Kingdom of Cambodia

Ministry of Industry, Mines and Energy

MRC SEA HYDROPOWER ON THE MEKONG MAINSTREAM

MRC SEA CAMBODIA NATIONAL SCOPING WORKSHOP

NATIONAL POWER and HYDROPOWER DEVELOPMENT PLANS IN CAMBODIA

on 16-17 July 2009, Phnom Penh, Cambodia

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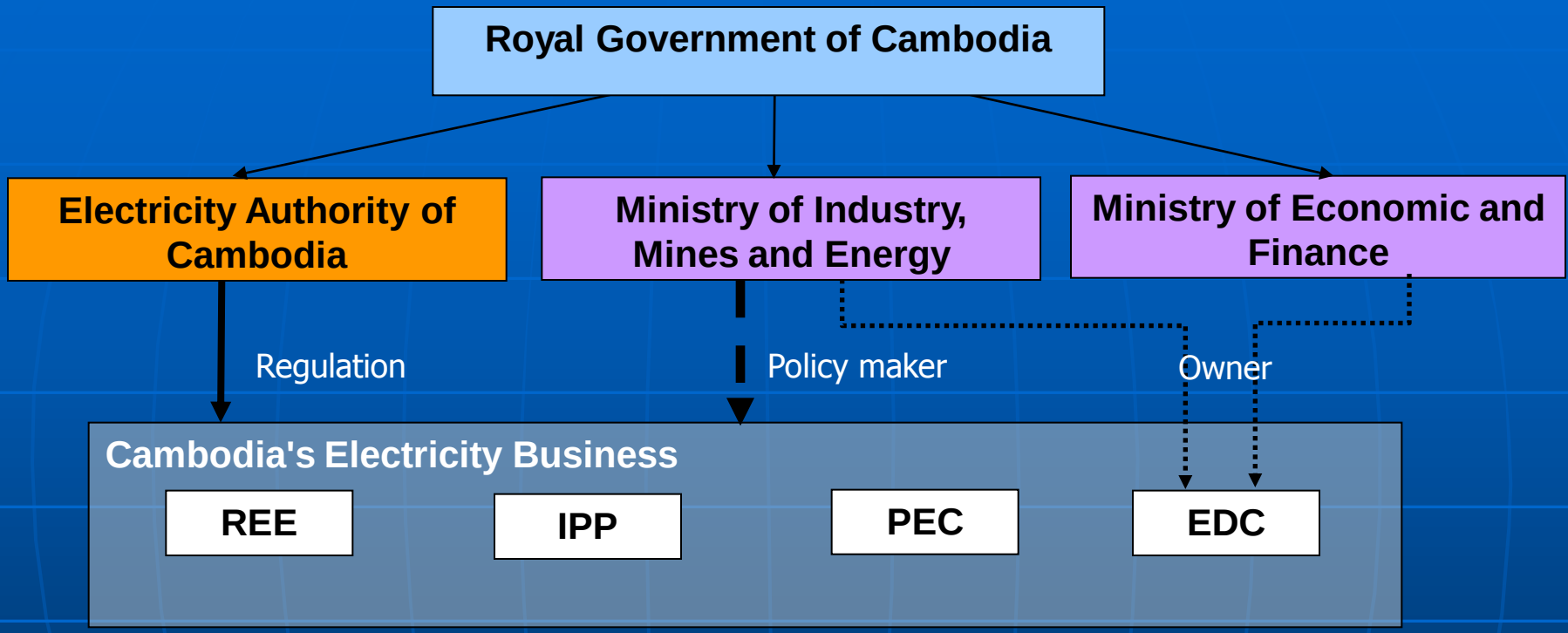
Hydro-Electricity Department

General Department of Energy

Overview of Power Sector

- **Total Capacity output (EDC, IPP & REE) in 2007 : 314 MW and 1349 GWh**
- **Projection in 2024 : 3045 MW and 16244 GWh**
- **At present, only 20 % of households has access to electricity**
- **Annual energy consumption per capita: 103 kWh**
- **22 small isolated power system**
- **High potential of hydro source : more than 10,000 MW (50% in the Mekong River mainstream, 40% in the tributaries of Mekong River and 10% in the South-western coastal area outside the Mekong Basin).**

