

A Joint Initiative of



सत्यमेव जयते

Government of India



Government of Sikkim

Power for All

Sikkim





Foreword



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Power, Coal and Renewable Energy

Government of India



सत्यमेव जयते
Government of India

Electricity consumption is one of the most important indices for measuring the development level of a nation. The Government of India is committed to improving the quality of life of its citizens by ensuring adequacy of electricity availability. The aim is to provide each household access to electricity, round the clock. The 'Power for All' program is a major step in this direction.

Sikkim, a land locked state on the foothills of eastern Himalayas is blessed with natural beauty and is on its way to becoming a Hydro Power hub of India.

This joint initiative of Government of India and Government of Sikkim aims to further enhance the satisfaction levels of the consumers and improve the quality of life of people through 24x7 power supply. This would lead to rapid economic development of the State in primary, secondary & tertiary sectors resulting in inclusive development of the State.

I compliment the State Government and wish them all the best for implementation of this program. The Government of India will complement the efforts of Government of Sikkim in bringing uninterrupted quality power to each household and establishment in the State.

Foreword



Pawan Chamling

Chief Minister

Sikkim



Government of Sikkim

Sikkim is blessed by mother nature as it is home to beautiful and unexplored territories. The State is also on its way to becoming a major power hub of the country. Simultaneously, the State faces a dichotomy where about 14,000 households do not have access to electricity. The situation is further complicated by the fact that Sikkim has a very difficult terrain and low population density.

The State Government is committed to live up to the challenges and extend electricity access to the unconnected households and provide all the households with 24X7 electricity.

The utilities in Sikkim have lined up various programs of investments to achieve the objectives of the 24X7 Power for All Program.

The State Government will provide all necessary support to the power utilities in achieving the various milestones and targets outlined in this PFA Roadmap.

I would like to thank the Government of India, Hon'ble Prime Minister and Hon'ble Union Minister of State for Power, for supporting Sikkim towards implementation of 'Power for All' program.



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Government of India

Joint Statement



Government of Sikkim

24X7 Power for All Program for Sikkim will be implemented by the Government of Sikkim with active support from the Government of India. The Program aims at providing 24X7 supply to all electricity consumers and providing electricity access to all unconnected households in the State.

This PFA Roadmap document highlights all-encompassing power sector interventions including generation, transmission, distribution, renewable energy and energy efficiency/DSM measures proposed to be implemented during FY16 to FY19.

The Government of Sikkim shall continue to support the power sector through targeted capital subsidy schemes aimed at supporting the poor and marginal consumers and elimination of regional disparities in the State.

The State Government is committed to support the utilities and other development agencies engaged in the power sector in implementation of the various measures and targets considered in the PFA Roadmap.

The State Government will put in place appropriate/ suggested State level governance mechanisms for periodic review and monitoring of the PFA Roadmap implementation.

The Ministry of Power, GoI would supplement the efforts of State on various issues to be dealt with at the Central Government level including those listed in this document. The MoP, GoI shall also endeavor to support the State in availing concessional financing arrangements for power utilities in the State.

The State Government shall endeavor to support utilities in improving/ maintaining their financial sustainability and credit worthiness.

The Central and State Governments would meet regularly over the next four years to review and monitor the progress on the rollout plan and strive to achieve the objectives of the program by taking the necessary steps as envisaged in the PFA Roadmap.

Jyoti Arora, IAS

Joint Secretary

Ministry of Power

Government of India

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List of Abbreviations

Abbreviation	Full Form
A&G	Administrative & General
ABR	Average Billing Rate
ACA	Additional Central Assistance
ACS	Average Cost of Supply
ARR	Aggregate Revenue Requirement
AT&C	Aggregate Technical & Commercial
BADP	Border Area Development Program
BEE	Bureau of Energy Efficiency
BOOT	Build Operate Own Transfer
BPL	Below Poverty Line
CAGR	Compound Annual Growth Rate
CEA	Central Electricity Authority
CGS	Central Generating Station
CKM	Circuit Kilometers
CoD	Commercial Operation Date
CSST&DS	Comprehensive Scheme for Strengthening of Transmission & Distribution Systems
CTU	Central Transmission Utility
DDUGJY	Deendayal Upadhyaya Gram Jyoti Yojana
DPR	Detailed Project Report
DSM	Demand Side Management
DT/ DTR	Distribution Transformer
EBIDTA	Earnings Before Interest Depreciation Taxes and Amortization
EE	Energy Efficiency
EESL	Energy Efficiency Services Ltd
EHV	Extra High Voltage
EPDS	Electricity and Power Department, Sikkim
EPS	Electric Power Survey
ER	Eastern Region
FY	Financial Year
GFA	Gross Fixed Asset
GIS	Geographical Information System
Gol	Government of India

Abbreviation	Full Form
GW	Gigawatt
HEP	Hydro Electric Project
HH	Household
IPDS	Integrated Power Development Scheme
IPP	Independent Power Producer
ISTS	Inter State Transmission System
IT	Information & Technology
kWh	Kilowatt Hour
LED	Light-emitting Diode
LILO	Loop In Loop Out
LT	Low Tension
MNRE	Ministry of New and Renewable Energy
MoP	Ministry of Power, Government of India
MU	Million Unit of Electricity (in kWh)
MVA	Mega Volt Ampere
MW	Mega Watt
NER	North Eastern Region
NHPC	National Hydroelectric Power Corporation
NLCPR	Non-Lapsable Central Pool of Resource
NTPC	National Thermal Power Corporation
O&M	Operation & Maintenance
P&L	Profit & Loss
PAT	Profit After Taxes
PBT	Profit Before Taxes
PFA	Power For All
PFC	Power Finance Corporation
PGCIL	Power Grid Corporation Of India Limited
PLF	Plant Load Factor
POSOCO	Power System Operation Corporation
PP	Power Purchase
PV	Photo Voltaic
R&M	Renovation & Modernization
RAPDRP	Restructured Accelerated Power Development and Reform Program
RE	Renewable Energy
REC	Rural Electrification Corporation
RGVY	Rajiv Gandhi Grameen Vidyutikaran Yojana
RPO	Renewable Energy Purchase Obligation
SECI	Solar Energy Corporation of India
SHP	State Hydro Plants
SLDC	State Load Dispatch Center



PFA Roadmap - Sikkim



Abbreviation	Full Form
SPDC	Sikkim Power Development Corporation
SPV	Special Purpose Vehicle
SREDA	Sikkim Renewable Energy Development Agency
SSERC	Sikkim State Electricity Regulatory Commission
STPS	Super Thermal Power Station
STU	State Transmission Utility
T&D	Transmission & Distribution
ToR	Terms of Reference
TPS	Thermal Power Station
VGf	Viability Gap Funding
YoY	Year on Year

1. Executive summary

1.1. Introduction

The Power for All (PFA) program is a joint initiative of Government of India (GoI) and State Governments, aiming to achieve availability of 24X7 reliable power to all households, agriculture, industry, commercial business and all other electricity consuming entities by the end of FY19. This document sets as a roadmap to achieve the underlying objective of the PFA program in the State of Sikkim.

The Energy & Power Department, Sikkim (EPDS), Government of Sikkim is responsible for generation, transmission and distribution function within the State.

1.2. Connecting the unconnected

The State has achieved 100% village level electrification. At the household level, as per the latest estimates 14,225 rural and 2,845 urban HH are to be electrified by FY 19.

The estimated demand in FY 19 for the State is about 148 MW. This is inclusive of demand from domestic consumers and expected increase in commercial and industrial demand in the State.

1.3. Power Generation and Supply Adequacy

Sikkim is naturally endowed with rich Hydro Power potential. The State's generation capacity is contributed solely by the hydro stations. Sikkim Power Development Corporation (SPDC)/ Energy & Power Department are responsible for

development of hydro projects below 25 MW and projects of 25 MW and above are allotted to IPP's. The total installed capacity & Central Sector allocation to Sikkim is 229.7 MW (as on 31st May'15).

Sikkim has a planned capacity addition of around 57 MW from 3 Central Generation Stations. The State has 17 upcoming HEPs under various stages of execution, being developed by private sector companies, having a cumulative capacity of 3,791.5 MW. The State is entitled to 12% of the installed capacity as free power. By FY 19 EPDS is expected to have installed capacity of 647 MW. EPDS is expected to be peak surplus during the period FY 16 to FY 19. The State may need to enter into medium term/short term agreement with other distribution licensees/ trading entities to off-load this surplus power.

1.4. Adequacy of transmission network

Intra-state transfer of power within the State of Sikkim is undertaken by EPDS, while inter-state transfer is largely done by the ER system of the PGCIL and TPTL (Teesta Valley Power Transmission Ltd). The power scenario of the State is more or less satisfactory but a large proportion of the infrastructure for transmission and distribution was constructed during the seventies and eighties and has become old and obsolete leading to increased outages and delays in fault location and restoration.

Present Intra-State Transmission System (ISTS) comprises of 517 Ckt. Kms of Transmission lines



and 22 Substations with 304.5 MVA Capacity. 7 New projects worth Rs 2,005 Cr are under various stages of development. These include investment under the Comprehensive Scheme, network augmentation for Pakyong airport, and additional investments for last mile connectivity.

1.5. Adequacy of distribution network

The Energy & Power Department's network system comprises of 11 KV sub-transmission systems which form the distribution backbone at the district level and LT distribution systems which deliver electricity to the majority of the end consumers.

Sikkim has 19 numbers of 66/11 KV Substations and 2,863 Distribution Transformers with Transformation capacity of 205 MVA and 235 MVA respectively. These are spread across the four districts of the State. Apart from this, the length of 11KV HT Feeders and LT Feeders is 3,713 and 6,918 ckt. kms. The SPDC has achieved 79% Consumer metering so far.

There are various ongoing Central and State Government schemes to accelerate network extension and augmentation works. Under the DDUGJY scheme, EPDS has proposed various network extension, strengthening and augmentation works in order to develop a robust sub-transmission and distribution infrastructure in rural areas. The total cost for the proposed plan is close to Rs. 613 Cr. covering all the four districts. Under the IPDS scheme, EPDS has planned extensively to improve its sub-transmission and distribution infrastructure in urban areas with a total proposed outlay of Rs. 263 cr. The total investment proposed by the EPDS under distribution is about Rs. 1,704 Cr. Out of the total requirement, the state is yet to identify funding sources for proposed investments totaling Rs. 282 Cr.

1.6. Clean energy and energy efficiency

The State has an installed capacity of 45.5 MW from 15 Small Hydro Power projects. Additionally, 11 Solar Roof Top projects have been commissioned with a total capacity of 0.7 MW at an estimated cost of Rs. 15 Cr, realized through 90% VGF from Central Government.

SPDC is presently constructing 2 SHPs with a capacity of 15 MW and is developing additional 4 SHPs with a total capacity of 29.25 MW. Additionally, EPDS has proposed 13 new SHPs with a total installed capacity of 69 MW at an estimated project cost of Rs.1,035.00 Cr. To honor the State's commitment to renewable power, SREDA has proposed installation of solar powered projects in the State of Sikkim with a cumulative capacity of 2.5 MW by FY 19.

Further, to promote energy efficiency and conservation measures in the State, Government of Sikkim is conducting awareness programs among all categories of consumers. The State is planning to study the distribution system to assess the potential of energy efficiency program.

1.7. Tariff impact and financial turnaround

Owing to increase in revenues, lower purchase costs and reduction in losses, no tariff increase is required for utility to become financially viable. Present gap between ACS (Rs.12.16/kWh) and ABR (Rs. 4.20/kWh) is estimated to be Rs.7.97/kWh in FY 15. The expansion in consumer base, proliferation in energy requirement and upsurge in infrastructure investments proposed under the PFA Roadmap are expected to translate into Year on Year Tariff impact varying from 2.06 Rs./kWh to 1.39 Rs./kWh.

On the basis of above considerations, a Roadmap to achieve '24x7 Power for All' targets has been formulated and detailed in this document.

2. Background

Situated in the east of India, Sikkim is the least populous state in the country with a little over 0.6 million inhabitants (as per 2011 census) and the second smallest state in geographical size after Goa covering approximately 7,096 sq. km. Sikkim's economy is largely dependent on agriculture and tourism. As of 2014, the State had the third-smallest GDP in the country. Gangtok is the capital and the largest city in the State.

The landlocked state of Sikkim is wedged between the Tibet autonomous region of China to the north and east, Bhutan to the south-east, Nepal towards the west and the Indian state of West Bengal to the south. Sikkim is endowed with a seamless blend of natural wealth and a geographically diverse landscape nestled amidst the Himalayan Range; and enjoys the climate range from subtropical to temperate to alpine. The State houses the Kangchenjunga, the world's third-highest peak, which is located on Sikkim's border with Nepal. A nice mélange of unsurpassed possessions of its culture, natural scenery and biodiversity, Sikkim has emerged as a popular tourist destination. The key highlights of the State are reflected in Table 1

As of FY14, according to the State's economic survey the per capita income at constant prices (FY05) was at Rs. 83,527 which is relatively higher than the national level of Rs. 39,904. This gives an

indication that Sikkim is one of the progressive states in the country.

Sikkim is also one of the least densely populated state with only 86 persons per square kilometer. However, it has had a high population growth rate of 12.89% over the period of FY 2001-11. Increase in urban population by 157% over the past decade clearly indicates strong growth in the extent of urbanization and the continuance of migration of population from rural to urban areas. Figure 1 indicates the high extent of urbanization in the most populous districts of the state.

