constructed indicators that are related to aid for the developing country's electricity sector with Lao PDR electricity sector as an example in this research. Affordability, access and energy security have been given as indicators related to the electricity sector so far. In this report, we initially have set three steps for indicator settings from the viewpoint of aid for developing countries. The indicators are Program goal, Program outcome and Program output from the top.

The Program goal is to interlock with the development plan of both aiding country and counter-aiding country.

The Program output is something that was directly affected by aid project; the program outcome is goal, which is achieved through program output.

The maxims we have learnt throughout this study about electricity indicator construction are as follows:

- 1) To construct indicators under unique circumstances of the country and make clear definitions for respective indicators
- 2) To prioritize in time the achievement of indicator goals
- 3) To add qualitative indicators
- 4) To monitor while focusing on the interrelation between indicators with different steps

5. Overviews of the activities of World Bank and ADB

The World Bank and ADB supported Lao PDR mainly with new large-scale hydroelectric development until early 1980, but rural electrification (poverty reduction) and capacity building become a focus now because of relocation of residents and environmental problems. Hydroelectric generation and transmission grid enhancement projects are promoted.

The World Bank and ADB make loans to Lao PDR government's portion of the IPP share. ADB invests in LHSE through loans to Lao PDR's government. ADB offers policy risk guarantees and supports hydroelectric generation and transmission in GMS's framework and rural electrification in terms of poverty reduction.

The World Bank's major prospects are IFC's assistance to EDL finance, promoting investment on small hydroelectricity, arranging water resources law, and managing river basin and modeling. The bank also provided advice MEM for IPP contracts and considers providing avoided cost calculation. ADB supports small hydroelectricity FS and an energy-saving master plan as well as purchase of IPP constructed transmission lines.

Fig. 31 Supporting activities of World Bank and ADB for Lao PDR (1996~2008)

	World Bank(WB)				ADB		
	Capacity Building Financial Support	Generataion	Transmission	Rural Electrification	Generataion	Rural Electrification	Capacity Building
1996		1982 Nam Ngum1 Power Project	1992 Provincial Grid Integration Project		1987 Xeset Generation plant project		2006~ Northern Power Transmission Project
1997				1998-2004 Southern Provinces Rural Electrification project	1996~ Nam Leuk Hydropower	1997~ 2002 Power transmission and distribution project :loan	1994 Theun HinbounGeneration plant project
1998				:support of capacity building of rural electrification and	1997~ Development plan research of Nam Ngjep hydroelectric power plant in Laos TA and loan		
1999				EDL (power sector: 82%)		1998~ Northern Area Rural Power Distribution Project :TA and loan	1999 Analyzing and Negotiating Financing Options for the Nam Leuk Hydropower Project Cost overruns TA
2000					2002~ Nam Theun2 Hydropower Development Project TA and loan		
2001	2002-2004 Laos PDR Financial Management Adjustment Credit) :Finance for capacity building						
2002			2007~ Na Bong-Udon Thani Power Transmission – PFR1: TA and loan				2003 Northern Area Rural Power Distribution (NARPD)
2003					2003~ 2004 Nam Leuk Hydropower project		
2004			2007-2013 GMS Power Trade (Laos) Project :Enhancement of transmission and distribution system and support of Load Dispatch Center •Hony Lampha Ghai project :FS of hydroelectric project •TA of Collector Substation System (power sector: 86%)				2003 GMS Power Interconnection Project Phase I
2005					2005~ Nam Theun2 Hydroelectric Project		
2006	2007-2008 Third Lao PDR Poverty Reduction Support Operation Grant	2005~ Nam Theun 2 Hydroelectric Project :construction of hydroelectric power plants including dams and reservoirs		2006-2010 Rural Electrification Phase I Project of the Rural Electrification (APL) Program :loan and grant of rural electrification (power sector:85%)	2006~ Nam Ngum 3 Hydropower Project TA	2006~ Northern Power Transmission Project	
2007	:financial support of National Growth and Poverty Eadication Strategy] of Laos government (power sector: 12%)						
2008							

Fig. 32 Supporting activities of World Bank and ADB for Lao PDR (2007~present)

	World Bank(WB)				ADB			Other institutions
	Capacity Building Financial Support	Generataion	T ransmission	Rural Electrification	Generataion	Rural Electrification	Capacity Building	
2007	2007-2013 GMS Power Trade (Laos) Project 2008 Fifth Poverty Reduction Support Lao PDR Fourth Poverty Reduction Support Operation		2007-2013 GMS Power Trade (Laos) Project ;Enhancement of transmission and distribution system and support for Load Dispatch Center • Honoy Lampha Ghai ;FS of hydroelectric power project • TA of Collector Substation System (power sector: 86%	2006-2010 Rural Electrification Phase I Project of the Rural Electrification (APL) Program ;loan and grant for rural electrification (power sector:85%) 2008-2014 Greater Mekong Subregion Nam Theun 2 Hydroelectric Project - Social Safeguards Monitoring	2007~ Cumulative Impact Assessment for the Nam Ngum3 Hydropower Project 2008~ Nam Theun2 Hydroelectric Environmental and Monitoring Report	2006~ Northern Power Transmission Project	2007 Na Bong-Udon Thani Power Transmission Project	
2008	2009 Fifth Poverty Reduction Support (finished) 2010-2011 Lao PDR: Post-Ketsana Community Driven Disaster Recovery			2009-2012 Small and Mini Hydroelectric Development Project				2009-2010 Lao Renewable Energy Strategy Development and Capacity Building (Finland)
2009	2010-2011 -Sixth Poverty Reduction Support Operation Program (PRSO-6) June 2009 Tariff study update project (IDA)	2010 Water Resource Management and Hydropower Planning Hydropower Concession Management				2010- Greater Mekong Subregion Northern Power Transmission Project		2010~2012 Interlinkages between Energy and Livelihoods—Data, Training and Scenarios for Sustainable Energy Planning in Laos (INES) (Finland Future Research Center (FERC))
2010	WB (2009) Project Appraisal Document for the Lao PDR Technical Assistance for Capacity Building in the Hydropower and Mining Sectors Project 2011-2014 Lao Rural Electrification Phase II Project	2010-2014 -Technical Assistance for Capacity Development in Hydropower and Mining Sectors Project for Lao People's Democratic Republic (PDR)		2010-2014 Rural Electrification Phase II Project of the Rural Electrification (APL) Program	2011- Greater Mekong Subregion Nam Ngum 3 Hydropower Project			2011- Advisor dispatch from Korea 2011~ Lao PDR Renewable Energy; Decree on Implementing and Development Strategy, Data Collection and Capacity Building
2011	2011-2015 Lao PDR Mobilizing Ethnic Communities for Improved Livelihoods and Wellbeing 2011-2016 - Second Poverty Reduction Fund Project (PRF II)				2011-2014 Renewable Energy Development in Remote Communities Project			

