

HYDROPOWER DEVELOPMENT IN LAO PDR

Chansaveng BOUNGNONG
Director of Power Sector Planning Division
Department of Electricity
Ministry of Energy and Mines, Lao PDR
Vientiane, October 2009

BACKGROUND OF LAO PDR



- **Area of 236,800 km sq;**
- **16 Provinces + Capital and 139 districts;**
- **Population of 5.8 million (2007);**
- **GDP of USD 4.1 billion (2007);**
- **GDP per Capita of USD 701 (2007);**
- **Mountainous area with major tributaries of the Mekong River covering 35% of total Mekong River basin.**
- **Relatively high annual rainfall.**
- **Hydropower potential: 23,000 MW**
- **Existing installed capacity of 1826 MW (7.9%)**
- **Produced energy of 9,500 GWh/Y**
- **Produced energy per capita of 1570 kWh/Y**
- **Exported energy per capita of 1360 kWh/Y**

HISTORY OF POWER SECTOR DEVELOPMENT

- Memorandum of Understanding on the power exchange program was signed with the Royal Thai Government in 1993 and 1996 under which 3,000 MW is to be supplied to Thailand and subsequently increased 7,000 MW is agreed;
- In 1998 and 2006 MOUs were signed with the Government of Vietnam for 3000 MW and subsequently 5000 MW is agreed;
- In 1999 Agreement on Cooperation in Power Sector was signed with Cambodia;
- Power Sector Strategy is being developed and updated from time to time;
- Power sector opened to private foreign direct investments;
- Legal framework has been improved from time to time to meet international financing requirements.

POWER SECTOR POLICY

- Maintain and expand affordable, reliable and sustainable electricity supply to promote economic and social development;
- Promote power exports as well as domestic power supply to earn revenues to meet Government development objectives with particular emphasis on poverty eradication;
- Develop and enhance the legal and regulatory framework to facilitate power sector development by either public, private or public private partnership;
- Gain capacity building through international technical know-how and expertise;
- Ensure accountability and transparency of environmental and social impacts and thereby achieve sustainable development

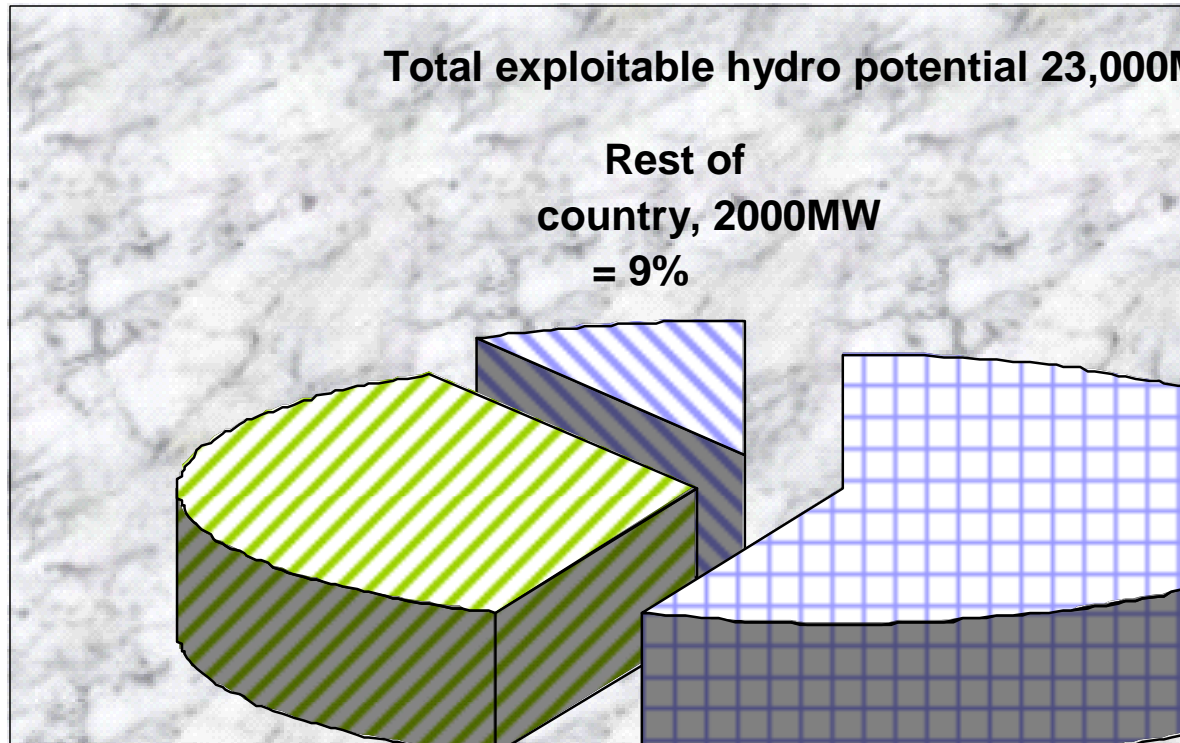
OBJECTIVES OF POWER SECTOR DEVELOPMENT

- Provide a source of foreign exchange to fund economic and social development and alleviate poverty;
- Meet the commitments under intergovernmental MOUs and Agreements with Thailand, Vietnam and others;
- Extend rural electrification to promote better socio-economic development and reach the government target of 70% and 90% by year 2010 and 2020 respectively;
- Integrate power sector and maintain its economic development as a whole with international communities through its power exchange programs and foreign direct investment.