Figure 1: District wise Urban and Rural Divide (2011 Census)

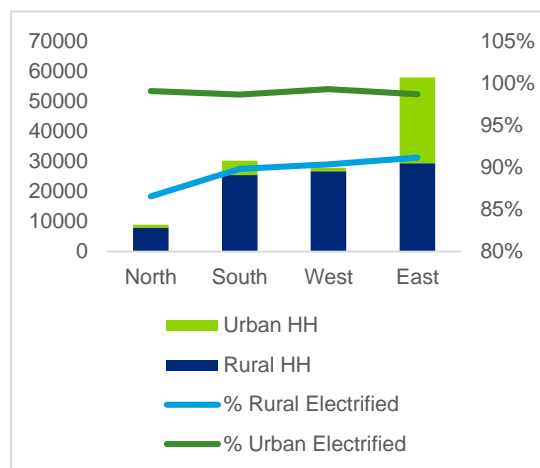


Table 1: Key Highlights of State: Sikkim

Parameter	Information
Year of Creation	Established on May 16, 1975
Population & Demographics	Total Population at 6,10,577 as per 2011 census <ul style="list-style-type: none"> 75% Rural, 25% Urban Decadal population growth: 12.89%
Area	7,096 square kilometers (0.22 % of country)

Parameter	Information
	<ul style="list-style-type: none"> Forest cover – 3,359 sq kms (0.5% of country) Total cropped area – 152 sq kms (0.8% of country)
Administrative Set-up	<ul style="list-style-type: none"> 4 Districts 16 sub-divisions 425 Villages (100 % Electrified)
Natural Resources	<ul style="list-style-type: none"> Vast Forest Resources with diverse range of Flora & Fauna Other Resources: Minor Minerals
HHs	As per 2011 Census data : Total 1,29,006 HHs (92.5 % Electrified) <ul style="list-style-type: none"> Urban 35,718 (98.7% Electrified) Rural 93,228 (90.2 % Electrified)

2.1. Sikkim Power Sector At a Glance

Table 2 provides an overview on the present status of the power sector in the state.

The Energy & Power Department of Sikkim (EPDS) is responsible for generation, transmission and distribution function within the State.

The Sikkim State Electricity Regulatory Commission (SSERC) was established in 2003, in accordance of the Section 82 of the Electricity Act, 2003. The Commission is designated to function as an autonomous authority responsible for regulation of the power sector in the State.

Table 2: Sikkim Power Sector at a Glance

Aspect		Key Highlights		
Demand Position	Supply	The State of Sikkim witnessed the lowest power demand amongst all states in the country with a peak demand of 83 MW during FY15. The State has not faced any peak demand shortage or energy shortage for the past three years. The demand supply situation in peak and energy terms during FY15 is tabulated below:		
		Parameter	Peak (MW)	Energy (MU)
		Requirement	100	388
		Availability	100	856
		Gap	0%	0%
Generation	The total installed power generation capacity available to the State as on March, 2015 was 229.7 MW (Source: CEA), with the following break-up:			
	Mode	Installed Capacity (MW)		
	State	47.3		
	Private	23.4		
	Central	159		
	Total	229.7		
Transmission	Energy & Power Department, Government of Sikkim is responsible for the intra state transmission of electricity and the CTU (PGCIL) manages the Inter-state transmission of power. The total inter and intra-state transmission capacities in the state are listed below: (Source: Power Department, Sikkim)			
	Category	No. of EHV Substations	Transformation Capacity (MVA)	Line Length (ckt kms)
	Intra-state	22	304.5	289.3
	Inter- State	3	1,975	639
Distribution	Energy & Power Department, Government of Sikkim is responsible for distribution of power in the State (March, 2015).			
	Licensee	License Area		Consumers Served
	EPDS	Entire State of Sikkim		1,00,276

3. Power Supply Scenario

3.1. Power Supply Position

The State of Sikkim has witnessed no power and energy deficit for the past three years. This is primarily attributable to the reduction in peak demand and energy requirement over the last three (3) years as is evident from Table 3. The power supply scenario is complemented with the fact that Sikkim is also among the few states to have 100% electrification in villages.

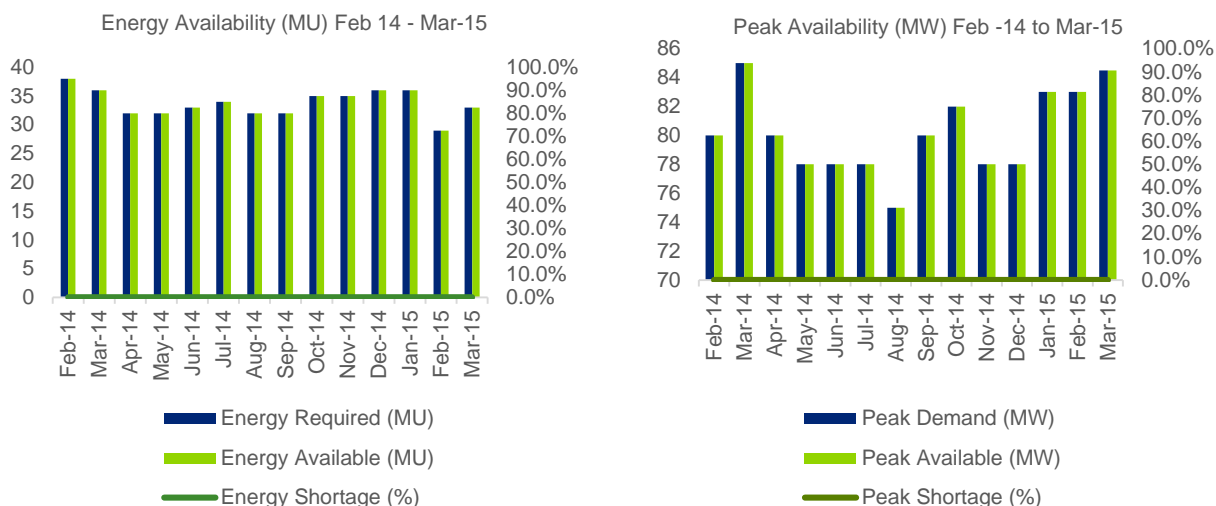
As can be seen in Table 3, the energy demand has more or less stagnated whereas the peak demand reflects a decreasing trend.

It is important to note that the annual peak requirement may not represent the seasonal demand variations which is essential to ensure the achievement of objectives under 24X7 PFA Scheme. In the case of Sikkim, there has not been any monthly peak or energy shortage over the past 12 months, which is reflected in the annual peak and energy figures as shown in Figure 2.

Table 3: State's Peak Deficit (%) Trend

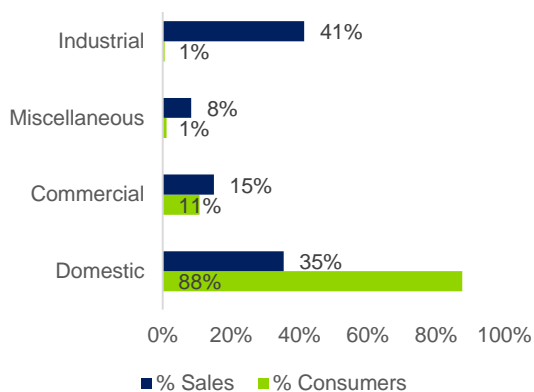
Particulars	FY12	FY13	FY14	FY15
Energy requirement and availability				
Energy requirement (Mus)	380	372	402	388
Energy available (Mus)	936	826	842	856
Energy shortage	0%	0%	0%	0%
Peak power demand and supply				
Peak Demand (MW)	83	83.66	102	100
Peak Available (MW)	90	90	100	100
Peak Shortage (%)	0%	0%	2%	0%

Figure 2: Peak and Energy deficit trends in Sikkim during FY15



3.2. Consumer & Sales Mix

Figure 3: Consumer and Sales Mix (MU)



As can be seen in Figure 3, 88% of the domestic consumers contribute to only 35% of the energy sales, whereas 1% of the industrial consumers contribute to about 41% of the energy sales. These figures are indicative of the extent of industrialization in the State.

3.3. Methodology for Demand Projections

In line with the objective of PFA program, to provide 24X7 power to all households, the demand projection has been done separately for electrified and un-electrified rural and urban HHs. For rest of the consumer categories a growth rate identified on

the basis of the State's estimation of the expected growth in tandem with a review with the past trend has been considered.

Estimation of Rural and Urban electrified and un-electrified HHs

The number of rural and urban HHs are estimated based on the available census data for 2011 and have been extrapolated with past 10 years CAGR to arrive at the estimates for FY15. Same has been shown in Table 4.

The State has achieved all the targets of Xth & XIth Plan Period under RGGVY Scheme.

As per a survey done by EPDS the total unelectrified rural HH in the state is 14,225. Similarly around 2,845 HH in urban areas are remaining to be electrified. The estimated urban and rural HHs along with the status of electrification as at the end of FY15 is provided in Table 5.

Estimation of energy requirement from HHs

The energy requirement from HHs has been estimated under the following three broad categories:

- Latent requirement from existing HHs on account of increase in energy availability;

- b) Additional energy requirement due to electrification of un-electrified HHs; and

Table 4: Estimated HH in Sikkim

Particulars	Census 2001	Census 2011	Decadal Growth	CAGR	Total H/H by 2015 based on Census No.s (CAGR)
Total HHs	1,10,000	1,29,006	17%	1.61%	1,37,498
Rural HH	80,200	93,288	16%	1.52%	99,103
Urban HH	29,800	35,718	20%	1.83%	38,402

Table 5: Estimated Un-electrified Households (end of FY15)

Particulars	Urban	Rural	Total
Total HHs	37,713	93,288	1,31,001
Electrified	35,557	79,063	1,14,620
Balance (covered under PFA)	2,845	14,225	17,070

- c) Additional energy requirement due to construction of new urban and rural HHs.

Latent energy requirement from existing HHs

Latent demand growth from already electrified HHs has been estimated based on expected increase in consumption levels in accordance with the objectives of the PFA program. Such growth would not only include the increased energy requirement due to elimination of power shortages and network constraints but also the natural growth in consumption levels due to lifestyle changes. The year on year increase in per HH urban and rural consumption per day for EPDS is presented in Table 6.

Additional energy requirement due to electrification

All the un-electrified HHs, both rural and urban is expected to be electrified by the end of FY19 and the proposed year wise electrification plan of EPDS considered for the purpose of power supply related projections is summarized in the Table 7.

Additional energy requirement due to construction of new HHs

In order to estimate the energy requirement for newly constructed HHs, the expected number of newly constructed HHs has been estimated based on the past growth of HHs at a CAGR of 1.83% and 1.52% for urban and rural areas respectively. The corresponding energy requirement from new HHs is estimated based on the estimated per HH per day consumption detailed above.

Table 6: Per HH per day consumption (kWh)

Particulars	FY16	FY17	FY18	FY19
Rural	3.50	3.60	3.70	3.80
Urban	5.26	5.32	5.36	5.40

Table 7: Grid Electrification Plan (Urban & Rural HHs Nos.)

Particulars	FY15	FY16	FY17	FY18	FY19
Urban					
Opening Un-electrified HHs	3,157	2,857	2,000	571	-
Electrification of Newly Constructed HHs	698	702	715	728	741
Electrification of Existing UE HHs (Opening of FY15)	300	857	1,429	571	-
Balance Un-electrified HHs	2,857	2,000	571	-	-
Rural					
Opening Un-electrified HHs	14,225	14,225	11,380	7,113	-
Electrification of Newly Constructed HHs	1,500	1,509	1,532	1,556	1,580
Electrification of Existing UE HHs (Opening of FY15)	-	2,845	4,268	7,113	-
Balance Un-electrified HHs	14,225	11,380	7,113	-	-

Estimation of energy requirement from other consumer categories

The energy requirement projections from other consumer categories have been done factoring the expected natural growth as well as the additional growth arising out of increased availability of electricity in accordance with the PFA Roadmap.

For the remaining consumer categories such as industrial, commercial, public lighting, agriculture, public water works etc. CAGR of 22.5% has been considered to arrive at the projected demand. This growth rate is based on the expected increase in industrial and commercial load in the State. This growth includes 10 MW for Pakyong airport, 20 MW for industrial units expected in east and south Sikkim and another 10 MW for IPP construction power.

3.4. Demand Projections

The energy input requirement at the State periphery based on the transmission and distribution losses is

shown in Table 8. Considering the T&D loss trajectory of the EPDS, the energy requirement at State periphery is expected to increase nearly 1.7 times, from 395 MU in FY15 to 697 MU in FY19. Figure 4 summarizes the projected sales to the various categories detailed in previous sections.

The share of domestic sales is expected to decrease from 44% in FY 16 to 34% in FY 19, while the share of other than domestic categories is expected to increase from 56% to 66% over the period of FY15-19.

T&D Loss level target set by the EPDS in line with the AT&C loss targets set by the Ministry of Power in has been used to estimate the energy input requirement. In this exercise the intra-state transmission losses are included in the T&D loss figures of the State.