Fig. 33 Supporting activities of World Bank and ADB for Lao PDR (2012~under planning)

	World Bank(WB)				ADB			Other institutions
	Capacity Building Financial Support	Generataion	Transmission	Rural Electrification	Generataion	Rural Electrication	Capacity Building	
2012	<p>2012 Lao Seventh Poverty Reduction Support</p> <p>2012 Lao-People's Democratic Republic and Mekong River Commission – Mekong Integrated Water Resources Management Project</p>				<p>2012- Greater Mekong Subregion Nam Ngum 3 Hydropower Project (Underplanning)</p> <p>Nam Ngiep 1 Hydropower Project (Underplanning)</p> <p>Nam Ngiep 3 Hydropower Project (Underplanning)</p> <p>Xepian Xenamnoy Generation plant project</p>			
		Institutional, Technical, Financial and Legal Advisory Services for Hydropower Concession Management				(under planning) Nabong 500 kV Substation and Transmission Facility Project	(Underplanning) GMS Northern Power Transmission2	

6. Preparation to institutionalize a national electricity development indicator

6.1 Preparation to institutionalize national electricity development indicator

6.1.1 Preparation for setting a national electricity development indicator

The important theme for Lao PDR in the future is to share the goals with donors.

The following steps are necessary.

- 1) Prioritize policies among different policy goals (e.g., improving EDL's financial status and promotion of local electrification, which mutually works in the opposite direction/ raising of electricity tariffs based on the cost).
- 2) Clearly make definitions of indicators to suit to policy goals. For example, as for energy security, the definition varies from country to country; thus, the definition of energy security by Lao PDR is necessary.
- 3) Carry out benchmark comparison for each indicator in other countries with consideration of Lao PDR's economic developmental stage and review the goal settings.
- 4) Take a multi-sector approach, including MEM (Ministry of Energy and Mines), MAF (Ministry of Agriculture and Forestry), MPWT (Ministry of Public Work and Transportation), MPI (Ministry of Planning and Investment), MOF (Ministry of Finance), EDL, EDL-gen and IPPs.

6.1.2 Steps for setting national electricity development indicators

The following approach for the preparation of setting electricity development indicators and updates is proposed.

- STEP1) Agree on a list of desirable indicators with Lao governments
- STEP2) Confirm consistency of published indicators and seek for the necessary but missing data (e.g., collect latest country reports on energy sector, including ones written in Lao PDR language; confirm consistency among various data sources about import value, etc.)
- STEP3) Make inventory of missing data (e.g., SAIFI, SAIDI)
- STEP4) Examine accessibility of data available
- STEP5) Make several economic development scenario under cooperation with NERI and make relevant target (e.g., example of Thailand: Jutamanee, M and S, Kumar [2012])
- STEP6) Agree on appropriate indicator with Lao governments
- STEP7) Review, maintain and update periodically and confirm the outcomes of the policy (e.g., Case of Mexico: Claudia, et al [2012])

6.2 Electricity sector industry organization

In order to set up an organization to make the aforementioned development indicators and to continuously monitor, reform of current organization is necessary.

The current setup of the Lao PDR electricity industry is single buying. Thus the role sharing is similar to Thailand and Indonesia, which also adopts single buyers. The model that falls between the Thailand model and the Vietnam model is preferred. DEPP should be in charge of policy and international relations including GMS and ASEAN like NEPO in Thailand. The DEM and DEP function is to be transferred to an independent regulatory committee. Regulatory institutions can be affiliated with MEM at first (e.g., ERAV of Vietnam), but should be targeted at political and financial independence in the end.

Such a foundation of independent regulatory institutions is also necessary to address the current EDL's financial status. The current organizations of MEM, DEM, DEB, IREP and Prime Minister's Office that hold permission authority for electricity business could be integrated into independent regulatory authority.

Fig. 34 Comparison in roles of departments in each electricity market

	Single Buyer			Wholesale Competition	Retail Competition
	Thailand	Indonesia	Laos	Vietnam	Philippines
Generation and Transmission Planning Function (PDP, TDP)	EGAT (Single Buyer)	MEMR	MEM	IE under the direction of MOIT	DOE
Overall Policy International Relations	EPPO (under Ministry of Energy)	MEMR	MEM_DEPP	MOIT	DOE
Regulation	(Energy Regulatory Commission)	MEMR	MEM_DEM	ERAV under the direction of MOIT	ERC
IPP business	MOE	MEMR	MEM_DEB	MOIT	DOE
Single Buyer	EGAT	PLN	EDL	-	-

Note1 : MEMR (Indonesia): Ministry of Energy and Mineral Resources

MOIT (Vietnam): Ministry of Industry and Trade

ERC (Philippines): Energy Regulatory Commission

IE (Vietnam): Institute of Energy

DOE (Philippines): Department of Energy

EPPO (Thailand): Energy Policy and Planning Office

MOE (Thailand): Ministry of Energy

Note2 : In energy regulatory commission of Thailand there are seven staff members

