ENERGY AND POWER IMPACT
(opportunities and risks)

MRC SEA for Hydropower on the Mekong Mainstream

MRCS Initiative on Sustainable Hydropower
On behalf of the SEA Team

What issues are addressed in each SEA stage ?

Baseline Assessment

Address trends and different perspectives on:

- Policies on power sectors and cross-border power trade
- Demand growth projections and electrification
- Power Sector development plans (generation expansion)
- Energy resource base /fuel import policies of countries
- Analysis of Alternatives for power supply – grid / off grid (e.g. conventional, RE and DSM) + policies for alternatives like feed-in tariff

Impact Assessment

Focuses on development opportunities + risks

20-yr BDP Probable Future Scenario (With/Without LMB mainstream and groups.

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1. Regional distribution of energy and power benefits.
2. Main impacts on individual LMB power sectors.
3. Regional development contribution of other power-related impacts

Avoidance, Mitigation Enhancement

Address the above building on the Baseline and Impact Assessment outcomes

Impact Phase - Focuses on 3 questions

1. What is the regional distribution of power benefits with/without LMB mainstream + different groups
2. What are the impacts on individual LMB domestic power sectors?
3. What is the regional development contribution of other power-related impacts to integrate with other sector analysis?

All From a Power Sector Development Perspective

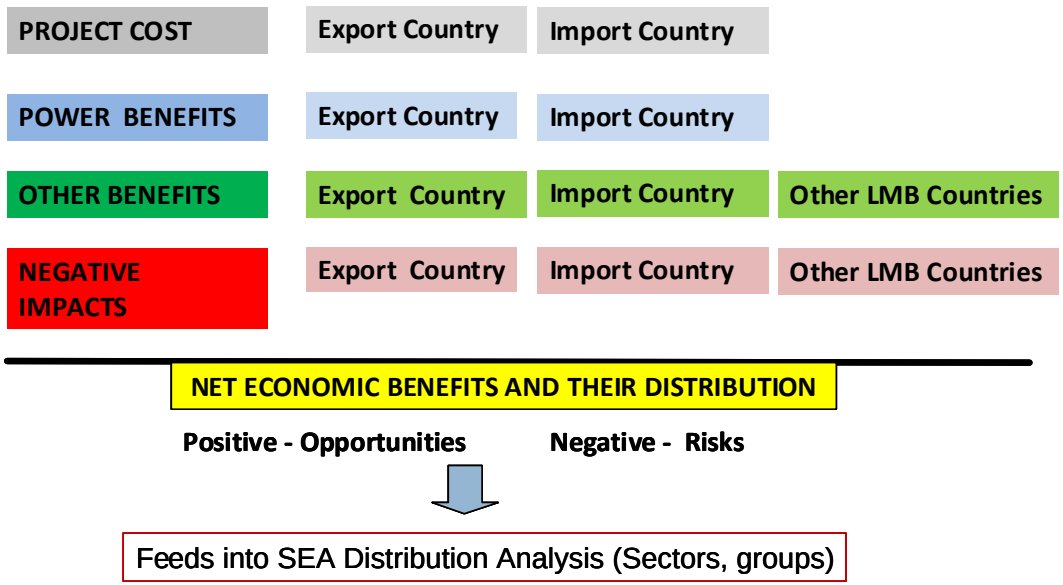
Q1. What is the impact on regional distribution of LMB power benefits

Approach

Economic analysis of power benefits based on:

- MRC Hydropower Data Base
- Economic supply costs (project by project)
- Competing cost of alternatives for bulk power receiving system
- Power Revenues (economic valuation)
- Assessment is Not a financial or revenue flow analysis.

Integration with other parts of the SEA



Regional distribution of economic benefits in LMB power sectors

Table 2.1 Regional Distribution of LMB Power Benefits for the 20-year Probable Future (with and without LMB mainstream dams) and sensitivity cases

LMB Regional Distribution	POWER SUPPLY (GWh/Year)					PROJECTED POWER EXPORT (GWh/Year)					PROJECT INVESTMENT ($USM)				
SCENARIO[1]	CAM	LAO	THAI	VIE	TOTAL	CAM	LAO	THAI	VIE	TOTAL	CAM	LAO	THAI	VIE	TOTAL
2030-20Y-with MD	3,677	20,412	60,694	35,058	**119,840**	19,384	64,004	0	0	**83,389**	11,669	27,165	0	2,771	**41,605**
2030-20Y-w/o MD	1,703	9,038	26,206	16,346	**53,293**	1,618	28,571	0	0	**30,189**	1,268	11,857	0	2,771	**15,896**
2030-20Y- MD in zone 2 only	1,703	12,287	50,558	21,240	**85,787**	1,618	57,816	0	0	**59,434**	1,268	22,031	0	2,771	**26,070**
2030-20Y- zone 3 only	1,703	16,759	30,423	16,346	**65,231**	1,618	32,788	0	0	**34,406**	1,268	16,402	0	2,771	**20,441**
2030-20Y- zone 4 only	3,677	9,441	32,126	30,164	**75,408**	19,384	30,542	0	0	**49,927**	11,669	12,447	0	2,771	**26,886**

LMB Regional Distribution	GROSS BENEFIT OF SUPPLY ($USM/Year)					GROSS EXPORT REVENUE Estimated ($USM/Year)					NET OVERALL POWER BENEFIT ($USM/Year)				
SCENARIO	CAM	LAO	THAI	VIE	TOTAL	CAM	LAO	THAI	VIE	TOTAL	CAM	LAO	THAI	VIE	TOTAL
2030-20Year with MD	782	3,555	5,284	2,559	**12,179**	1,250	4,676	0	0	**5,926**	722	5,272	832	834	**7,659**
2030-20Y-w/o MD	362	1,574	2,281	1,193	**5,410**	100	2,113	0	0	**2,214**	273	2,394	381	629	**3,677**
2030-20Y- zone 2 only	362	2,140	4,401	1,550	**8,453**	100	4,219	0	0	**4,319**	273	3,958	699	682	**5,613**
2030-20Y- zone 3 only	362	2,919	2,648	1,193	**7,122**	100	2,425	0	0	**2,526**	273	3,556	436	629	**4,894**
2030-20Y- zone 4 only	782	1,644	2,797	2,201	**7,424**	1,250	2,259	0	0	**3,509**	722	2,546	459	780	**4,506**