Current Structure of Electricity Sector



- Ownership of EDC
- Policy; Planning; Development; Technical standard
- Tariff, license, finances and performance; Enforce the regulations, rules and standards

Energy Policy

-To provide an adequate supply of energy throughout Cambodia at reasonable and affordable price,

-To ensure a reliable and secured electricity supply at reasonable prices, which facilitates the investments in Cambodia and developments of the national economy,

-To encourage exploration and environmentally and socially acceptable development of energy resources needed for supply to all sectors of Cambodia economy,

-To encourage the efficient use of energy and to minimize the detrimental environmental effects resulted from energy supply and consumption.

Cambodia Power Sector Strategy

Cambodia Power Strategy Components:

A- Development of Generation

B- Development of Transmission

C- Power trade with neighboring countries

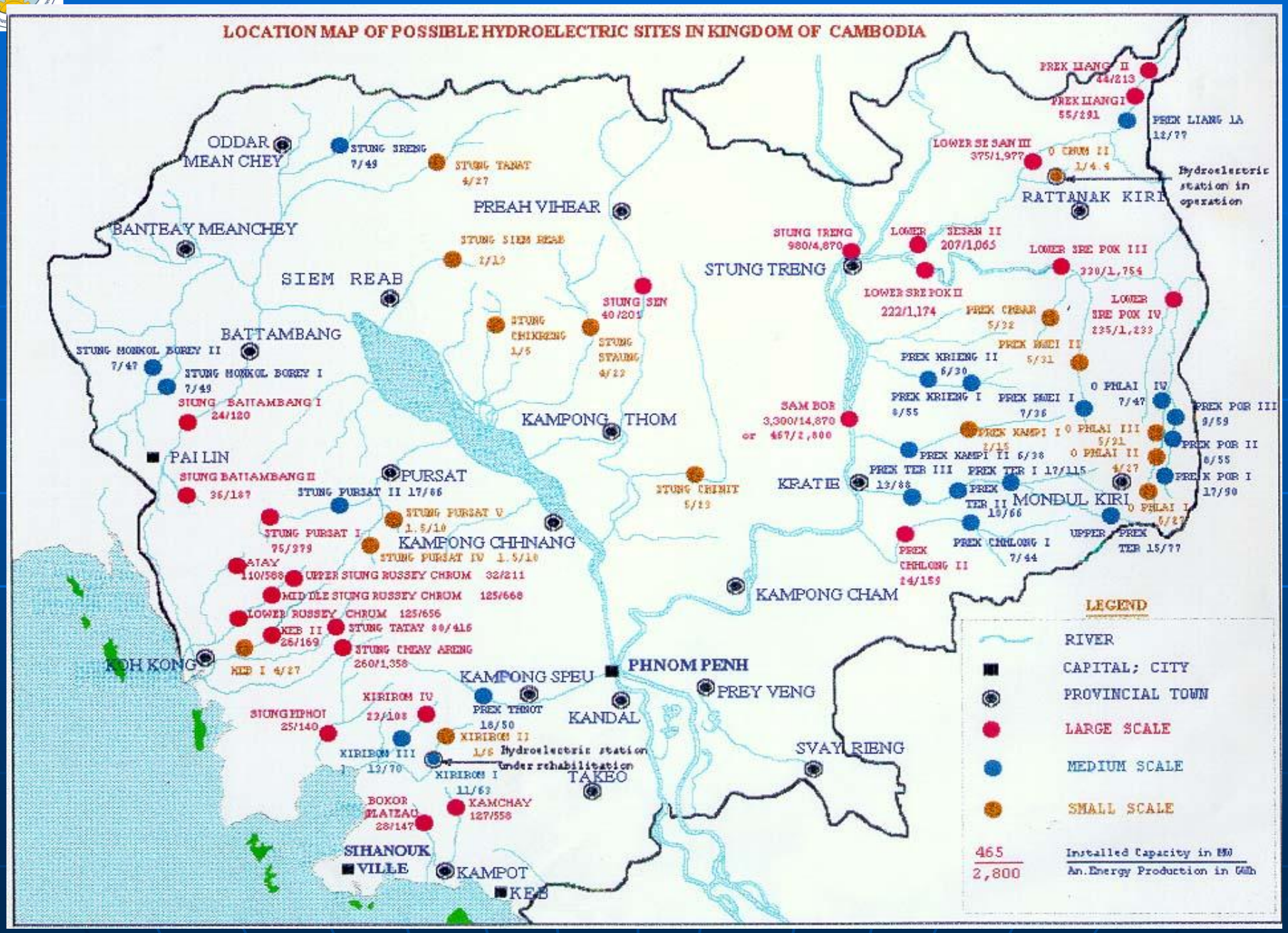
A- Development of Generation

- 193 MW Kamchay Hydro-project BOT by Sinohydro from China (2011)
- 200 MW Coal Power Plant, BOO project by Power Synergy Corporation in SHV (2011)
- 120 MW Atay Hydropower Plant, BOT by CYC from China (2012)
- 338 MW Lower Russei Chhrum Hydro Power Plant, BOT by Michelle Corporation from China (2013)