Source: Governments information of respective countries

Fig. 35 Roles of each department in Lao PDR (2013)

	Operation of regulatory organization	MPI	Prime minister office	DEPP	DEM	DEB	IREP	EDL
1) Regulations for generation transmission and distribution businesses	Issues licenses to the new entrants (generation)				○			
	Transmission wheeling rate guidelines					○		
	Approval of expansion/improvement plans for transmission assets related to the Transmission Development Plan (TDP)		-	-	-	-	-	-
	Determination of charges and fees related to Ancillary Services		-	-	-	-	-	-
	Publication of going public regulations for the privatization of distribution companies, and related regulations		-	-	-	-	-	-
	Promulgation of rules, guidelines and procedures related to the licensing of power sales companies					○		
	Publication of other guidelines related to the enforcement of grid codes and distribution codes, and the assessment of technical and business plans.					△		○
2) Price regulation	Calculation of transmission costs		-	-	-	-	-	-
	Industry		○					
	Commercial		○					
	Household		○					
	Price control method for transmission							
	Price control method for distribution		-	-	-	-	-	-
3) Metering	Establishing approval guidelines for MSPs(Meter Service Providers)		-	-	-	-	-	-
	Establishing traceability of measurement standard guidelines				○			
4)Rural electrification	Evaluation of electrification methods						△	
	Evaluation of universal charges		-	-	-	-	-	-
	Evaluation of new participants to rural electrification						△	
	Publication of guidelines for distribution contracts etc. between DUs in franchised territories which are deemed unviable.						×	
5)Energy saving and renewable energy	Establishing DSM regulation framework				○			
	Enforcing purchases of renewable energy						△	
6) Subsidy	Subsidy for fuels		-	-	-	-	-	-
	Subsidy for groups		-	-	-	-	-	-
7)Consumer protection	Necessary information required for application of license/approval from regulatory organizations, and evaluation of this data				○			
	Public hearings and handling of complaints		×	×	×	×	×	×
8)Assessment of assets related to the unbundling of sectors	Review and approval of Transition Supply Contracts		-	-	-	-	-	-
	Assessment of unrecoverable investments		-	-	-	-	-	-
	Establishment of classification standards for voltage transmission assets and sub transmission assets, and the publication of guidelines on the Delineation of Transmission and Sub transmission Assets		-	-	-	-	-	-
9) Technical standard	LEPS				○			
10) Electricity policy / PDP / Energy data collection	Energy Consumption data			○				
11) Start of Investment procedure	Issuance of Concession Agreement	○						

Note1: LEPS = Lao Electric Power Technical Standard

Note2: ○: Have the function

×: Don't have the function

△: under preparing

- : N/A

Source: Interview with ME

Fig. 36 Roles of electricity regulatory organization in Asian countries

Operation of regulatory organization	Cambodia (EAC)	Vietnam (ERAV)	Thailand (Energy regulatory commission)	The Philippines ERC	
	VM ³	VM→SB	SB	RC	
Total staff	52	53	-	249	
Total staff/sector	52	53	-	249	
#of professional staff	32	-	-	-	
Budget(thousand US\$)	510	-	-	2860.7	
Budget/sector(thousand US\$)	510	-	-	2861	
Budget/person(thousand US\$)	9.81	-	-	11.49	
1)Regulations for generation, transmission/distribution	Issues licenses to the new entrants (Generation)	o	o	o	-
	Transmission wheeling rate guidelines	o	o	-	o
	Approval of expansion/improvement plans for transmission assets related to the Transmission Development Plan (TDP)	x	o	-	o
	Determination of charges and fees related to Ancillary Services	x	o	-	o
	Promulgation of rules, guidelines and procedures related to the licensing of power sales companies	o	o	o	o
	Publication of other guidelines related to the enforcement of grid codes and distribution codes, and the assessment of technical and business plans.	x	o	o	o
	Calculation of transmission costs	-	o	o	o
2) Price regulation	Tariff permit for industry	o	o	o	o
	Tariff permit for commercial	o	o	o	o
	Tariff permit for household	o	o	o	o
	Price control method for transmission	-	Not yet define	ROR	RC
	Price control method for distribution	ROR	Not yet regulated	ROR	PC, ROR
	Establishing approval guidelines for MSPs(Meter Service Providers)	x	x		o
3) Metering	Establishing traceability of measurement standard guidelines	x	x		o
	Evaluation of electrification methods	x	x	x	o
4) Rural electrification	Evaluation of universal charges	x	o	o	o
	Evaluation of new participants	x	o	o	o
	Publication of guidelines for distribution contracts etc. between DUs in franchised territories which are deemed unviable.	-	x	N/A	o
	Establishing DSM regulation framework	x	o		o
5)Energy saving and renewable energy	Enforcing purchases of renewable energy	x	o		o
6) Subsidy	Subsidy for fuels	No subsidy for fuels	No	x	

	Operation of regulatory organization	Cambodia (EAC)	Vietnam (ERAV)	Thailand (Energy regulatory commission)	The Philippines ERC
		VM ³	VM→SB	SB	RC
	Subsidy for groups	VM ³ residence in Phnom Penh only	Residential, Rural residential customers	Residential(150kWh/month, Commercial (Below 12kV, 150 kWh /month), Government & Non Profit organization, Water, Pumping for agricultural	
	Necessary information required for application of license/approval from regulatory organizations, and evaluation of this data	○	○	-	○
7) Consumer protection	Public hearings and handling of complaints	○	○	-	○
	Review and approval of Transition Supply Contracts	x	x	-	○
8) Assessment of assets related to the unbundling of sectors	Assessment of unrecoverable investments	x	○	-	○
	Establishment of classification standards for voltage transmission assets and sub transmission assets, and the publication of guidelines on the Delineation of Transmission and Sub transmission Assets	○	○	-	○
9) Technical standard		○	EVN	EGAT	?
10) Energy Consumption data			MOIT	EGAT	DOE

Note 1: VM=Vertical Monopoly, SB=Single Buyer, WC=Wholesale Competition, RC=Retail Competition

Note 2: RC=Revenue Cap, PC=Price Cap, ROR=Rate of Return

Note 3: Cambodia has one major and a large number of small vertically integrated supplies.