Notes:

1 Scenarios are based on the MRC Basin Development Plan (BDP 20 year Probable Future - 2030 snap shot)

2 Gross benefit of supply is based on avoided thermal costs in country where power is consumed

Q1. Summary

- **Overall power benefits to LMB are significant.** With BDP 20-yr Probably Future Scenario (2030) with/ without LMB mainstream dams (MSSPs) and SEA sensitivity cases of different groups of dams:
  - Difference in net overall economic power benefit 20-PFS with/without proposed LMB mainstream dams is about $US 3-4 billion annually by 2030.
  - Net economic benefit for the upper Lao PDR group is half (48.6 %) the estimated overall economic benefit in the power sector for all 12 MSDP.
  - Economic power benefit depends on the future generation mix assumed
  - Over longer term, greatest beneficiary is Lao PDR in all cases.
- **Mainstream projects in Laos and Cambodia represent roughly two thirds of the total new energy potential of hydroelectric projects identified in the LMB** (i.e. hydropower schemes not yet operating or undergoing firm development).
- **Power supply from LMB mainstream hydropower schemes is consistent with LMB power sector policies -** expressed in legislation and combination of National Power Development Plans (PDPs), Regional Power Trade Agreement (2003) and Bilateral Power Trade MOUs.

Q2. What is the impact on individual LMB domestic power sectors (LMB mainstream)

From national power development perspective

- **Development of its mainstream proposals is most critical to the power sector in Cambodia:** This reflects the limited power supply options at present for low-cost bulk power supply (including tributary dams) to displace imported diesel.
- **The Lao PDR power sector can develop tributary projects for domestic use and exports continue at a healthy pace without mainstream projects** given the large inventory of economically attractive tributary projects in Laos. Other benefits would be forgone.
- **The scale of electricity demand in Thailand and Vietnam (96% of LMB combined) and the cost of alternative forms of power supply (thermal) are such that development of LMB mainstream projects would have a minor impact on electricity prices in those power systems**, and not radically alter the energy supply strategies of those countries applying least-cost criteria alone.

Q2. Summary

if LMB mainstream projects are not pursued

- Limited direct impacts on power systems of **importing countries** (Thailand and Viet Nam). Tariffs would not be appreciably affected. Benefits of supply diversity benefits forgone.
- Impacts on **Cambodia's domestic power sector would be greatest** of all LMB countries. Cambodia may pursue coal imports for bulk power supply.
- Both Lao and Cambodia would **forgo potential power benefits** such as:
  - Power export revenue earnings (earnings are more limited in initial years as debt is serviced, equity contribution recovered).
  - Long-term flexibility for power supply as a development catalyst when 25-yr concession periods end (e.g. choice to continue to export, or used as greater portion of project output for domestic energy economy).

Q3. What is the regional development contribution of other power-related impacts?

Three factors considered in the assessment were the level and regional distribution of:

- Regional FDI Investment
- Regional Employment - excluding indirect employment for services and E&M equipment contracts)
- Regional Power Sector emission reduction (e.g. Co2) avoided in thermal power stations (oil, coal and natural gas) when hydropower is used.

Q3. other regional development contributions estimated for different scenarios

LMB Regional Distribution	WAGES DURING CONSTRUCTION[2,3] ($USM)					TOTAL PRESENT VALUE OF WAGES Constuction and Operation ($USM)				
SCENARIO[1]	CAM	LAO	THAI	VIE	TOTAL	CAM	LAO	THAI	VIE	TOTAL
2030-20Year with MD	2,769	7,484	0	754	**11,007**	3,334	9,012	0	909	**13,254**
2030-20Y-w/o MD	345	3,314	0	754	**4,413**	415	3,990	0	909	**5,314**
2030-20Y- zone 2 only	345	6,081	0	754	**7,180**	415	7,322	0	909	**8,646**
2030-20Y- zone 3 only	345	4,550	0	754	**5,649**	415	5,479	0	909	**6,802**
2030-20Y- zone 4 only	2,769	3,480	0	754	**7,004**	3,334	4,191	0	909	**8,434**

	GHG EMISSION OFFSET4 (Million Ton CO_2/Year)				
Ton/MWh by Country[5]	0.86	0.86	0.65	0.97	
SCENARIO	CAM	LAO	THAI	VIE	TOTAL
2030-20Year with MD	3	18	39	34	**94**
2030-20Y-w/o MD	1	8	17	16	**42**
2030-20Y- zone 2 only	1	11	33	21	**65**
2030-20Y- zone 3 only	14	20	1	16	**52**
2030-20Y- zone 4 only	8	21	3	29	**61**

Notes:

1 . Scenarios are based on the MRC Basin Development Plan (BDP 20 year Probable Future - 2030 snapshot)

2. Assumes wages only in the country where project is constructed (adjustments would be made for 2 LMB dams spanning Lao and Thailand). Excludes indirect jobs / wages such as from services, mechanical & electrical equipment manufacture/supply, etc.

3. SEA baseline report considers the split between local and foreign jobs mostly from the GMS region

4. Gross GHG based on avoided thermal generation in the country where power is consumed. Gross is different than net GHG impact, which subtracts potential for GHG emissions from reservoirs (a contoversial topic - see Climate Change analysis).