- 246 MW Tatay Hydro power plant (2015)
- 400 MW Lower Sesan II & Lower Srepok II Hydro power plant (2016) by EVN
- 108 MW Stung Chay Areng Hydro power plant (2017) by China Southern Grid (CSG)
- 2600 MW Sambor Hydro power plant (2019) by China Southern Grid (CSG)

No.	Generation Expansion Plan	Fuel	Power (MW)	Year Operation
1	Kirirom III Hydro power Plant	Hydro	18	2010
2	Kamchay Hydro Power Plant	Hydro	193	2011
3	200 MW Coal Power Plant (I) in Sihanouk Ville - Phase 1	Coal	100	2011
4	Atay Hydro Power Plant	Hydro	120	2012
5	200 MW Coal Power Plant (I) in Sihanouk Ville - Phase 2	Coal	100	2012
6	700 MW Coal Power Plant (II) -Phase 1	Coal	100	2013
7	Lower Stung Rusey Chhrum Hydro Power Plant	Hydro	338	2013
8	700 MW Coal Power Plant (II) -Phase 2	Coal	100	2014
9	Tatay Hydro Power Plant	Hydro	246	2015
10	700 MW Coal Power Plant (II) -Phase 3	Coal	100	2015
11	700 MW Coal Power Plant (II) -Phase 4	Coal	100	2016
12	Lower Sesan II + Lower Srepok II	Hydro	400	2016
13	Stung Chay Areng Hydro Power Plant	Hydro	108	2017
14	700 MW Coal Power Plant (II) -Phase 5	Coal	100	2017
15	Add 700 MW Coal Power Plant at Offshore	Coal	200	2018
16	Sambor Hydro Power Plant	Hydro	2600	2019
17	Coal Power Plant (III) or Gas Power Plant	Coal/Natural Gas	400	2020
Total			**5,323**	