Note4: ○: Have the function

×: Don't have the function

△: under preparing

-: N/A

Source: Data for Cambodia, Vietnam, Thailand, and The Philippines are JICA/Nagayama study (2006)

7. JICA's role in electricity networking program

JICA's role in program goal and program outcome in electricity infrastructure improvement is not direct. However, in program output, JICA, World Bank, and ADB's demarcation is relatively easy to carry out. In order to elevate the program outcome effect, it is recommended that World Bank and ADB create a regulatory outline while JICA is in charge of skill training.

Fig. 37 JICA's roles in achieving program goal

		JICA		Need coordination with other donors
		Direct impact	Indirect impact	
Enhancement of stable, sustainable and efficient electric power supply for realization of socio-economic development plan	GDP per capita		△	△
	Power consumption per capita		△	△

Fig. 38 JICA's roles in program outcome (1)

		JICA		Need to coordinate with other donors
		Direct impact	Indirect impact	
Energy Security (Stable supply to meet domestic needs)	Annual import ratio		○	○
	Import ratio by EDL in dry season		○	○
	Export value of hydro as a proportion to total export		○	○
	Share of coal (domestic supply) to total domestic supply		○	○
	Share of hydropower as a proportion to Total government revenue		○	○
	RE ratio		○	○
Investment promotion	Green Energy		○	○
	Energy conservatory / Energy intensity		○	
	Number of IPP projects under PPP scheme established		○	
	FDI in Electric Sector / Total FDI		○	
	Domestic investment in Electric Sector		○	
	Share of IPP(e) / Total capacity		○	
	Share of IPP(d) / Total capacity		○	
Financial independence	Self-Financing Ratio = Operating Cash Flow less Debt Service / Capital Investment (%)		○	○
	ROA=Profit before income taxes / Total Assets		○	○
	ROE = Net profit / Total Equity		○	○
	Debt ratio = Total Liabilities / Total Equity and Liabilities		○	○
	Profit ratio		○	○
	Debt service ratio		○	○
	LRMC / Average Tariff : ratio		○	○
	Establishment of cost-reflective tariffs (Less-cross subsidy)		○	○
	Subsidy/Average Electricity Tariff			
	Receivable Turnover Period (day)			

Fig. 39 JICA's roles in program outcome (2)

Contribution to national economy			JICA		Need to coordinate with other donors
			Direct impact	Indirect impact	
Poverty reduction	Affordability : Income Improvement	Income Affordability = Cost of Subsistence Electricity / Poverty Income Level (%)		○	○
	Access	Household Access		○	○
		Village Access		○	○
	Gini-index			△	△
Effective utilization of water resources	Agriculture value added			△	△
Industrial development	Industry value added			△	△
BOP	Foreign Reserves / Balance of Payment			△	△
Environment			Direct impact	Indirect impact	Need to coordinate with other donors
Consideration to environment	CO2 emission kg per 2000US\$ of GDP		△		△
	CO2 emission metric ton per capita		△		△

Fig. 40 JICA's roles in program output

Contribution to national economy				JICA		Need to coordinate with other donors	
				Direct impact	Indirect impact		
Reinforcement of electricity administrative management capability	Support of review of energy development policy and electric power development policy	Arrangement of energy related statistical database		◎			
		Energy power development policy formulating comprehensive PDP		◎			
		Formulating policy on improvement of electricity facilities development		◎			
	Strengthening of regulatory framework	Draw up a roadmap that aims at reinforcement of regulatory function		◎			
		Enhancement of examination and inspection function of the ministry and local governments	Environmental regulation		△		◎ WB/ADB
			Establishment of cost-reflective tariffs				
			LEPTS		◎		
			Definition of rules				◎ WB
Equal access to transmission line					◎ ADB		
Electricity station facilities	Power generation (Large scale hydroelectric)	Starting plans (about 60~100MW) for establishing medium sized hydro power plants corresponding to peak hours and/or dry season	MW				
	Power transmission	Setting plans for increasing efficiency of power transmission and distribution system (maintenance of transmission and distribution network)	Transmission and distribution losses(system losses) %				
			Interconnection to GSM			◎ ADB	
			km	○	○	○	
Rural electrification (small / mini-hydro)	Reinforcement of renewable energy development including mini hydro power plants, promotion of local electrification (Relation)			◎		◎	
Enhancement of business administration capability for electricity business undertakers	Financial and planning capacity	Draw up optional investment plan by EDL	%			△	
	Organization management capacity	Tariff collection efficiency (unpaid ratio)	day			△	
		Accounts receivable turn over periods				△	
		Draw up optional investment plan by EDL				△	
		Draw up action plan to improve customer service	Customer meter			○	
	Project implementation and supervision capacity	Sales per employee Profit per employee			◎	◎ WB	

Demarcation to address current major problems between JICA, the World Bank group, and ADB are as indicated in Fig.41.