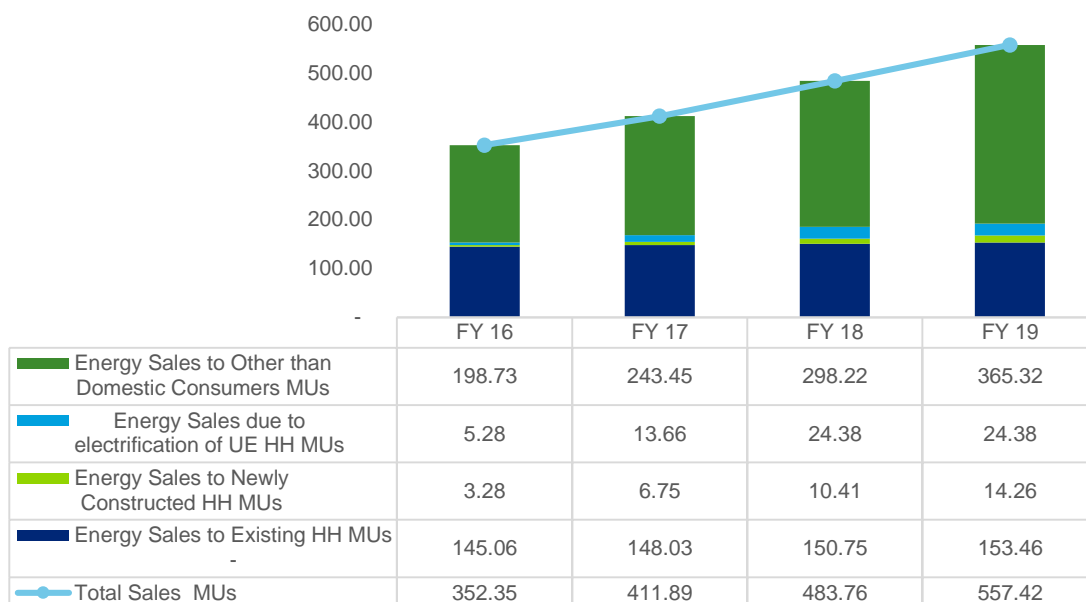
For estimation of peak demand, average load factor (53.6%) has been calculated using CEA power supply position data for FY14 and FY15.

Table 8: Energy Requirement & Peak Demand Projections

Particulars	Units	FY15 (RE)	FY16	FY17	FY18	FY19
Energy requirement/ Sales	MU	254	352	412	484	557
Distribution Losses	%	35.56%	34.30%	29.60%	25.00%	20.00%

Particulars	Units	FY15 (RE)	FY16	FY17	FY18	FY19
Energy Input Requirement	MU	399	536	585	645	697
Load Factor	%	53.6%	53.6%	53.6%	53.6%	53.6%
Peak Demand	MW	83	114	125	137	148

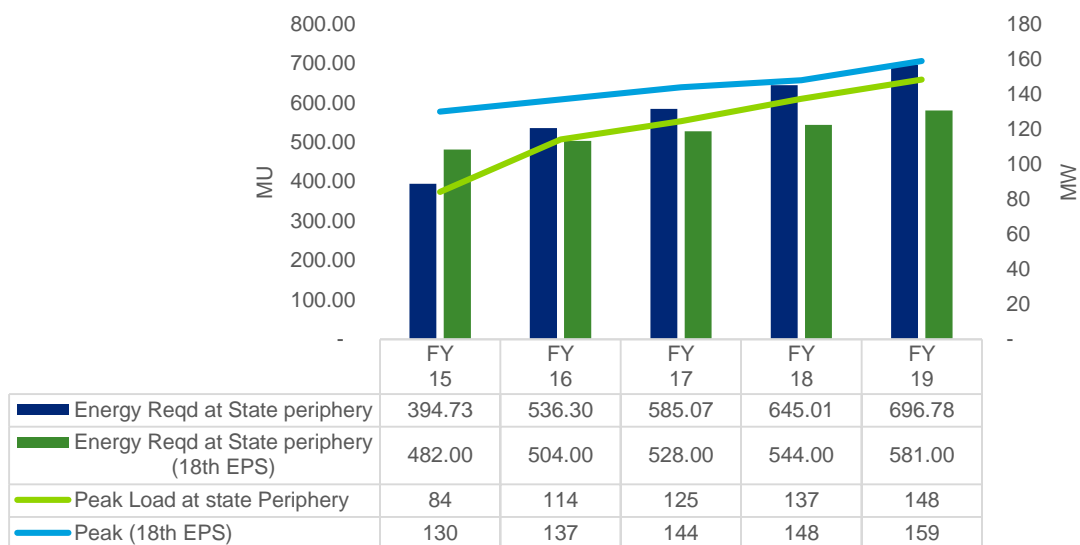
Figure 4: Projected Energy sales (MU) – EPDS



The energy requirement is projected to grow at a CAGR of 15.2 % to reach 697 Mus in FY19 from the present levels of 395 MU in FY15. Similarly, the peak demand is projected to grow at a CAGR of 15.2% reaching at 148 MW in FY19 from 84 MW in FY15. While the projected energy requirement in MU terms is expected to surpass the 18th EPS estimates from FY18 onwards, the projected peak demand in MW is expected to fall short of the 18th EPS estimates. The variance in the peak demand projections is due to the significant difference in the load factor used in the 18th EPS (at 41.86% in

FY15) vis-à-vis the actual load factor witnessed (54.9% in FY15). Due to the significant variation observed in the load factor, the projections in the PFA Roadmap have been based on the load factor estimated based on power supply position data provided by CEA. The projected peak demand and energy requirement is represented in Table 8. The subsequent chapters layout the various elements of the PFA Roadmap covering power generation, transmission, distribution, RE/EE and financial viability related aspects essential for enabling achievement of PFA objectives in Sikkim.

Figure 5 : Project Peak Demand & Energy Requirement vs 18th EPS estimates - State



4. Generation Plan

4.1. Generation Capacity Requirement

The State is poised to witness a steep increase in the energy requirement and peak demand from the present level of 395 MU & 84 MW in FY15 to 697 MU and 148 MW in FY19. In order to meet the increase in power demand, the State needs to carefully plan to either develop its own generation capacity or tie up with Central Generating Stations/ IPPs. This chapter evaluates the readiness of the state for meeting the projected power demand scenario and highlights the steps required and the way forward in view of the gaps and issues identified therein.

4.2. Existing Generation Capacity

Sikkim is blessed with ample hydel resource with an estimated hydro power potential pegged around 8,000 MW. Sikkim Power Development Corporation (SPDC) and Energy & Power Department are responsible for development of hydro projects below 25 MW. Projects of 25 MW and above are allotted to IPP's.

The total allocated capacity available with the State, as on Oct 31, 2015, is 229.7 MW including allocation from Central Generating Stations. The share of hydel power generators in the installed capacity stands at 70%. Break-up of the installed capacity by ownership and source is provided in Table 9.

4.3. Generation Plan

The generation plan for the State envisages the proposed capacity additions by the state agencies along with the allocated share of upcoming Central Sector and IPP Stations. The generation capacity addition and power procurement plans have been aligned with the energy requirement and power demand assessed in the earlier sections of this document.

Inter-State/ Central Sector Projects

Sikkim depends heavily on allocations from Central Generating Stations to meet its energy demand primarily during lean hydro periods. Table 10 provides the Central Sector allocation to the State

Table 9: Installed Capacity (MW) as on Oct 2015

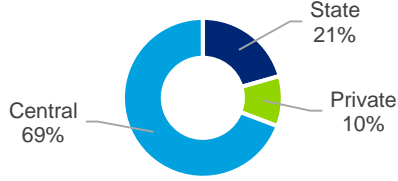
Share	Sector	Thermal	Hydro	RE	Total
	State	0	0	47.3	47.3
	Private	0	23.4	0	23.4
	Central	68	91.269	0	159
	Total	68	114.669	47.3	229.7

Table 10: Plant wise details of allocated capacity from Central sector projects (As per CEA power supply position report for August 2015)

Sl.	Source	Capacity (MW)	%	Allocated Capacity (MW)
	Central Sector			
1	FSTPP, NTPC (Unit 1-5)	1,600	1.63%	26
2	FSTPP-III, NTPC	-	-	-
3	KHSTPP-I, NTPC	840	1.55%	13
4	KHSTPP-II, NTPC	1,500	0.33%	5
5	TSTPP, NTPC	1,000	2.40%	24
	BARH STPS (Unit 4, Stage 2)	660	1.29%	8
6	RANGIT-III, NHPC	60	13.33%	7
7	TEESTA – V, NHPC	510	13.19%	67
	Others			
8	CHUKHA, PTC	270	2.22%	5
9	Unallocated Power	833	1.7%	14
	TOTAL			159

The State is entitled to 12% free power from Teesta V and Rangit Hydro power stations.

The State has been allocated a share of 57 MW from the upcoming Central Sector projects as per the details provided in Table 11.

State Sector Projects

At present, the Energy and Power Department along with Sikkim Power Development Corporation have an aggregate generating capacity of 47.3 MW dedicated to meet the State's energy requirement. These plants are classified in the small hydro (SHP) category and hence the details have been covered in the renewable energy plan chapter.

Independent Power Producers

IPP's are responsible for development of hydro projects above 25 MW capacity in the State on

BOOT basis. Government of Sikkim has an option to invest 26% of equity in the project SPV's and also charges a royalty of 12% of net energy available annually for the first 15 years and 15% of net energy beyond 15 years of operation and an additional 1% for local area development.

Till now, two IPPs have been commissioned in the State from which it receives 12% of net energy available annually as royalty. Details of these plants are provided in Table 12. Government of Sikkim had allotted projects to various developers, most of which have got delayed owing to controllable/uncontrollable factors. These projects are expected to be completed in the upcoming years. The combined generating capacity of the upcoming plants is about 4,141.5 MW and the details of the projects is listed in Table 13 with the revised expected date of completion.

Table 11: Upcoming Central Generating Stations

Plant Name	Fuel	Capacity (MW)	Allocated (MW)	Expected CoD	Status
Muzaffarpur Ext. (Kanti TPP) U 1,2	Gas	390	2	2018	Under Construction
Barh STPP-1 U1-3	Coal	1,980	38	FY 17-18	Under Construction
Barh STPP-2 U 1,2	Coal	1,320	17	Yet to Confirm	Under Construction
Total			57		

Table 12: Operational IPP's in Sikkim

Name of Project	Capacity (MW)	Location	Project Developer
Chuzachen HEP	96	East Sikkim	Gati Infrastructure Ltd.
Jorthang Loop	96	South Sikkim	DANS Energy

Table 13: Upcoming IPP's in Sikkim

No. of Projects	Capacity (MW)	MoU Signed	LoI Issued	Expected Commissioning Date (MW)				
				FY16	FY17	FY18	FY19	Beyond FY19
17	3,791.5	19	7	246	1,392	0	767	1,387

4.4. Anticipated Power Availability Position

The ongoing and proposed projects by the State Agencies indicate that the State is expected to become significantly power surplus, thereby creating opportunities for export to other states. The State is expecting capacity additions of around 2,405 MW (with 12% free power allocation to the State) by FY19 most of which is expected from the ongoing IPPs.

Further, in the period FY16 to FY19, 57 MW of thermal capacity additions are expected from Muzaffarpur (Kanti Bijlee) and Barh STPS plants.

A total of 20 MW is expected from RE sources during the period FY16 to FY19. These proposed capacity additions mean that the EPDS is expected to have 647 MW capacity by FY19. This is sufficient to cater to the expected peak demand of 148 MW in FY 19.

4.5. Key Issues

Since most of the capacity additions expected in the future are through the IPPs, the State needs to focus on the commissioning of the plants to avoid time and cost overrun. The State needs to put in place adequate mechanisms for review and monitoring of progress of the IPPs.

4.6. Fund Requirement

The respective private parties are responsible for making funding arrangements for their upcoming IPP plants. The State is not providing any equity/debt funding to these projects.

The total fund requirement by the State Agencies for development of proposed schemes are discussed under the RE chapter.

4.7. Expected Demand Supply Scenario

Expected generation availability and demand supply scenario over the period of the PFA Roadmap is shown in the following graphs.