Hydro Site


LOCATION MAP OF POSSIBLE HYDROELECTRIC SITES IN KINGDOM OF CAMBODIA
ODDAR MEAN CHEY
STUNG SRENG 7/49
STUNG TANAT 4/27
PREAH VIHEAR
BANTEAY MEANCHEY
STUNG SIEM REAB 1/12
SIEM REAB
STUNG SEN 40/201
STUNG CHIKRENG 1/5
STUNG STAUNG 4/22
BATTAMBANG
STUNG MONKOL BOREY II 7/47
STUNG MONKOL BOREY I 7/49
STUNG BATTAMBANG I 24/120
PAI LIN
STUNG BATTAMBANG II 36/187
PURSAT
STUNG PURSAT II 17/86
STUNG PURSAT V 1.5/10
STUNG PURSAT I 75/279
KAMPONG CHHNANG
STUNG PURSAT IV 1.5/10
ATAY 110/568
UPPER STUNG RUSSEY CHROM 32/211
MIDDLE STUNG RUSSEY CHROM 125/668
LOWER RUSSEY CHROM 125/656
KEB II 26/169
STUNG TATAY 80/416
STUNG CHEAY AREING 260/1,358
KEB I 4/27
KOH KONG
KAMPONG SPEU
PHNOM PENH
PREY VENG
KIRIROM IV 22/108
PREK THNOT 18/50
KIRIROM II 1/6
KIRIROM III 12/70
KIRIROM I 11/63
Hydroelectric station under rehabilitation
STUNG HPHOT 25/140
KANDAL
SVAY RIENG
TAKEO
BOKOR PLATEAU 28/147
KAMCHAY 127/558
SIHANOUK VILLE
KAMPOT
KEB
KAMPONG THOM
STUNG CHINIT 5/13
KRATIE
SAM BOR 3,300/14,870 or 467/2,800
KAMPONG CHAM
PREK LIANG II 14/213
PREK LIANG I 55/291
PREK LIANG IA 12/77
LOWER SE SAN III 375/1,977
O CHUM II 1/4.4
RATTANAK KIRI
Hydroelectric station in operation
STUNG TRENG 980/4,870
LOWER SESAN II 207/1,065
LOWER SRE POK III 220/1,754
STUNG TRENG
LOWER SRE POK II 222/1,174
PREK CHBAR 5/32
LOWER SRE POK IV 235/1,232
PREK KRIENG II 6/30
PREK KRIENG I 8/55
PREK KAMPI I 2/15
PREK KAMPI II 6/38
PREK TER III 13/88
PREK TER I 17/115
PREK TER II 18/66
PREK CHHLONG I 7/44
PREK CHHLONG II 24/159
PREK MEI II 5/31
PREK MEI I 7/36
O PHLAI IV 7/47
O PHLAI III 5/21
O PHLAI II 4/27
O PHLAI I 5/27
MONDUL KIRI
UPPER PREK TER 15/77
PREK POR III 9/59
PREK POR II 6/55
PREK POR I 17/90
LEGEND
RIVER
CAPITAL; CITY
PROVINCIAL TOWN
LARGE SCALE
MEDIUM SCALE
SMALL SCALE
465
2,800
Installed Capacity in MW
An. Energy Production in GWh

29 of Hydropower Projects in Master Plan Study

No	Project	Capacity (MW)
1	Sambor	3300
2	Prek Chhlok II	24
3	Prek Ter III	13
4	Prek Ter II	10
5	Sre Pok IV	235
6	Sre Pok I	17
7	Lower Sre Pok II	222
8	Lower Se San II	207
9	Stung Treng	980
10	Se Kong	New
11	Lower Se San II	375
12	Prek Liang I	55
13	Prek Liang IA	12
14	Prek Liang II	44
15	Lower Se Sre Pok III	330
16	Middle St. Russey Chrum	125
17	Stung Chhay Areng	260
18	Stung Tatay	80
19	Stung Metoek I	175
20	Stung Metoek II	210
21	Stung Metoek III	50
22	Stung Kep II	26
23	Upper St. Russey Chrum	32
24	Stung Pursat I	75
25	Stung Pursat II	17
26	Stung Sen	40
27	Stung Battambang II	36
28	Stung Battambang I	24
29	Bokor Plateau	24

Generation shortage and hydropower development

Issues

- Price hike and shortage of imported fuel oil (energy security)
- Hydropower is national resources that can be exported to neighboring countries
- No experience in MIME ➔ To mobilize money, experts and technology of private sector
- Lowering of high electricity tariff and improvement of low electrification level

Strategies

- Hydropower as the main energy source of National Grid
- To export clean energy to Vietnam and Thailand
- To promote and encourage power trade for power export business
- Domestic power supply and transmission by RGC initiative

