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An Analysis Of Policy and Development of Hydropower in Lao PDR

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Abstract : *Since the second phase of the socio-economic development plan (1986-1990), Lao PDR has taken over expansion electricity due to the growth of social and economy according to the abundance of natural resources, there are many rivers among the country areas as this reason the government has taken to develop hydropower is the main develop the country. This study reviews the history of hydropower development and the country has successful on hydropower development as The Five Years National Socio-Economic Development Plan. The paper examines by using strength, weakness, opportunity, and threat (SWOT) to analysis renewable energy policy and incentive policy on hydropower development.*
Keywords: *Hydropower, Renewable Energy Policy, Electricity Law, Laos and SWOT Analysis.*

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I. Introduction

Energy is the most important factors of living human society and developing countries mostly, Laos's landscape along Mekong river, in the north is the mountains part cover by forest and plant variety, climate is tropical moist and rich with natural resources, the source of water streams rivers dense placing from north to south especially Mekong river flow through along about 1.835 km, it's the border between Lao PDR and Thailand about 1.500 km favorable facilitate the development of water power resources are much larger in lower Mekong basin (Asia Pacific Parliamentary Forum n.d.). Lao's government used to promote to develop renewable energy is one of the strategic priorities to provide energy security and to support the development of national social-economic and, social programs to reduce poverty by creating favorable conditions for the domestic and foreign investors to invest the project development of renewable energy in communities or villages level. Based on strategy renewable energy development substitute Lao PDR no. 324/LB dated 11 October 2011 that Lao PDR has the potential and ability to meet renewable energy to achieve proportional use of renewable energy (Renewable Energy Development Strategy in Lao PDR 2011) up to 30% equal to 1.489 Ktoe of total power use 4,930 Ktoe in 2025.

Global hydropower capacities are estimated to be at least 25 GW in 2016, with total capacity reaching about 1,096 GW. Drought conditions improved notably in America and Asia estimated that global generation rose by more than 3% relative to 2015, to about 4,100 TWh. China's domestic market continued to contract, but the country retained the global lead with 8 .9 GW added. Significant capacity also was added in Brazil, Ecuador, Ethiopia and, Vietnam, Peru, Turkey, Lao PDR, Malaysia and India (REN2 n.d.).

The orientation of industrial development in the five-year period 2006-2010 is to give priority to developing the electricity and processing industries catering to domestic consumption and exports while continuing to promote renewable energy. 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).

Since 2005, five dams have been completed: Nam Mang 3 (40 MW), Nam Theun 2 (1,088MW), SeSet 2 (76MW), Nam Lik 1/2 (100MW) and Nam Ngeum 2 (615MW) which combined have a capacity of 1,919 Megawatts, which can supply energy of 8,022 GWh per annum, an increase of approximately three times compared to 2005. Of these, three dams are a private investment (IPP). Presently, there are 14 dams that have minimum energy 1 MW, and if small dams are included there are 29 dams across the country, which have a capacity of 2,583.72MW and can produce energy of 11,514 GW.

The total private investment in the electricity sector during 2006-2009 was US$2,995.5 million, which is an increase of 88.5% compared that in the plan period from 2001 to2005. The total electricity production increased 9.3% per year. The electricity sector has shared 15% of total industrial production and accounted for 3% of GDP. However, the global financial crisis has adversely impacted economic development, especially

exports and mega investment projects. Of these, the shortage of raw materials, especially fuel, is one factor, which has directly impacted the business sector.

The Law on investment promotion of Lao PDR in Articles 40 to 55 of the 2009, the Government of Lao PDR offer income tax holidays for timeframes between 1 to 10 years per investment type and location, department of Energy Promotion and Development (EPD) of the Ministry of Energy and Mines (MEM) offers investors baseline incentives in the form of free access to land (including areas to be flooded), a waiver on land conversion fees (US$15,000 per hectare1), a 'reasonable' tax holiday, a waiver on withholding taxes on net profit repatriated, waivers or reduced rates on import duty for materials, equipment and supplies, the unlimited use of foreign labor in both skilled and unskilled functions, extended concession periods of 25- 30 years, waivers from other taxes and duties and offshore banking facilities.

