

ENERGY AND POWER SUMMARY

(Avoidance, mitigation and enhancement considerations)

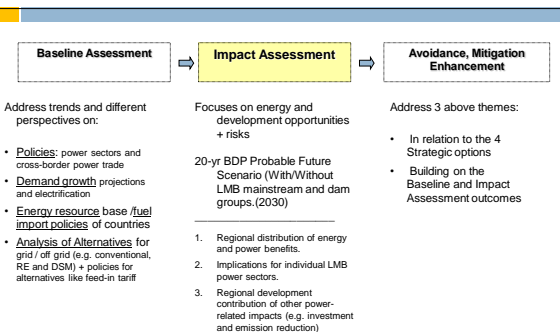
MRC SEA for Hydropower on the Mekong Mainstream

MRCs Initiative on Sustainable Hydropower

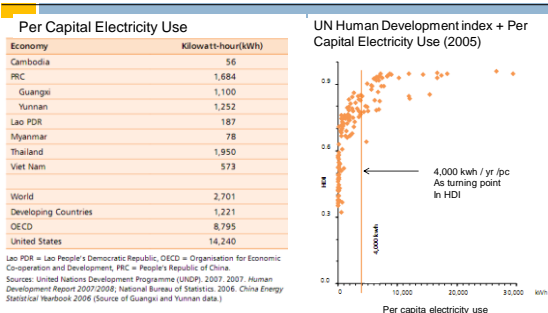
Presentation by Lawrence J.M. Haas
Based on Carlos Yermoli - SEA Team

What issues are addressed in each SEA stage ?

From an energy and power perspective



From SEA Baseline Assessment: Electricity use relative to other countries + UN Human Development Index



Source: Building Sustainable energy futures in the GMS, AI

With = Mkwatt-hour
Source: United Nations Development Programme (UNDP), 2007. Human Development Report 2007/2008. Bangkok: United Nations Development Programme, 2007.

From SEA Impact Assessment: 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)					PREDICTED POWER EXPORT (GWh/Year)					PROJECT INVESTMENT (\$USM)				
	CAM	LAO	THAI	VIET	TOTAL	CAM	LAO	THAI	VIET	TOTAL	CAM	LAO	THAI	VIET	TOTAL
SCENARIO ¹															
2030-20Yr-with MD	3,677	20,412	60,604	35,058	119,849	39,384	44,004	0	0	83,388	13,669	22,185	0	2,771	41,665
2030-20Yr-w/o MD	1,703	9,038	26,206	16,346	53,293	1,658	29,574	0	0	30,189	1,246	11,857	0	2,771	15,896
2030-20Yr MD in zone 2 only	1,703	12,267	50,558	21,240	85,767	1,658	27,814	0	0	29,494	1,248	22,031	0	2,771	26,079
2030-20Yr zone 3 only	1,703	10,209	30,423	14,588	56,923	2,028	30,788	0	0	32,496	1,246	18,482	0	2,771	24,481
2030-20Yr zone 4 only	3,677	9,441	32,125	30,154	75,400	39,384	30,542	0	0	69,927	13,669	12,447	0	2,771	28,886

LMB Regional Distribution	GROSS EXPORT OF SUPPLY (\$USM/Year)					GROSS EXPORT REVENUE (Estimated \$USM/Year)					NET OVERALL POWER BENEFIT (\$USM/Year)				
	CAM	LAO	THAI	VIET	TOTAL	CAM	LAO	THAI	VIET	TOTAL	CAM	LAO	THAI	VIET	TOTAL
SCENARIO															
2030-20Yr-with MD	782	3,555	5,284	2,555	14,176	1,250	4,626	0	0	5,926	722	1,272	892	834	2,699
2030-20Yr-w/o MD	382	1,526	3,243	1,933	6,455	100	2,313	0	0	2,514	293	2,394	881	428	4,625
2030-20Yr zone 2 only	382	2,140	4,401	1,550	8,453	100	4,215	0	0	4,319	273	3,516	689	682	5,191
2030-20Yr zone 3 only	382	2,223	2,648	1,193	7,322	100	2,425	0	0	3,609	272	3,516	436	628	4,894
2030-20Yr zone 4 only	782	3,641	2,792	2,201	7,424	1,250	2,258	0	0	3,609	722	2,446	450	786	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 assumed thermal loads in country where power is consumed