List of Hydropower Projects granted to Private Sector's Participation

No.	Project's Name	Inst. Capacity/ Ann. Energy (MW)/(GWh)	Project's Cost in Mio. US$ (Estimated)	Remark
1	Kirirom III	18/73	47.1	**Under constr. by CETIC**
2	Kamchay	193.2/498	280	**Under constr. by Sinohydro**
3	Battambang II	36/187	65	**PF/S by KTC, (Korea)**
4	Battambang I	24/120	49	
5	Stung Atay	120/465	179	**Start Construction (CYC)**
6	LowerSt.Russei Chhrum	235/805	290	**CYC,MOU Devlt.sign 7Apr2007**
7	Midl.St.Russei Chhrum	125/668	275	**PF/S,KTC(Korea), (Permission)**
8	UpperSt. Russei Chhrum	32/221	65	
9	Stung Chay Areng	300/1,475	732	**PF/S&F/S,CSG (MOU)**
10	Stung Tatay	80/250	215	**PF/S&F/S,CHMC (MOU)**
11	Sambor	2600	4,947.85	**PF/S&F/S, CSG (MOU)**

List of Hydropower Projects granted to Private Sector's Participation (Con.)

No.	Project's Name	Inst. Capacity/ Ann. Energy (MW)/(GWh)	Remark
12	Lower Se San II	400/1,954	PF/S & F/S by EVNI; (MOU)
13	Lower Se San I	96/485	
14	Lower Sre Pok III	330/1,754	PF/S & F/S by GGEP (China) (MOU)
15	Lower Sre Pok IV	235/1,233	
16	Prek Liang I	64/258	PF/S by KTC Cable, (Korea) (Permission Letter)
17	Prek Liang II	64/260	
18	Lower Se San III	180/953	
19	Stung Treng	980/4,870	PF/S & F/S by Bureyagesstroy (Russia) (MOU)
20	Stung Pursat I	75/379	PF/S & F/S by CGGDC (China) (MOU)
21	Stung Pursat II	17/86	PF/S & F/S by CGGDC (China) (PL)
22	Stung Sen	40/201	F/S by KENERTEC Resource (Korea) (PL)
23	Prek Chhlong II	24/159	PF/S & F/S by Camdara Engineering (MOU)

B- Development of Transmission

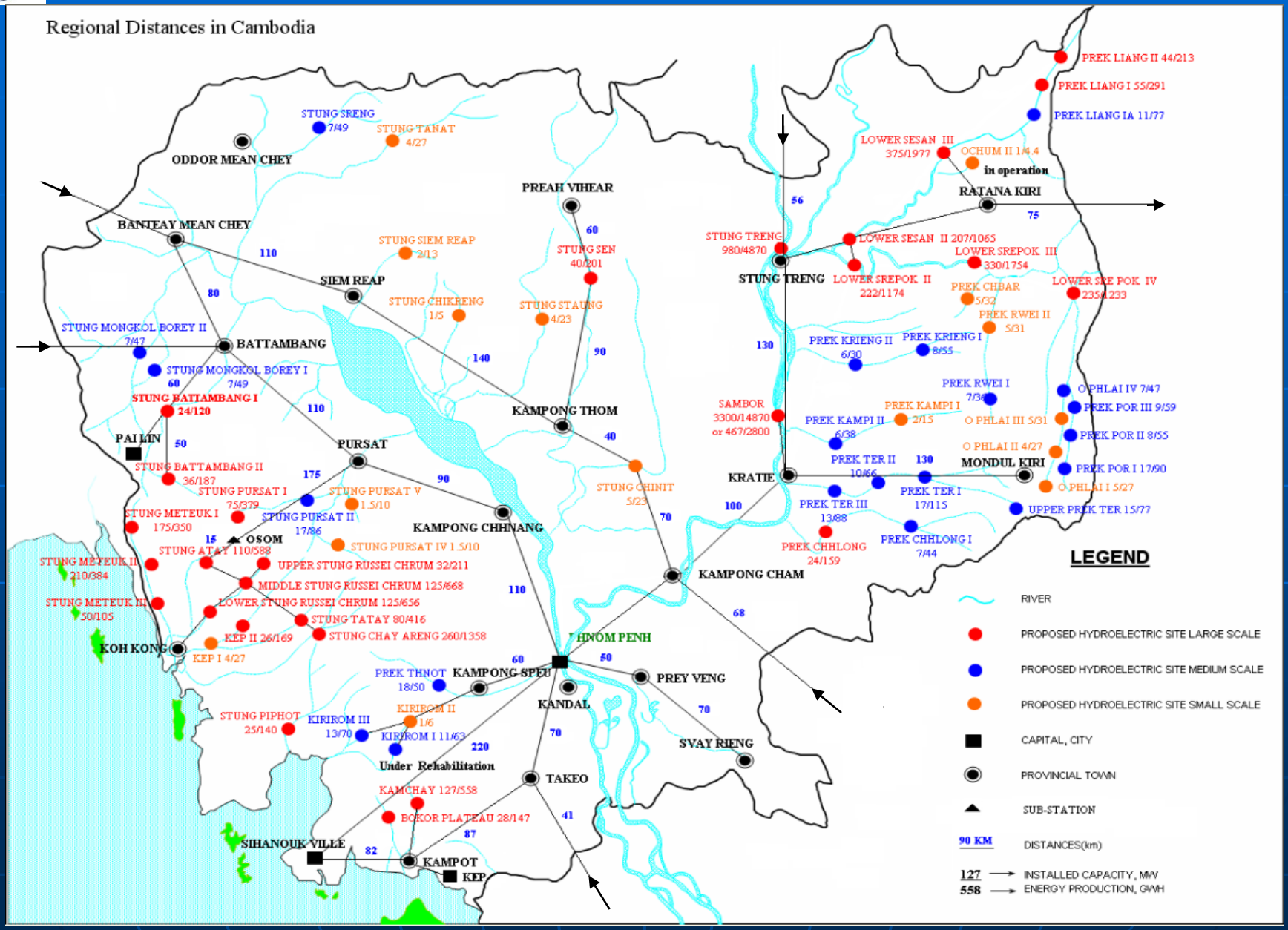
- 115 kV, Kirirom 1 – Phnom Penh (2001)
- 115 kV BOT(private investment of US$32 million) interconnecting with Thailand to supply Banteay Meanchey, Siem Reap and Battambang (late 2007)
- 220 kV Phnom Penh - Viet Nam via Takeo ,ADB+NDF (2009)
- 110 kV Vietnam (Tai Ninh) - Kampong Cham, WB (2010)
- 115 kV Lao (Ban Hat) - Stung Treng, WB (2010)
- 230 kV Takeo – Kampot, KFW (2010)

