

Request for Proposal (RFP)

Full Economic Appraisal of the potentials of Solar PV energy in Cambodia

The Clarification Note to Bidder's queries

Process Number No: 9753

Reference to the above RFP, UNDP has received the below queries from bidder and we would like to share the clarification as below:

No.	Questions	Answers
1	With reference to the mentioned RFP, I was wondering if you can share links to the following reports/ information- i. UNDP (2018) De-risking renewable energy investment (DREI) ii. Electricity Authority of Cambodia (2017), EAC's Consolidated Report for year 2017; Salient features of power development in kingdom of Cambodia.	(1) The De-risking renewable energy investment (DREI) is being finalized. This report will be shared to selected bidder only. (2) The Salient features of power development in kingdom of Cambodia is attached.



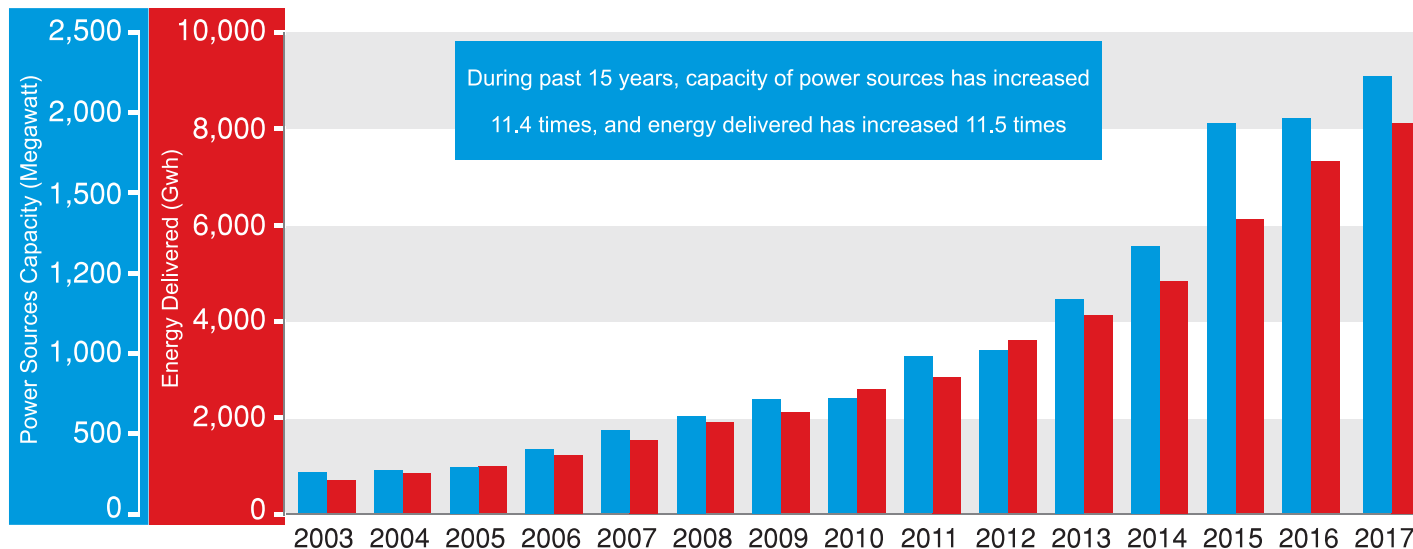
Salient Features of Power Development in Kingdom of Cambodia

(EAC's Consolidated Report for Year 2017)



1. Development of Power Sources

1.1 Progress of Development of Power Sources during past 15 years



Power Sources Capacity (MW)	205	208	231	325	419	490	579	584	793	825	1,088	1,359	1,986	2,115	2,283
Energy Delivered (GWh)	693	814	977	1,203	1,517	1,858	2,077	2,515	2,788	3,527	4,051	4,713	5,990	7,175	7,966
Energy Increase (%)		15.41	19.80	24.46	26.73	22.52	11.76	21.08	13.26	23.84	14.83	16.35	27.09	19.79	11.03