Focus in this Presentation

1. Strategic Options – fill in more detail regional distribution of power benefits + (AEM) considerations,
2. In mind of the 1995 Mekong Agreement, MRC BDP, MRC Preliminary Design Guidance, etc.
3. Understanding scale and significance of AEM considerations for power sectors, and
4. Focus on opportunity side of impact equation (development risk and opportunities)

From a Power Sector Development Perspective

Strategic Options & AM&E considerations

From the energy and power perspective

Overall Strategic Options	Energy & Power Avoidance Considerations	Energy & Power Mitigation Considerations	Energy & Power Enhancement Considerations
Decide not to proceed on mainstream	Focused on alternatives (for energy supply and potential export revenue foregone.	Alternatives	n.a
Defer decision on mainstream	Until key uncertainties are resolved / arrangements in place	Focused on understanding implications for project design, operation and costs.	Focused on understanding institutional arrangements, and power-related implications
Proceed with caution on a phase basis	By dam group / location & Project-specific avoidance (local and TB)	Implementation with reinforced national regulatory / safeguard systems, bilateral agreements emerging from negotiation, and transboundary cooperation	
Proceed with all projects	Project-specific avoidance (local and TB)	(e.g. as under 1995 Agreement and project specific PNPCA agreements)	

Alternatives question in Avoidance

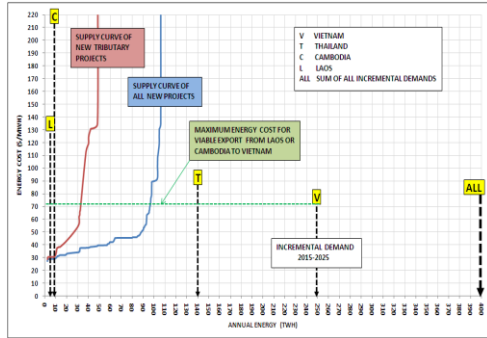
- **Strategic Options 1 & 2:** Two main considerations:
 - Alternatives for power supply to replace/defer LMB mainstream supply (65,000 GWh ~ 10 x Nam Theun 2's)
 - Alternatives to replace forgone export revenue (in economic terms \$US1.2 billion for Cambodia and \$US 4.6 billion for Lao PDR annually by 2030 – less debt repayment + other cost during concession period).
- **For All Strategic Options (1,2,3-4)**
 - More conventional alternatives to meet incremental demand (e.g. from coal imports for Thailand, Viet Nam and possibly Cambodia – Cambodia may also choose Lao hydro imports).
 - Accelerating alternatives for RE supply + DSM in all countries

Option 1: Regional stakes not proceeding with LMB mainstream schemes – Energy & Power only

- **Cambodia:**
 - Other imports for bulk supply
 - Increased cost of domestic supply (relative to alternatives for bulk supply)
 - Forgone export revenue
- **Thailand and Vietnam as Importers:**
 - Small increase in the cost of domestic supply
 - Less energy supply diversity
- **Lao PDR:**
 - Continue tributary hydropower for domestic bulk supply/export
 - Forgone mainstream export revenue
 - Forgone future power supply (after concession periods)
- **Regional power sector**
 - Forgone GHG emission 50 million tones Co2/yr by 2030
 - Other economic stimulus (distribution would change – e.g. less in Lao PDR)

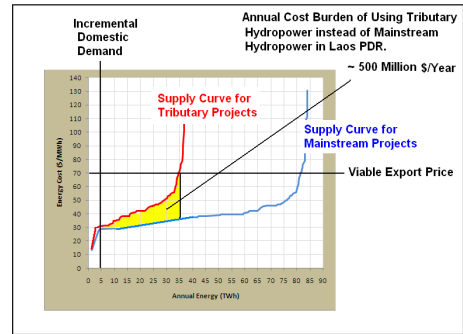
Quantum of energy from all mainstream dams (65 TWh/yr) is **24% of Vietnam and Thailand energy demand in 2010, 6% by 2030.** Vietnam and Thailand making up 96% of LMB power demand

