

IFC Workshop on Sustainable Hydropower & Regional Cooperation

***“Moving from bilateral connections to system-to-system
approaches – the experience of Lao PDR”***

By Viraphonh Viravong

Vice Minister, Ministry of Energy & Mines, Lao PDR

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1. How energy connections could evolve?
2. STS Model: Expected benefits and business risks
3. The experience of Lao PDR

How Energy Connections could evolve?-1

- **Large Hydropower Potential** in Myanmar , Lao PDR and Cambodia in ASEAN;
- **Rich Natural Gas Resources** in Brunei Darussalam, Indonesia, Malaysia, Thailand and Vietnam;
- **Reasonable Oil Resources** in Brunei Darussalam, Indonesia, Malaysia, Thailand and Vietnam;
- **Large Coal Reserves** in Indonesia and Vietnam;
- **Enormous Geothermal Potential** in the Philippines;
- All ASEAN have **Plenty of Biomass**;

How Energy Connections could evolve?-2

- Great deal of complementarities in the energy sector in ASEAN: Not only in the diversity of resource endowment but also in the seasonal characteristic of supply and demand of electric power;
- Good potential for developing energy markets;
- Expanding power grids proved to be both economically and environmentally desirable:
 - Billions of dollars saved through shared reserve margin & peak power;
 - Presently, 80% of all power generation is non-renewable, emitting greenhouse gases, acid rain, toxic wastes, etc. while enormous potential for hydro, tidal, solar, wind and geothermal sites exist around the region: 12,500 MW of hydropower from Lao PDR would help to avoid emitting 30-60 M tons of Carbon Dioxide into the atmosphere annually;
- Future demand can be met from wheeled electricity rather than constructing the next power plant;

How Energy Connections could evolve?-3

- Through bilateral and regional agreements, it would be possible to develop and utilize resources more efficiently:
 - Lao PDR, Thailand and Vietnam could develop and utilize a combination of thermal and hydropower more efficiently ;
 - Malaysia and Indonesia can use their gas and coal reserves more efficiently while allowing Lao PDR, Cambodia and Myanmar to develop large and untapped hydro potential;
- The improved efficiencies are reflected in reduced customer costs, while expanding markets for each power producer --- a massive win-win situation;
- Increased energy interdependence improves the relationship between countries and decreases risk, again improving investment climates: Cooperation could bring more benefit than Competition in the energy sector.

Current Model Description in Laos

- Exports are primarily on a BOT basis, from large projects such as Nam Theun-2, with dedicated transmission; a percentage of the output is reserved for Lao domestic use;
- Sales are made via a long term PPAs at negotiated prices;
- The project assets will be returned to the Lao government at the end of the concession period;
- EDL is the single-buyer for all domestic consumers; it also provides transmission and distribution services;
- There are other exports and imports as well; for example, to meet local load requirements in some parts of the country.

Concerns with current model

- Only very large projects, with significant energy output, can support the required project investments; these projects maybe limited in number;
- The export IPP projects do not enhance the Lao grid;
- A lot of surplus power from many plants under contract (PPAs with EDL), but can only export this power on a system-to-system basis;
- Laos does not get benefits from more substantial inter-system relations;

STS Model: Expected benefits & risks-1

- Expected benefits:
 - Enhanced trade and exchanges with neighbors;
 - Lower system costs, greater reliability;
 - Ability to sell surplus from aggregate of small plants;
 - Enhanced opportunities to sell energy and capacity;
 - Development of the grid;
 - Impartial grid operations;

STS Model: Expected benefits & risks-2

- Risks:
 - The surplus power mix is not optimal for export;
 - Export market is smaller than expected;
 - Export prices are lower than expected;
 - Cover domestic PPA costs, but with low profits;
 - Do not cover domestic PPA costs;
 - Lao demand (e.g., from industry) is much greater than expected; to meet export obligations would need to curtail domestic load;
 - Lao demand is much lower than expected (e.g., expected industrial load does not materialize); power surplus is larger;
 - Financial risks as cannot sell aggregated power on a back-to-back basis; credit worthiness issues; possible need for credit enhancement;
 - The grid does not develop adequately;
 - The grid is not operated in a reliable and impartial manner; effect on neighbors' willingness to contract, especially for firm power;