Primary Energy Resources of Lao PDR

Resource	Reserves	Potential for Use in Power Generation
Oil and Gas	Two exploration concessions in central and southern Lao PDR. Mapping and geophysical investigations are being carried out, including deep hole drill (2,560 m). Results are being evaluated	Possibly in the longer term (10-15 years), if sufficient reserves found
Coal (Lignite)	Major resource located at Hongsa in north-west Lao PDR. About 810 million tons proven reserve, of which over 530 million tons is deemed economically recoverable. Energy content 8-10 MJ/kg, relatively low sulfur content of 0.7-1.1%	Sufficient reserves for about 2,000 MW installed capacity
Coal (Bituminous and Anthracite)	Reserves, mainly anthracite, dispersed in various fields throughout Lao PDR. Exploration ongoing. Total proven reserve to date about 100 million tons. Energy contents 23-35 MJ/kg.	Current annual production of 130,000 tons, used for local factories or export. Possible longer-term option for around 500 MW installed capacity, depending on results of exploration.
Solar	Annual solar radiation received in Lao PDR about 1800 kWh/m ² , possibly less in mountain areas. Corresponds to conditions in southern Europe (Italy, Spain).	Photovoltaic modules already used for small-scale (e.g. 100 W) remote applications.
Wind	Mean wind speeds at Luang Prabang and Vientiane around 1 m/s, in mountain areas likely to be somewhat higher.	Costs in areas of less than 4 m/s likely to be in upper end of range US\$ 0.05-0.25 per kWh, hence limited potential
Geothermal	No significant known reserves.	Limited potential for power generation
Biomass (agriculture waste)	Biomass resources dispersed throughout the country.	Current share of biomass (mainly wood fuel) in total energy consumption about 88%. Wood-fired cogeneration (heat and power) plants could be economic for self-supply in wood processing facilities
Hydropower	Average annual precipitation about 2,000 mm. Total runoff around 240,000 million m ³ . Theoretical hydropower potential of 26,000 MW (excluding mainstream Mekong).	Exploitable hydropower potential, including share of mainstream Mekong, around 23,000 MW.

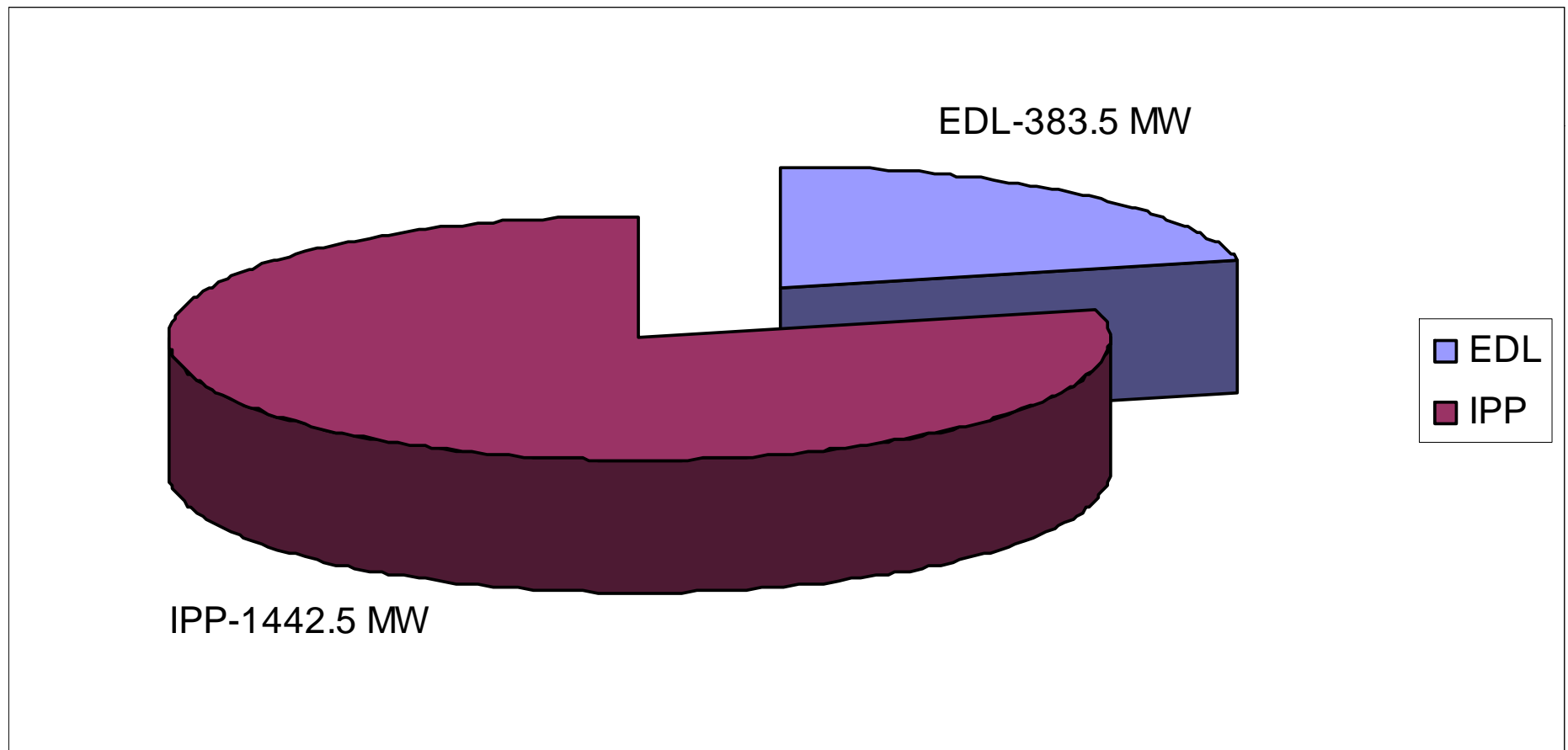
Exploitable Hydropower Potential of Lao PDR