Tributary Alternatives – Options 1&2 Hydropower Economic Supply Curves & LMB



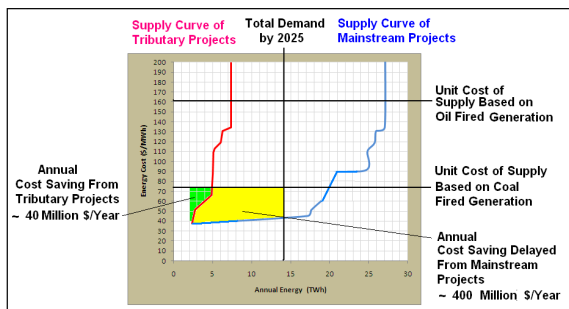
Implications for Lao PDR

– tributary versus mainstream alternatives (economic cost)



Implications for Cambodia

– tributary versus mainstream alternatives (economic cost)



RE Alternatives for grid connected supply

Renewable Energy (RE) all scales and co-generation (feed-in tariffs)

- Technologies: Biomass, Wind, Solar, Mini-Hydro, wave & tidal (etc)
- Analysis of trends, national programs and perspectives – see SEA Baseline
- Technology Specific Issues: cost, variability of supply, (demand response), resource base, competition for land / water, etc.

Demand Side Management

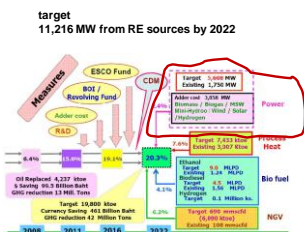
- Modalities: Peak Load Shifting, Improved end-use efficiency
- Issues: Trends and lead times. Role deferring rate of demand growth

Central conclusion of LMB Energy Policies

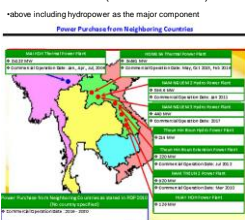
Renewable energy sources complementary not competing. All play a role to meet electricity access + supply challenges, environment (promote lower carbon energy systems) and maximize indigenous + regional energy resource use.

Example of Thailand – RE Promotion Trends Increasing & Import RE import considerations

Thailand Alternative Energy Development Strategies (2008-2022)



Thailand PDP (2010 Provisional)



Source: EPPQ, Ministry of Energy, 2010

Considerations for Strategic Option 2 – Deferring a decision

Relating to energy & power:

- **Comprehensive options assessment** – In regard to:
 - Clarification of national policies and strategies relating to potential mainstream dam alternatives for bulk supply
- Assessment of **what deferral means to power sectors in each country** and implications for investor/FDI investment in LMB power development
- **Confirmation of the operation of upstream Lancang-Mekong dams** impacting on LMB power generation / operation and level of other potential benefits and future cooperation – e.g. understanding opportunities for revenue generation and synergies with impact mitigation / enhancement in other sectors in dry season flows.
- Others considerations relating **institutional arrangements** for mitigation / enhancement strategies.

Mitigation and Enhancement Strategic Options 3 & 4

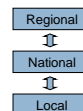
Consideration in the general approach relating to power sector

- **National Level:** Reinforcing capacity and scope of national regulatory / safeguard systems (env., social, safety of dams)
- **Bilateral Cooperation:** Reflect bilateral agreements emerging from negotiations.
- **Regional Level:** Enhancing aspects of transboundary cooperation related impacts of power generation on other sectors (e.g. as under 1995 Agreement and project-specific PNPCA transboundary agreements)

including LMB cooperation with China (e.g. scope to optimize operation considering non-power impacts & power production);

Reinforcing capacity for Mitigation and Enhancement – key strategic considerations

- **Safeguard philosophy – Transboundary orientation**
 - MRC as a mechanism (supporting national systems)
 - E.g. expanding Preliminary Design Guidance for mainstream schemes
- **Introducing benefit sharing arrangements**
 - Between States (part of 1995 Agreement – BDP)
 - Additionally - Regional > National > Local
 - Part of tariff mechanism (consumers as user pay principle)
- **Reinforcing Institutional Arrangements/Capacities**
 - To cooperation in the management of the transboundary risks specific to the LMB mainstream projects
 - Ensuring clarity in assignment of responsibilities / accountability
 - Ensuring participation in impact monitoring, assessment and collective responses to unforeseen impacts + seize development opportunities