As development infrastructure of Lao PDR used to develop hydropower is the main important to improve livelihood among the resources of the country. The purpose of this paper is to review the history of thedevelopment of hydropower energy since started until the moment by using SWOT analysis especially developing hydropower that government attempted to issue incentive policies for thedomestic and foreign investor, particularly investment on hydropower energy.

II. History ofLaos' Hydropower Energy Facility andEstablishment

2.1 Hydropower Development in Laos

Electric du Laos has been established in 1959, in that time Electric du Laos was just a small unit to serve the French military and a part of central Vientiane. The growing of Electric du Laos has started in 1966-1971 when the project of electric dam NamNgum1 term 1 completed construction with capacity 30 MW, 28 million dollars of construction cost under the World Bank contract fund NamNgum1 development (NamNgum1 development fund agreement 1966) simultaneously loans from Federal Germany 30.10 million Denmark to develop the project installation engines running by steam water diesel. In Sokpaluang station with installation capacity 8 MW and the construction of Vientiane electric transmission. In 1975, fundamental of electricity sector still weak, small and, not broadly yet. There are only 42 MW installation capacities of the nationwide, can produce electricity 241 KWh and supply consumption 19,000 families.

In 1976-1979s has increased power generation of NamNgum1 dam from 30 to 110 MW further in 1983-1990s, has increased the installation of NamNgum1 dam 150 MW and the nationwide have power generation 162 MW for this electric expansion of Vientiane in two terms can supply electricity consumption 47,372 families in 1990. In 1991-1999, which is the term potential growth and lie during the economic-financial crisis but, in this term has also completed projects in 8 provinces, leading amount of electricity to 255,882 compared 1975 increased 11.8 times. In 2000-2005 has completed more projects construction of electric dam 6 projects that can supply consumption until the moment 408,206 increased from 1975 to 21.4 times.

Electricite du Laos has created plan to develop the production and its electrical distribution system periodically for 10 years, until 2010 the power generation of EDL is 288MW and collaborate with private sector 1,360 MW of which, EDL can produce 1,500 kWh and increased the customers to 734,000; electric consumption concludes 70% of all families in the country can have electricity to use 1,140,400 families or equal 90% in 2020.

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.

2.2. Hydropower Market Development in Laos

After 1975, the electricity sector is still very small, all over the country are just installed 32,8 MW. Laos's 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. Subsequently, the power sector continued to growth, therefore, in 1990 hydropower plant of Nam Ngum1

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.

Targets for 2015 Hydroelectricity: Construct medium and large hydropower projects in the Northern, Central and the Southern parts to have enough electricity meet the domestic demand by the year 2012. During the period 2011-2015, complete construction of 8 power stations with an installed capacity of 2,862 MW which will produce energy 15,321 GWh per year and construction of 10 additional projects adding up to 5,015 MW of hydropower and costing US$ 11,295 million.

2.3. Expansion of Electrical Transmission Line

In the past, EdL relied primarily on multilateral and bilateral finance with the ADB and the World Bank are playing a central role in the north and the south for transmission and distribution projects and bilateral funds from Japan and India. In the border areas also have 22kV transmission lines that connect with neighboring countries to facilitate the purchase, sale,and exchange of electricity and focusing on expanding the electricity network into rural areas to spur development and wipe out poverty among ethnic groups.

