



The Sustainable Development of Electricity Sector In Lao PDR.

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Abstract

Overview of development of energy sector in general and in particularly in electricity sector of Lao PDR. This paper will provide the legal system related the development and management energy and electricity sector. As well as the potentials, opportunities and challenges for electricity sector in the future. In additional, paper also analysis how Laos will reach sustainable development in the electricity sector of Lao PDR. This paper also emphasis the role of government for sustainable development of electricity sector new condition: climate change and the area of cover forest decline, becoming more urbanized and better integrated within the Greater Mekong Subregion. Beside that the paper will provide the electricity sector contribute economics growth in Lao PDR sustainably and some suggestions for government to enhance the efficiency of development of electricity sector to ensure the sustainable development of electricity sector in the future. This paper will divide in to 4 sessions such as: (1) introduction, (2) the electricity sector development, (3) suggestions for sustainable development of electricity sector of Laos and (4) conclusions,

Key words: electricity sector, the government, the Sustainable development and energy sector.



1. Introduction

Electricity sector of Laos has developed significantly since 1975 after Laos has proclaimed. Electricity sector has become the most important sector of national industry in recent year and will be the Asian battery in the future. In Lao PDR, the 6th Party Congress set as a national development goal for the country the exiting of Least Developed Countries group by the year 2020. A means for reaching this goal to push GDP growth by increasing the investment level considerably including foreign direct investment. Large-scale hydropower projects are considered one of the few available alternatives for attracting foreign direct investments, gaining export earnings, and thus reducing poverty. According to the National Poverty Eradication Programme, investment in large-scale projects will contribute to the creation of wealth through a market-oriented, taxable transformation of natural resources and creating jobs for local people. (Lao PDR 2003).

Laos is a landlocked country (nowadays sometimes called land linked country) in the South-Eastern Asia, the area of 236,800 km². There is 70% mountainous and more than 90% located in Mekong river basin and the urban population is 34.4 % of total population (2018). Pulation is 6.8 million (2018). It shares borders with China, Thailand, Myanmar, Vietnam and Cambodia. Laos belongs to the Least Developed Countries (LDC) with the average GNI per capita about 1050 USD in 2010 (Atlas method (current US\$), World Bank Database (2012)). Laos is the land-locked former kingdom, but nowadays a country in a fast modernization process (see e.g. Evans 1999).

Laos has begun the World Trade Organization accession process, with the intention of joining that organization as soon as possible. Laos is today a single-party socialist republic. The only legal political party is the Lao People's Revolutionary Party (LPRP). The capital city is Vientiane and other large cities include Luang Prabang, Savannakhet and Pakse. Laos is crisscrossed with a myriad of rivers and streams. The largest river is the Mekong River, flowing for 1,898 kilometers from the North to the South, with 919 kilometers of the river forming the major portion of the border with Thailand. Today it is estimated that some 60% of all the water entering the Mekong River system originates from Laos. Rivers and streams provide great potential for hydropower development with 51% of the power potential in the lower Mekong basin contained within Laos (Lao National Tourism Administration 2012).

In 2016, its real GDP per capita was US\$ 2,352. GDP (at current price) increase year by year as follow: 12,917.5 billion kip (2000), 28,947.8 billion kip (2005), 55,694.0 billion kip (2010),



and 117,251.6 billion kip (2015) and 212,478.9 (2018) which growth rate average around 6.5 percent in period from 1990 to 2018 (ADB, key indicator). Structure of Output (% of GDP at current producer prices) through some years as in Table 1 follow.

Table 1: Output Structure of Economic Sectors in Laos

(Unit: Percent of GDP)

Year	2000	2005	2010	2015	2018
Agriculture	48.5	36.7	30.6	19.7	18.3
Industry	19.1	23.5	29.8	31.0	34.9
Services	32.4	39.8	39.6	49.4	46.8

(Source: ADB, key indicators)

Traditional energy sources (mostly fuel wood and charcoal) are giving way to electricity and petroleum. While the Lao PDR imports all of its petroleum products, it has large hydropower potential, and a major portion of existing hydropower capacity is for power exports. The key energy sector objectives of the government include bringing electricity to all by expanding and improving the main grid or, where cost effective, by off-grid electrification; and earning foreign exchange by setting up export-oriented hydropower projects and exporting electricity. The government's energy objectives have remained remarkably consistent since the 1990s and through the SAPE period; only priorities for achieving the policy objectives have undergone some change from time to time (ADB, 2010, *Energy Sector in the Lao People's Democratic*).