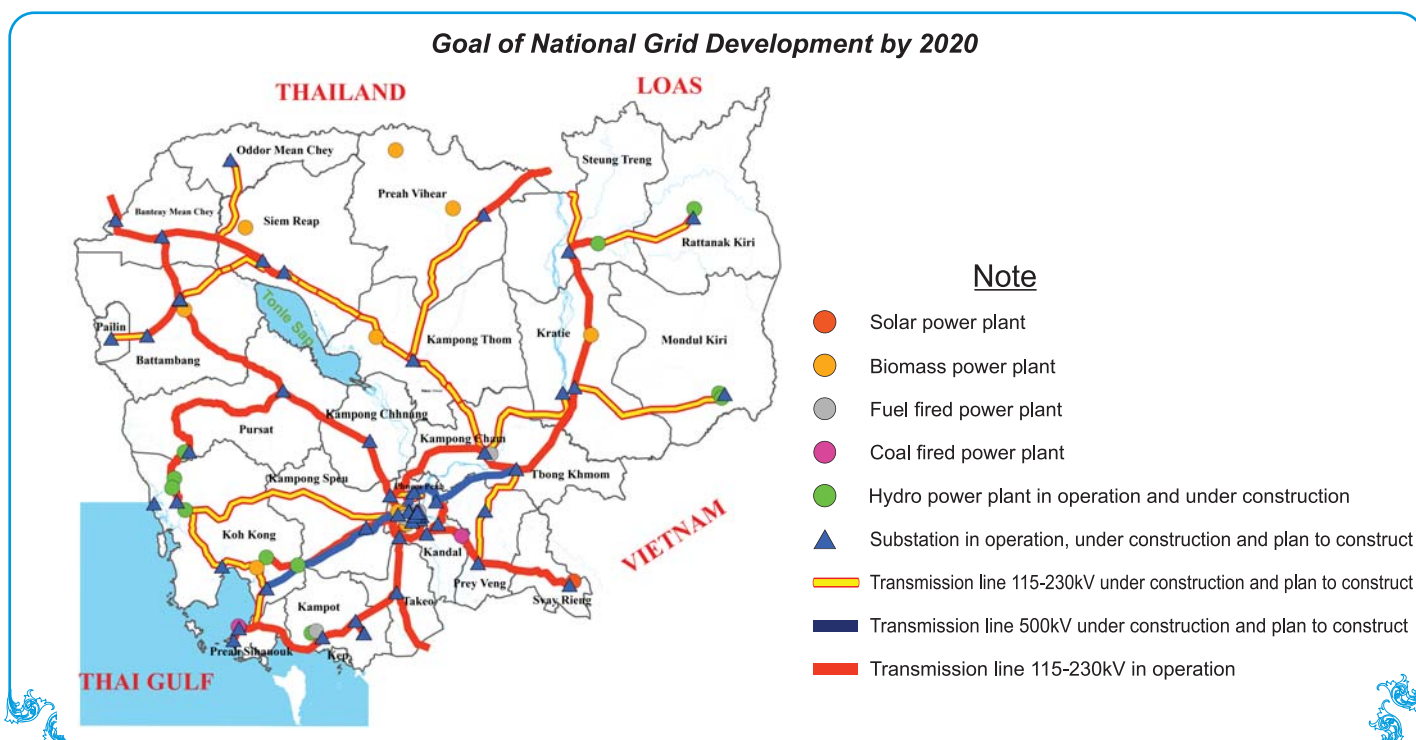
1.2 Data on Different Sources of Power for Cambodia

Power Sources	2016			2017			Plan for 2018		
	MW	GWh	%	MW	GWh	%	MW	GWh	%
1. Domestic Generation									
Coal	403.00	2,551.17	35.56	538.00	2,829.12	35.51	538.00	3,020.58	33.27
Hydro power	929.70	2,619.11	36.50	979.70	3,217.79	40.39	1,329.70	4,209.25	46.36
Fuel Oil	274.49	362.13	5.05	251.33	381.14	4.78	251.33	260.43	2.87
Renewable Energy	51.27	43.35	0.60	84.27	48.61	0.61	72.27	60.06	0.66
Captive Generation by Industry and Licensees	39.79	16.44	0.23	13.19	9.59	0.12	10.63	8.68	0.10
Total Domestic Generation	1,698.25	5,592.20	77.94	1,866.49	6,486.25	81.42	2,201.93	7,559.00	83.26
2. Import Power Sources									
Thailand	135.50	346.19	4.82	135.50	269.56	3.38	135.50	266.37	2.93
Vietnam	277.00	1,201.78	16.75	277.00	1,153.85	14.48	277.00	1,178.19	12.98
Lao	4.00	34.88	0.49	4.00	56.52	0.71	4.00	75.62	0.83
Total Import	416.50	1,582.85	22.06	416.50	1,479.93	18.58	416.50	1,520.18	16.74
3. Total Power Sources	2,114.75	7,175.05	100.0	2,282.99	7,966.18	100.0	2,618.43	9,079.18	100.0
4. Increase over prev. year	22.95	1,185.49	19.79	163.24	791.13	11.03	335.44	1,113.00	13.97

2. Progress of Electrical Transmission Service

2.1 Development Plan for National Grid by 2020

National Grid consists of three main components: HV substations, HV transmission lines, and Dispatching Center. Development of National Grid has three main objectives: 1) Provide opportunity to develop and integrate all power sources in the country into one grid system, 2) Control of power sources based on time and season to meet the electrical demand and 3) Transmit power sources to cities and provinces throughout the country to consumers. Development plan of National Grid by 2020 is shown in the figure below.