Figure 6: Capacity Additions (MW) during FY 16 to FY 19

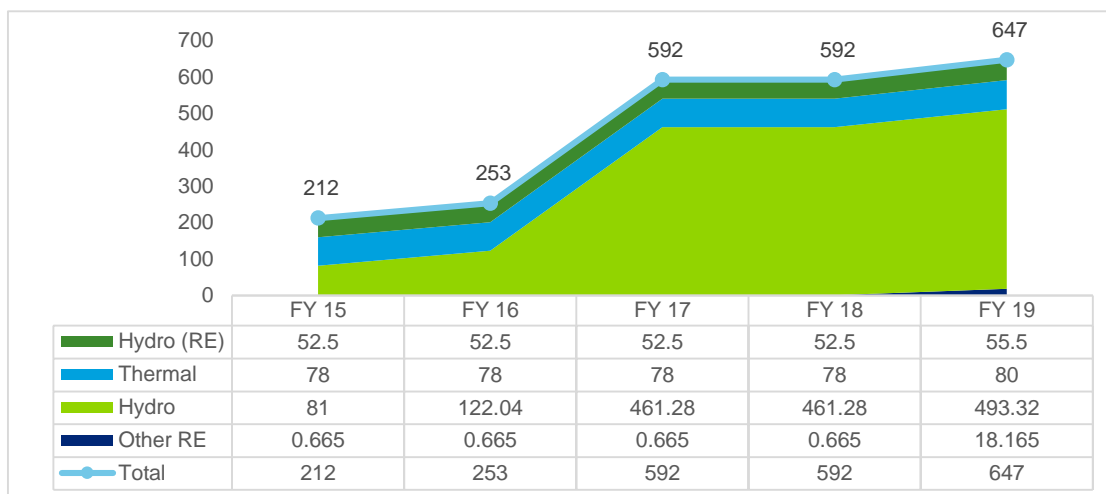


Figure 7: Energy Availability in MU for FY 16 to FY 19

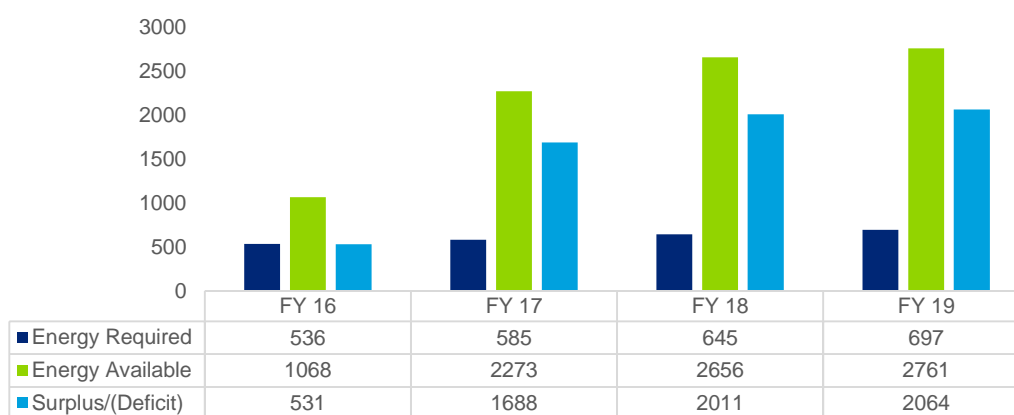


Figure 8: Peak Availability in MW for FY 16 to FY 19

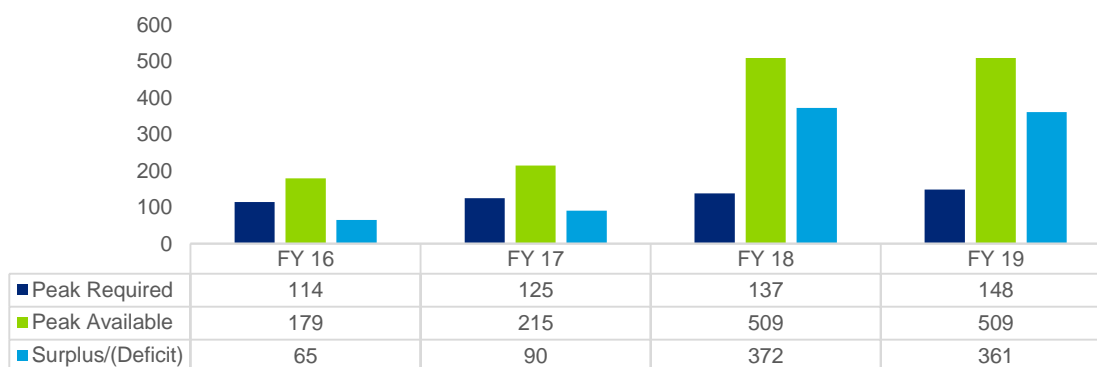


Table 14: Source Wise Energy availability for EPDS (MUs)

	State	Central	Private	Total
FY 16				
Other RE	0.41	-	-	0.41
Hydro	-	355.75	74.18	429.94
Thermal	-	513.86	-	513.86
Hydro (RE)	71.36	-	52.18	123.54
Total	71.77	869.62	126.36	1,067.75
FY 17				
Other RE	0.41	-	-	0.41
Hydro	-	354.78	1,282.45	1,637.23
Thermal	-	512.46	-	512.46
Hydro (RE)	71.17	-	52.03	123.20
Total	71.57	867.24	1,334.48	2,273.29
FY 18				
Other RE	0.41	-	-	0.41
Hydro	-	354.78	1,665.63	2,020.41
Thermal	-	512.46	-	512.46
Hydro (RE)	71.17	-	52.03	123.20
Total	71.57	867.24	1,717.66	2,656.47
FY 19				
Other RE	9.32	-	-	9.32
Hydro	-	354.78	1,746.75	2,101.53
Thermal	-	522.29	-	522.29
Hydro (RE)	75.53	-	52.03	127.56
Total	84.85	877.07	1,798.79	2,760.70

5. Transmission Plan

5.1. Transmission capacity requirement

The intrastate transfer of power within the State of Sikkim is undertaken by EPDS. Inter-state/ inter-regional transfer of power is undertaken by the ER system of the CTU/ PGCIL.

The State is poised to witness a steep increase in the energy requirement and peak demand from the present level of 395 MU & 84 MW in FY15 to 697 MU and 148 MW in FY19. A well-planned and strong transmission system will not only ensure optimal utilization of transmission capacities but also of the generation facilities and would also facilitate in achieving ultimate objective of cost effective delivery of reliable power to end consumers in accordance with the objectives of the PFA Program.

5.2. Existing Transmission System

Intra-state Transmission System

Given the terrain, geographical size and electricity load in the State, the intra-state transmission system comprises of various lines and sub-stations at 132 kV and 66 kV only. The 66 kV network forms the majority of the intra-state transmission system and also doubles up as the sub-transmission system. In this Roadmap, the categorization of various 66 kV systems and proposals into transmission and distribution system been considered in accordance with the practice followed by the EPDS.

Table 15: Existing Transmission system in the state

Sl.	Transmission line	Voltage	Line Length (in km)
1	Sagbari (Rangit) to Melli	132 kV	32.50
2	Sagbari (Rangit) to Galyshing	132 kV	14.80
3	Chuzachen to New Rangpo	132 kV	21.00
Total			68.30
1	Melli to LLHP	66 kV	49.00
2	LLHP to Tadong	66 kV	4.66
3	Power Grid to LLHP	66 kV	3.00
4	Melli to Namchi	66 kV	29.00
5	Namchi to Gyashing	66 kV	33.00
6	Melli to Mamring	66 kV	23.00
7	Namchi to Rothak	66 kV	10.00
8	Rothak to Soreng	66 kV	16.00
9	LLHP to Rongli	66 kV	32.00
10	Rongli to Sishney	66 kV	8.00
11	Rongli to Rhenock	66 kV	17.00
12	LLHP to Bulbuley	66 kV	15.00
13	Bulbuley to Sichey	66 kV	4.00
14	Tadong to Sichey	66 kV	5.00
15	Tadong to Phadong	66 kV	21.00
16	Phadong to Mangan	66 kV	23.00
17	Magan to Meyong	66 kV	17.00
18	Meyong to Maltin	66 kV	14.00
19	Gyalshing to Pelling	66 kV	6.00

Sl.	Transmission line	Voltage	Line Length (in km)
20	Soreng to Sombria	66 kV	17.00
21	LLHP to Serathang	66 kV	51.00
22	Maltin to Lachung	66 kV	23.00
23	Malyin to Rambomchu	66 kV	17.00
24	Sagbari to Ravalgla	66 kV	12.00
Total			449.66

The State has 27 Intra-state transmission lines with an overall line-length of 517 kms and 22 substations with a capacity of 304.5 MVA. The abstract of the existing intra-state transmission network is provided in Table 16. The existing system is also shown in a line diagram in Figure 9

At present, the intra-state transmission and sub-transmission system is faced with the following issues:

- A significant proportion of the intra-state transmission system is more than 30 years old. The sign of ageing is evident from the fact that there are frequent outages.
- Rapid growth in demand over the past has rendered the existing infrastructure inadequate.

- Due to the geographical terrain of the State and lack of provision for proper sectionalization in the intra-state infrastructure, fault location and restoration process is time consuming.
- There is a lack of adequate switching/ protection systems due to which a fault at the tail end often causes tripping at the source end itself, thereby resulting in power disruption in wider areas.
- Due to lack of proper planning and systemic growth, the system is faced with long line lengths, undersized conductors, numerous spur lines etc. resulting in high T&D losses and severe voltage drop at receiving end.

In order to address the current deficiencies and meet projected load growth from future electrification works/ improved power supply position in the State, the intra-state transmission system will need commensurate capacity additions over the next few years.

Table 16: Existing Intra – State transmission Network (Dec 2015)

Particulars	Quantity	Capacity
Transmission Lines	No's	ckt kms
132 kV	3	68.30
66 kV	27	449.66
Substation	No's	MVA
132/66 kV	3	120
66/11 kV	19	205

Table 17: Existing Inter-State transmission system

Particulars	Capacity
Transmission Lines	Ckt kms
400 kV	224
220 kV	52
132 kV	326

Particulars	Capacity
66 kV	37
Sub Station	MVA
400 kV	1,575
220 kV	300
132 kV	100

Comprehensive Scheme (CSST&DS)

Owing to the continuance of weak intra-state T&D systems in the Eastern/ NER states of the country, CEA has developed the Comprehensive Scheme for Strengthening of Transmission & Distribution Systems (CSST&DS also referred to as 'Comprehensive Scheme') in consultation with the concerned State Governments and PGCIL. The Government of India, in September, 2014 has sanctioned an estimated cost of Rs. 4,754.42 crores for the states of Arunachal Pradesh and Sikkim under a new Central Sector Scheme of MoP.

Table 18: Proposed Intra State Infrastructure

Particulars	Quantity	Capacity	Cost (Rs. Crs)
Transmission Lines	No's	In km	920.46
220 kV and 132 kV	9	126	
Substation	No's	MVA	
220/132/66 & 132/66 kV	7	750	
66/11kV	4	70	

Under the Comprehensive Scheme, an amount of Rs. 1,569.6 Crs. is proposed/ sanctioned for the State of Sikkim which covers proposed investments totaling Rs. 920.46 Crs. in intra-state transmission infrastructure and Rs. 649.14 Crs. in distribution network up to 66/33 kV substation level. For the purpose of this Roadmap document the entire investment proposed under the Scheme is included in the Transmission Plan only.

The proposed investments under the Comprehensive Scheme would provide a reliable grid and ensure connectivity to the upcoming load centers. The proposed systems also provide necessary connectivity and access for construction power to the upcoming HEPs.

North Eastern Council (NEC) Funded Schemes

Along with the above mentioned works, North Eastern Council is also working on improving the transmission infrastructure in Sikkim. Presently, 11 NEC funded transmission projects are under implementation in different districts of the State with a total approved cost of Rs. 78.26 Crs

Table 19: Sub Station under the Comprehensive Scheme

Sl.	New- Sub-Station	Transformation (kV/ kV)	Numbers	MVA	Total
1	Samardong (GIS)	132/66	2	50	100
		66/11	2	10	20
2	Singhik	132/66	2	25	50
		66/11	2	10	20
3	Chungthang	132/66	2	25	50
		66/11	2	10	20
4	Namchi	132/66	2	25	50
5	Parbing (GIS)	132/66	2	50	100
6	Dikchu pool	132/66	2	50	100
		66/11	2	5	10
7	Legship Pool	220/132	7	33.3	200
Total (220/132 kV & 132/66 kV)			7 no.		650

Sl.	New- Sub-Station	Transformation (kV/ kV)	Numbers	MVA	Total
	Total (66/11 kV)			4 no.	70

* In addition to the above, the Scheme also includes 132 kV Bay extension works at Rangpo GIS (PG)

Table 20: Distribution works in Sikkim under the Comprehensive Scheme

Sl.	Transmission Line	Voltage	Circuits	Line Length (Km)
1	Samardong – Namthong	66 kV	S/c	15
2	Samardong – Mamring	66 kV	S/c	6
3	Samardong – Kumrek	66 kV	D/c	15
4	Kumrek – Rorathang	66 kV	D/c	15
5	Singhik – Passingdong	66 kV	S/c	20
6	Singhik – Mangan	66 kV	S/c	10
7	Chungtang – Lachen	66 kV	D/c	22
8	Chungthang – LILO point on Rabom – Maltin Line	66 kV	D/c	4
9	Manpur – Rothak	66 kV	D/c	20
10	Rothak – Sombaria	66 kV	S/c	0
11	Namchi – Old Namchi	66 kV	S/c	3
12	Namchi – New Namchi	66 kV	S/c	5
13	Rinchenpong – LILO point on existing Namchi – Gayzing Line	66 kV	D/c	2
14	Parbing – Sichey	66 kV	S/c	7
15	Parbing – Tadong	66 kV	S/c	12
16	Parbing – Pangthang	66 kV	D/c	15
17	Rorathang – LILO point on Pakyong – Rongli Line	66 kV	D/c	5
18	Pelling – Rellichu	66 kV	S/c	25
19	Dikchu Pool – Samdong	66 kV	S/c	10
20	Dikchu Pool – Makha	66 kV	D/c	20
21	Makha – Khamdong	66 kV	S/c	15
22	Khamdong – Temi	66 kV	S/c	12
Total 66 kV line			22 Lines	258

Table 21: New Sub- Stations proposed under Comprehensive Scheme

Sl.	Sub-Station	Transformation Voltages (kV/ kV)	No of Transformers	Transformer Capacity (MVA)	Total (MVA)
1	Rellichu	66/11	2	5	10
2	Passingdong	66/11	2	5	10
3	Lachen	66/33	2	5	10
4	Rinchenpong	66/11	2	5	10
5	Sombaria	66/11	2	5	10
6	Temi	66/11	2	5	10
7	Makha	66/11	2	10	20
8	Khamdong	66/11	2	5	10
9	Kumrek	66/11	2	10	20
10	Namthang	66/11	2	5	10

Sl.	Sub-Station	Transformation Voltages (kV/ kV)	No of Transformers	Transformer Capacity (MVA)	Total (MVA)
11	Rorathang	66/11	2	10	20
12	Samdong	66/11	2	5	10
13	Pangtong	66/11	2	5	10
Total 66/11 kV			13 no.		160

Table 22: Bay Extension Works in Existing Substations under Comprehensive Scheme

Sl.	Substations	Substation Voltage
1	Mamring	66/11
2	Rongli	66/11
3	Pelling	66/11
4	Rothak	66/11
5	Mangan	66/11
6	New Namchi	66/11
7	Sichey	66/11
8	Tadong	66/11

NLCPR Schemes

In order to improve the system reliability and to bring stability in the power system, EPDS has proposed additional transmission and distribution infrastructure investments under NLCPR Scheme of DoNER.