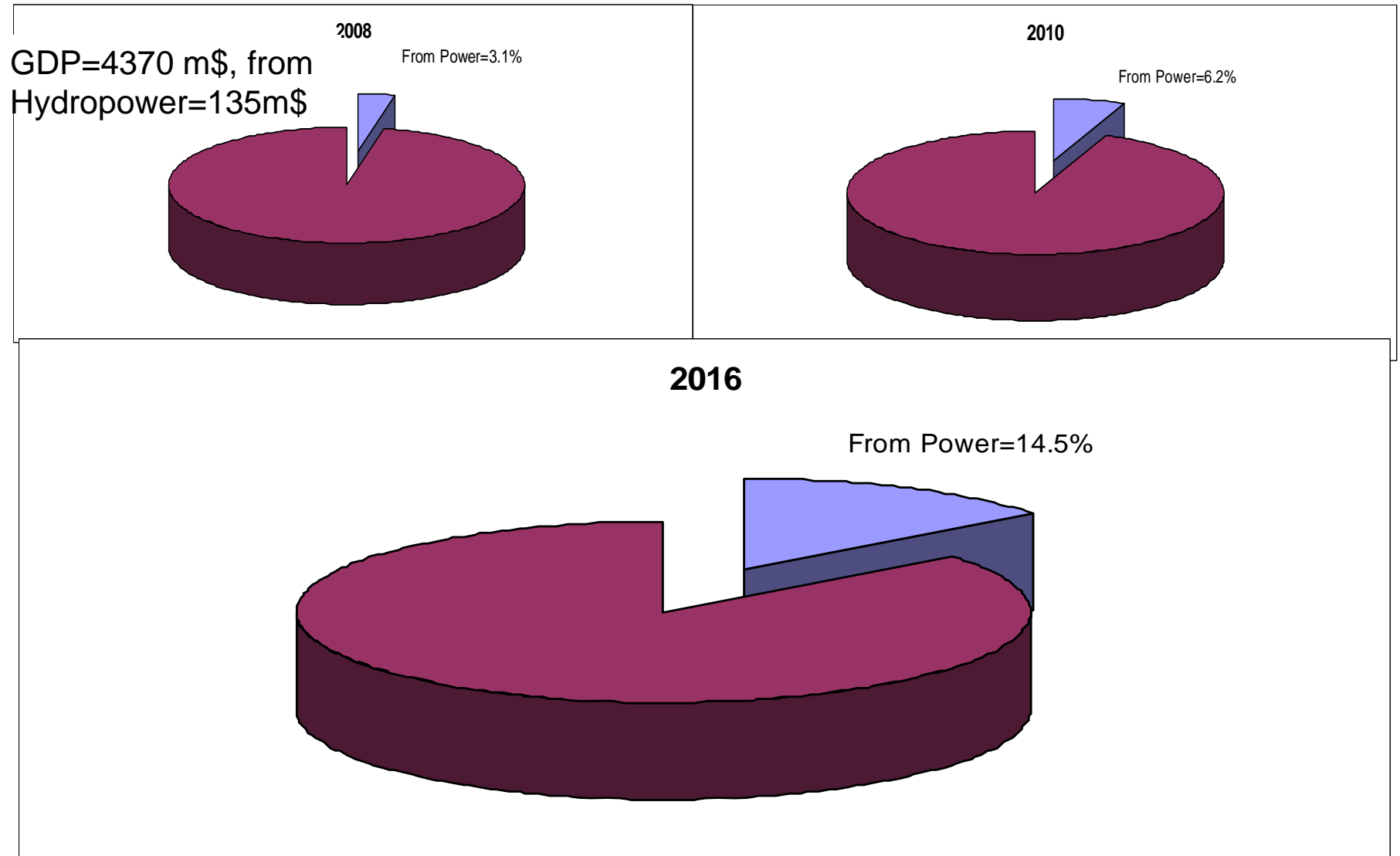
OWNERSHIP OF POWER GENERATION

The country's total installed Capacity: 1826 MW:

EdL 383.5 MW, IPP: 1442.5 MW



Revenue from Power Generation in GDP

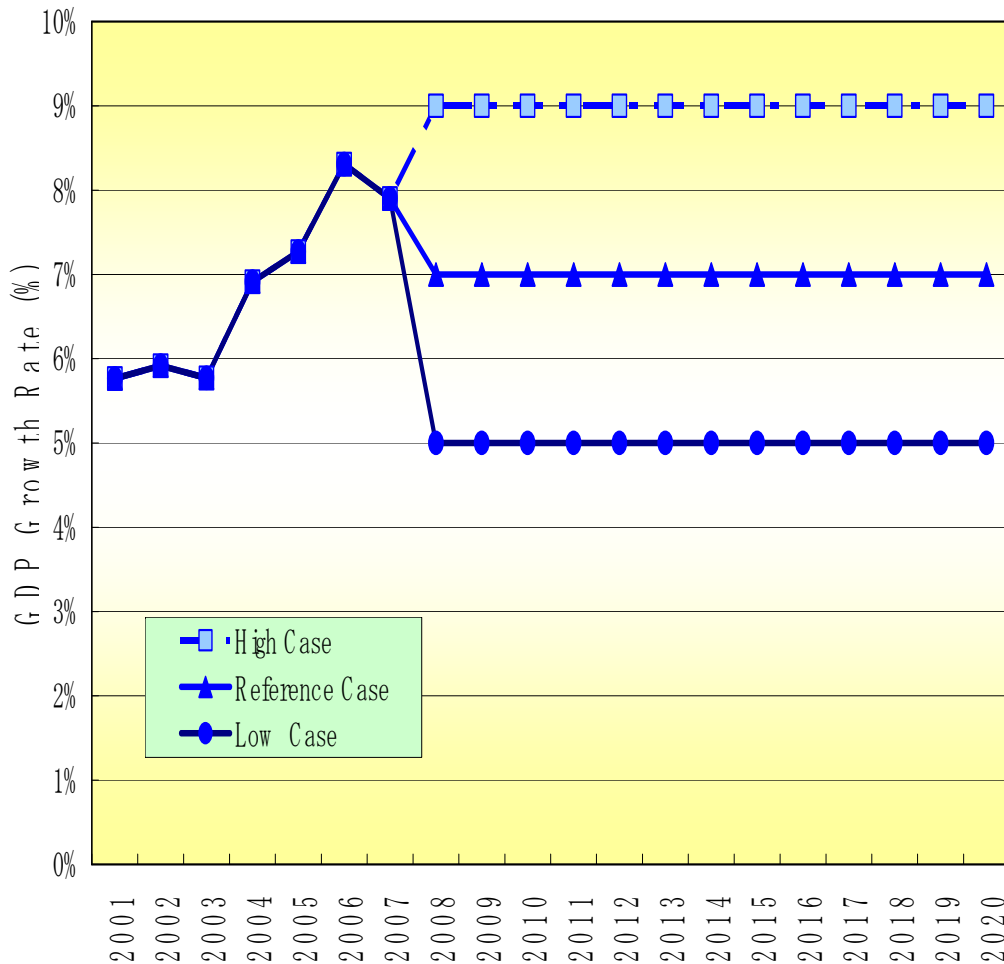


Electricity Tariff in Lao PDR

Electricity Tariff (Kip/kWh)	Jan-06	Jan-07	Jan-08	Jan-09	Jan-10	Jan-11
Residential						
0-25 kWh	1.55	1.79	2.06	2.36	2.72	3.13
26-50 kWh	3.21	3.31	3.41	3.51	3.61	3.72
>150 kWh-	9.00	9.00	9.00	9.00	9.00	9.00
Agriculture						
Low Voltage (0.4 kV)	3.65	3.82	4.01	4.22	4.44	4.65
Medium Voltage (22kV)	3.09	3.25	3.41	3.59	3.76	3.95