2.2 Infrastructure and Capacity of Electricity Supply of the National Grid at the end of 2017

Name	Transmission Lines	Substations
1. Southern and Western System	230 kV : 822 km(x2), 115 kV : 505km (x1), 115 kV : 209 km(x2)	25 substations: 6 in Phnom Penh, 1 in Takeo, 1 in Kampong Speu, 2 in Kampot, 2 in Preah Sihanouk, 2 in Banteay Meanchey, 2 in Siem Reap, 3 in Battambang, 1 in Kampong Chhnang, 2 in Pursat, 1 in Koh Kong, 1 in Prey Veng, 1 in Svay Rieng.
2. Connection Phnom Penh - Kampong Cham System	230 kV : 126 km(x2)	2 substations: 1 in Phnom Penh, and 1 in Kampong Cham
3. Connection between Kampong Cham- Kratie-Steung Treng System	230kV : 240 km(x2)	2 substations: 1 in Kratie, and 1 in Steung Treng
4. Lao PDR Border - Chheb District, Preah Vihear System	115 kV : 55km(x2)	1 substation in Chheb District, Preah Vihear
Total of infrastructures in operation	115-230kV= 1,957 km	30 substations supply directly to 19 provinces and extends supply to other 5 provinces

At the end of 2017, the above infrastructure of Cambodia National Grid enables import of electricity from Vietnam, Thailand and Laos, and supply from domestic generation to meet the electricity demand of 19 cities/provinces through substations in : Phnom Penh, Kandal, Takeo, Kampong Speu, Kampot, Kep, Preah Sihanouk, Banteay Meanchey and Poi Pet, Siem Reap, Battambang and Rattanak Mondul, Kampong Chhnang, Pursat and Ou Tasom, Koh Kong, Kampong Cham, Prey Veng, Svay Rieng, Kratie, Steung Treng, and Preah Vihear. From this infrastructure supply is extended to 5 other provinces of Tbong Khmum, Kampong Thom, Pailin, Rattanakiri, and Monduliri. At the end of 2017, on completion of 35 kV transmission lines from SeeSan2 to Ratanakiri and from Kratie to Monduliri the National Grid extends supply to 2 additional provinces of Rattanakiri and Monduliri. The above infrastructure of National Grid also supply electricity to industries or major industrial areas located near the 30 substations in these 19 provinces.

2.3 Transmission Lines and Substations under construction and planned

Project	Transmission Lines	Substations
1. Steung Treng-Rattanakiri Grid and Kratie-Mondul Kiri Grid	115 kV:105 km (x2)+ 140 km (x2)	construct 1substations in Rattanakiri, 1 in mining site and 1 in Mondul Kiri
2. Preah Sihanouk-Chamkaloung Grid, Chamkaloung-Phnom Penh Grid	230 kV : 50 km (x2) 500 kV : 140 km (x2)	construct a new substation in Chamkaloung and a 500kV Substation in Bek Chan
3. Prey Veng-Svay Angkor- Soung Grid	115 kV: 45 km(x1); 230 kV : 60 km(x1)	Construct a new substations in Svay Angkor
4. Kampong Cham-Kampong Thom-Siem Reap-Battambang Grid	230 kV : 326 km (x2)	construct 2 new substations: 1 in Kampong Thom, and 1 in Siem Reap
5. Kampong Thom – Preah Vihear (Chheb) Grid	115 kV : 138 km (x2)	
6. Krolanh Siem Reap – Oddor Meanchey Grid	115 kV : 75 km (x1)	Construct a new substation in Oddor Meanchey
7. Kampong Cham town – Prek Brosob (Kratie) Grid	115kV : 95 km	construct a new substation in Prek Brosob (Kratie)
8. Sre Ombel – Botumsakor Grid, additional Grid in Koh Kong Town and Tatay-Phnom Penh	115kV : 27 km (x1); 230kV : 71 km (x2) 230kV : 220 km (x2)	construct 3 new substations in Koh Kong
9. Rattanak Mondul-Pailin Grid	115kV : 45 km (x1)	construct a new substation in Pailin
10. Bek Chan-East Phnom Penh	500kV : 45 km (x2)	construct a new substation in East Phnom Penh
11. East Phnom Penh-Soung	500kV : 90 km (x2)	construct a new substation in Soung
Total Project	115kV - 230 kV - 500kV = 1,672 km	Add 16 new substations and NG can supply directly to 25 city/provinces