Proposals under the NLCPR also includes optic-fiber connectivity amongst all substations at 66 kV and above and implementation of a Central Load Despatch Center (CLDC) for the State.

Projects being funded under the NLCPR are outlined in Table 25. Further, 3 projects are proposed under NLCPR scheme totaling Rs. 102 Cr.

IPP Scheme (ISTS)

The main purpose of the scheme is to provide T&D infrastructure for evacuation of power from upcoming IPPs in the State.

Phase-1 of the project shall provide evacuation arrangement for 2,162 MW of power by FY 19 from 7 generating projects. Phase-1 is being executed in

two parts, A and B. Under the Part A of Phase -1 following schemes would be carried out:

- Establishment of New 2x500 MVA, 400kV sub-station at Kishanganj
- LILO of New Siliguri – New Purnea 400kV D/c line(quad) at new pooling station Kishanganj
- LILO of Siliguri – Dalkhola 220kV D/c line at new pooling station Kishanganj

Under the Part B of Phase-1, following schemes would be carried out:

- Establishment of 400/220/132kV (400/220kV, 16x105 MVA, Single Phase transformers and 220/132 kV, 3x100 MVA) Gas Insulated Substation at Rangpo
- Establishment of 220 kV gas insulated switching station at New Melli.
- LILO of Teesta III – Kishanganj 400kV D/c line (quad, Teesta III – Kishanganj 400kV D/c line to be constructed through JV route) at Rangpo with Twin HTLS conductor.
- Rangpo – New Melli 220kV D/c line (with single HTLS conductor)
- LILO of Rangit- Gangtok 132 kV S/c line & Gangtok- Melli 132 kV S/c line at Rangpo

- LILO of Teesta V – Siliguri 400kV D/c line at Rangpo
- Kishanganj – Patna 400kV D/c (quad) line

While the common transmission systems is being carried out under the Scheme, the respective generation developers have to develop their Immediate Evacuation Systems:

- Teesta-III : Teesta-III – Kishanganj 400kV D/c line with Quad Moose conductor [being implemented by TPTL, JV of Teesta Urja & POWERGRID]
- Jorethang : Jorethang – New Melli 220kV D/c line with Zebra conductor
- Rangit-IV : Rangit-IV – New Melli 220kV D/c line with Zebra conductor
- Chuzachen : Chuzachen – Rangpo 132kV D/c line with Zebra conductor
- Rongnichu : Rongnichu – Rangpo 220kV D/c line with Zebra conductor
- Bhasmey : Bhasmey – Rangpo 132kV D/c line
- Teesta-VI : Teesta-VI – Rangpo 220kV D/c line with Twin Moose conductor

Table 23: IPP Phase-1 Generating Projects

Sl.	Project	Capacity (MW)	LTOA (MW)	Comm. Schedule
1	Teesta-III	1,200 (6x200)	1,200	Dec-16
2	Teesta-VI	500 (4x125)	500	Apr-18
3	Jorethang	96 (2x48)	96	Commissioned
4	Rangit-IV	120 (3x40)	120	May-18
5	Rongnichu	96 (2x48)	96	June-18
6	Chuzachen	99 (2x49.5)	99	Commissioned
7	Bhasmey	51 (2x25.5)	51	Feb-18
Total		2,162	2,162	

In Phase-2 of the scheme, evacuation of power from 3 upcoming generation plants with a total of 193 MW is to be provided. One out of these 3 projects has already been commissioned and the commissioning of the other two projects is expected in FY19.

Table 24: IPP Phase-2 Generating Projects

Sl.	Project/ Applicant	Ins. Capacity (MW)	LT(O)A (MW)	Time Frame
1	Tashiding (Shiga Energy Pvt. Ltd.)	97	97	Mar-2017
2	Dikchu (Sneha Kinetic Power Projects Ltd.)	96	96	Oct-2015
3	Panan (Himagiri Hydro energy Ltd.)	300	0	Dec-2019
Total		592	193	

Phase-2 comprises creation of common transmission system from Tashiding HEP and Dikchu HEP as follows:

- Establishment of new 220/132kV substation at Legship Pool
- Legship Pool – New Melli 220kV D/c with twin moose/HTLS conductor
- Establishment of 2x50MVA, 132/66kV substation at Dikchu Pool
- Dikchu Pool – Rangpo (Samardong) 220kV D/c line with twin moose conductor / HTLS (to be operated initially at 132kV)
- Rangpo (Samardong) – Rangpo (POWERGRID) 220kV D/c line (to be initially operated at 132kV).

The Immediate Evacuation System from Tashiding and Dikchu HEP are:

- Tashiding – Legship Pool 220kV D/c line
- Dikchu – Dikchu Pool 132kV D/c line with moose conductor / HTLS

The proposals under Phase-2 also includes provision of intermediate evacuation system, under the scope generation developer, as outlined below:

- LILO of one circuit of Teesta-III – Rangpo-Kishanganj 400 kV D/c line at Dikchu HEP

- Creation of the 400/132kV switchyard facility with adequate 400/132kV transformation capacity at Dikchu.

300 MW Panan HEP (Himadri Hydro Energy Ltd.) has been requested to apply for LTOA at earliest for connectivity application.

The proposed evacuation system in Phase 1 and 2 is shown in Figure 10

Other Projects

Under the Border Area Development Project (BADP) Scheme, 66 kV power transmission line from Meyong to Maltin at Lachung Village in North

Sikkim in under construction with an estimated cost of Rs. 2.5 Cr.

There additional projects proposed under Additional Central Assistance (ACA) Scheme for the improvement and upgradation of existing system with a cost layout of Rs. 2 Cr. Details of the same are provided below.

- Replacement of 66 KV Control & Relay Panels of 66/11 KV Sub-station at Sichey.
- Revamping of 3x5 MVA, 66/11 kV Sub-station at 5th Mile Tadong, East Sikkim.

Table 25: Physical Progress of Projects under NLCPR Scheme

Sl.	Name of the Scheme	Cost (Rs. Lakhs)	Start Date	Target date of completion	Physical Progress as on 30 th September	Progressive expenditure to the end of the year (Rs. Lakhs)	Balance (Rs. Lakhs)
1	Construction of 132KV transmission line from LLHP to Nathula in Sikkim	3,100.87	28.02.2007	Dec'2015	95%	2,404.43	696.44
2	Complete electrification of Lord Buddha statue including garden along with conversion of existing overhead L.T. distribution lines into underground cable system with modernization and refurbishment of existing electrical network at Rabong Bazaar in South Sikkim	400.52	18.02.2009	Dec.'2012	100%	393.35	7.17
3	Construction of 66/11KV, 2X5MVA Sub-station at Perbing, Ranka, East Sikkim including drawing of 11KV HT transmission lines for power evacuation & other allied electrical works in and around Gangtok in East Sikkim	1,589.10	20.06.2011	March'2016	81.5%	1,151.68	437.42
4	Drawing of 66KV transmission line including construction of 2x7.5 MV Sub-Station at Marchak, East Sikkim	1,297.00	06.04.2011	Dec.'2015	82%	720.54	576.46
5	Installation of 1x15 MVA transformer and extension bay at 66/11 substation at Mamring, South Sikkim	760.78	23.03.2011	28.02.2014	100%	751.45	9.33
6	Drawing of New 66 KV D/C transmission line from LLHP to Tadong 66/11 KV Sub-Station.	901.98	07.10.2010	Sept.'2014 Extn.Applied	50%	294.20	607.78

Sl.	Name of the Scheme	Cost (Rs. Lakhs)	Start Date	Target date of completion	Physical Progress as on 30 th September	Progressive expenditure to the end of the year (Rs. Lakhs)	Balance (Rs. Lakhs)
7	Construction of 66/11 KV, 2x7.5 MVA Sub-Station with LILO arrangement at Old Namchi Bazaar including up-gradation of existing 2x2.5 MVA Sub-Station at Namchi, South Sikkim.	1,562.87	24.05.2011	Dec.'2014	100%	954.31	608.56
8	Construction of 66 KV line from Lachung to Maltin including construction of 66/11 KV, 5MVA switchyard at Lachung and additional bay at Maltin, Sikkim.	1,405.68	24.04.2012	March'2015	83%	589.02	816.66
9	Design, Supply, erection, testing & commissioning of 11/66 KV switchyard at Rabom Chu HEP with 2x5MVA, 11/66 KV transformer and construction of 66 KV transmission line from Rabom Chu to Maltin with additional bay at Maltin in North Sikkim	1,444.39	24.04.2012	Nov.'2014	89%	805.20	639.19
10	Augmentation of 66/11 KV, 2.5 MVA Phodong Sub-Station to 5 MVA and replacement of all electrical equipments, North Sikkim.	1,131.60	24.04.2012	June'2015	96%	619.88	511.72
11	Conversion of existing 440 volt LT distribution overhead lines including service connections into underground cable system at Gyalshing Bazaar and its surrounding areas in West Sikkim	481.91	17.06.2009	Jan.'2014	100%	345.68	136.23
12	Modernization of electrical network in and around Melli Bazar, South Sikkim.	1,102.04	18.01.2013	March'2015	100%	637.68	464.36
13	Establishment of 11/11 KV switching station, upgradation of 11 KV transmission system, augmentation & 23kV distribution substation, extension of phase balancing and enhancing the load carrying capacity of LT distribution network and improvement of service connection system under Pakyong Division.	2,633.10	29.04.2013	June'2015	53.75%	951.31	1,681.79
14	Modernisation & Beautification of Distribution System with conversion of overhead transmission line with underground cable system at Jorethang town, South Sikkim	981.53	28.10.2014	Oct.'2016	23.75%	271.81	709.72

Sl.	Name of the Scheme	Cost (Rs. Lakhs)	Start Date	Target date of completion	Physical Progress as on 30 th September	Progressive expenditure to the end of the year (Rs. Lakhs)	Balance (Rs. Lakhs)
15	Construction of 11 KV heavy duty transmission line from Mangan to Upper Dzongu and Lower Dzongu and installation of 11/11 KV control room at Phidang, Lower Dzongu and Lingza, Upper Dzongu, North Sikkim	1,771.39	QPR & UC not provided to Nodal Officer till date.		NA	342.00	1,429.39
16	Remodelling of power distribution system at Rangpo town, East Sikkim	1,665.00	Work tendered		0	0.00	1,665.00
17	Remodelling of electrical installation including system improvement works at Rhenock Bazar and 24ikkim areas in East Sikkim	1,595.00	Work tendered		0	0.00	1,595.00

5.3. Intra-state Transmission System Plan

proposed to undertake construction of the state specific projects as outlined in Table 28.

In order to ensure adequacy of intra-state transmission system for the State, EPDS has

Table 26: Ongoing Intra State Transmission Projects under EPDS

Sl.	Name of Work	Cost of the Project (Rs. Crs)	Physical Progress	Remarks
1	Integration of New Sub-Stations, Generating Stations under North District with Existing Central Load Dispatch Centre (CLDC) with Facility for Energy Auditing, Sikkim.	5.7	98%	Work progress under
2	Diversion of 66 KV Tr. Line from Tadong Sub-Station to I.C.A.R. Compound in D/C 66 KV tower for independent circuit for Phodong/North Sikkim including improvement of ground clearance of the 66 KV transmission system in North and East Districts.	6.1	70%	Work progress under
3	Construction of 66 KV S/C Tr. Line from 132/66 KV S/Y at Rabongla to Central University with 66/11 KV 2x5 MVA S/Stn. At Yangang, South Sikkim	18.6	60%	Work progress under
4	Procurement, Erection, Testing and Commissioning of 132/66 KV, 20 MVA Power Transformer for 132/66 KV Substation at Kyongsa, Gyalshing, West Sikkim including Electrification of the Chenrezig Shingkham Riwo Potala at Sangha Choeling, Pelling in West Sikkim	12.9	30%	Work progress. Part-II of the project is under tendering process.
	Total investment	43.3		

Table 27: Projects Proposed Under NLCPR Scheme

Sl.	Name of the Project/Schemes	Tentative Project Cost (Rs. Cr.)
1	Construction of 132/66 KV, 2x10 MVA sub-station at Ravaongla and construction of one outgoing bay at 132 KV LILO of Sagbari-Melli line at Sagbari in South Sikkim.	24
2	Drawing of Optical Ground Wire (OPGW) cables on existing 132 & 66 KV Intra-State Transmission lines and integration of leftover sub-stations with Central Load dispatch Centre with facility for Energy Auditing.	26
3	Creation of 132/33 sub-station at Samrdung, Melli and URHP and drawing of 33 KV line along the declared industrial belts in Sikkim.	52
Total		102

Table 28: Intra-state System Proposed for Sikkim (Pakyong Airport)

Name	Physical Plan
Pachey Khani 132/66/33 kV Pooling Station	132/ 66 KV 2X50 MVA 132/33 KV 2X20 MVA
Chuzachen to Pachekhani Pooling Station	D/C 132 kV (Zebra) – 20 kms
Bhasmey to Pachey Khani Pooling Station	D/C 132 kV (Zebra) – 8 Kms;
Pochekhani to New Rangpo PGCIL 400/220/132 kV Pooling Station	D/C 132 kV (Twin Moose) – 15 kms

The Pachey Khani pooling sub-station will supply power to the Pakyong Airport and will also provide alternate path for power evacuation from Chuzachen (99 MW), Bhasmey (56 MW), Rolep (51 MW) and Suntalaytar (30 MW). The other 3 lines will improve the power availability in different regions/ districts of the State.