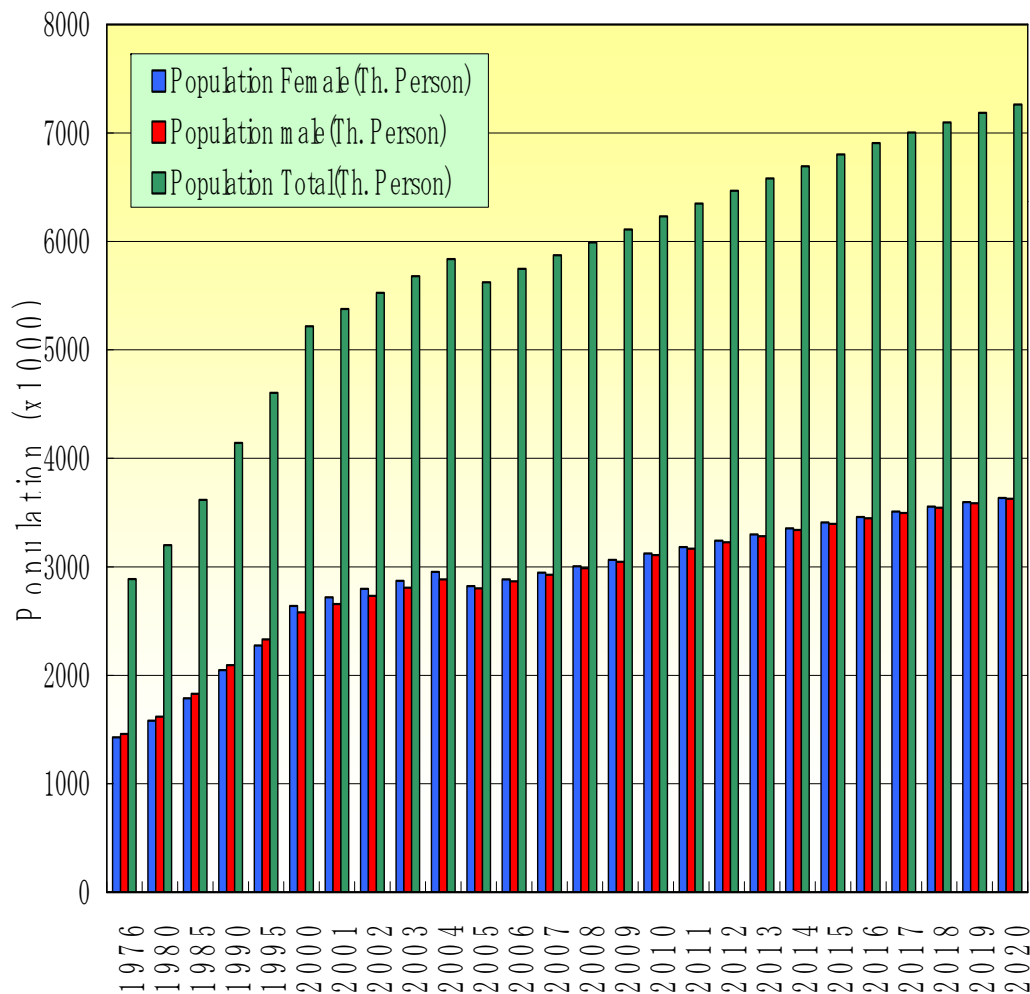
Exchange 1\$=8500Kip

Assumption : GDP Growth Rate



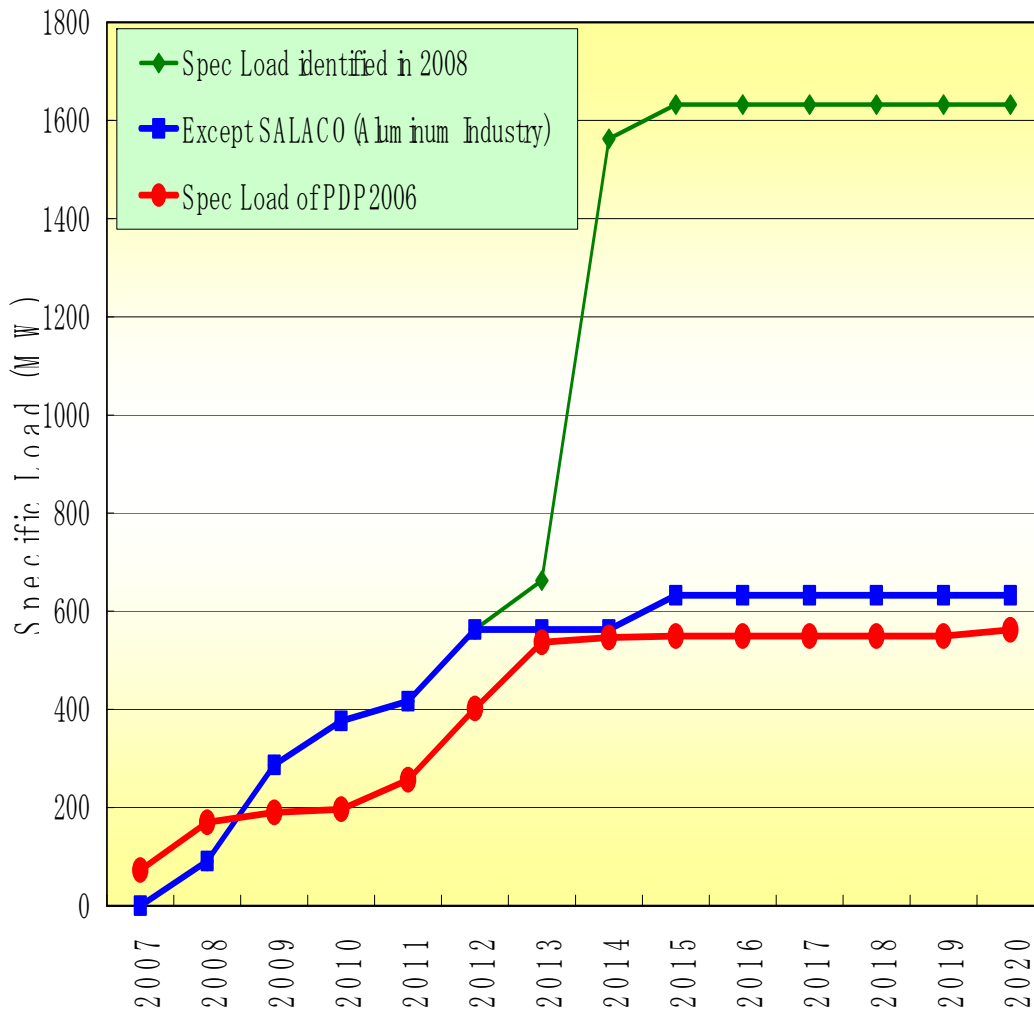
- GDP G.R.s are recorded between 5.8 and 8.3%
- It may be acceptable GDP G.R. is set in 7% (average records) as Reference Case
- 9% as High case, 5% as Low case
- Our concern is how Lao economy shall suffer from world wide economy crisis of 2008