Other considerations for Mitigation / Enhancement And improved safeguards

PLANNING AND INSTITUTIONAL CONSIDERATIONS

- ENHANCED REGIONAL POWER PLANNING LINKAGE TO BDP PROCESS
- INSTITUTIONAL MECHANISMS
 - COORDINATION OF OPERATION
 - BENEFIT SHARING (REGIONAL > NATIONAL AND IN NATIONAL SYSTEMS (NATIONAL-> LOCAL
 - COOPERATIVE MONITORING > COMPLIANCE + ADAPTIVE MANAGEMENT

REGULATORY CONSIDERATIONS

- LICENSING (TEMPORARY, CONSUCTION AND OPERATING LICENSES)
- OPERATIONAL OVERSIGHT EMERGENCY MANAGEMENT
- FLEXIBILITY IN CONCESSION AGREEMENTS AND PPAS FOR ADAPTIVE MANAGEMENT

OPERATIONAL CONSIDERATIONS (PARTICULARLY FOR CASCADES)

- OPERATING RULES
- BACKWATER EFFECTS
- UNIFIED FLOW MANAGEMENT
- EMERGENCY PROCEDURES

Other considerations for Mitigation / Enhancement

LINK WITH MRC & OTHERS DEVELOPING STANDARDS

- WITH A TRNSBOUNDARY ORIENTATION
- TOLERABLE IMPACT LEVELS
- IMPACT LEVEL DETERMINATION PROCEDURES

EXPLICIT MECHANISMS TO TRANSFER BEST PRACTICE

- USING FIRST PROJECT AS A MODEL
- DRAWING FROM REGIONAL / INTERNATIONAL EXPERIENCE
- REFLECTING IN FUTURE PROJECTS

INNOVATIVE FINANCING CONSIDERATIONS

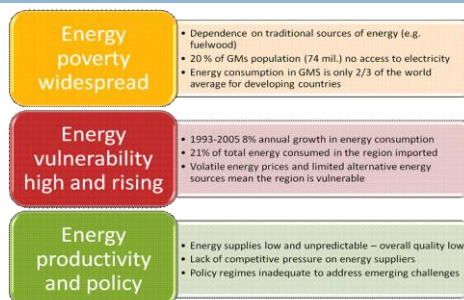
- BEYOND BENEFIT SHARING MECHANISMS
- CONSTRUCTION LICENSE AGAINST BONDS TO COVER MITIGATION COSTS
- ISSUE OPERATING LICENSES AGAINST ESCROW FUNDS FOR COMPENSATION

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)



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

Projected Peak and Energy Demand ADB RETA 6440 - 2010

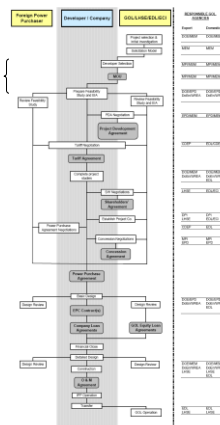
		2010	2015	2020	2025
Cambodia	Peak Demand (MW)	467	1,008	1,610	2,401
	Annual Growth		16.6%	9.9%	9.3%
	Estimated Load Factor	65%	66%	67%	69%
	Energy Demand (GWh)	2,659	5,828	9,449	14,302
Laos	Peak Demand (MW)	618	1,911	2,665	2,696
	Annual Growth		25.3%	6.9%	0.2%
	Estimated Load Factor	65%	66%	67%	68%
	Energy Demand (GWh)	3,519	11,049	15,641	16,060
Thailand	Peak Demand (MW)	23,936	31,734	42,024	53,824
	Annual Growth		5.8%	5.3%	5.1%
	Estimated Load Factor	72%	72%	72%	72%
	Energy Demand (GWh)	150,969	200,153	265,054	339,479
Vietnam	Peak Demand (MW)	19,544	32,210	48,662	71,445
	Annual Growth		10.5%	8.6%	8.0%
	Estimated Load Factor	72%	72%	72%	72%
	Energy Demand (GWh)	123,268	203,155	306,921	450,618
All Countries	Peak Demand (MW)	44,565	66,863	94,961	130,366
	Annual Growth		8.5%	7.3%	6.5%
	Estimated Load Factor	72%	72%	72%	72%
	Energy Demand (GWh)	280,415	420,184	597,066	820,458