The management of EDL's electricity system is divided into four parts: North, Central 1, central 2 and Southern:

a. North : consists of 6 provinces: Phongsaly, LuangNamtha, Oudomxay, Bokeo, LuangPhrabang and Xayaboury provinces.
b. Central 1 : consists of 5 provinces: Huaphanh, Xiengkhuang, Xaysomboun, Vientiane and Vientiane capital city.
c. Central 2 : consists of 3 provinces: Bolikhamxay, Khammouane and Savannakhet
d. South : consists of 4 provinces: Salavan, Sekong, Champasak,and Attapua

At present, the total length of transmission line is 52.377,56 km nationwide, the high-voltage transmission lines of 500kv (227 km) is for connection to the neighboring countries and the national transmission system and 230kv (1.371,14 km) are for connected throughout the neighboring countries and the country for national transmission system, the high-voltage transmission lines of 115kv (5.257,18 km) for connected the country and the medium-voltage (35kv, 34kv and 22kv) longer than 27,397,25 km and the low-voltage 0,4kv) longer than18.124,99kv for supply the consumers and expanding to remote area as the aim of the development.

III. Government Incentive Policies For Hydropower Development

Hydropower development in Laos is closely related to the government's incentive policies. These included the renewable energy development strategy (2011), Energy policy, National policy about environment and social sustainability of the hydropower sector in Lao PDR (2006), The Five Year National Socio-Economic Development Plan VIII (2016-2020) (8th NSEDP), The Vision 2030 Development Strategy 2025 8th Five-Years Energy and Mine Development Plan (2016-2020).

3.1. The Renewable Energy Policies and Relevant Electricity Law

Laos promulgated the electricity law which becomes effective on 12 April 1997 is to establish systematic standards for administration, production, transmission, distribution and, to manage tile exports arid imports through tile most effective use of natural resources. Law on electricity amended in 20 December 2011 that determines the principles, rule and measures on organization, operation, management and inspection of electrical activities for the high effectiveness of electricity generation and business operation with the aims to use the natural resource potentials in economical and sustainable manner to encourage the implementation of the national socio-economic development plan and improve the living conditions of the multi-ethnic people.

In 2005 promulgated the National Policy on Environmental and Social Sustainability of the Hydropower Sector in Lao PDR has aims to capitalize on these efforts by adapting and tailoring the principles developer under the NumTheun2 project to hydropower sector as a whole, therefore, enabling procedures to be streamlined and institutional. This policy statement, founded on the aforementioned three principles of sustainability there are: (1) economic sustainability relies upon the maintenance of the renewable resource base of non-renewable resource rents to support the development of other factors of production; (2) Social sustainability is based on the principles of inclusiveness, mutual understanding and consensus; and (3) Ecological sustainability relies upon the avoidance of irreversible environmental impacts such as the loss of biodiversity, accumulation of persistent pollutants or disruption of ecological cycles that applies to all large hydropower dams, where the large dams are defined as having installed capacity of higher than 50 MW or inundating more than 10,000 hectares of land at their full supply level, this approach will include addressing cumulative impacts and their mitigation supported by an appropriate institutional and financing mechanism.

3.2. The Rural Electrification Development Program

Since the Lao Parliamentary Assembly under the guidance of the ruling Communist Party during 1976-1979, the power sector has been able to provide electricity to the entire nation, increasing in 1979 to 25,000 households. After the 4th General Assembly in 1986, the Party's renewal strategy was formally promulgated, transforming a centralized management mechanism that seemed inconsistent with market management mechanisms, promoting a plurality of economic structures, managing market economy mechanisms and opening up international economic cooperation, improving the investment promotion policy aimed at attract foreign investors to develop natural resources. Under this innovative framework, this period has made investments in the field of hydropower, so that the power sector has continued to expand in the 1990s and has increased investment in electricity grid to rural areas, increasing electricity consumption to 293.49% in 2000, accounting for 35.9% of households across the country.