Assumption : Population



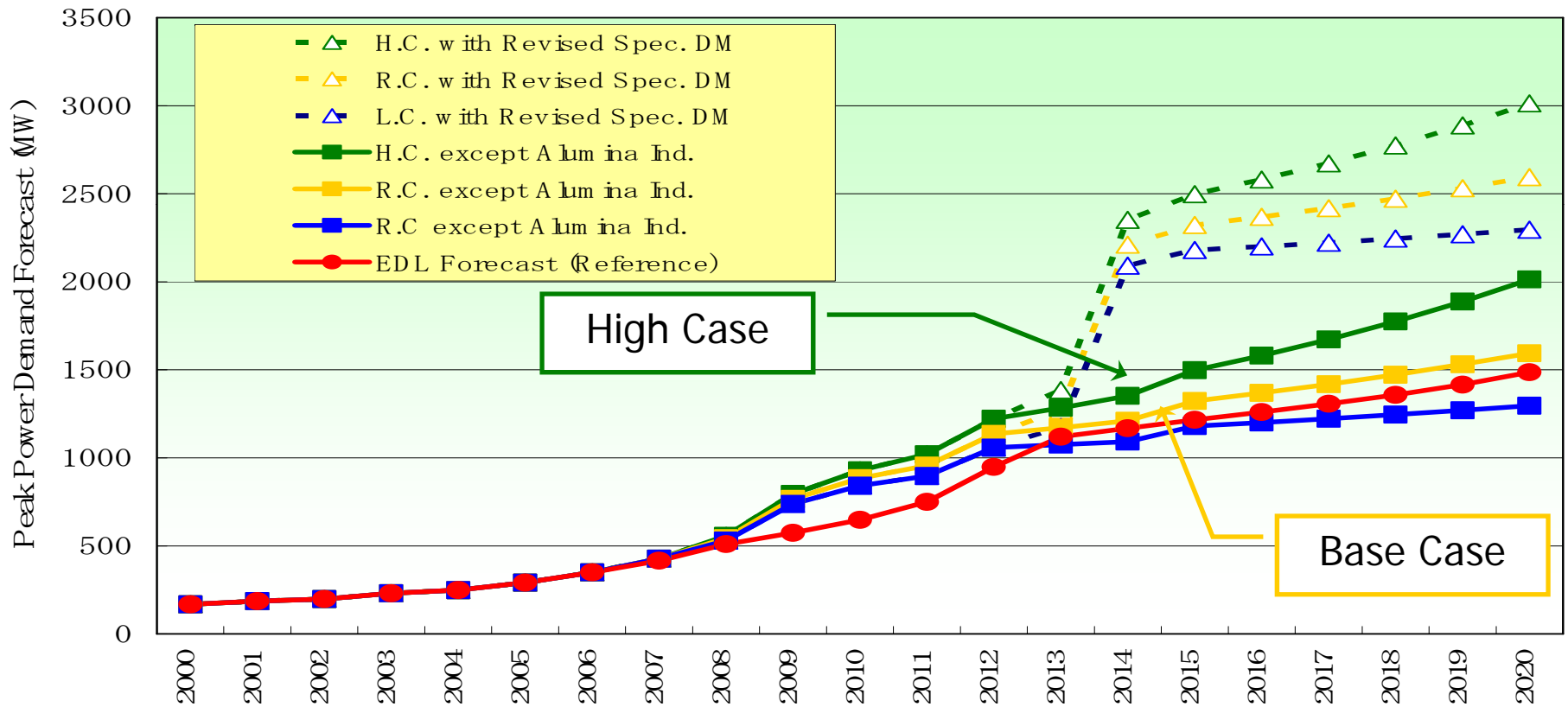
- Source is “Results from the Population and Housing Census 2005”.
- Population G.R.s are forecasted between 1 and 2%.
- Population shall reach over 7mill person in 2020.

Comparison among Spec. DMs



- Large gap in 2014 depends on SALCO's load.
- This load is too large to consider in PDP & TDP.
- SALCO should develop their captive power plant or search other power supplier
- We recommend to eliminate this load in the study.

Demand Forecast



GMS POWER INTERCONNECTION PROJECT



- Existing 500Kv Line
- Under implementation
- Expected 500Kv Line

DEVELOPMENT STATUS

68 Projects with estimated installed capacity of 22,069 MW:

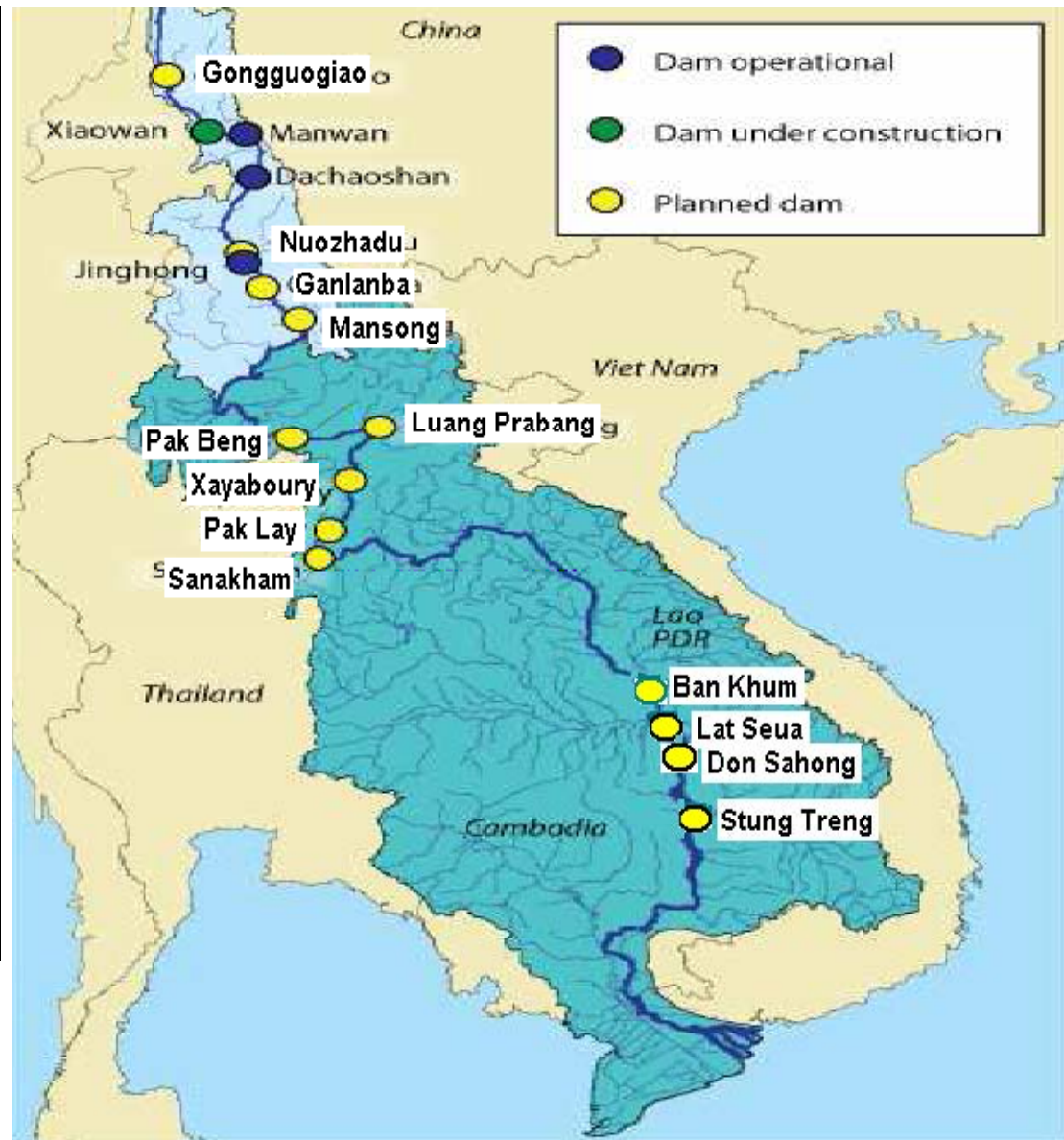
- ⚡ Projects at Feasibility Study stages/with Memorandum of Understanding (MOU): 43 Projects with estimated installed capacity of 12,373.5 MW
- ⚡ Projects at Preparation stage/with Project Development Agreement (PDA): 17 projects with estimated installed capacity of 7,245 MW
- ⚡ Projects under Construction / with Concession Agreement (CA): 8 Projects with installed capacity of 2,450.6 MW