As well as the management framework of electricity sector has improved significantly, particularly the legal system, planning, vision related electricity areas such as: the electricity law enacted in 9/5/2017, the strategy plan and vision of development was enacted.

However, on 23 July 2018, Dam collapse of Saddle Dam D, part of a larger hydroelectric dam system under construction in southeast Laos's Champasak Province, The dam collapse lead to widespread destruction and homelessness among the local population in neighboring Attapeu Province and 40 people were confirmed dead and at least 98 more were missing.

As the Lao PDR has been moving up in terms of gross domestic product (GDP) per capita due to stable economic growth, its energy consumption is also expected to continue to grow. This requires appropriate and effective energy sector policies general and particularly electricity sector



for now and into the future to ensure the sustain development or green development. Lao PDR's resource-based economy is driven by forestry, agriculture, hydropower and minerals. Together, these sectors account for more than half of Lao PDR's total wealth. Lao PDR will need to diversify its economy and increase environmental sustainability through robust management of its natural resources, including land resources. In 2030, Laos is strongly committed to the implementation Agenda for Sustainable Development and the achievement of the Sustainable Development Goals (SDGs).

According the SDGs for Lao PDR are: (i) End poverty in all its forms everywhere; (ii) End hunger, achieve food security and improved nutrition and promote sustainable agriculture; (iii) Ensure healthy lives and promote well-being for all at all ages; (iv) Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all; (v) Achieve gender equality and empower all women and girls; (vi) Ensure availability and sustainable management of water and sanitation for all; (vii) Ensure access to affordable, reliable, sustainable and modern energy for all; (viii) Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all; (ix) Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation; (x) Reduce inequality within and among countries; (xi) Make cities and human settlements inclusive, safe, resilient and sustainable; (xii) Ensure sustainable consumption and production patterns; (xiii) Take urgent action to combat climate change and its impacts; (xiv) Conserve and sustainably use the oceans, seas and marine resources for sustainable development; (xv) Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss; (xvi) Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels; (xvii) Strengthen the means of implementation and revitalize the global partnership for sustainable development; and (xviii) reduce impacts of unexploded ordnance in Lao PDR. We see that Lao PDR has target "Ensure access to affordable, reliable, sustainable and modern energy for all" be the part of sustainable development.

Therefore, authors chose to research ***"The Sustainable development of electricity sector in Lao PDR."*** to explorer the prospective and challenges for electricity sector and find the suggestions to promote sustainable development of electricity sector in the future.



2. The Electricity Sector Development.

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

After 1975, the electricity sector is still very small, all over the country are just installed 32,8 MW. Laos' hydropower market has been growing as the government promoted with a dedication to enhancing efficiency, capacity to provide electricity to the people across the country and export to neighboring countries as well as the abundance of water resources and geographic country, the government has transformed its energy policy into the dominant power of development. After the fourth session of the party in 1986, the party's new reform agenda was officially announced, transforming a centralized management mechanism that seems inconsistent with market economy management mechanisms, encourage many economic sectors to manage market economy and open wide economic cooperation with foreign countries, improving investment promotion policies aiming to attract foreign investors to develop natural resources, under this new management mechanism, the investors in the electricity sector over time have approved some foreign investors to invest in hydroelectric dams.

Laos is a natural rich country endowed with significantly indigenous energy potential. It has about 26,500 MW theoretical hydropower potential in the whole country. Approximately 18,000 MW is technically exploitable with about 12,500 MW discovered in the major Mekong sub-basins, and the rest in minor Mekong or non-Mekong basins. Referring to future hydropower development plans in the country, Laos has a new moniker employed by Thai Former Prime Minister Thaksin Shinawatra as "Battery of Asia." Regarding electricity exports, the annual growth rate during 1990 to 2004 reached the average of 11%, doubling the share of GDP from 1.4% in 1990 to 2.7% in 2004. Furthermore, solid growth of 8% in 2011 was mainly based on hydroelectricity and mining sectors (World Bank, 2012b).