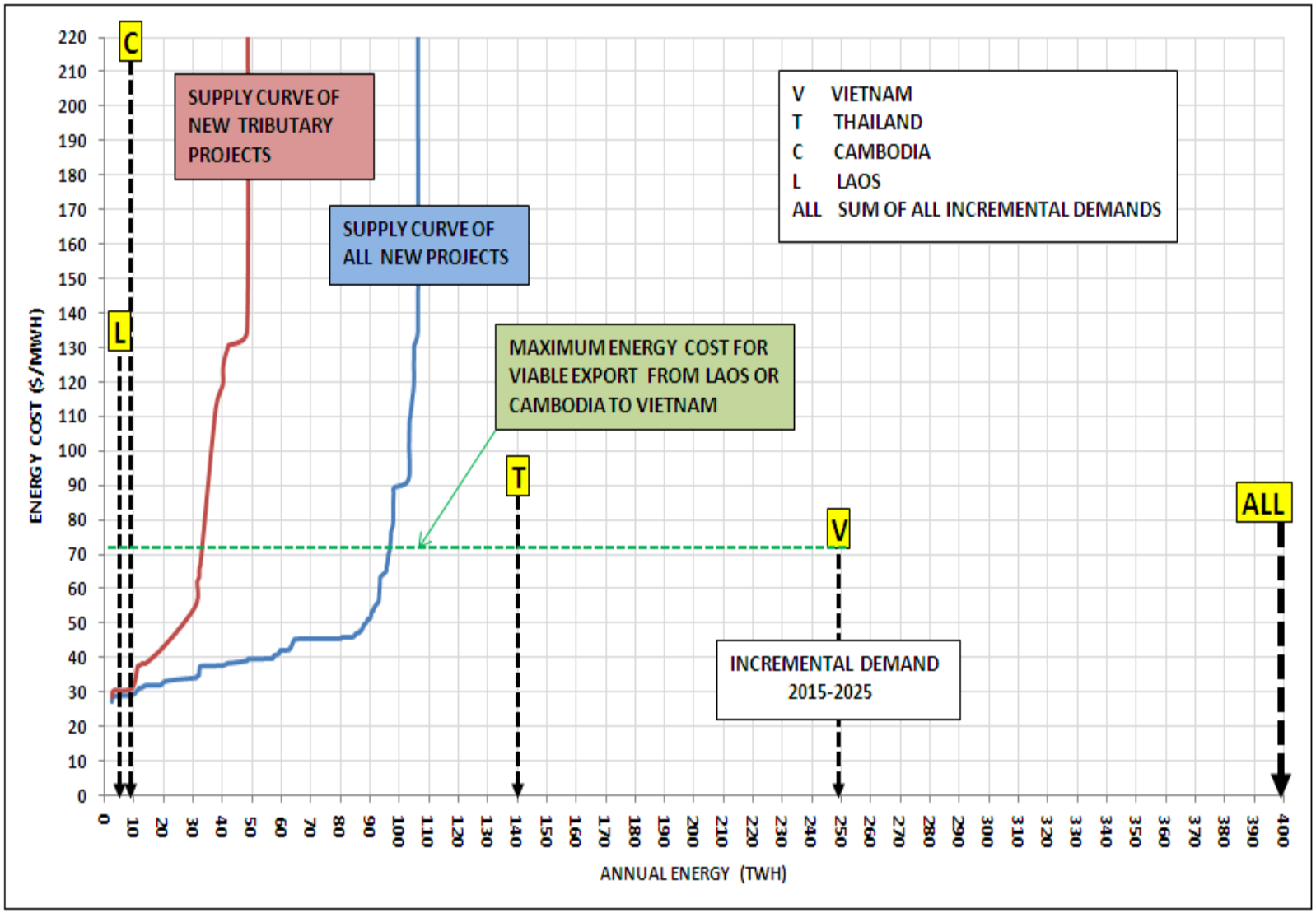
5. Specific GHG emission factor base on power generation mix in each country (i.e., type of thermal supply offset)

Q3. Summary

Net contribution needs integrated with analysis in other sectors

- **Regional FDI Investment Impact**
  in the LMB probably future scenario is 15.8 billion to 2030 without LMB mainstream. LMB mainstream would add about $US 25 billion. (see economic analysis for potential effects).
- **Regional Direct employment Impact**
  in LMB mainstream $US 8.0 billion (construction through operation). Other LMB / GMS indirect for equipment and services.
- **Regional Power Sector Emission Impact**:
  LMB mainstream dams calculated to have gross thermal offset of 52 million tonnes Co2/yr by 2030. Net 40-50 million tonnes Co2 Net GHG emission reduction in LMB regional power sector of 70-80 million tonnes Co2 /yr by 2030 – mainstream + tributary. (level of emissions from reservoirs is contested- See Climate Change analysis).