3. Progress of Electricity Supply to Consumers

3.1 Development of Sub-transmission Lines and Distribution Network

In Cambodia, the electricity supply to consumers is of 3 types: 1) through grid sub-station of National Grid for bulk sale to consumers with load of more than 10 MW; 2) through sub-transmission line operated by subtransmission licensees for supply to MV consumers with load of more than 275kVA; and 3) through MV and LV lines of distribution licensees for supply to retails consumers with load up to 275kVA. MV consumers with capacity above 275kVA are allowed to choose the electricity supply through sub-transmission lines of subtransmission licensees or through MV lines of distribution licensees. Sub-transmission lines are medium voltage (MV) transmission lines used to transmit electricity from grid substations to distribution licensees and MV consumers with load of more than 275kVA. Distribution network consists of MV lines, transformers, low voltage lines, and connection devices for supply to consumers with load up to 275kVA. Subtransmission and distribution network developed by December 2017 are given in the table below:

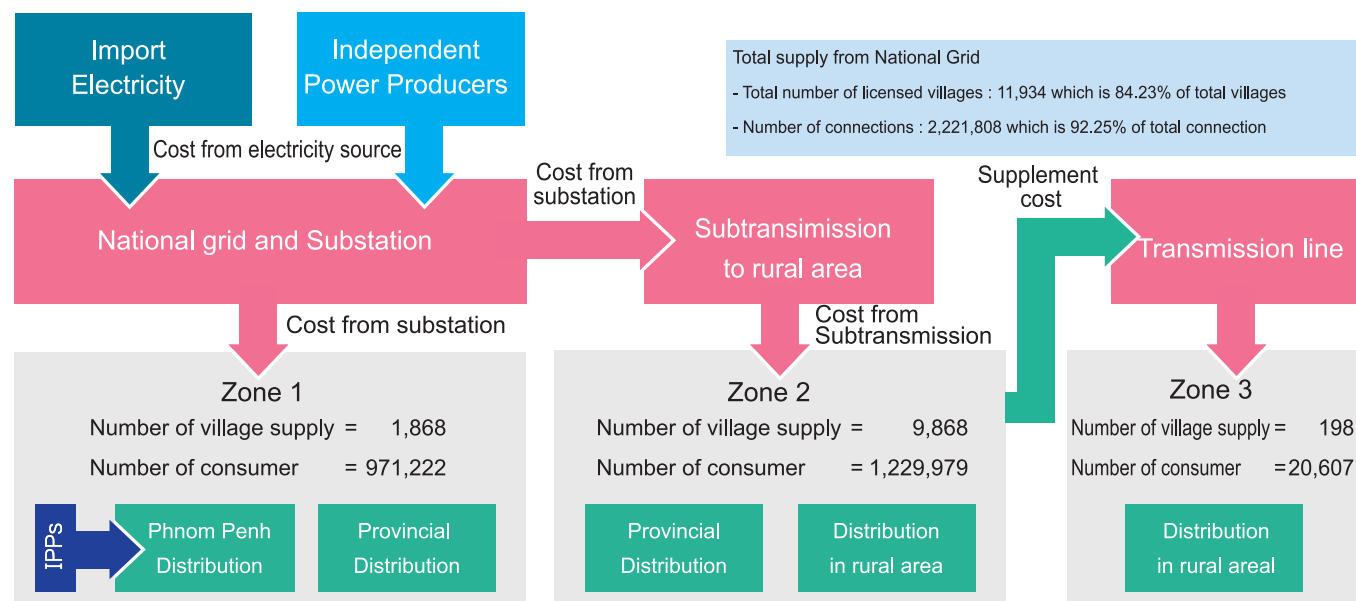
Sub-transmission and Distribution Network developed by December 2017

Type of Facility	Unit	Invested by EDC	Invested by Licensee	Total
MV Line	Km	14,477.31	14,497.3	28,974.61
Transformer	Unit	7,033	6,662	13,695.00
LV Line	Km	5,397.19	22,464.6	27,861.79
Connectivity device	connection	971,222	1,438,685	2,409,907
Estimated invested fund	Million USD	488.27	727.91	1,216.18