Outline of Regional Energy Landscape

- Power Demand Forecast in GMS countries - Mw
 - Years 2012 2020 2030
 - Cambodia 762 1,715 5,144
 - Lao PDR 1,020 2,550 4,667
 - Myanmar 1,806 5,689 19,911
 - Thailand 26,121 47,018 63,474
 - Vietnam 19,713 39,426 78,852
 - Yunnan, PR China 22,765 39,840 59,759
 - Total GMS 72,187 136,237 231,806

- Planned Mw in Laos 3,200 12,500 25,000
- % of Export 68% 80% 75%
- Available from Laos, Gwh 55,000 100,000

Regional Cooperation and Interconnections

- Lao PDR in 2014:
 - 23 interconnections, including 5 x 500 Kv / 10,000 Mw T.L. capacity with Thailand;
 - 7 interconnections and 5,000 Mw MOU for power trade with Vietnam;
 - 4 interconnections and 2,000Mw MOU with China;
 - 2 interconnections and 2,000 Mw MOU with Cambodia;
- Lao PDR and Singapore are discussing 100 Mw of power trade through Thailand and Malaysia grids:
 - Technical viability;
 - Allowable existing capacities?
 - Time & Duration of cross border power trade?
 - System congestion, including security and reliability?
 - Planning and Operation mechanism for system operators?
 - Financial viability;
 - Tariff structure?
 - Wheeling charges?
 - Import duties, taxation, etc.?
 - Commercial and Legal Agreements;

Lao Hydropower: 1970-1990

Model: Traditional development by state-owned utility with government/ international institutions assistance

- Example 1: Nam Ngum-1 HPP commissioned in 1971
 - Originally two 15 MW generators;
 - Two 40 MW generators were added in 1978;
 - A fifth 40 MW unit added in 1984;
 - 3x40 Mw are being added, COD by 2018;
- Example 2: The 45 Mw Xeset-1 commissioned in 1990, was originally planned to be a 2.6 Mw project to supply local demand only;
- Both projects were developed to resolve domestic power insufficiency, but ***interconnections with much larger Thai grid greatly reduced generation cost and provided more reliable supply to domestic grid;***

Lao Hydropower: 1990-2014

Participation of Private sector: IPP / BOT

- Export on Project-by-Project basis with 10-15% supply to local grid;

Increased Bilateral Exchanges

Example of large project located in international river and by private sector: Xayaburi HPP

- Run-of-river scheme on the Mainstream of the Mekong, with small pondage: A Transparent Dam Design with respect to sediment transport;
- Most technologically advanced fish passage systems ever designed for tropical river;
- Installed capacity: 1,285 MW, 90% for export;
- US\$3.5 Billion; project financing largely by Thai banks; Design and engineering by CNR and Poyry, other international consultants;
- Construction began Dec 2012, commercial operation begins 2019; 30-year concession;
- Meeting all International standards of Hydropower Sustainability, including 1995 Mekong Agreement;

Example of small project in international river, and by private sector: Don Sahong HPP

- Run-of-river scheme on one of the many channels of the Mekong, using 15% of river flow;
- Developer using “natural” fishways, by improving existing channels;
- Installed capacity: 256 MW for domestic supply;
- US\$721 million, project financing by Malaysian banks with international experts;
- 4 years of construction could begin as early as February; 25-year concession period;
- No potential significant trans-boundary impacts are anticipated; All international hydropower sustainability criteria were met;

Vision for Lao Hydropower: 2015-2020

- **2015-2020: Establishment of System-To-System transactions, examples:**
 1. 3,000 Mw EDL-EGAT STS Agreement;
 2. Export of 100 Mw from Laos to Singapore, through Thailand/ Malaysia grids or LTMS PIP, using existing transmission facilities.
 3. 3,000 Mw CSG-EGAT STS through Laos

Vision for Lao Hydropower: 2020-2030

❑ **2020-2030: Establishment of Regional Power Trade**

- Example: Electricity Trading between Laos-Thailand-Malaysia-Singapore could save as much as US\$26 billion over 10 years for the 4 countries involved; study by ERIA;
- Cross-border power trade is technically feasible but needs a business model and legal agreements.