Next Phase of the SEA: Hydropower Supply Curves



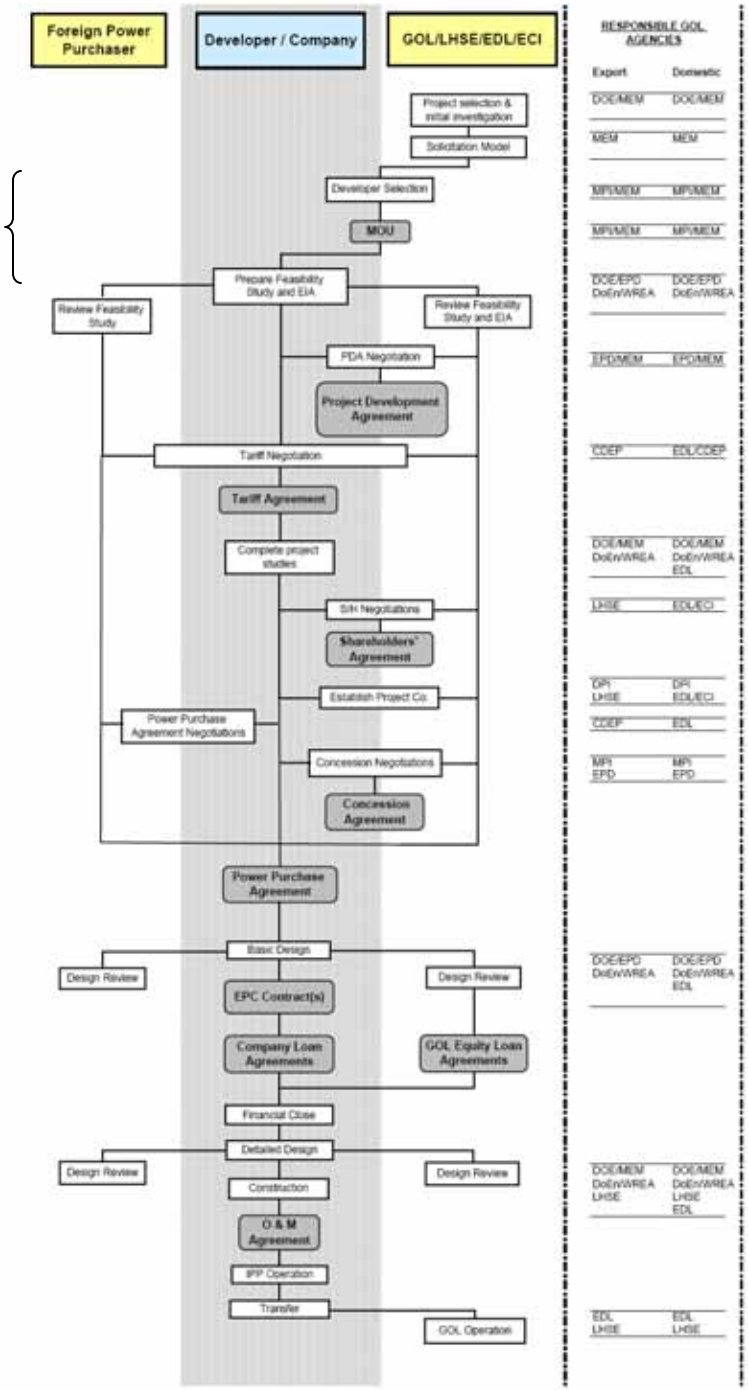
Status of Projects in National Regulatory Systems

Illustration of Lao PDR

Most mainstream proposals are here in the regulatory system

- MOUs / LOAs
- feasibility study and EIAs /SIAs

- For tributary &
- Mainstream dams



Thank you

Additional Information

slides in handouts attached. Also see the SEA energy and power presentation, summary and working paper at http://www.mrcmekong.org/ish/SEA.htm

Wider regional energy picture (GMS)

Energy poverty widespread

- Dependence on traditional sources of energy (e.g. fuelwood)
- 20 % of GMs population (74 mil.) no access to electricity
- Energy consumption in GMS is only 2/3 of the world average for developing countries

Energy vulnerability high and rising

- 1993-2005 8% annual growth in energy consumption
- 21% of total energy consumed in the region imported
- Volatile energy prices and limited alternative energy sources mean the region is vulnerable

Energy productivity and policy

- Energy supplies low and unpredictable – overall quality low
- Lack of competitive pressure on energy suppliers
- Policy regimes inadequate to address emerging challenges

Source: Building a sustainable energy future the GMS, ADB 2009

Electricity consumption in LMB / GMS

relative to other countries + UN Human Development Index

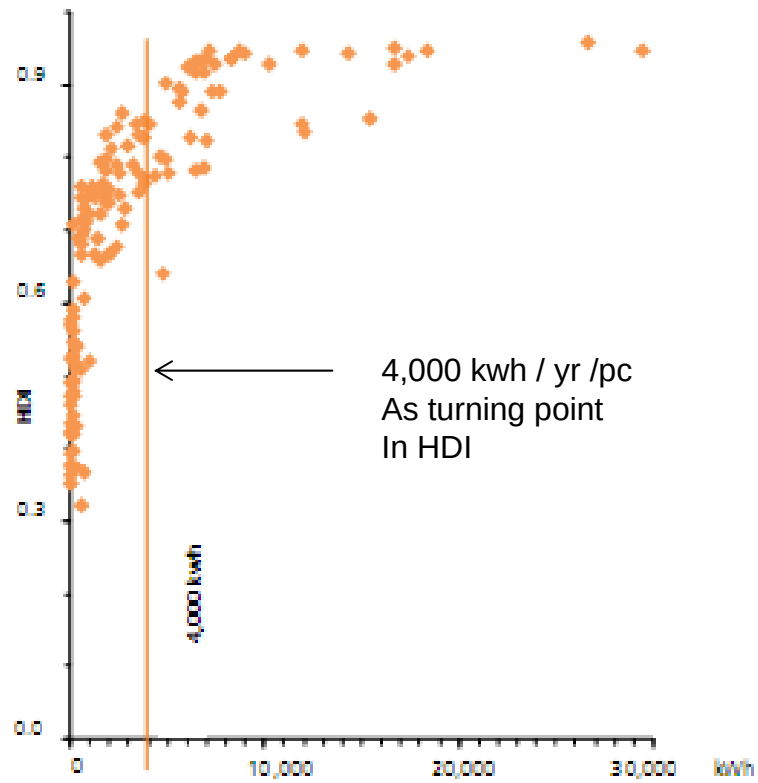
Per Capital Electricity Use

Economy	Kilowatt-hour(kWh)
Cambodia	56
PRC	1,684
Guangxi	1,100
Yunnan	1,252
Lao PDR	187
Myanmar	78
Thailand	1,950
Viet Nam	573
World	2,701
Developing Countries	1,221
OECD	8,795
United States	14,240

Lao PDR = Lao People's Democratic Republic, OECD = Organisation for Economic Co-operation and Development, PRC = People's Republic of China.