Additionally, the State will also benefit by means of increased availability of inter-regional corridors through amplification of the various new lines and augmentations proposed between the ER/ NR.

Further, EPDS has proposed two additional schemes which include last mile connectivity for connecting to the network created under Comprehensive scheme and construction of 33 kV

lines. These two schemes have a total financial layout of Rs. 260 Cr.

5.4. Adequacy of transmission planning (intra-state)

The PGCIL and CEA have undertaken a detailed studies to finalize the transmission and sub-transmission infrastructure projects under the Comprehensive Scheme approved by the Government of India. The proposals were developed with a 10 year planning horizon.

In view of the demand growth project for the State under the PFA Roadmap, the transmission system proposals appears to be adequate.

5.5. Fund Requirement (Intra-state only)

The EPDS has proposed a total investment of Rs. 1,070 crores in the intra-state transmission systems as per the scheme wise details outlined in Table 29.

Table 29: Intra-State Transmission System Fund Requirement

Scheme	Investment (Rs. Cr.)	Funding Source
Various Schemes under EPDS	43.3	NEC
NLCPR	102	DONER
BADP	2.5	State Government
ACA	2.0	DONER
Comprehensive Scheme	1,569	Ministry of Power, Gol
Pakyong Airport	185	Gol/PFC
Last Mile connectivity	150	Gol/PFC

Scheme	Investment (Rs. Cr.)	Funding Source
Construction of 33 kV lines	110	Gol/PFC
Total	2,163.8	

Of the above schemes EPDS is yet to tie up sources of funding for Pakyong airport, Last mile connectivity and 33 kV lines schemes totaling Rs. 445 Cr.

5.6. Transmission Issues

In addition to the infrastructure related issues highlighted earlier, the other major issues to be dealt with by the State include the following:

Segregation of SLDC/ STU Functions

- The EDPS is presently undertaking functions of both STU and Distribution Licensee for the State.
- The State needs to segregate the STU and SLDC functions into a separate entity in compliance with the provisions of the Electricity Act, 2003.

Strengthening of SLDC/ Load Despatch

- Load Despatch needs significant strengthening including investments in RTUs/ Data-ogging/ Communications Systems/ setting up of a fully enabled control room etc.
- Given the network configuration in the State, complete visibility at 66kV level is a must for ensuring effective load despatch within the State.
- While the State has already initiated a plan for necessary investments and creation of a CLDC, commissioning the same at the earliest would be critical to achieve the end objectives of the PFA Program.

5.7. Action Plan & Support Required

In line with the proposed transmission plan, the following action points outlined in

Table 30 have been identified for respective stakeholders to be able to make suitable arrangements for making adequate power transmission systems available for the State in accordance with the requirements of the PFA Roadmap.

Table 30: Action points and timelines

Stakeholder	Action Points
EPDS	<ul style="list-style-type: none"> • Outline physical rollout plan for all schemes along with year wise scheduling; • To finalize plan for segregation of STU/ SLDC functions in compliance with the provisions of the Electricity Act, 2003 within 3 months. • Finalize investment plan for improvement in switching and protection systems in the intra-state transmission network within next 6 months. • Operationalization of the Centralized Load Despatch Centre (CLDC) on priority. EPDS to highlight any assistance/ capacity building support required from CEA/ POSOCO/ PGCIL.
PGCIL	<ul style="list-style-type: none"> • Timely award and execution of intra-state transmission works proposed under the Comprehensive Scheme. • Quarterly reporting of the various intra-state works being undertaken by PGCIL under the Comprehensive Scheme.
Gol	<ul style="list-style-type: none"> • Funding arrangement for unfunded portion of the transmission plan of EPDS

Figure 9: Power Map of Sikkim

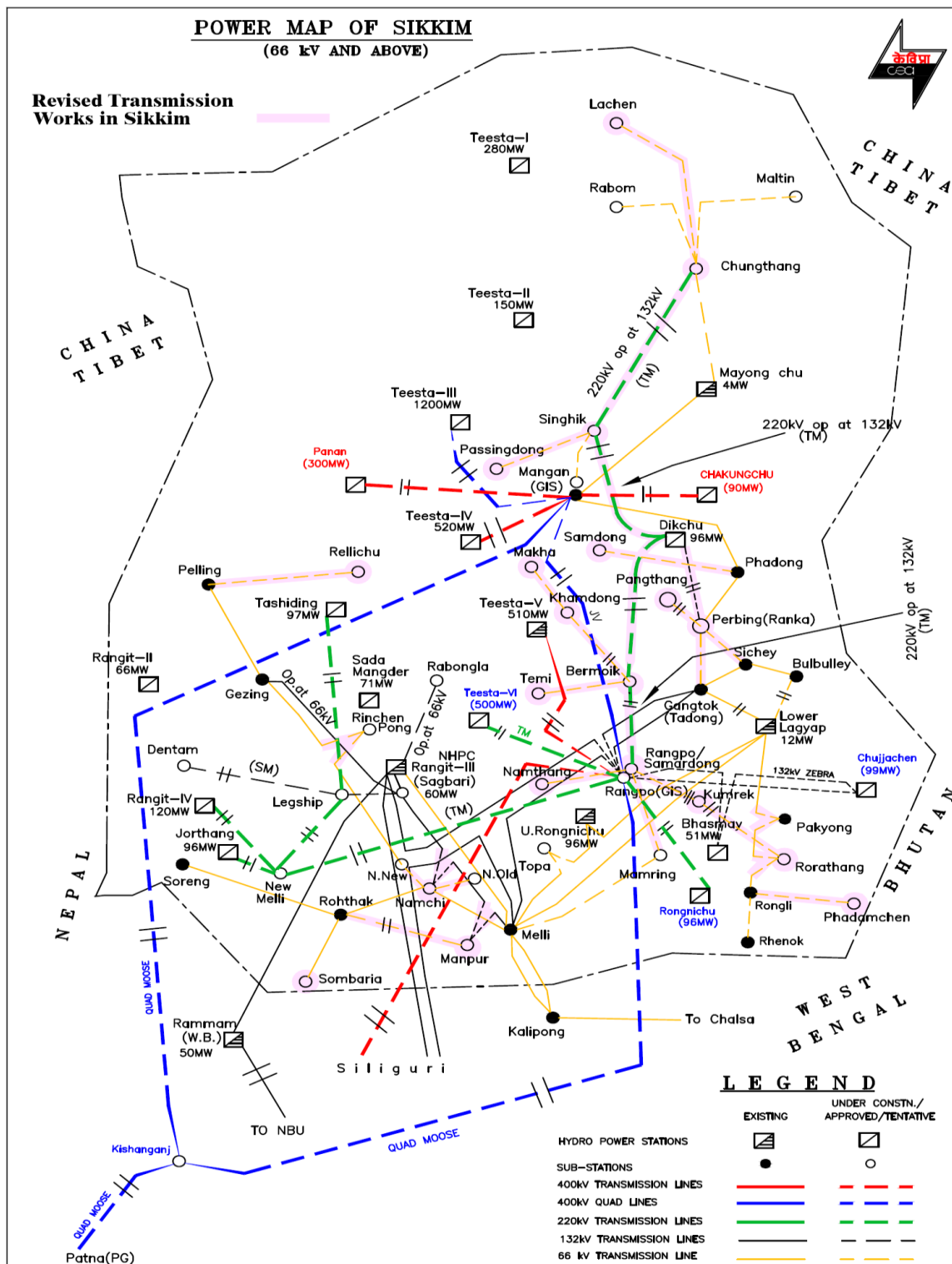
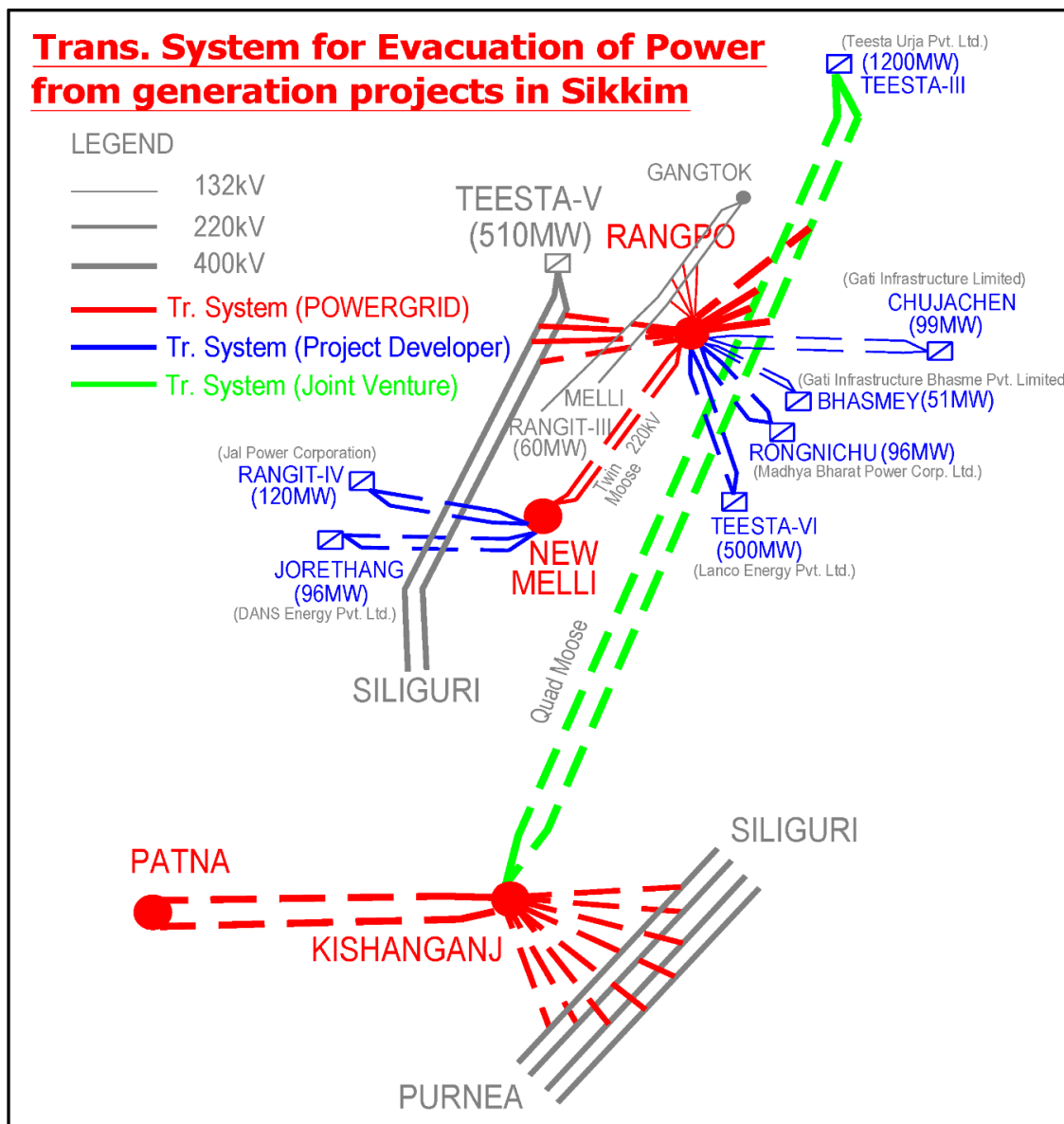


Figure 10: Evacuation plan of IPPS in Sikkim



6. Distribution Plan

6.1. Objectives of the Distribution Plan

The power demand of the State is projected to increase in the FY19 due to natural increase in demand from the present consumer base and more importantly because of the initiatives proposed under this PFA Roadmap which aims to achieve 100% electrification in urban as well as rural areas of the State and provision for 24X7 supply to all consumers. This would require commensurate investments in the sub-transmission and distribution infrastructure.