Status of Projects in National Regulatory Systems

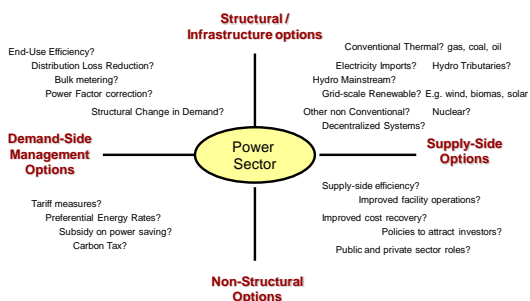
Illustration of Lao PDR

Most mainstream proposals are here in the regulatory system

- MOUs / LOAs
- feasibility study and EIAs /SIAs
- For tributary &
- Mainstream dams



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



Optimum Mainstream Development Idealized IRP case

Ideally in IRP Power Planning projects should be developed:

- in order of increasing energy cost and to serve loads with highest marginal cost of supply.
- For projects targeting more than one power system this implies an established regional pricing system.

Planning mainstream development to maximize power sector value presumes full control of the dispatch of every resource into a system of specific load characteristics and generation mix. This is difficult for projects expected to serve different systems.

CAVEATS AND SAFEGUARDS

CAVEATS

- Market oriented development may conflict with optimum resource use or power system economic criteria (hence BDP)
- Even in the most successful market based generation systems. Partly due to the long times required for new generation to react to market signals.

SAFEGUARDS - power related

- Open transmission access & cost of service based transmission tariffs are critical so national consumers / other sectors do not subsidize exports.
- Cross-border PPAs require host country commitment under conditions of domestic deficits.

PLANNED DEVELOPMENT CONCEPT Power Planning Perspective

- LOWEST INDIVIDUAL IMPACT (REGIONAL)
- LOWEST OVERALL IMPACT (REGIONAL)
- HIGHEST NET ECONOMIC VALUE (REGIONAL)
- LOWEST UNIT ENERGY COST (NATIONAL)
- COMBINED CRITERIA

LMB Schemes: relative ranking

	Current Budget MS	DC MS	Cost at Start MS	Annual Capital Cost MS	Annual O&M Cost MS	Total Annual Cost MS	Mean Annual Energy GWh	Energy Cost \$/MWh	Energy Rank	Annual Power Supply						Net Annual Economic Benefits			Net Unit Benefit \$/MWh	Net Unit Benefit Rank		
										LA	TH	CA	VI	LA	TH	CA	VI	Total			Rank	
Don Sahong	491	981	589	59	4.9	84.3	2,375	27.1	1	454	1,671	0	0	152	26	0	0	176	1	74.6	1	
Pak Beng	1,516	330	1,649	166	13.2	179.5	5,268	34.1	5	527	4,741	0	0	260	82	0	0	325	6	61.7	6	
Luang Prabang	1,555	389	1,944	196	15.6	211.6	5,437	36.9	7	348	0	0	0	4,884	167	0	0	34	240	8	44.2	10
Stoyokly	1,288	321	1,607	162	12.9	175.0	5,025	29.9	3	654	5,432	0	0	322	71	0	0	423	4	68.6	4	
Pakay	1,542	335	1,875	189	13.4	182.3	5,421	33.6	4	542	4,879	0	0	273	84	0	0	357	5	62.1	5	
Senakham	1,174	294	1,468	148	11.7	159.8	5,015	31.9	3	502	4,514	0	0	262	59	0	0	321	7	63.6	3	
Bangphon-Pakchom	1,485	366	1,832	185	14.7	199.4	5,318	37.5	6	502	4,786	0	0	247	82	0	0	319	8	58.5	8	
San Kum	2,458	614	3,072	310	24.6	334.2	8,424	58.6	8	4,277	4,217	0	0	712	95	0	0	719	11	91.0	2	
Lutrua	1,187	295	1,479	149	11.8	160.6	5,244	45.6	10	5,244	0	0	0	420	91	0	0	420	9	128.5	7	
Sumbor	4,181	2,091	6,272	633	41.8	674.4	14,870	45.4	9	0	2,874	1,487	10	408	0	36	508	114	660	2	44.4	9
Shung Treng	2,649	1,160	4,129	416	29.5	446.0	4,870	61.6	11	0	674	487	3,408	0	13	59	37	-8	11	-1.8	11	

Note:

- Social and Environmental Mitigation cost incorporated above are only those in developer prepared IEE / EIAS
- As project configuration is not decided for the Thakho project it is not included in this illustration