Sources: United Nations Development Programme (UNDP). 2007. 2007. *Human Development Report 2007/2008*; National Bureau of Statistics. 2006. *China Energy Statistical Yearbook 2006* (Source of Guangxi and Yunnan data.)

UN Human Development index + Per Capital Electricity Use (2005)



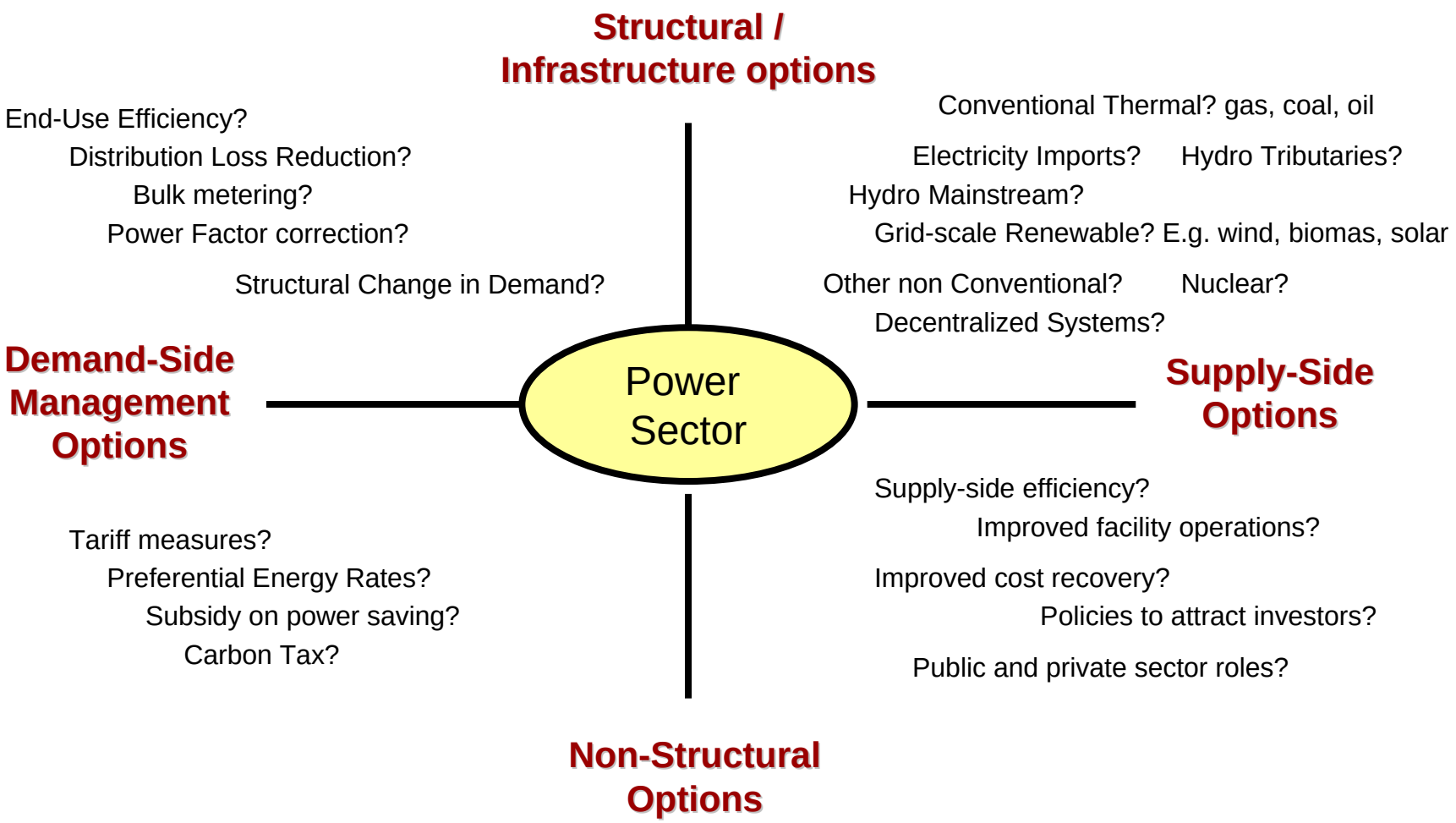
Per capita electricity use

Source: Building Sustainable energy futures in the GMS, AI

kWh = kilowatt-hour.