DEVELOPMENT STATUS (CONT')

- For electric generation and consumption, hydropower type comprises of 99.8% of total, the rest is diesel generation and solar photovoltaic sets.
- Electrification ratio is estimated at 60% in 2008.

LIST OF DAMS ON THE MEKONG MAINSTREAM (LAOS)

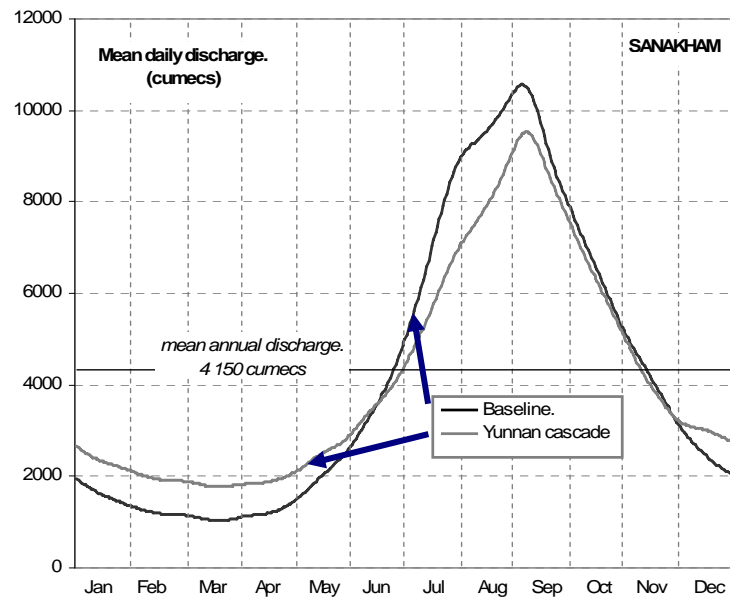
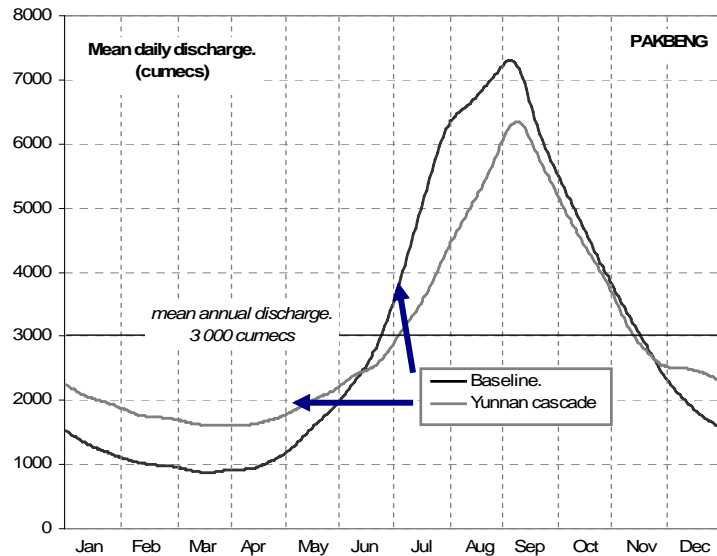
No.	Name	MW
1	Pak Beng	1,230
2	Luang Prabang	1,410
3	Xayaboury	1,260
4	Pak Lay	1,320
5	Sanakham	570
6	Ban Khum	2,330
7	Lat Sua	800
8	Dong Sahong	240
	TOTAL	9,160



THE IMPACTS OF UPSTREAM REGULATION.

