



Sustainable Rural Electrification Plans and practical investment case studies

Planning scenarios and criteria Phnom Penh 4-5 March 2010









GEOSIM planning process





Key points for scenario discussion

- First discussion to be continued during meetings with counterparts
- Propose to continue the method which was discussed and agreed during the pilot phase for Kampong Cham Province
- Points
 - Criteria for selection of development poles
 - Load forecast: « poor » category was the population under the poverty line
 - Definition of the « unelectrified areas »: small REE area are considered unelectrified
 - Targets and constraints for the scenarios



Spatial analysis - Selection of DPs

It takes into account 3 main components



- The IPD score is calculated thanks to a <u>multisector database</u> and an <u>analytical</u> <u>evaluation grid</u>
 - Criteria with weights
 - Indicators with values
 - Suggest to keep those discussed in the pilot phase



Spatial analysis - Evaluation grid 1/3

Element	Criteria	weight	indicators	value	
	Best hospital		Health Post (Non building)	0.1	
			Health Center (Non Building) & Health Post	0.3	
lth		2/3	Former District Hospital & Health Center	0.5	Þ
ea			Referral Hospital	0.8	
Ĭ			National Hospital	1	
		1/3	Piped water (>50 hh)	1	
	Quality of access to water (best available in the village)		Piped water (<50 hh)	0.7	
			Well	0.6	D
			Other	0.2	
			None	0	

IPD health = 2/3*0.5 + 1/3*0.6 = 0.53



Spatial analysis - Evaluation grid 2/3

Element	Criteria	weight	indicators	value	
			1-49	0.2	
	Kindergarten students	1/8	50-99	0.5)
	Rindergarten students	170	100-149	0.8	
			>=150	1	
			1-349	0.2	
C	Primary schools students	2/8	350-599	0.5)
Ō		2/0	600-999	0.8	
at			>=1000	1	
nc	Secondary schools students	3/8	1-299	0.2	
Ī			300-499	0.5	
			500-699	0.8)
			>=700	1	
			1-999	0.2	
	High schools students	4/8	1000-1799	0.5	
			1800-2499	0.8	
			>=2500)

IPD _{education} = 1/8*0.5 + 2/8*0.5 + 3/8*0.8 + 4/8 * 1 = 0.99



Spatial analysis - Evaluation grid 3/3

Element	Criteria	weight	indicators	value		IPD $_{1} = 2/8*0.7$
			1-699	0.1		
	Population	2/8	1400-2099	0.7	5	+ 2/8*0.6
			>=2100			+ 1/8*0.2
			0	_1		
	Travel time to closest market	∩/Q	1-74	0.6	ノ	+1/8 *0.4
	(minutes)	2/0	150-299	0.4		· 7/ 0*1
ک س			>=300	0		+2/8*1
ΙΟ			0	1		= 0.65
Ō	Distance to closest road (km)	1/8	1-4	06		
Ш́			>=10	0.2		IPD.::u.a.=
ca			0	1		vinage
Ľ			1-49	0.6		1/3*IPD health
	Travel time to closest road (minutes)	1/8	50-99	0.4	ン	⊥ 1/ 3*IDD
			>=200	0.1		+ 1/3 II D education
			ACLEDA PLC bank &		5	+ 1/3 * IPD local economy
	Credit & saving points	2/8	Amret (micro-finance)	0.7		
	Credit & Saving points	2/0	Amret (micro-finance)	0.7		- 0.72
	/		No service	0		= 0.72

Development poles and electrification status



Key points for scenario discussion

- Suggest to keep the method agreed during the pilot phase
- Load forecast: « poor » category was the population under the poverty line

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Load Forecast – assumptions to be tailored by Province

20% losses

- 5,7 persons per HH, pop growth 2,5%/y
- HH: Rich 10%, 30% medium, 60% lower
- Y 20: Rich 15%, 35% medium, 50% lower
- Consumption (fixed for the country)

Poor:	13 kWh/m	176W
Medium:	43 kWh/m	288W
Rich :	68 kWh/m	427W

- Public services (health centres, water pumping, public lighting...) f(village pop.)
- Small industry and shops (small mills, carpentry, metal works) f(village pop.)

Connection rates

- □ HH: y1-35%, y10-98%, y20-98%
- □ Services : y1-80%, y10-100%, y20-100%
- Consumption growth rates
 - □ HH: y1-10: 5%/y y11 -20: 1%y
 - □ services: y1-10: 5%/y y11 -20: 5%y



Load Forecast – 2009 demand by district



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Need to agree on the scenarios to consider, eg:

Scenario 1: by 2020, all villages should be grid-connected
 → outputs: total length of MV lines used, approximate cost for the total investment

Scenario 2: assessment of the cost for the extension of three 22 kV lines which could be undertaken by private operators by 2012, and enough energy supplied by EDC

in addition to the lines for which investments have been secured:

→ outputs: total length of MV lines used, approximate cost, profitability

Scenario 3: by 2012, all villages located within a 5 km buffer around existing and planned 22 kV lines should be grid-connected; remaining villages will benefit from an offgrid option (biomass, hydro, diesel, PV hybrids, stand alone PV /Pico)