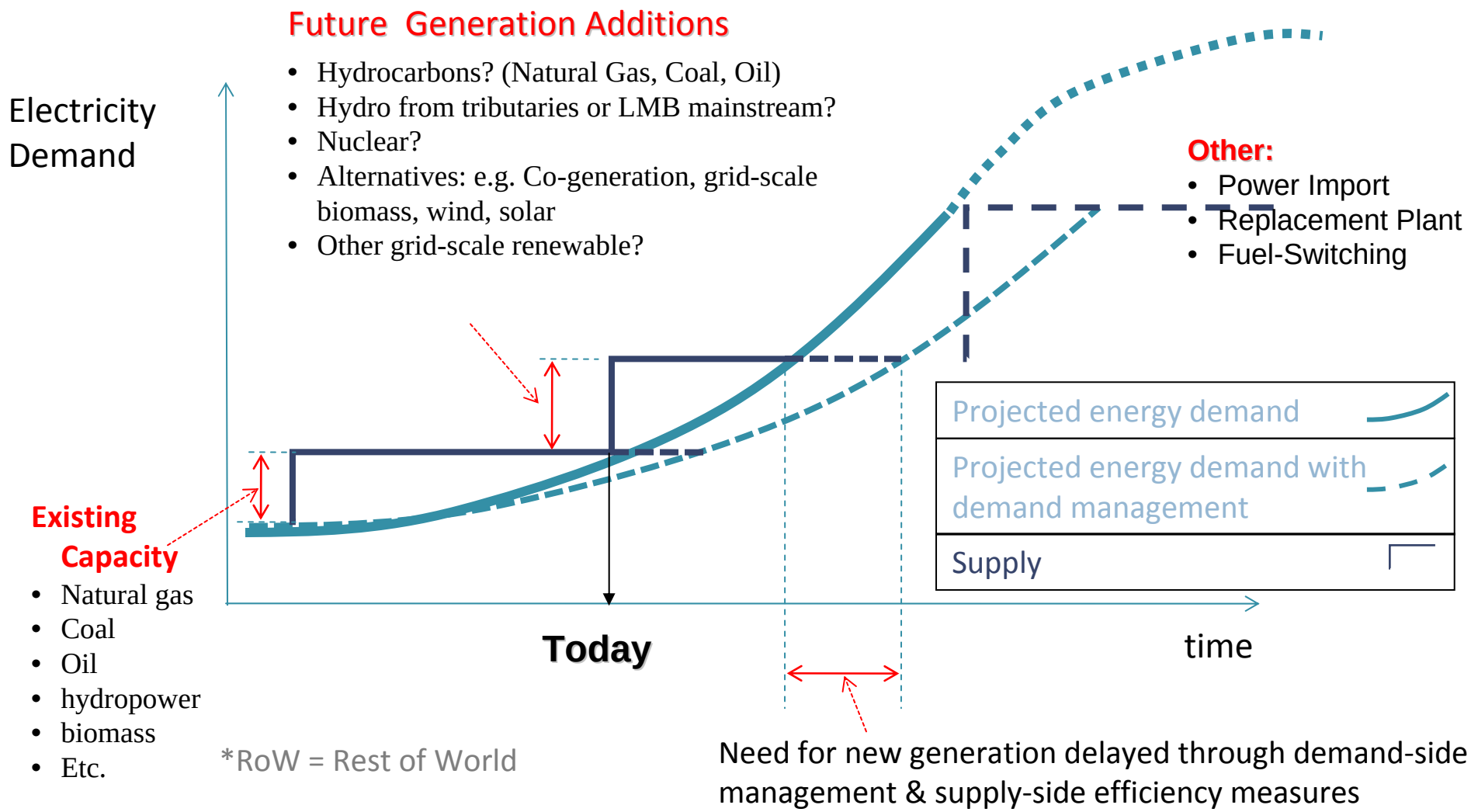
Source: United Nations Development Programme (UNDP). 2007. *Human Development Report 2007/2008 Fighting climate change: Human solidarity in a*

Balancing Demand and Supply Options - at all Scales - an aspiration in energy policies

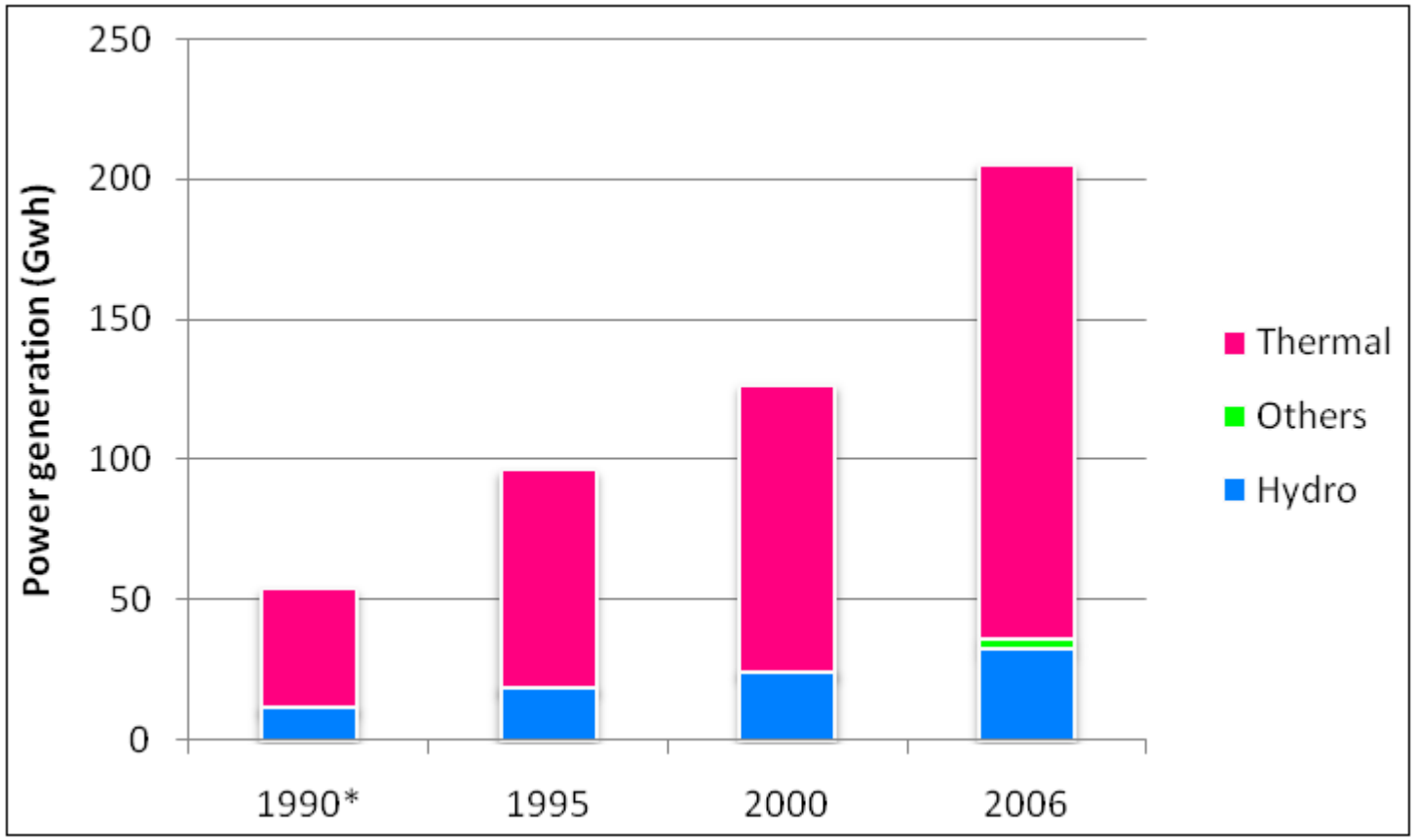


What this means?