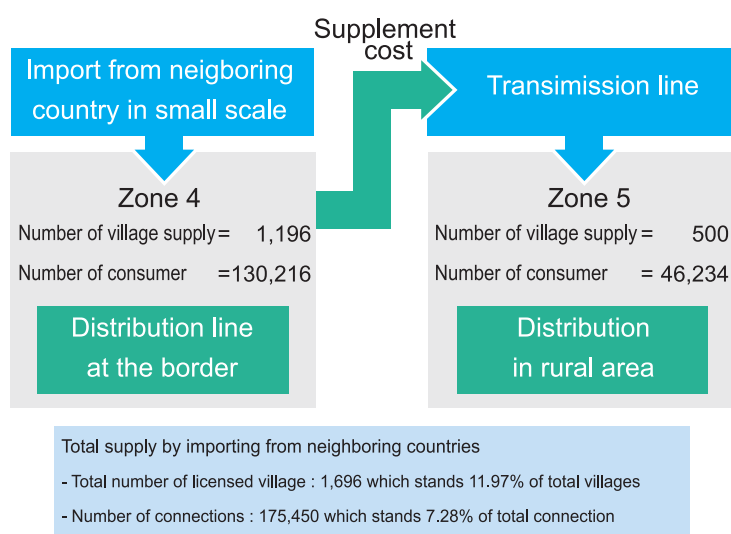
3.2 Structure and Categories of Electricity Supply in Cambodia at 2017 Year-End

Electricity supply in Cambodia has been planned and developed according to the viability of supply for each area. At the end of 2017, electricity was supplied to consumers through 2,409,907 connections. The supply system is classified into 3 categories as follows: 1) electric power supply through National Grid. 2) electric power supply to areas, where the national grid has not yet reached, by importing electric power from neighboring countries through MV lines and 3) Minigrid having electric power supply by diesel generator or by other technology for supply to areas, where supply is not available either from the National Grid or by import from neighboring countries. Structure of electricity supply for each category, number of electrified villages, and number of consumers for year end 2017 are illustrated in the figures below:-

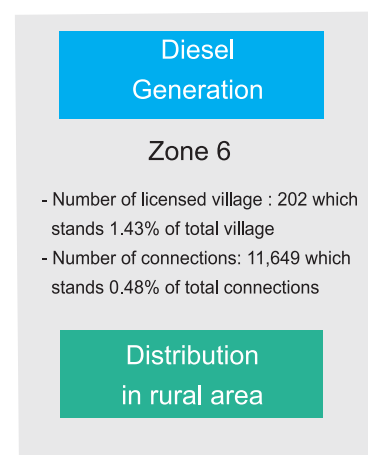
1. Electricity supplies through National Grid



2. Import from neighboring Country in small scale



3. Mini-Grid



3.3 Grant of Distribution License, License Zone, and Development of Distribution Network

Name of Province	Total Num. of Villages	License Granted	License Zone Granted		Electrified		Under construction Villages	Villages not yet granted
			Villages	%	Villages	%		
Banteay Meanchey	644	21	644	100.00	589	91.46	55	0
Battambang	800	31	774	96.75	713	88.76	61	26
Kampong Cham	916	38	874	96.72	793	85.93	81	30
Kampong Chhnang	560	15	542	96.79	387	68.08	155	18
Kampong Speu	1,344	23	1,325	98.59	1,147	85.13	178	19
Kampong Thom	749	20	653	87.85	583	74.58	70	91
Kampot	488	8	488	100.00	479	98.16	9	0
Kandal	1,010	60	1,010	100.00	914	90.50	96	0
Koh Kong	117	9	115	98.29	81	68.70	34	2
Kratie	253	11	220	86.96	139	48.18	81	33
Mondul Kiri	90	1	90	100.00	35	38.89	55	To EDC
Phnom Penh	909	18	909	100.00	888	97.69	21	0
Preah Vihear	229	15	199	86.90	157	63.82	42	30
Prey Veng	1,137	28	1,132	100.00	854	75.00	278	0
Pursat	507	15	493	97.24	477	93.91	16	14
Rattanakiri	243	5	243	100.00	127	52.26	116	To EDC
Siemp Reap	876	21	854	97.49	723	82.08	131	22
Preah Sihanouk	111	15	111	100.00	104	93.69	7	0
Steung Treng	128	3	128	100.00	49	38.28	79	To EDC
Svay Reang	690	5	690	100.00	314	45.51	376	0
Takeo	1,119	33	1,119	100.00	1,025	91.60	94	0
Oddor Meanchey	286	7	286	100.00	165	57.69	121	0
Kep	18	2	18	100.00	18	100.00	0	0
Pailin	79	2	79	100.00	77	97.47	2	0
Tbong Khmum	865	16	807	94.10	720	82.03	87	51
Whole Country	14,168	348 *	13,832	97.63	11,558 **	81.58	2,245	336

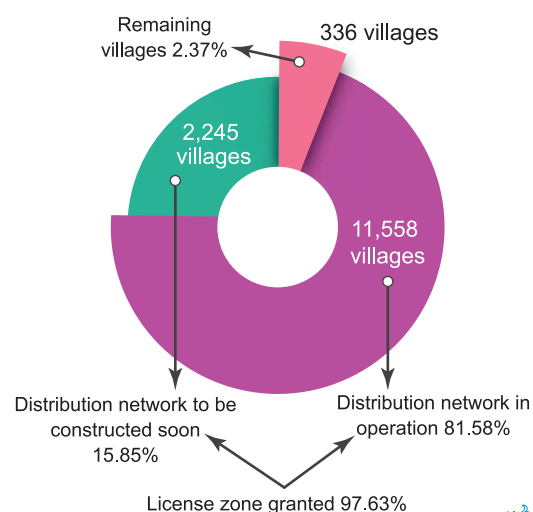
Note : * Registered Licensees.