→ outputs: projected grid network likely to exist in 2012 (projected MV lines and electrified settlements) + off-grid projects



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Scenario 1 – 100% grid connection 2020

□ Simulation 1 hypothesis:

- 100% village will have been electrified by 2020
- MV grid network to be the unique supply options
- 98% household will be connected
- Calculation principle
 - Connect the village with lowest levelized kWh cost (combine distance and load)
 - Follow the roads, not cross obstacles
 - Three phases :

Planning

process

- 2009-2010→extension from EDC 22KV lines+simulated REEs lines
- 2011 to 2015 → new extension including new commissioned lines

2016 to 2020 → last extension to reach 100% grid connection







Scenario 1, Phases 2 and 3

Phase 2 – 2011 -2015

- by 2012, 115 and 22 kV lines between Ponhea Kraek to Skun via Kampong Cham will be commissioned
- 154 loc./year to be connected (input parameter) thanks to commissioning of line from Vietnam

Phase 3 – 2016 - 2020

- -Skun (Cheung Prey) Phnom Penh (South West)
- Kampong Cham Kratie (North East)
- Kampong Cham to the North along the river to Stueng Trang
- Kampong Cham to the South along the river to Srei Santhor
- → 154 villages per year in order to achieve 100% connection



Expected situation end 2015 and 2020 in Kampong Cham





Results example for Kampong Cham 100% grid extension

	Pop 2009 '000	Villages connected	dem 2009 kWh/cap	MV line length km	km/vill age	cost per village \$	cost per HH	Invest for Trans (M\$)	Invest for Dist (M\$)
2008 to 2010	284	219	76	201	1,5	50 000	219	4,8	6,2
2012 to 2016	1 113	770	75	1 317	1,7	97 000	382	32	43
2016 to 2020	448	770	80	1 071	1,4	63 000	612	26	22
total	1 845	1 759	76	2 589	1,5	76 000	413	62	72

Total investment: 134 M\$



Results example for 3 private line extensions



Grid extension <i>Towards</i>	Investment for transmission (MUS\$)	Investment for distribution (MUS\$)	Total investment (MUS\$)	
Chamkar Leu	2,0	3,3	5,3	
Stueng Trang	4,0	7,4	11,3	
Dambae	2,1	1,6	3,7	
TOTAL	8,0	12,3	20,3	

Key issue: how to attract private investors into this?

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Estimated IRR for investor over 11 years (1)

- Implies that investor should be comfortable with a 11 year PPA
- Purchase from EDC@ 15 cents, no cost of finance, no inflation, no investment subsidy, sensitivity to end-user tariff

	Customer tariff (US\$)				
	0.25 0.30 0.35				
Dambae	1%	9%	15%		
Chamkar Leu	8%	17%	25%		
Stueng Treng (2 sides of river)	9%	18%	26%		

Need at least a 30 cents tariff in order to cover Transmission and distribution investments



Estimated IRR for investor over 11 years (2)

Purchase from EDC@ 15 cents, no cost of finance, no inflation, no investment subsidy, sensitivity to end-user tariff, but with additional demand of 1MW per line coming from rubber plantations

Additional demand: 1MW	Customer tariff (US\$)				
	0.25	0.30	0.35		
Dambae	20%	33%	44%		
Chamkar Leu	21%	33%	44%		
Stueng Treng (2 sides of river)	15%	26%	36%		



Estimated IRR for investor over 11 years (3)

Purchase from EDC@ 15 cents, no cost of finance, no inflation, no investment subsidy, end-user tariff fixed at 25 cents: what level of investment subsidy would be required to make the investment attractive?

	Subsidy (% of the initial investment) 0% 10% 20% 40%					
Dambae	1%	3%	5%	11%		
Chamkar Leu	8%	10%	13%	20%		
Stueng Treng (2 sides of river)	9%	11%	14%	21%		

Very substantial : cover Transmission or distribution



Policy discussions

Investment related incentives

- Are subsidy schemes envisaged? % investment? Flat / kW? / connection
- Are soft loans considered? Through a special bank?
- Sustainability of the national incentive scheme?
- Fiscal incentives
 - Import duties situation?
 - Tax incentives: Deduct a % investment cost from taxes payable, Accelerated depreciation, Waving profit taxes
 - VAT exemption
- Grid connection issues
 - Long term PPA at least 10 years
 - Comfortable enough rate: min 10cents for mini hydro, higher for smaller sites?
 - Take off obligation from the utility.
 - Rate of bulk purchase rate from the grid
 - Issue of tariff to end-users: flexible ?



Discussion points

- Criteria for selection of development poles
- Load forecast: « poor » category was the population under the poverty line
- Definition of the « unelectrified areas »: small REE area are considered unelectrified
- Targets and constraints for the scenarios
 - □ 100% grid extension
 - Public and private grid extension + off grid options





Capacity & Institutional strengthening for rural electrification & development – decentralized energy option (CAP REDEO)

Supported by the Intelligent Energy Europe Agency (IEEA) and French Ministry of Foreign Affairs (MAE)

Thank you for your attention

http://www.cap-redeo.com/





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