Subsequently, the power sector in Lao PDR continued to growth, therefore, in 1990 hydropower plant of Nam Ngum1 Hydropower increasing its production capacity to 150 MW, completed Set dam1 45 MW in 1991, completed Theun Hin Boun 220 MW in 1998 and HouyHor 152 MW in 1999, Num Leuk 60 MW in 2000 so, all installation is 634.5 MW, can generate average electricity 2.951,9GWh/year.

Expected in late 2016, the electric project of Lao PDR is given to EDL coverage 17 programs. There are 27 projects with a concession that the EDL represents the government shares with the developer of private domestic and foreign. The average age concession is approximately 25 to 30 years due to the age of each project concession different such as projects with an installed capacity lower than 15 MW will last concessions average about 30 years and the project with an installed capacity greater than 15 MW a concession on average around 27 years. Continued until 2020, Laos has the power of 63 projects for construction and generation; with an installed capacity of 8,612,15MW can produce power 45,358,90GWh/year. 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”.

Try to bring a new power station into operation to boost the electricity exports and to meet the needs of domestic production and consumption. Investment in electricity and regional industries will be encouraged. The average electricity production increased 21.12% (current price) and increased 9.3% (constant price), which covered 3.1% of GDP and reached 97% of the Sixth Plan target (Laos 2005).

The Lao PDR is home to abundant energy resources, although the country’s current fuel mix is based on relatively few of these resources—approximately 62.1% of existing electricity generation is hydropower-based, 37.5% is coal-based, and the remainder is biomass-based (MEM 2016). Power sector decision makers are increasingly interested in understanding the potential role of energy resources beyond hydropower in the future of their nation’s electricity system. To this end, the Lao Ministry of Energy and Mines (MEM) is working to improve its tools, data, and analytic capacity to inform energy planning to 2030. This includes building capacity within MEM to analyze the opportunities for, and the impacts of, future energy system investment alternatives that could diversify its electricity generation mix and help ensure energy security and economic growth. To contribute to these efforts, the objective of this report is to support MEM in assessing the availability and quality of energy resource data that will serve as a foundational input to



technical potential, economic potential, and other planning-related analyses of Lao PDR's domestic energy technologies.

Laos is committed to implement the Agenda for Sustainable Development and the achievement of the Sustainable Development Goals (SDGs) in 2030. Sustainable Development Goals (SDGs) of Laos has 18 indicators and electricity sector is include SDG 7 (ensure access affordable and modern electricity for all localized SDGs Indicators)

In 2020, Laos will has 60 dams and predict it will generate income for country more than 1 trillion \$/year and in recently Laos has 40 dams.

The electricity and mining sector contribute 94.342 trillion kip in GDP and account for 12% GDP and compare to the period 2006-2010 increase 9,22% . 2015, the cross country has 38 dams completely which 10 trillion invested capital and total capacity production 6,265 MWh. There are some dams has established completely like: Nhum 2, teurn hinbun, nun u 2, nawm u 5, nawm u 6, num khan 2, num ngiep 2, factory Hong sa that can produce 33,315 million Kh/year . It will 3,3 time when compare to 2010. The domestic consumption ratio is 20,4% and export ratio is 79,6%.

In 2015, the cross country, there are 38 factories completely which more than 10 trillion \$ investment capital , by 6,265 MWh capacity production. Therefore, increase 26 factories completely and capacity production increase 4,334 MWh and 3,2 time compare to 2010, in addition there are some projects has been constructing and in repairing process as like: Xayabuly Dam, Donsahong, num ngum 3, num u 1,3,4 and 7, num ngiep 1, xepien –xenamnoy.

In 2015, **38 hydroelectricity projects** were operational (i.e. 26 more than in 2010), generating an output of 6,265 MW. The recent projects include **Nam Ngum 2, Nam Ou 2, 5 and 6, Nam Khan 2, Nam Ngiep 2**, and the **Honga Thermal Power Plant**. To date, more than 85% of villages and nearly 90% of households have continuous access to electricity.

In 2015, cross the country has 148 cities access 100% account for 85,54% total villages and 89,78% of total house when compares to 1975 that we see it more than 200 time and it more than target 9,78% . as well as there are 14,327 house use solar power account for 1,27% total house in country.