** Due to a time lag in grant of license for an area and its electrification, the number of villages licensed is higher than electrified.

Distribution License Zone Granted and MV Backbone Constructed for Year Ended 2016

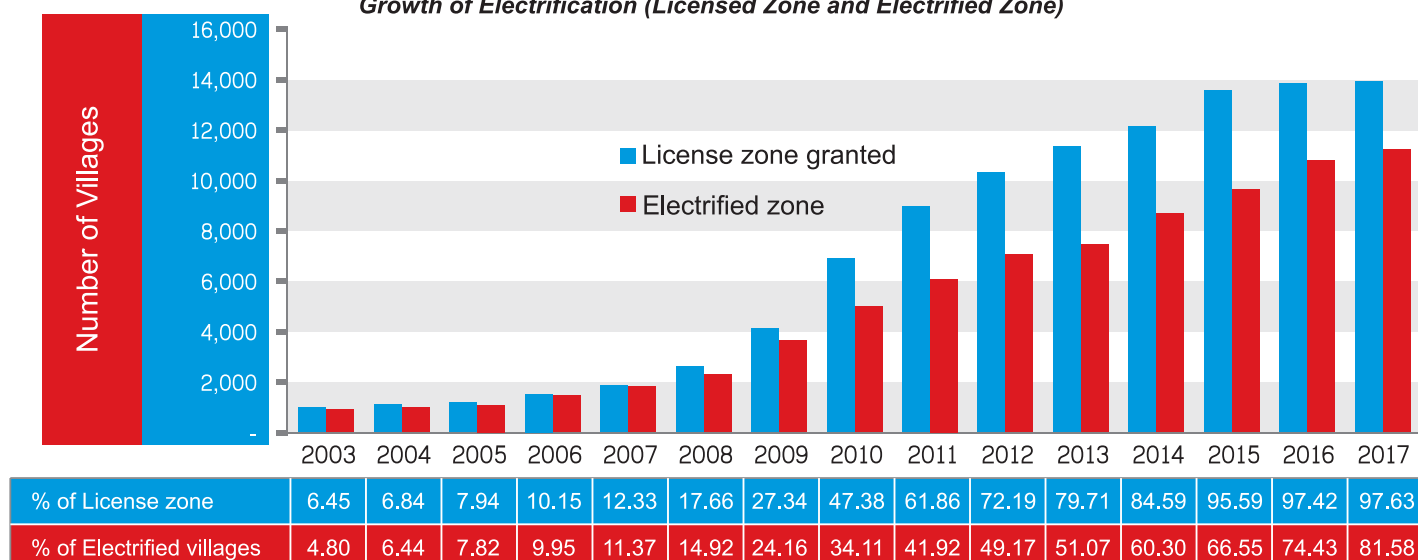


Situation of Electrification in Cambodia (City + Rural as at December 2016)



3.4 Growth of Distribution Network Development for Past 15 Years

Growth of Electrification (Licensed Zone and Electrified Zone)