Fig. 41 Present program address to major problems

		Countermeasures on electricity management programs by donors
1) Stable power supply for domestic consumers		
	1-1) Energy security problems	JICA offers each kind of yen loan (in process)
	1-2) Problems of governance concerning investment promotion	
	a) Problems concerning governance of electricity sector	JICA“Project for the Improvement of the Governance Mechanism for Sustainable Power Development Planning”(in process) World Bank: Hydro power Concession Management Institutional, Financial and legal Advisory Services for Concession Management JICA: Improvement of Power Sector Management (IPSM)
	b) Equal access to transmission lines for domestic and export	World Bank/IDA, “Tariff study” (2009)JICA“Project for the Improvement of the Governance Mechanism for Sustainable Power Development Planning”(in process)
	c) Various data are underdeveloped	JICA: Data collection Study on Energy Sector in Lao PDR (2012)
	1-3) Problems concerning EDL’s financial independence a) No set-up of peak-off-peak tariffs b) Tariff structure doesn’t reflect cost of sales c) Only energy char is set	World Bank/IDA, “Tariff study”(2009) ADB Energy Efficiency project (under planning)
	1-4) Problems concerning international balance of payments	All projects
2) Contribution to domestic economy		
	2-1) Poverty Reduction	Rural Electrification Projects (World Bank, JICA)
	2-2) Effective usage of water resources	World Bank: Water Resource Management Hydro power planning World Bank: Hydro power Concession Management Institutional, Financial and legal Advisory Services for Concession Management
	2-3) Industrial development	
3) Consideration to environment		
		World Bank: Water Resource Management Hydro power planning World Bank: Hydro power Concession Management Institutional, Financial and legal Advisory Services for Concession Management

Reference Fig. 1 Electricity export in each project (2011)

Source: MEM Annual Report 2011-2012

Dam	Unit	Plan 2011-2012 FY		2010-2011 (10_12/2010)+(1_9/2011)		2011-2012 Estimated		2012-2013 Estimated	
		kWh	US\$	kWh	US\$	kWh	US\$	kWh	US\$
2	3	4	5	4	5	6	7	8	9
Energy Supply in Total	kWh	12,319,152	639,852,456	10,749,925	513,426,958	13,864,368	670,438,156	15,460,710	834,411,766
Dom supply for 17 bruch offices	kWh	2,709,734	204,553,690	2,319,702	162,626,000	2,685,833	200,473,377	3,470,000	277,600,000
Export to Oversea	kWh	9,609,418	435,298,766	8,430,223	350,800,958	11,178,535	469,964,779	11,990,710	556,811,766
Unsdar EDL-Gen Operation	kWh	296,418	11,846,000	633,505	24,956,000	454,883	17,966,000	539,910	19,602,000
Theun Hinboun	kWh	1,450,000	74,058,653	1,266,966	63,261,181	1,545,583	77,872,534	1,450,000	74,058,653
Houy Ho	kWh	155,000	8,060,000	139,646	7,226,293	640,861	33,904,732	155,000	8,060,000
Nam Theun 2	kWh	534,000	224,868,000	6,390,105	255,357,484	6,478,000	239,543,724	5,354,000	224,868,000
Nam Ngum 2	kWh	2,354,000	116,466,113	-	-	2,059,209	100,677,790	2,354,000	116,466,113
Xekaman 3	kWh							883,800	39,771,000
Theun Hinboun Extention	kWh							1,254,000	73,986,000
Import Figure (1) + (2)	kWh	1,427,361	72,542,000	1,656,804	81,385,000	1,839,897	88,633,000	2,285,560	113,097,400
Import from outside country	kWh	583,091	33,943,000	752,676	41,418,000	842,458	44,446,000	418,215	26,733,000
Vietnam	kWh	34,230	2,054,000	34,531	2,072,000	34,064	2,044,000	37,206	2,228,000
Thailand	kWh	376,304	20,911,000	603,323	31,904,000	687,999	34,476,000	221,811	14,178,000
China	kWh	172,556	10,978,000	114,823	7,442,000	120,395	7,926,000	159,198	10,327,000
Buying from IPP Hydropower Plants	kWh	844,270	38,599,000	904,128	39,967,000	997,440	44,187,000	1,867,346	86,364,400
Theun Hinboun	kWh	32,027	1,907,000	30,350	1,728,000	22,847	2,593,000	32,633	2,030,000
Honey Ho	kWh	3,873	185,000	4,062	194,000	4,331	209,000	7,520	336,000
Nam Theun 2	kWh	354,839	14,538,000	417,359	16,664,000	388,152	15,772,000	319,097	14,709,000
Nam Lik 1/2	kWh	428,153	20,344,000	445,074	20,983,000	561,625	24,307,000	435,000	20,923,000
Nam Nguem 5 (NN5)	kWh	-	-	-	-	-	-	375,000	17,558,000
Nam Yaung	kWh	-	-	-	-	-	-	237,000	11,092,000
Nam Yone	kWh	12,585	885,000	4,969	259,000	9,097	638,000	12,825	904,000
Nam Thaa 3	kWh	5,573	338,000	2,265	136,000	3,273	198,000	8,023	486,000
Nam Kaa	kWh	20	1,000	48	3,000	5	0	18	1,000
Suga Mill Mithphonh	kWh	7,200	401,000	-	-	5,520	307,000	5,400	300,000
Nam Phao	kWh	-	-	-	-	2,590	163,000	3,431	216,000
XeKhaman3	kWh							98,200	4,419,000
Theun Hinboun Extension	kWh							316,000	12,324,000
TadSalen	kWh							17,200	1,066,400

Reference Fig. 2 Electricity HHI in Southeast Asian countries

Laos (2011)			Philippines (2010)			Thailand (2010)			Indonesia (2010)			Malaysia (2010)			Vietnam (2010)		
Source of Electricity	Share	(Share) ²	Source of Electricity	Share	(Share) ²	Source of Electricity	Share	(Share) ²	Source of Electricity	Share	(Share) ²	Source of Electricity	Share	(Share) ²	Source of Electricity	Share	(Share) ²
Hydro	99.34	9868	Hydro	12	132	Hydro	3.50	12	Hydro	10.40	108	Hydro	5.17	27	Hydro	29.03	843
RE	0.07	0	RE	15	219	RE	2.10	4	RE	5.60	31	RE	1.02	1	RE	0.06	0
OIL	0.41	0	OIL	11	110	OIL	0.70	0	OIL	20.30	412	OIL	2.93	9	OIL	4.22	18
GAS	0.00	0	GAS	29	829	GAS	74.80	5595	GAS	23.60	557	GAS	56.51	3193	GAS	45.94	2111
COAL	0.00	0	COAL	34	1183	COAL	18.80	353	COAL	40.10	1608	COAL	34.37	1182	COAL	20.74	430
Total	100		Total	100		Total	100		Total	100		Total	100		Total	100	
HHI		9869	HHI		2474	HHI		5966	HHI		2717	HHI		4411	HHI		3402

Note: Electricity production from renewable sources includes hydropower, geothermal, solar, tides, wind, biomass, and biofuels.