Accordingly, the objectives of the distribution plan, in accordance with the 24X7 PFA program objectives, includes the following:

- a) Making provision for 24X7 supply to all connected consumers through capacity augmentations and building redundancies in the upstream network for improving reliability of supply;
- b) Ensuring provision of electricity access to over 17,070 rural and urban unconnected households in the State;
- c) Provision of 24X7 supply to demand growth from existing consumers and that arising from new consumer growth in the State;

- d) Making system improvements for reducing AT&C losses in accordance with the targets agreed with the MoP; and
- e) Adopting appropriate technologies and systems to support RE integration and EE/DSM measures in the State.

6.2. Existing Distribution System

EPDS's distribution network comprises of 66 KV and 11 KV sub-transmission systems forming the distribution backbone at the district level and LT distribution systems which deliver electricity to majority of the end consumers. A district wise overview of department's network infrastructure in terms of installed transformation capacity and line lengths of feeders at various voltage levels is provided in Table 31.

Sikkim has made significant progress in expanding electricity access in the past. Presently (2015), 93% urban HHs and 62% of the rural HHs are already electrified. The high rate of urbanization in the past in the past decade is expected to continue due to the continuance socio-economic developmental changes in the State. Figure 12 reflects the rural and urban electrification levels in Sikkim as per 2011 Census data.

Table 31: EPDS, Sikkim – Existing Network Details (March, 2015)

Particulars	Sikkim		East District		West District		North District		South District	
	No.s	Capacity	No.s	Capacity	No.s	Capacity	No.s	Capacity	No.s	Capacity
Transformation Capacity										
66/11 KV Substations (MVA)	19	205	8	107	3	15	2	18	6	65
11 KV/ LT Distribution Transformers (MVA)	2,863	235	930	123	855	47	316	18	762	46
Lines										
HT Feeders (ckt kms.)	-	3,713	-	1,201	-	1,326	-	442	-	745
LT Feeders (ckt kms.)	-	6,918	-	2,021	-	2,171	-	799	-	1,927

Figure 11 : Circle Wise AT&C Losses (FY15)

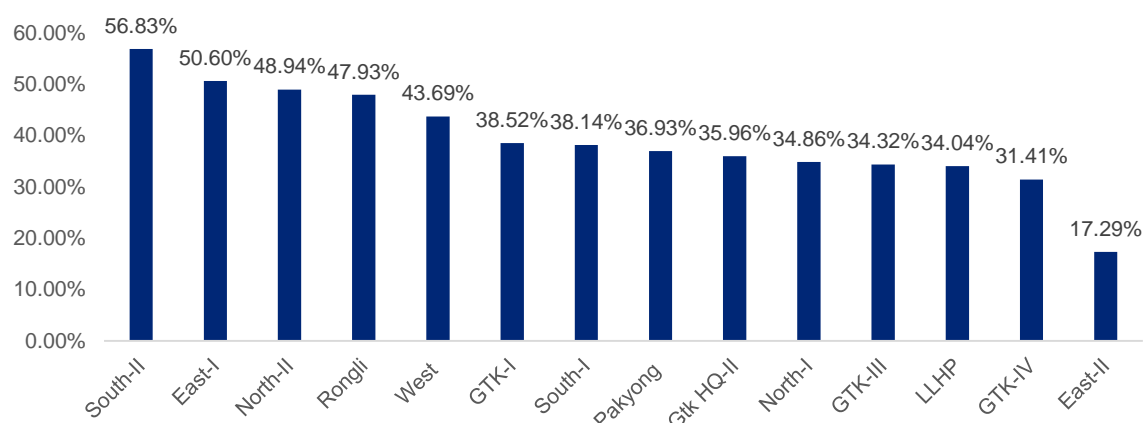
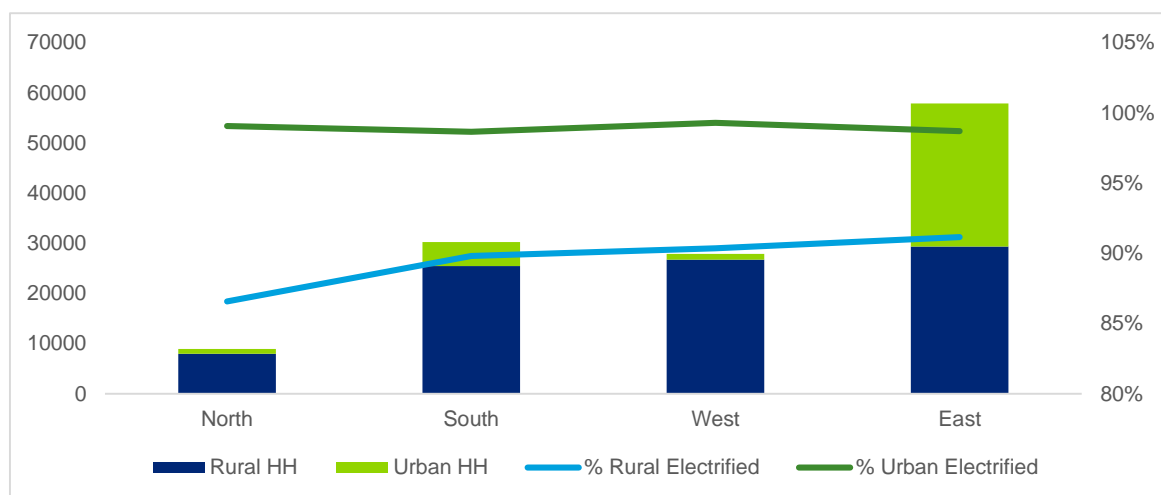


Figure 12: Rural & Urban HH Electrification Levels – Sikkim (2011 Census)



79% of the consumers in the State are metered as of now, while 21% are yet to be metered. 19,445 un-metered domestic consumers account for majority (about 78%) of the total un-metered consumers in the State. Figure 10 presents the metering status across different consumer categories.

AT&C Loss figures for the EPDS have been varying significantly over the past few years, mainly due to fluctuating collection efficiency levels.

DT Failure Rate in the four districts of Sikkim vary between 4% and 13%. North District has the lowest DT failure rate of 4% while South and West Districts have the highest failure rates. Further, the reliability indices presented in Table 32 indicate that the distribution system is available for about 75% of the time. This is mainly due to frequent tripping on overloaded sections of the network combined with natural calamities and difficult terrain. The department has proposed the capacity addition in distribution systems to improve the reliability of the system.

Figure 13: DT Failure Rate in Sikkim

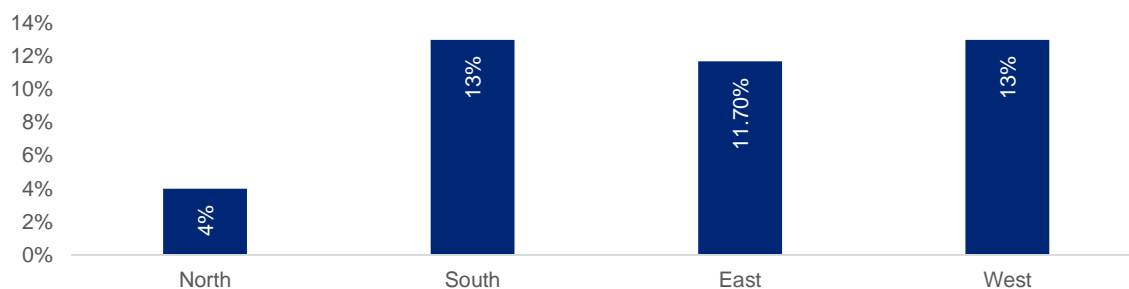


Figure 14: Status of Metering in different Consumer Category

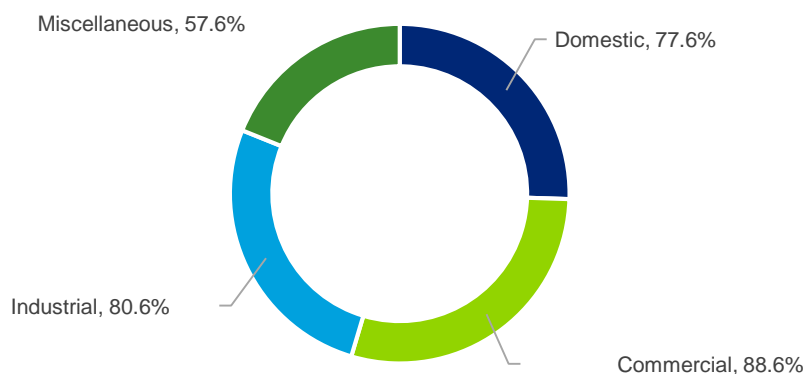


Table 32: Reliability Indices of Sikkim

Sl.	Name of Circle	System Average Interruption Duration Index (SAIDI)=Customer Hours/ No. of Consumer	Average Service Availability Index(ASAI)=((No. of Hours in month-SAIDI)/No. of Hours in Month)x100
1	LLHP Circle	2,402.35	72.55%
2	Mangan North II Circle	2,533.73	71.05%
3	South Circle I (Jorethang)	2,088.07	75.83%
4	Pankyong Circle	2,566.78	70.69%
5	Rongli Circle	2,253.27	74.32%
6	Phodong (North I) Circle	2,186.83	75.01%
7	Rangpo (East II) Circle	2,515.77	71.27%
8	South II (Ravangla) Circle	2,256.93	74.20%
9	West Circle (Gyalshing)	2,519.20	71.20%
10	East Circle I (Topakhani)	2,636.95	69.88%

6.3. Central and State Government Schemes

The objective of the Central/ State Government schemes has been to enhance the reach, reliability and quality of electricity to end consumers and to improve financial position of the utility by way of reducing the AT&C losses. The following schemes are presently underway and are at various stages of implementation in Sikkim, which not only provide the funding assistance but also aim towards enhancing the technical capacity of EPDS.

Deen Dayal Upadhyaya Gram Jyoti Yojana

Under the DDUGJY scheme, EPDS has proposed various network extension, strengthening and augmentation works in order to develop a robust sub-transmission and distribution infrastructure, including provision for providing access to 38,990 consumers in rural areas. The total cost for the proposed plan is approximately Rs. 613 Cr. covering all the four districts of the State. The abstract of the proposed plan is highlighted in Table 33 and the details of the same is provided as Annexure.

Integrated Power Development Scheme (IPDS) and R-APDRP

Under the IPDS Scheme, EPDS has planned extensive improvements its sub-transmission and distribution infrastructure in all urban areas in the four districts of Sikkim. Table 34 provides a summary of the infrastructure works proposed under IPDS. Details of the same are provided in Annexure. The proposed layout under the IPDS scheme has been around Rs. 263 Cr out of which investments worth Rs. 15.21 Cr are approved by the Nodal Agency. The State may have to seek additional assistance in order to complete the proposed strengthening program.

Apart from the IPDS scheme, there are ongoing projects under Part A & B of the RAPDRP scheme with a total estimated cost of Rs. 144.3 Cr. Under Part A of the Scheme works related to preparation of baseline data, metering of 66 and 11 kV feeders, consumer indexing, GIS and asset mapping, establishment of IT based customer service center etc. have already been completed. New DTs installed after January 2013 are being metered and new additions in the infrastructure are planned to be

mapped on to the GIS system in the next phase of the project.

Projects under Part – B of the scheme for Gangtok is presently ongoing and is expected to be completed within FY 16.

Schemes under North Eastern Council

NEC is the nodal agency for the economic and social development of the North Eastern Region. In order to improve the power supply scenario in the north eastern states, NEC is supporting the State of Sikkim to improve, upgrade and modernize its distribution and transmission infrastructure and has sanctioned funding for projects to be taken up during the next four years with a total outlay of Rs. 120.11 Cr.