For Grid Based Generation Expansion with Demand-Side Management



Power Generation Mix in LMB countries 1990-2006 – Thailand 22% Import + Rising- VN to start coal imports in 2-3 years



Cambodia – interest in LMB mainstream LMB hydropower

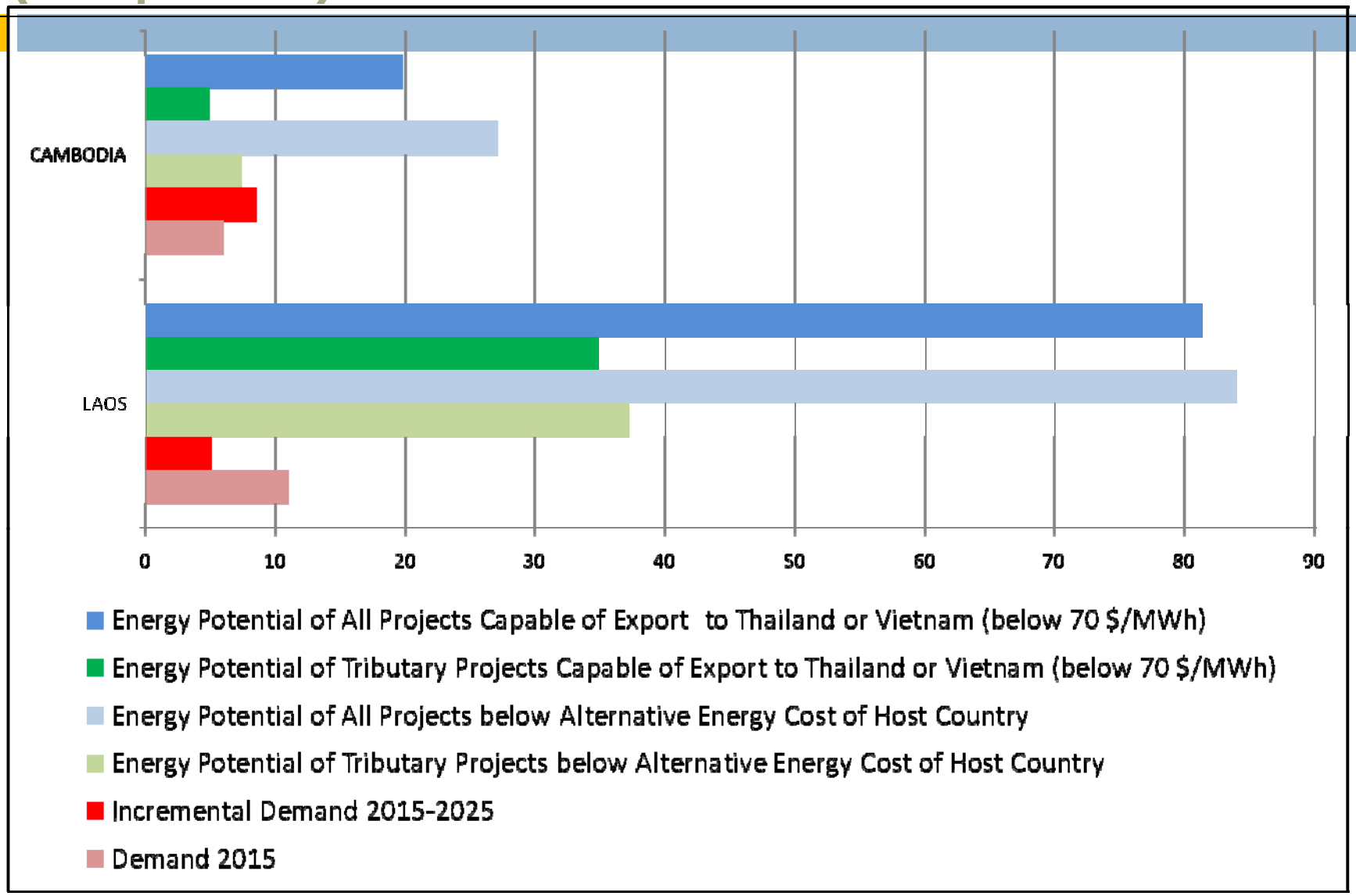
Main Factors – Opportunity for:

- Revenue from power export.
- Secure a portion of electricity generation from mainstream projects for domestic power needs – (significant relative to current demand and supply costs).
- Have a large renewable power source after concession term expires (to decide for export or use for domestic supply).

Lao PDR – interest in LMB mainstream LMB hydropower

- MoUs for power export (e.g.)
  - 7,000 MW with Thailand – potentially including MLMB
  - 5,000 MW with Vietnam – potentially including MLMB
- Revenue from power export.
- Portion of generation from projects for domestic power needs (FDI in other sectors e.g. mining).
- Power source after concession term expires (to decide for export or use for domestic supply).