Source: Data for Lao PDR: MEM installed capacity (2011)

Other countries: Generation (GWh) of respective countries (2010): WDI

< Reference 3. Evaluation on development indicators >

Indicators of program goal

		Unit	Source	Data			Evaluation Criteria					Reference	Comments
				2010~2015	2015~2020	2020~2025	Accessibility	Comparability	Verifiability	Fit between output and outcome	Total		
Enhancement of stable, sustainable and efficient electric power supply for realization of socio-economic development plan	GDP per capita(2011) (2000 constant price)	USD	WDI 591(Laos) 737(Vietnam)	< Benchmark > 1206(Indonesia) 1413(Philippines)	< Benchmark > 2699 (Thailand)	3	3	3	N/A	9			
	Power consumption per capita (kWh)	kWh	WDI 357 (Laos)	640 (Indonesia) 140 (Philippines) 1034(Vietnam)	2243 (Thailand)	3	3	3	N/A	9			

Note 3: High evaluation 2: Middle evaluation 1: Low evaluation 0: No data available

Indicators of program outcome (1) Stable supply of electricity

	Unit	Source	Data			Evaluation Criteria					Reference	Comments		
			2010~2015	2015~2020	2020~2025	Accessibility	Comparability	Verifiability	Fit between output and outcome	Total				
Energy Security (Stable supply to meet domestic needs)	Annual import ratio	%	MEM	45% (2012 Average)										
	Import ratio by EDL in dry season	%	MEM	66% (March 2012)				2	2	2	3	9		
	Export value of hydro as a proportion to total export	%	BOL/IMF	10.5%(2010) 27%(2013): IMF projection				2	2	2	3	9		
	Share of coal (domestic supply) to total domestic supply	%	PDP2012	0%	4%(2015)Hongsa(100MW/2,356 MW)				2	2	2	3	9	
	Share of hydropower as a proportion to Total government revenue	%	IMF / MEM annual report	4.4%(2010)	5.2%(2016)				3	3	3	3	12	In MEM annual report, there are data for IPP, EDL respectively
	RE ratio (Solar + Wind + Small hydro + Solid waste + Biomass / Biogas + Geothermal)	%	PDP2012 RES/D(2011) WDI	0.18% (2011)	RES/D RE: 243MW (2020)	30% of Total energy consumption by 2025 RES/D RE: 728MW (2025) =<Benchmark: Mwh Base> Vietnam 0.1% (2010) Malaysia 1.02% (2010) Indonesia 5.6% (2010) Thailand 2.1% (2010) Philippines 14.8% (2010)		3	3	3	3	12		
	HHI		WDI MEM	Laos(2011) 9,869	<Benchmark> Thailand (2010) 5966	<Benchmark> Philippines 2,474(2010) Indonesia 2,717(2010) Vietnam 4,411(2010) Malaysia 2,282(2010)					3			
	Green Energy (RE + Hydro + Gas)		WDI MEM	99.5% (2011)		<Benchmark: MWh Base> Vietnam 75% (2010) Malaysia 62.69% (2010) Indonesia 39.6% (2010) Thailand 80.4% (2010) Philippines 55.1% (2010)		3	3	3	3	12		
	Energy intensity Total Primary Energy Consumption per dollar of GDP	EIA	Ibu per Year 2005 U.S.D (Market Exchange Rates)	Laos 10,832(2010)		<Benchmark> Thailand (2010) 20,585 Philippines (2010) 9,283 Malaysia (2010) 17,392 Indonesia (2010) 16,049 Vietnam(2010) 25,108		3	3	3	3	12		
	Investment promotion	Number of IPP projects under PPP scheme established	%	MEM	(Xekaman, NT2)				2	2	2	3	9	
FDI in Electric Sector / Total FDI		value / FF	MPI	0.72% (2011)				3	3	3	3	12		
Domestic investment in Electric Sector		value / FF	MPI					3	3	3	3	12		
Share of IPP(e) / Total capacity		%	MEM (PDP 2010-2020)	15% (2011)		13% (2020)		3	3	3	3	12		
Share of IPP(d) / Total capacity		%	MEM (PDP 2010-2020)	31% (2011)		76% (2020) <Benchmark> Philippines 55.1% Vietnam 75%		3	3	3	3	12		
Financial Independence	Self-Financing Ratio = Operating Cash Flow less Debt Service / Capital Investment (%)	%	EDL	0.07 (2010) 0.06(2011)		Target>30%(WB covenants)		2	2	2	2	8		
	ROA = Profit before income taxes / Total Assets	%	EDL	1.35 (2010)	<Benchmark> 7.7% (2011 EGGAT)			3	3	3	3	12		
	ROE = Net profit / Total Equity	%	EDL	1.58 (2010)	<Benchmark> 12.2% (2011 EGGAT)			3	3	3	3	12		
	Debt to equity ratio	Ratio	EDL	0.64(2010) 1.3 (2011)	<Benchmark> EGAT 0.59 (2011)	Target<1.5(WB covenants)		3	3	3	3	12		
	Profit ratio	%	EDL	5.09 (2010)	<Benchmark> 7.3% (2011 EGGAT)			3	3	3	3	12		
	Service coverage ratio	%	EDL	1.21 (2011)		Target> 1.5(WB covenants)		2	2	2	2	8		
	Estimated Government Subsidy for residential customers @ 150kwh	US AID	US cents/kwh	Laos 0	<Benchmark> Thailand 8.8 Philippines 0 Malaysia 4.51 Indonesia 8.38			1	1	1	3	6		
	Estimated Average Set (Cost of sale) for residential customers @ 150kwh	"Implementation Completion and results report of the Rural Electrification program" (2012)	US cents/kwh	EDL's Cost of supply 959kip/kWh (11.9 US cents / kWh) (2009) 946kip/kWh (11.8 US cents / kWh) (2010) 976kip/kWh (12.2 US cents / kWh) (2011)	<Benchmark> Thailand 19.18 Philippines 19.84 Indonesia 15.61 Malaysia 15.25			1	1	1	1	4		
	LRMC / Average Tariff : ratio	Ratio	World Bank (Tariff study) Merako (2012)	LRMC/Average tariff = 1.02 (Average tariff (2011) 647 kip/kWh LRMC: 661kip/kWh (Distribution LV before loss)) <Benchmark: Merako(2012)> Merako(Philippines) 1 Malaysia 1.56 Thailand 1.58 Korea 2.05 Taiwan 2.16 Indonesia 1.98	<1	<1		1	1	1	1	4		
	Subsidy/Average Electricity Tariff	Ratio	EDL /USAID	Laos(0), Only In-kind	<Benchmark> Thailand 0.85 Indonesia 1.16 Malaysia 0.42	<Benchmark> Philippines 0		1	1	1	1	4		
Establishment of cost reflective tariffs	Ratio of Industrial users to residential user	JETRO (2012)	Laos (1.05)	<Benchmark> Thailand 1.33 Indonesia 1	<Benchmark> Philippines 0.6 Malaysia 0.86 Vietnam 0.84		1	1	1	1	4			
Receivable Turnover Period (day)	Days	Annual Report	85(2.3%)	45(1.2%);Target	EGAT(7days)		3	3	3	3	12			