4. Growth of Consumer Connections in Cambodia

4.1 Growth of Consumer Connections for Past 15 Years

Growth of Consumer Connections to all Types of Electrical Supply Areas

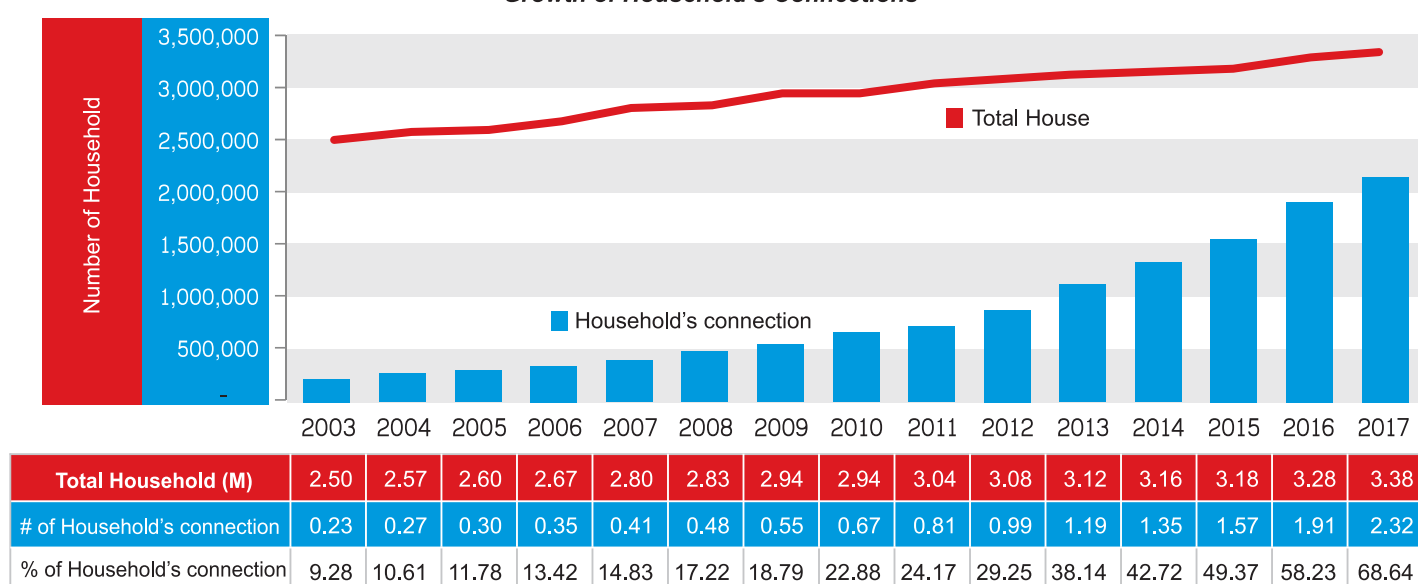
Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Total Consumer's Connection (million)	0.23	0.27	0.30	0.35	0.41	0.48	0.55	0.67	0.81	0.99	1.19	1.35	1.75	2.15	2.41
Increased over pre. year	26.80	17.55	12.29	17.01	15.87	17.41	13.35	21.75	9.21	22.64	24.94	19.94	29.75	23.26	11.60

Number of Connections and Electrical Power Categorized by Type of Consumers between 2015-2017

Year	Residents		Commercial and Industrial		Government		Total	
	Consumer	GWh	Consumer	GWhkWh	Consumer	GWh	Consumer	GWh
2015	1,708,044	1,798.33	67,434	3,116.89	3,220	170.70	1,778,698	5,085.92
2016	2,084,022	2,180.84	71,305	3,511.94	3,997	202.97	2,159,324	5,895.75
2017	2,315,930	2,695.46	89,108	3,863.13	4,869	223.27	2,409,907	6,781.86

4.2 Growth of Household's Connections for Past 15 Years

Growth of Household's Connections



5. Progress of Electricity Tariff Reduction

5.1 Tariff Reduction Plan for Electric Power from National Grid

In accordance to Ministry of Mine and Energy's Prakas No.0094 dated 24 February 2015, the Royal Government of Cambodia set out tariff reduction plan for electric power from National Grid for 2015-2020 as follows:

Type of Purchase	Unit	Tariff to be applied for year					
		2015	2016	2017	2018	2019	2020
1.Electricity supply from National Grid							
Purchase at High Voltage from Grid Substation	\$/kWh	0.1270	0.1240	0.1240	0.1240	0.1240	0.1240
Purchase at Medium Voltage from Grid Substation	\$/kWh	0.1290	0.1260	0.1260	0.1260	0.1260	0.1260
2. Electricity supplied by EDC in Phnom Penh and Takhmao							
Industrial and commercial customer who is connected to MV at 22kV	\$/kWh	0.1770	0.1770	0.1670	0.1650	0.1630	0.1620
Residents, governmental organizations, and embassy (>200kWh/month)	Riels/kWh	820	780	770	750	740	730
Residents consume between 51 to 200kWh/month	Riels/kWh	720	720	720	720	720	720
Residents not consuming more than 50kWh/month	Riels/kWh	610	610	610	610	610	610
3. Electricity Supplied by EDC in Provincial Towns and Rural Areas							
Industrial and commercial customer who is connected to MV at 22kV	\$/kWh	0.1700	0.1675	0.1650	0.1640	0.1630	0.1620
Bulk sale from sub transmission line to distribution licensee	\$/kWh	0.153	0.1470	0.1450	0.1440	0.1430	0.1420
Residents, governmental organization, and embassy (>50kWh/month) in provincial towns	Riels/kWh	820	780	770	750	740	730
Residents, governmental organization, and embassy (>50kWh/month) in rural areas	Riels/kWh	820	790	790	770	760	750
Residents consume between 11 to 50kWh/month in provincial towns and rural areas	Riels/kWh	820	790	610	610	610	610
Residents consume less than 10kWh/month in provincial towns and rural areas	Riels/kWh	820	480	480	480	480	480
Water pump for agriculture from 9:00 pm to 7:00 am	Riels/kWh	820	480	480	480	480	480
4. Electricity supplied by Licensee and Sub Transmission Licensee							
Industrial and commercial customer who is connected to MV at 22kV	\$/kWh	0.1725	0.1675	0.1650	0.1640	0.1630	0.1620
Sub transmissions licensee sale to distribution licensee	\$/kWh	0.1510	0.1470	0.1450	0.1440	0.1430	0.1420
Residents, Government, and Embassy (>50kWh/month)	Riels/kWh	1,000-3,000	800	790	770	760	750
Residents consume between 11 to 50kWh/month in provincial town and rural area	Riels/kWh	1,000-3,000	800	610	610	610	610
Residents consume less than 10kWh/month in provincial town and rural area	Riels/kWh	1,000-3,000	480	480	480	480	480
Water pump for agriculture from 9:00 pm to 7:00 am	Riels/kWh	1,000-3,000	480	480	480	480	480