CONTRASTING EXPORT POSITIONS OF LAOS AND CAMBODIA
(TWh per Year)



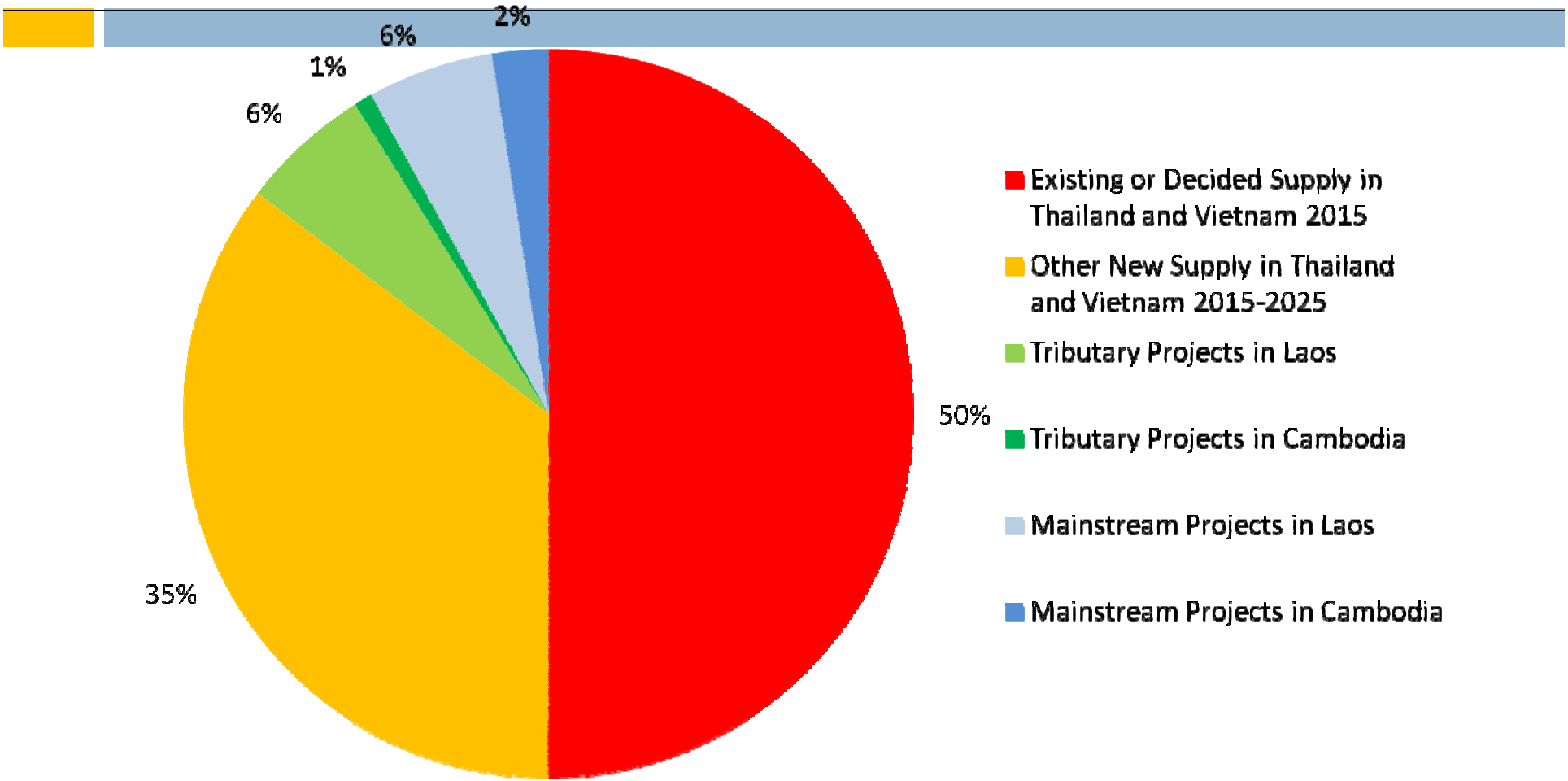
Thailand – interest in LMB mainstream LMB hydropower

- MoU with Lao PDR for 7,000 MW – may encompass LMB projects (hydropower and lignite coal in Lao)
  - Existing, Committed, Planned (5548 MW including Hongsa TPP)
- Interest in reliable lower cost power options.
- Mitigation of power supply risk through diversification of generation mix and fuel / import sources
- Thai interests as investors in LMB projects

Vietnam interest in mainstream LMB hydropower

- Part of Energy / Power Import Equation
  - Current import from China (700 MW)
  - MoU with Lao PDR 5,000 MW
  - MP VI: imports to reach 4,800 MW by 2020 representing 7% of peak
  - 800 MW from Lao committed to date
  - VN Projected to start importing coal for power generation from 2014-2015 (national reserves are poor quality)
- Vietnam interest as investors in LMB projects

IMPACT ON SUPPLY MATRIX OF IMPORTING COUNTRIES



ALTERNATIVE ENERGY COSTS

Thermal Generation Technology	Energy Cost of each Technology $/MWh	Percent Use of each Generation Technology			
		LAOS	THAILAND	CAMBODIA	VIETNAM
High or Medium Speed Diesel Units using Diesel Oil	352.3	30.0%		50.0%	
Low Speed Diesel Units Using Bunker Oil	160.0	20.0%			
Combined Cycle Units using Natural Gas	96.4		60.0%		
Steam Turbine Units using Coal	73.0	50.0%	40.0%	50.0%	100.0%
ALTERNATIVE ENERGY COST ($/MWh)		**174.2**	**87.1**	**212.6**	**73.0**

IMPACT ON END-USER TARIFF OF IMPORTING COUNTRIES

Contribution of Mainstream Dams to Total Energy Supply	8.0%
Energy Cost Saving Relative to Thermal Aternatives	37.0%
Saving at Generation Level	3.0%
Estimated Savings at End User Level	1.5%