Note 3: High evaluation 2: Middle evaluation 1: Low evaluation 0: No data available

Indicators of program outcome (2)

Contribution to national economy

			Unit	Source	Data			Evaluation Criteria					Comments
					2010~2015	2015~2020	2020~2025	Accessibility	Comparability	Verifiability	Fit between output and outcome	Total	
Poverty reduction	Affordability : Income Improvement	Income Affordability = Cost of Subsistence Electricity / Poverty Income Level (%)	% months Total Urban Rural	WB(2013)	97.716 kip/month household			2	2	2	2	8	
	Access	Household Access = Households with a Commercial Connection / Total Households	%	EDL	78.53%(2011)	<Benchmark> 86.8% (2010: Thailand)	<Benchmark> 97.3 (2010: Vietnam) 90%(by 2010: gov's target)	3	3	3	3	12	
		Village Access = Communities with Commercial Supply / Total Communities	%	EDL	68.99%(2011)			3	3	3	3	12	Village Access figure should be higher than Household access figure
	Gini-index		Index	WDI	Laos 0.36(2008) <Benchmark> Thailand 0.4(2009) Indonesia 0.34(2005) Vietnam 0.36(2008)			3	3	3	3	12	
	Residential electrical consumption		GWh	Electricity Statistics 2011	1,004,074(2011)			3	3	3	3	12	
Effective utilization of water resources	Agriculture value added (constant 2000 US\$)		USD	WDI	178(2010)	<Vietnam> 130(2010) <Philippine> 165(2010) <Indonesia> 155(2010)	<Thailand> 205(2010) <Malaysia> 400(2010)	3	3	3	3	12	
	Irrigation electrical consumption		GWh	Electricity Statistics 2011	46,185(2011)			3	3	3	3	12	
Industrial development	Industry value added (constant 2000US\$)		USD	WDI	183(2010)	<Vietnam> 336(2010) <Philippine> 461(2010) <Indonesia> 496(2010)	<Thailand> 1203 <Malaysia> 2177	3	3	3	3	12	
	Industry and commercial electrical consumption		GWh	Electricity Statistics 2011	584,087(Industry:2011) 598,738(Commercial:2011)			3	3	3	3	12	

Environment

			Unit	Source	Data			Evaluation Criteria					Comments
					2010~2015	2015~2020	2020~2025	Accessibility	Comparability	Verifiability	Total		
Consideration to environment	CO2 emission kg per 2000US\$ of GDP		kg per 2000 US\$ per GDP	WDI	0.57 (2009)	<Philippines> 0.6 (2009) <Thailand> 3.91 (2009)	<Vietnam> 2.4 (2009) <Thailand> 1.6 (2009) <Indonesia> 1.7 (2009) <Malaysia> 1.4 (2009)	3	3	3		9	
Consideration to environment	CO2 emission metric ton per capita		metric ton per capita	WDI	0.29 (2009)		<Vietnam> 3.9 (2009) <Indonesia> 7.1 (2009) <Malaysia> 1.9 (2009)	3	3	3		9	

Note 3: High evaluation 2: Middle evaluation 1: Low evaluation 0: No data available