According to the plan of Resolution No. 7 (Five Years Plan 2001-2005) of the Central Party Committee, the National Assembly continues to ensure social stability and political stability, to gradually expand the economy, gradually becoming industrial and emerging. On the basis, the development of the power sector has grown strongly. During this period, Lao PDR received international funding combined with the government, which has been able to develop many power grids. Therefore, the number of permanent residents in 2005 increased to 483,133 households, equivalent to 48.30 percent of households consuming electricity. In addition, there has been a development of rural electrification systems so that people in remote areas that are not able to access permanent electricity have access to electricity from small power plants

IV. The First Hydropower Energy Resource Facility And Establishment

The first hydropower energy in Lao PDR is Nam Ngum1 Dam, is a hydroelectric dam on the NamNgum River; it was the first hydropower dam that built in Lao PDR that, constructed in 1968, located in Keoudom district, Vientiane province. Nam Ngum1 Dam supplied electricity to domestic consumption accounted for 19.1% and more importantly in the dry season. The namngum1 dam can supply electricity up to 33.5% and it plays an important role in providing electricity to local people and neighbors as well as Thailand. The NamNgum1 hydropower dam has been constructed and used since 1971; the construction and repair of the NamNgum1 hydropower dam are divided into the following stages:

Phase 1: In 1968 was built and completed in 1971, for this power plant, it is located on the foot of the dam, consisting of two generators, of each unit is 15MW and also has facilities for expansion of the plant to install three additional power generators. Electricity generated from electricity generators will be delivered from Nam Ngum1 Dam to Phone tong station and delivered from Phone tong station in Vientiane to the 115-kV transmission line of Thailand Electric Power Generation or EGAT NongKhai Station.

Phase 2: Started construction in 1976 and completed in 1978, install two additional 40MW power generators, electricity generated from electricity generators will be sent to the appropriate station and from Phone tong Station to connect to the 115 kV system of EGAT Station Udon2 Thailand.

Phase 3: Started construction in 1983 and completed in 1984, installed one more generator with a capacity of 40 MW. Thus, the total of installation of Nam Ngum1 is 150MW and the average of power generation has increased to 865GWh per year.

In the year 2003-2004, NamNgum1 dam has been repaired to improve the capacity of engine No. 1 and 2 has increased the engine for each 2.5MW. Therefore, the NamNgum1 dam is installed at 155 MW. The NamNgum1 hydropower dam has always been developed, consisting of research and surveys at all times in order to raise the capacity of the reactor to the utmost benefit to the Lao nation. Further in 2014, after surveys more combined with both financial and human resources, the expansion of the NamNgum1 hydropower project will become an extension project of 6-7-8engines. Based on the capacity of the generating resources in the area. It is a large basin that, there are millions of cubic meters of cannons that can increase generation more than 155MW as previously mentioned. The government has been considering changes the electricity price policy as a period of consumption and season so financial analysis and a possibility to increase the number of engines and expand production capacity for extension section project to 120MW, under the structure of the new electricity generation price set by the government, it seems that this option is a good choice to promote production during the dry season it reduces the rate of import foreign electricity in dry season (Peak hours) as a result, the increasing imported electricity effect Electricite du Lao's financial a lot.

The Nam Ngum1 project expansion, there are two components are No.6 Engine (40MW): the project started in 2016 the construction will be 36 months. This project is built to solve to supply electricity consumption during when the maximum usage of electricity or call Peak load in the dry season and help to manage the NamNgum1 basin effective according to the benefit when releasing the water in rainy season. For the No.7 and 8 engine (80MW) the project started in the end of 2014 and the construction will be 3 years this project for support electric domestic that consumption increase everyday especially Vientiane capital during high usage electricity or call Peak load of dry season when electricity supply is not sufficiently high, and the

amount of electricity imported from abroad is too high. Adding electricity from the original is installed from 155MW to 275 MW. However, this is still continuing to carry out the important functions of the NamNgum1 hydropower dam that conservation is a major source of fisheries, anti-drought and floods, water supply to irrigation for agriculture, develop Nam Ngum1 area to be a place attractive for the tourist, maintain and develop as a source for all species of animals to enhance biodiversity and preserve area of the city, protect the source of clean electricity and sustainable in the future.