Five years previous, we can exported electricity power to Thailand, Vietnam and Cambodian increase 4 times compare to 2010 and predict in 2016 it could export the electricity



power to Myanmar which income average more than 300 million \$ and the value of export increase year by year .

The Government of Laos* presented its Vision for 2030 in the energy and mining sector, aimed at speeding up the country's modernization and industrialization. This strategy is above all based on the development of hydroelectricity. Laos's current plans foresee the completion of at least **19 hydroelectricity projects** from now to 2020, with an installed capacity of about 3,500 MW. In all, more than 60 projects are planned, generating an annual output of 60,000 GWh and \$1 billion in annual income. The government's goal is to supply **98% of the country's households** with electricity (<http://www.initiativesrivers.org>)

The development of a quantified understanding of energy resource potentials is a crucial preliminary energy planning analysis step. Energy resources—for example, solar, hydro, wind, coal, natural gas, etc.—are the primary input to the energy supply and demand balance. Demand for energy services provided by electricity—for example, lighting, cooling, water heating, etc. -is, for the most part, not dependent on the resources that supply this electricity; however, the different electricity generation technologies that supply this electricity are fundamentally tied to the availability of particular energy resources (Rogner et al. 2012). Therefore, any assessment of energy planning alternatives requires a detailed understanding of the energy resources available - including type and quantity, the location of these resources, and the technical and economic constraints that may impact their use. Not all physically available energy resources may be developable due to technical constraints to development in protected areas, certain terrain features, populated urban zones, water bodies, and other relevant constraints. Additionally, economic constraints may further limit these technically available resources to those that can be developed and provide for electricity generation at a cost below available project revenues. These considerations are important for identifying energy planning alternatives that are based on a technically and economically screened understanding of energy resource availability (Brown et al. 2016).

Any discussion of technical potential must start with the resource potential—i.e., the theoretical availability of various energy resources—as this is a foundational input to the subsequent analyses of technical potential and economic potential. The definition of resource potential and its relationship to the types of generation potential differs for RE and non-RE resources. Therefore, it is important to make a distinction between these definitions and clarify



how they are addressed in the current assessment. FIGURE 2 presents the types of RE generation potential analyses and the relationship that resource potential has to these analyses as a foundational input. Technical potential and economic potential are discussed in detail in the sections that follow.

Lao PDR's power supply is expected to grow rapidly from 6,441 MW in 2016 to 10,277 MW in 2020. Despite of such high power supply growth, there is a very high opportunity for Lao PDR's power business due to huge demand from Greater Mekong Subregion ("GMS") in addition to the local demand. EDL-Gen is and will be the major power generator in Lao PDR serving more than half of domestic demand.

Table 2: Power Supply and Demand in Laos and GMS

MW	2010	2011	2012	2013	2014	2015	2016	2017	2020F
EDL-Gen Capacity	-	387	881	881	881	1,131	1,131	1,319	2,400
Other Capacity	1,931	1,54	2,080	2,370	2,43	4,675	5,31	5,952	7,877
Total Lao PDR's Supply⁽¹⁾	1,931	1,93	2,961	3,251	3,31	5,806	6,44	7,400	10,277
Domestic Demand⁽²⁾	476	527	614	649	744	760	828	1,493	3,488
GMS Demand⁽³⁾	83,259					48,371			212,005

Source: Laos' GSO and Estimations

And the electricity supply also increase year by year as we can see the statistic of electricity supply through some years: 825,71 GWh (2000), 1,333.58 GWh (2005), 3,012,22 (2010) and 6,803,27 (2015) and(2018). According to above statistic of electricity that can see the trend of electricity supply increase year by year with the average growth %/year. Besides that, the electricity of consumption also increase too that showing by amount of electricity of consumption some year like: 639.86 GWh (2000), 1,011,06 GWh (2005), 2,440,73 (2010) and 4,238,60 (2015) and(2018). According to above statistic of electricity that can see the trend of electricity supply increase year by year with the average growth %/year (Ministry of Energy and Mines, Lao PDR Lao PDR Energy Statistics 2018). The development of electricity sector that we can see through the statistic of electricity exportation from the previous years like: 2,793 GWh (2000), 2,506 (2005), 6,646 (2010), 11,549 (2015) and(2018) with the average growth %/year. The biggest exported market of Lao electricity products is Thailand market. Despite the high average annual growth rate of consumption during this period, Laos also importing from neighboring



countries to meet the demand during the dry season and from the border areas not connected to the grid.