- 230 kV, Kampot – Sihanoukville , ADB+JBIC (2011)
- 230 kV, Phnom Penh - Kampong Cham, BOT (2012)
- 230 kV, Phnom Penh - Battambang via Kompong Chhnang-Pursat, BOT(2012)
- 230 kV, Kratie - Stung Treng, India (2012)
- 230 kV, Phnom Penh – Sihanoukville, Road N.4, BOT (2013)
- 115 kV, Phnom Penh –Svay Rieng Via Neakleung, BOT (2014)
- 230 kV, Kampong Cham - Kratie , CUPL, BOT (2016)
- 230 kV, Stung Chay Areng – Osom, BOT (2017)
- 230 kV, Kampong Cham – Kampong Thom – Seim Reap, BOT (2019)

	Existing Transmission and Expansion Plan	Year Operation	T/L (km)
1	115 kV, Kirirom I - Phom Penh (CETIC)	2001	120
2	115 kV, Thailand - Bantey Meanchey - Siem Reap - Battambong	2007	203
3	220 kV, Phnom Penh - Takeo - Viet Nam, (construct the substation in Takeo), (ADB + NFD)	2009	110
4	115 kV, Reinforcement of transmission line and construct substation at **WPP** (West-Phnom Penh), (WB)	2009	30
5	230 kV, Takeo - Kompot, (construct substation in Kompot), (KFW)	2010	87
6	115 kV, Steung Treng - Loa PDR, (construct substation in Steung Treng), (WB)	2010	56
7	110 kV, Kampong Cham - Viet Nam, (construct 3 substations: - Kampong Cham, - Soung, - Pongnearkreak), (WB)	2010	68
8	230 kV, Kampot - Sihanouk Ville, (construct 2 substations: - Vealrinh - Sihanouk Ville), (ADB + JBIC)	2011	82
9	230 kV, Phnom Penh - Kompong Chhnang - Pursat - Battambong, (construct 3 substations: - Kompong Chhnang, - Pursat, - Battambong), (CYC)	2012	310
10	230 kV, Pursat - Osom, (construct 1 substation in Osom Commune), (CYC)	2012	175
11	230 kV, Kampong Cham - Kratie	2012	110