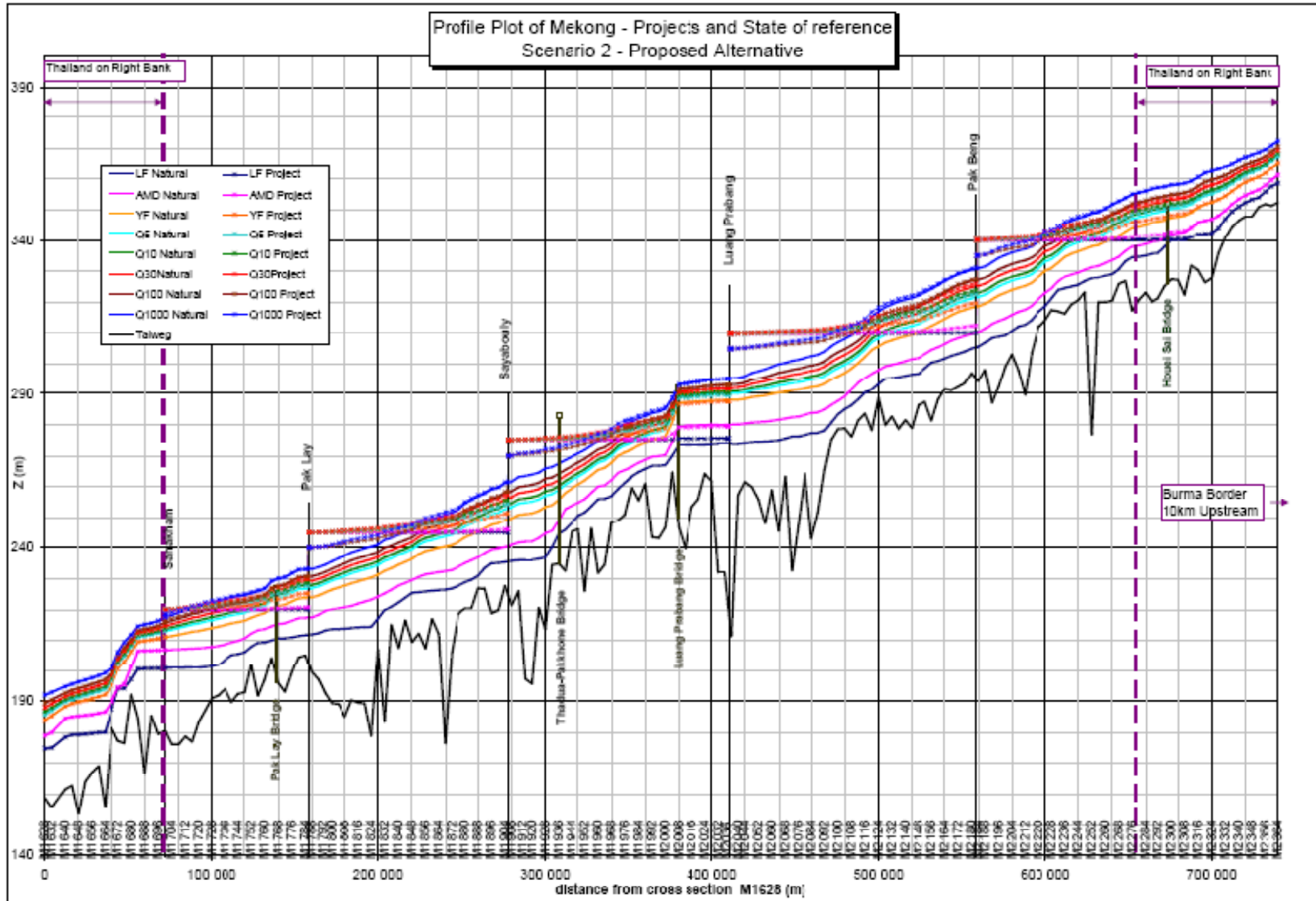
1. On the annual flow hydrograph

- the reallocation of flow from the flood to the low flow season is clear
- the amplitude of the mean annual hydrograph decreases
- the major impact is the increase in flows during the low flow season, which in March increase by 70 to 80%
- mean discharges in July and August – as the reservoirs refill - decrease by 20 ~ 30%.
- there is a delay in the onset of the flood season.
- average peak flows decrease by 10%.
- between September and November there is little impact



Optimization Study Scenario 2

Longitudinal profile:



Optimization Study Result

Project Name	Location (km)	Power (MW)	Energy (GWh)	Operating water Level	Tail water Level	Maximum head	Discharge
Pak Beng	2188	1012	4722	340	310	30	5000
Luang prabang	2036	1288	5602	310	280	30	6000
Sayabuly	1930	1472	6838	275	240	35	6000
Pak Lay	1818	1002	4369	240	220	20	7000
Sanakham	1737	692	3202	220	205	15	7000
Total		5466	24733				

CHALLENGES

1. **GOL Target:**
 - 70% Households to be electrified by 2010;
 - 90% Households to be electrified by 2020;
2. **Generation:**
 - Hydro Power source
 - Turmal Power
 - Renewable Energy source
 - Other sources
3. **Power Grid Development:**
 - National Grid
 - IPP Grid
4. **Mekong Mainstream Development:**
 - MRC Rule
 - Cascade (Study)
 - EIAS indepth study and detailed cumulative impact assessment (CIA)



THANK YOU.