5.2 Achievement of Tariff Reduction Plan and Electric Power Supply to Resident Consumers in 2017

Number of Residents and Tariff of Electrical Power Categorized by Capacity of Supply in 2017

Electricity Supply (kWh)	Blocks of Consumption by Residential Consumers in kWh per month							
	0-10	11-50	51-100	101-200	201-1000	1001-2000	>=2000	Total
1. Phnom Penh And Takhmao								
Number of Residents	116,942	193,369	70,076	92,199	124,200	7,170	2,173	606,129
Number of Residents (%)	51.20%		26.77%		22.03%			100%
Electrical Power Tariff per kWh	610R		720R		770R			
2. Provinces and Rural Areas								
Number of Residents	241,147	902,268	312,543	152,398	90,401	7,564	3,480	1,709,801
Number of Residents (%)	14.10%	52.77%	33.13%					100%
Electrical Power Tariff per kWh	480R	610R	770R in EDC Areas and 790R in areas of distribution licensees					

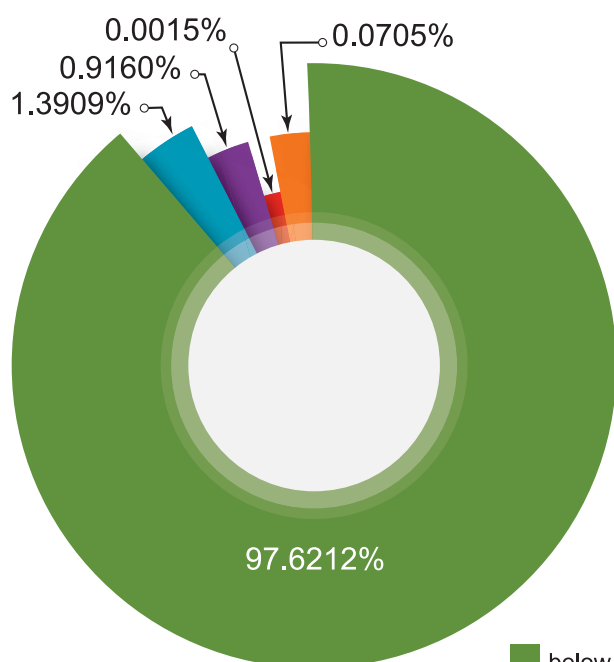
5.3 Electricity Tariff in Cambodia in 2017

In 2017 electricity tariff for area that receive electric power from National Grid is determined according to National Grid's tariff scheme. Difference in tariff between areas exists only for small number of areas where supply is not from national grid and actions are being taken to reduce the number of such areas. The details of different tariff slabs in 2017 is given in table below:

No.	Electricity Tariff Riel per Kilowatthour	License Granted	Num. of Villages	Electricity Sale		Consumers	
				kWh	%	Num	%
1	below or equal 800R	307	12,680	6,620.53	97.6212%	2,316,595	96.13
2	range of 850R to 990R	6	342	94.33	1.3909%	30,786	1.28
3	range of 1,000R to 1,500R	27	566	62.12	0.9160%	50,877	2.11
4	range of 1,600R to 2,500R	11	185	4.78	0.0705%	11,359	0.47
5	range of 2,600R to 3,000R	3	17	0.10	0.0015%	290	0.01
Total		348 *	13,832	6,781.86	100%	2,409,907	100%

Remark : * Some licensees are permitted to apply several tariff range; therefore, the total number of license in each tariff range is greater than number of licensees.

Proportion of Electricity Sale by Tariff



Percentage of Consumer by Tariff Range