	Existing Transmission and Expansion Plan (Con.)	Year Operation	T/L (km)
12	230 kV, Kratie - Stung Treng, (India)	2012	126
13	230 kV, Phnom Penh - Kampong Cham, (CUPL)	2012	100
14	230 kV, Phnom Penh - Sihanouk Ville (along national road 4), (CHMC)	2013	220
15	115 kV, East Phnom Penh - Neakleung - Svay Rieng, (construct 2 substations: - Neakleung, - Svay Rieng), (CHMC)	2014	120
16	230 kV, Stung Tatay hydro - Osom substation, (CHMC)	2015	15
17	115 kV, WPP - EPP, (construct substation GS4 at SPP)	2015	20
18	230 kV, Kratie - Kampong Cham, (CUPL)	2016	100
19	230 kV, Reinforcement of transmission line on the existing pole, Phnom Penh – Kampong Cham (transmit power from Lower Sesan II + Lower Srepok II)	2017	100
20	230 kV, Stung Chay Areng - Osom substation (CSG)	2017	60
21	230 kV, Kampong Cham - Kampong Thom - Siem Reap, (construct 1 substation in Kampong Thom), (KTC)	2019	250
Total Transmission Line			**2,227**

Transmission Site



C- Development of Power Trade

- Import from Thailand at 115 kV starting 2007 to serve northern grid up to 80 MW
- Import from Vietnam at High voltage 220 kV 220 MW by 2009 to serve southern grid and Phnom Penh
- Import from Vietnam to Kompong Cham Province at high voltage 110 kV with capacity 20 MW by 2010
- Import from Lao to Stung Treng Province at 115 kV with capacity until 20 MW by 2010
- 5 Cross border MV links from Vietnam and 8 from Thailand at 22 kV to serve Cambodian communities close to the border.

No.	Existing Power Import and Planning	Fuel	Power (MW)	Year Operation
1	Import Thailand - Banteaymeanchey - Siem Reap - Battambong	Import	20	2008
2	Import Viet Nam - Phnom Penh	Import	220	2009
3	Import Lao PDR - Stung Treng	Import	20	2010
4	Import Viet Nam - Pongnearkreak - Soung - Kampong Cham	Import	20	2010
	Total		**260**	

Total Power: (Power Generation) + (Power Import)

: 5,323 + 260 = 5,583 MW (2020)

Issue of Power Supply System in Cambodia

- Lack of power supply
- High electricity tariff
- Low dependability of power supply etc., cause by inadequate system of power supply
- About 90% of total installed capacity of 314 MW in 2007 was supply by diesel power generation using imported fuel. Electrification level in Cambodia is one of the lowest in Southeast Asian countries.
- To cope with the above mentioned status, RGC formulated Cambodia Power Sector Strategy 1999-2016 in 1999 for empowerment of institutional and organizational part of power sector through:

Issue of Power Supply System in Cambodia (Con't)

- Promoting the development of indigenous resources
- Reduce the dependence of the imported fuel

- From this viewpoint of energy security and efficient use of energy resources, RGC employs the promotion of hydropower development as a power sector policy.
- However, only two small hydropower stations operating so far. (Kirrirom 12MW and Modulkiry 1MW)

Conclusion and Recommendation

- Cambodia needs to use its hydropower potential to meet future electricity demand and reduce its dependence on imported fuel and for the power trade with neighboring countries. This hydropower potential has more certainty of development compared to other energy resources like petroleum and gas whose development is at the exploration stage.
- There is optimism in the future of Cambodia's hydropower potential could contribute to the energy supply and strengthen the Nation's energy security.
- Most of hydropower projects are in planning stage and their study levels are very preliminary. Hence the collected information should be updated during each stages of development of these projects

Thank you for your attention

Angkor Templ in Seam Reap Province