Indicators of program output

			Unit	Source	Data			Evaluation Criteria					Comments	
					2010~2015	2015~2020	2020~2025	Accessibility	Comparability	Verifiability	Fit between output and outcome	Total		
Reinforce ment of electricity administra tive managem ent capability	Support of review of energy development policy and electric power development policy	Arrangement of energy related statistical database			Can collect data by dispatching staff	Can collect through internet Man dated to submit energy consumption data	Data collection activities are institutionalized	3	3	3	3	12		
		Energy power development policy formulating comprehensive PDP			Preparation for NPDP	Institutionalized NPDP	Integration to GSM framework	3	3	3	3	12		
		Formulating policy on improvement of electricity facilities development			Unsolicited bidding system	Preparation for Solicited bidding system	Solicited bidding system is institutionalized	3	3	3	3	12		
	Strengthening of regulatory framework	Enhancement of examination and inspection function of the ministry and local governments	Draw up a roadmap that aims at reinforcement of regulatory function			Preparation for establishing Independent regulatory authority	Establishment of Independent regulatory authority	Financial of Independent regulatory authority is property	3	3	3	3	12	
			Environmental regulation			Environmental regulation which do not hinder FDI	Environmental regulation which do not hinder FDI	Environmental regulation which do not hinder FDI	2	2	2	2	8	
			Establishment of cost-reflective tariffs Ratio of Industrial (over 5MW) to residential (150kWh-) price		JETRO (2012)	1.05 Vientiane	<Benchmark> BKK 1.33 Manila 0.6 JKL 1 KL 0.86 Hanoi 0.84		3	3	3	3	12	
			LEPTS			LEPTS are institutionalized	LEPTS are institutionalized	LEPTS are institutionalized	3	3	3	3	12	
		Definition of rules			Definition of rules concerning consumer protection, allocation of subsidies are prepared	Definition of rules concerning consumer protection, allocation of subsidies are prepared	3	3	3	3	12			
		Equal access to transmission line			Equal access to transmission line is guaranteed	Equal access to transmission line is guaranteed	3	3	3	3	12			
Electricity station facilities	Power generation (Large scale hydroelectric)	Starting plans (about 60-100MW) for establishing medium sized hydro power plants corresponding to peak hours and /or dry season	MW	Statistic year book 2011 PDP 2012	527 MW(2011)	2356MW(2015)	8265MW(2020)	3	3	3	3	12		
		Setting plans for increasing efficiency of power transmission and distribution system(maintenance of transmission and distribution network)	Transmission and distribution losses(system losses) %	EDL WDI MEM(The Strategy Plan) PDP (2010-2020)	Transmission loss 33% + Distribution loss 10.78% →13.78% (2010)	14.24% (2015) <Benchmark> Vietnam (10%) Indonesia (9.4%) Philippines (11.5%)	12.68% (2020) <Benchmark> Japan (4.4%) Thailand (6.3%)	3	3	3	3	12		
		Interconnection to GSM			Bilateral transaction	Multilateral transaction	Integration to competitive market	1	1	1	1	4		
		km	Statistic year book 2011	3342km (115KV)				3	3	3	3	12		
	Rural electrification (small / mini- hydro)	Reinforcement of renewable energy development including mini hydro power plants, promotion of local electrification (Relation)	MW	REDS (2011 Oct)	13MW (2011)	140MW (2015)	243MW (2020) 728MW (2025)	3	3	3	3	12		
Enhancem ent of business administra tion capacity for electricity business undertaker s	Financial and planning capacity				Preparation for NPDP	NPDP Institutionalized	Update NPDP by themselves	1	1	1	1	4	Difficult to measure	
		Tariff collection efficiency (unpaid ratio)	%	EDL	2.2%(2011)			3	3	3	3	9		
	Organization management capacity	Accounts receivable turn over periods	day	EDL	85days(2010)			<Benchmark> EGAT (7days)	3	3	3	3	9	
		Draw up optional investment plan by EDL				Preparation for NPDP	NPDP Institutionalized	Integration to GSM framework	2	2	2	2	6	
		Draw up action plan to improve customer service				# of new customer visits increased # new tariff system offered	# of new customer visits increased # new tariff system offered	# of new customer visits increased # new tariff system offered	2	2	2	2	6	
	Project implementatio n and supervision capacity	Customer meter			EDL Electricity Statistics 2011	86526(2011 :EDL)			2	2	2	2	6	
			Sales per employee = sales / number of employee	USD	EDL, annual report	59,539 (2010)	<Benchmark> PLN (2011) 487,115 TNB (2011)	<Benchmark> EGAT(2011) 526,720	3	3	3	3	9	
	Net profit per employee	USD	EDL, annual report	2,962 (2010)	<Benchmark> PLN (2011) 16,845 TNB (2011) 5,790	<Benchmark> EGAT (2011) 38,527	3	3	3	3	9	Difficult to measure		

Note 3: High evaluation 2: Middle evaluation 1: Low evaluation 0: No data available

Indicators to look at electricity sector comprehensively

Sector Performance	Unit	Source	Data			Evaluation Criteria					Comments
			2010~2011	2015~2020	2020~2025	Accessibility	Comparability	Verifiability	Fit between output and outcome	total	
1	Blackout ratio / SAIDI / SAIFI Duration of Outage (SAIDI) = Total Duration of Forced Outage per Year / Total number of Customers (Hours Forced Outage per Customer per Year).	Hours Forced Outage per Customer per Year	No data	No data	No data	0	0	0	0	0	No SAIFI, SAIDI Data
2	Reserve Margin = (Available generation capacity (MW) - Historical Peak Load (MW)) / Historical Peak Load (MW). (%)	% MW MW				0	0	0	0	0	
3	Labor Productivity = No of Customers / Employee		EDL	226.6(HH/employee)		3	3	3	3	12	
4	Average Plant Load Factor = Total Annual Generation Output (MWh) / (8,780(hr)* Installed Capacity (MW))	MWh MW				0	0	0	0	0	
5	Consumption Density = Annual Energy Sales / Total length system distribution network (MWh/km)	MWh/km				0	0	0	0	0	
6	Electricity of electricity consumption to GDP = $\frac{\Delta \text{in Electricity consumption}}{\Delta \text{in GDP}}$		EDL WDI EIA	1.76 (2000-20005) <Benchmark> Thailand 1.09 (2000-2005) Philippines 0.78 (2000-2005) Indonesia 1.15 (2000-2005) Malaysia 1.9 (2000-2005) Vietnam 1.12 (2000-2005)		3	3	3	3	12	

Note 3: High evaluation 2: Middle evaluation 1: Low evaluation 0: No data available

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