❖ **The Challenges**

We emphasis for hydropower. Because the hydropower is the main electricity production resource account for more than 85%. Major problems of Lao hydropower sector relate to lack of capacity and poor institutional environment, such as insufficient quality of environmental and social assessments, ineffective regulatory framework, a lack of transparency, and the failure to conduct comprehensive consultations with all stakeholders. The opportunities and challenges of hydropower development are complex, and ultimately dependent on the resources, skills, and will to invest responsibly, with due regard to economic, environmental and social aspects of sustainable development and management. The governance gap remains a crucial challenge that will increase over time if the government does not take strategic and continued actions to enhance governance and institutional capacity.

3. Suggestions for Sustainable Development of Electricity Sector of Lao PDR.

Some maintain contain of policy: Lao PDR should maintain and expand affordable, reliable and sustainable electricity supply to promote economic and social development and tap the country's potentials aiming at promoting power generation for export to provide revenues to meet Government development objectives with particular emphasis on poverty eradication. As well as develop and enhance the legal and regulatory framework to facilitate power sector development by either public or private parties. Lao PDR should gain capacity building through exotic technical know-how and expertise and ensure accountability and transparency of environmental and social impacts and thereby achieve sustainable development.

The Government of Lao PDR is prioritizing the following strategies:

Making the power sector more sustainable. This means strengthening the power system planning and the project selection process to ensure that only economically viable, fiscally sustainable, and environmentally justifiable projects are selected. Investments would have higher returns and lower risks but would be fewer. The public entities in the power sector needs to be strengthened through stronger financial and corporate management and improved commercial orientation. As the detail like that:

- Meeting domestic demand for energy.



Domestic demand for electricity is expected to increase, reflecting the government's policy on the acceleration of rural electrification and industrial development. Since the supply sources are largely in the north and south, while the growth in demand will be most rapid in the central region, the planned investments in transmission and distribution systems are projected to require substantial increase in financial resources. Therefore, options to achieve similar results in system operations but at much lower costs to the public sector will need to be explored, such as involving the private sector.

- Developing the country's hydropower resources sustainably and optimally.

Harnessing the potential on a sustainable basis requires addressing the associated challenges, such as assessing and minimizing negative social and environmental impacts, balancing domestic consumption needs and export opportunities, and using revenues generated from electricity exports to decrease the dependence on natural resource-intensive sectors.

- Developing renewable energies beyond the development of hydropower export potential.

Lao PDR's Renewable Energy Development Strategy sets out the efficient utilization and development of all energy resources. Policy priorities focus on small power development for self-sufficiency and grid connection, biofuels production and marketing, and development of other clean energies in the country.

- Strengthening institutions in the energy sector.

Institutional strengthening is required to promote renewable energy and energy efficiency, and improve energy demand-side management, energy auditing, and regulatory interventions.

4. Conclusion

The Lao country's abundant water resources and mountainous terrain have allowed the Government of Lao to set up a master plan to develop hydropower and export large quantities of hydroelectric energy. Quick growth and steep forecasted size of the energy sector with respect to the economy and Government's revenues will put a lot of pressure to develop institutional environment, policies and fiscal framework to properly use natural resources in Lao PDR's development strategy. There is a need to better assess strategically the hydropower development options for Lao PDR and the use of hydropower development generated revenues to poverty reduction activities. The collective benefits to the country can be maximized if individual hydropower investments are assessed as part of a river basin approach (to understand cumulative hydrological, environmental and social impacts, as well as to increase the economic potential for



any given level of impacts) as well as the energy sector development strategy (The World Bank, 2010c, p. 11).

The mechanisms for accountability and democratic control and the needs for participatory approaches to hydropower planning and management need to be well recognized and to be strengthened in Lao PDR. Processes and activities related to risk assessment and management need to be established and developed in the energy sector. Currently the risk management lies on private sectors/investors shoulders and as for the risk.

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