V. Current Hydropower Energy Resource Facility and Establishment in Laos

Lao PDR has been developing hydropower so far since 1975 to2015 it was 40 years. Currently, throughout the country, there have been 38 projects that are under operation with a production capacity of 1 MW and more; the total installed capacity of the projects is 6.258,95 MW. Out of this, the government via EDL owns 13 hydropower dams with installation capacity of 681,5 MW and Independent power producers (IPPs) or private manages 25 dams with installation capacity of 5.577,45 MW and there are 25 projects under construction, it is currently installed at 3683 MW.

VI. The Swot Analysis

The vision of the government to develop energy is develop energy in the direction of industrialization and modernization, exploiting and using the natural resource potential to ensure that it is sustainable, promoting strengthen national economic, provide electricity consumption enough in domestic and stable, linking energy and exchange with neighbor's countries and the region, developed energy with green and bright

6.1 Strengths

a. Lao PDR has abundant of natural resources and many rivers
b. Political is stable and peaceful
c. Within the organization is solidarity
d. Previously, the government respected and implemented the concession agreement and other agreements although is not a high benefit but is also reliable by the private and international investors
e. Lao PDR choose hydropower energy is the main important part because hydropower is renewable energy without pollution, clean energy and sustainable and it can also help to resist the drought and flooding
f. The government promotes fully hydropower development and to create a favorable convenient condition for the investors
g. Consumers also need more

6.2 Weakness

a. Limited knowledge of human resource
b. There are restrictions on material, equipment, and technology
c. The government does not have much the capital to invest

6.3 Opportunities

a. The nation has inflow income and the economy is growing
b. People have electricity to use, improving the livelihoods of the people and the people have income
c. There is no financial risk because the government did not pay the cost of all investment
d. The people in remote areas have been developing the structure, the road due to the coming in of electricity system as the people said where the dam is built and the road has been developed too
e. Lao PDR having a good relationship with the neighbor's countries so that will keep the market well
f. For the economic sectors are enthusiastic because of the participation of enterprises, domestic and foreign investors.
g. The concessional conditions, law, and regulation related trend to be an international
h. The officials in the relevant field have the opportunity to upgrade their knowledge to prepare and serve alongside the development of the electricity system/

6.4 Threats

a. The global economy has changed and also the exchange rate because of the economic and political of the big countries and the financial crisis affects the imbalance of the global financial system that creates pressure on our country's economy such as the price of oil, inflation, currency appreciation, a tax of merchandise, etc.).
b. Integration and international transformation require a gradual transformation to cope with the phenomenon such as the impact of business competition, environment impacts, culture - social effects and other.
c. The impacts on energy development are the changing of climate: global warming, air pollution, flood disaster, drought, earthquakes and severe storms.

VII. Conclusion

In this paper has described about the history of starting point and origin of hydropower development of Lao PDR as the reason that the government attempts to develop the country and relate to the natural resources by choosing hydropower energy is the main important sector to develop economic, infrastructure, improving the livelihood condition of Laotians since Electric du Laos has been established in 1959 further in 1966-1971 started to develop the first dam is NamNgum1 without the capital but government have a contracts of the budget loan with international organization to develop this dam and after that the government has always continued to develop and built hydropower dams until the moment. The way of the government to develop hydropower are promoting, investment promotion policies, attracting in domestic and foreign investors by providing the necessary information, tax policy, taxation, labor, the right to use the land, access to the capital sources according to the Five Year National Socio-Economic Development Plan. The incentive investment by sector, by azone that aims to research and development the rural remote areas, protection environmental and bio-diversity, efficient use of natural resource and poverty reduction. In the future, the researchers may discuss more the barriers and challenges that Lao government face and how the government solves the problem on renewable energy projects.

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