Table 33: Distribution Infrastructure covered under DDUGJY Scheme

DDUGJY Particulars	New		Augmentation/Replacement	
	Numbers	Capacity	Numbers	Capacity
Transformation Capacity				
66 / 33 KV Substations (MVA)	6	47	0	0
33 KV / 11 KV Substations (MVA)	9	43.35	0	0
11 KV/ LT Distribution Transformers (MVA)	732	24.832	645	53.609
Lines				
33 KV Feeders (ckt kms.)	0	161	0	0
11 KV Feeders (ckt kms.)	0	2,421.66	0	724
LT Feeders (ckt kms.)	0	2,045.51	0	537.57

Table 34: Distribution Infrastructure covered under IPDS Scheme

Particulars	New		Augmentation/Replacement	
	Numbers	Capacity	Numbers	Capacity
Transformation Capacity				
66 / 33 KV Substations (MVA)	169	128	3	6
66 / 11 KV Substations (MVA)	5	50	0	0
33 KV / 11 KV Substations (MVA)	91	89	300	50
11 KV/ LT Distribution Transformers (MVA)	189	60	92	31
Lines				
33 KV Feeders (ckt kms.)	0	64	0	0
11 KV Feeders (ckt kms.)	0	427	0	40
LT Feeders (ckt kms.)	0	675	0	366

Table 35: Details of Projects proposed under NLCPR funding

Sl.	Name of the Project/Schemes	Estimated Project Cost (Rs. Cr.)
1	Up-gradation of Namchi transmission & distribution network with high voltage distribution system (HVDS) under South Sikkim.	22.85
2	Drawing of 11 KV Heavy Duty transmission lines by interconnecting 66/11 KV sub-stations and installation of 11/11 KV sub-station in various strategic locations under Tumin-Lingee, Sang-Rumtek, Martam-Rumtek and Temi-Namphrik Constituencies under Circle in East Sikkim.	27.5
3	Up-gradation, Augmentation and Remodeling of the existing transmission & distribution system of Soreng, Chakung & its surrounding area under Soreng Constituency, West Sikkim.	24.85
4	Automation and computerization of electricity billing system at all billing centres, including software, hardware, indexing, data transfer and all associated items.	12.5
5	Replacement of existing 11 KV 3-ph tr. Line to 11 KV Heavy Duty line on 11 mtrs pole from Mangan to Chungthang, North Sikkim.	17.6
6	Remodeling, modernisation and extension of electrical network at Ranipool Bazar and adjoining areas to underground system including street light upto Rumtek Monestry, Pakyong and surrounding areas in East Sikkim.	27
7	Extension of one 66 KV Bay at 66/11 KV Switch Yard, Pelling along with S/C transmission line from Pelling to Dentam and construction of 66/11 KV, 2x5 MVA sub-station at Dentam in West Sikkim.	22.25
8	Modernization and Conversion of Overhead LT distribution line to underground system at Yangang Bazar in South Sikkim.	9
9	Establishment of 66/11 KV, 2x2.5 MVA sub-station at Machong and 11/11 KV switching centre at Rolep with 11 KV heavy duty line from Machong to Rolep via Chochen Pherry in East Sikkim.	20
10	Drawing of 11 KV heavy duty transmission line from Phodong to Mangan, North Sikkim.	9.02
11	Retrofitting, refurbishment and replacement of aged equipments with renovation of structures for 66/11 KV switchyards at Mamring and Topakhani in East Sikkim.	18.5
12	Strengthening along with replacement of existing conductor by Panther on Double circuit's line from Melli to LLHP and single circuit line from Melli to Mamring.	28

Table 36: Status of R-APDRP projects in Sikkim

Particulars	Sanctioned Amount	Remarks
R-APDRP PART-A		
Value of projects sanctioned	Original sanction: ₹26.30 crore Revised sanction(final): ₹11.63 crore	This covers setting up of IT infrastructure in Gangtok, D.T. & Feeder metering, GIS mapping of assets in Gangtok & Upper Tadong, Consumer Indexing, setting up of Customer Care Centre (CCC) in Gangtok, part expenditure on account of setting up of Data Centre and Data Recovery Centre in Kolkata and Berhampore(W.B.).
R-APDRP PART-B		
No. of projects sanctioned	1	Gangtok (Work in Progress) Upper Tadong (Not sanctioned)
AT&C Loss (%)	Gangtok – 59.12%;	Baseline Figures



Schemes proposed under NLCPR – Non-Lapsable Central Pool of Resource (DoNER)

In order to improve the reliability of sub-transmission and distribution system and to supply 24x7 power to consumers, EPDS has proposed projects proposed to be funded by NLCPR (DoNER). Details of the projects and the estimated cost is provided in Table 35.

Schemes proposed under Border Area Development Program (BADP)

Various projects have been proposed for the development of distribution infrastructure in areas where Sikkim shares borders with Nepal, Bhutan and Tibet, primarily focusing on socio-economic development of the people and creating a secure environment in the these areas. These projects are proposed to be taken up in the coming years to augment, renovate and upgrade the existing system with an estimated cost of Rs. 58.3 Cr.

Additionally, there are 6 ongoing projects under the BADP with a layout of Rs. 9.74 Cr. Details of the proposed and upcoming projects are provided in the Annexure.

Schemes proposed under Additional Central Assistance

Under the ACA Scheme, projects with an estimated cost of Rs. 92.55 Cr. are proposed. Projects under the scheme emphasize on extension, strengthening, upgradation, renovation, and refurbishment of the existing distribution infrastructure thereby providing adequate and reliable power supply to end consumers. Details of the proposed projects is provided in the Annexure.

Schemes for non-IPDS areas and other schemes

EPDS has identified some areas which need system strengthening to meet the upcoming demand. These areas are predominantly rural

localities and need investments on the line of IPDS. The works include installation of 66/11 and 33/11 kV substations and laying of new lines (LT and HT) along with associated DTs. The total fund required under these works are about Rs. 225 Cr.

Further, the EPDS requires an amount of Rs. 57 Cr. for establishment of a training center, renovation of buildings and DPH Gangtok. The department is yet to identify source of funds to carry out these works.

6.4. Funding Plan

The following table shows the funding requirement for the distribution system investment proposals described above.

Table 37: Fund Requirement in Rs. Cr. under various schemes

Scheme	FY16	FY17	FY18	FY19	Total
IPDS (Requisitioned)	40	120	103	0	263
DDUGJY (Requisitioned)	184	184	245	0	613
NEC+NLCPR	78	118	157	39	392
ACA+BADP	30	45	60	19	154
Non-IPDS areas	45	45	67	67	225
Other Schemes	57	0	0	0	57
Total	434	512	632	125	1704

The total fund requirement for the distribution system works in the state is about Rs. 1,704 Cr, a significant proportion of which is expected to be funded through the Central Government Schemes (DDUGJY and IPDS).

While funds are available for all schemes, EPDS is yet to identify sources of funds for “non-IPDS scheme” and “other schemes”. The total amount under these two schemes is Rs. 282 Cr. Further, the state would require the unapproved portion of the IPDS. The total fund requirement stands at 529.79 assuming the state will be able to secure the requisitioned amount under DDUGJY.

It may be noted that the proposed investment plan is drawn from the need assessment document of the State. Further, the funds availability and gap information will be available once the DPRs of the

proposed projects are confirmed/ approved by the respective Nodal Agencies

6.5. Rollout Plan

Table 38 shows the infrastructure roll-out plan for EPDS.

6.6. Action Plan & Support Require

In line with the proposed distribution plan, the action points outlined in Table 39 have been identified for respective stakeholders to be able to make suitable arrangements for strengthening the distribution function of the State in accordance with the requirements of the PFA Roadmap. Further, the State should approach GOI/ other agencies for providing funds corresponding to the unapproved part of IPDS and DDUGJY (if Any).

Table 38: Distribution Infrastructure rollout plan for Sikkim

Item	Capacity at the end of FY 15	FY 16	FY 17	FY 18	FY 19	Total	FY 19 Capacity
66 /33/11 KV Substations (MVA)	405	24	21	31	41	116	521
66 /33/11 KV Substations Nos	72	28	56	85	113	282	354
11 KV/ LT DTs (MVA)	469	18	35	53	71	176	644
11 KV/ LT DT (Nos)	5,726	79	158	237	316	791	6,517
HT (33&11 kV) Feeders (ckt kms.)	7,427	159	318	477	635	1,589	9,015
LT Feeders (ckt kms.)	13,837	223	445	668	891	2,226	16,063

Table 39: Action Points & Timelines

Stakeholder	Action Points
EPDS	<ul style="list-style-type: none"> 100% electronic metering with AMR of commercial and industrial consumers by July, 2016. This is considered essential in view of the continuance of high AT&C losses despite having a favourable sales mix from industrial/ HT consumers in the State. 100% metering of Domestic consumers by December, 2016. The EPDS shall prepare a detailed AT&C loss reduction plan within 6 months of signing of this Roadmap for ensuring the MoP targets on the same are achieved by the State. Preparation of DPRs for non - IPDS town by March 2016 Establishment of Energy Auditing and Energy Accounting cell for monitoring of commercial and technical losses in the system.
PFC / REC	<ul style="list-style-type: none"> To provide suitable financing options for proposals/ projects not covered under the Central Government schemes.

7. Renewable Energy Plan

7.1. Introduction

Sikkim Renewable Energy Development Agency (SREDA) is the Nodal Agency for development of renewable energy in the State of Sikkim. The State has positioned itself as a favorable destination for renewable energy projects. The RE power potential for Sikkim has been assessed at about 5,307 MW. Presently, the State has an installed capacity of 52 MW from RE sources.

To develop and exploit the State's huge hydro power potential, Government of Sikkim has awarded several projects with cumulative capacities ranging up to 3600 MW (*Please refer Chapter 4 – Generation Plan*) to independent power producers.

The State's annual energy demand is expected to increase from 395 MU in FY15 to 697 MU in FY19. The contribution of renewable energy by the end of this period is expected to be 8.5% of the energy requirement for the State. Most of the renewable energy consumed by the State is expected to be sourced from the state's own SHPs.

While the State awaits a policy for promotion of investments of renewable energy projects, the Sikkim State Electricity Regulatory Commission has come out with draft regulations (SSERC Grid Interactive Distributed Solar Energy Systems) Regulations 2014 for grid connected solar PV systems. The proposed regulatory framework provides an opportunity for the consumer to opt for Net Metering scheme and offset his electricity consumption by means of rooftop solar PV systems.

The SSERC is also to notify final regulations for establishing Renewable Purchase Obligations (RPO) for the EPDS. The following sub-sections of this chapter elaborate on the RE generation related plans of various agencies in the State.

7.2. Existing Renewable Energy Sources

Source wise break-up of RE generation potential in Sikkim is shown in Table 40.

Table 40: Source wise RE potential in Sikkim

Source	Potential
Wind	98 MW
Bio Mass	2 MW
Solar	4,940 MWp
SHP	267 MW

EPDS and Sikkim Power Development Corporation Limited (SPDCL) are engaged in development of SHPs in the State. Projects of capacity 25 MW and above are awarded to IPP's and private players and the State charges royalty from these players in the form of free power. State owned SHPs are listed in Table 41.

Table 41: List of SHPs owned by EPDS

Sl.	Name of Plant	Installed Capacity (MW)
1	LLHP	2x6.00
2	JPH	6x0.35
3	Rimbi-I	2x0.20
4	Rimbi-II	2x0.50
5	Rothak	2x0.10
6	Rongnichu	5x0.50
7	Chaten	2x0.05
8	Meyongchu	2x2.00

Sl.	Name of Plant	Installed Capacity (MW)
9	URHP	4x2.00
10	Kalez	2x1.00
11	Lachung	2x0.10
12	Rabomchu	2x1.50
13	Lachung HE Project	2x1.5
14	Manglay H.E Project	2x1
15	Rongli H.E Project	2x2.5
Total		45.50

7.3. RE Plan

EPDS

A total of 69 MW from 13 SHPs are proposed to be added by EPDS at an estimated investment of Rs. 1035 crores. The details of the proposed capacity addition are shown in the Table 43.

Additionally, the EPDS has proposed to undertake R&M/ augmentation works on 8 old SHPs with a total capacity of 15.20 MW as outlined in Table 42. These investments will not only provide an additional benefit of 3.8 MW but also improve PLF of the old SHPs which have become non-functional over the years.

Table 42: R&M and Augmentation Projects Proposed by EPDS

Project	Capacity	Augmentation	Cost (Rs. Cr.)
Meyongchu HEP to 3 x 2 MW, North Sikkim	2X2 MW		2.00
Rabomchu HEP to 4 x 1.5 MW, North Sikkim	2X1.5 MW	4x1.5 MW	25.00
Lachung stage-I to 2 x 500 KW, North Sikkim	2X100 KW	2x500 KW	8.00
Rimbi State-I, West Sikkim	2X200 KW		1.00
Rimbi State-II, West Sikkim	2X500 KW		1.00
KKHEP, Dentam, West Sikkim	2X1000 KW		2.00
Jali Power House, East Sikkim	350X6 KW		0.50

Project	Capacity	Augmentation	Cost (Rs. Cr.)
Rongnichu State-II HEP, East Sikkim	500X5 KW		2.00
Total	15.20 MW		41.50

SPDC

SPDC is currently undertaking construction of 2 projects totaling 15 MW capacity. Further, SPDC has proposed to undertake construction of 29.25 MW capacity, expected to be commissioned by FY22. These projects are listed in Table 44.

Table 43: New plants proposed in Sikkim under EPDS

Name of Plant	Capacity (MW)	Cost (Rs. Cr.)
2 x 2.5 MW Rin Chu Small Hydel, North Sikkim	5	75
6 x 4 MW Taram Chu Micro Hydel, North Sikkim	24	360
2 x 2.5 MW Taryang Chu Micro Hydel, North Sikkim	5	75
2 x 1.5 MW Lingza Chu Micro Hydel, North Sikkim	3	45
0.5 x 2 MW Ringyang HEP, North Sikkim	1	15
1 x 2 MW Kissim Khola HEP, South Sikkim	2	30
1.5 x 2 MW Sarchokchu HEP, North Sikkim	3	45
0.5 MW Hee Khola HEP, West Sikkim	0.5	7.5
0.5 MW Dentam Khola HEP, West Sikkim	0.5	7.5
0.5 x 2 MW Esanglay Khola HEP, West Sikkim	1	15
2 x 3.5 MW Chuba HEP, East Sikkim	7	105
2 x 2.5 MW Upper Rongli HEP, East Sikkim	5	75
4 x 3 MW Upper Rimbi HEP, West Sikkim	12	180
Total	69	1,035

Table 44: Proposed Capacity Addition by SPDC

Name of Plant	Capacity	Status /COD
Chettan H. E Project (Under Const.)	3 MW	Under Cons (by 2018)
Relli Chu, West Sikkim	12 MW	Under Cons
Chuba HEP	7 MW	By 2019
Upper Rongli HEP	5 MW	By 2020

Name of Plant	Capacity	Status /COD
Upper Rimbi HEP	12 MW	By 2021
Ramphok Chu HEP	5.25 MW	By 2022

SREDA

SREDA has proposed installation of solar powered projects in the State with a cumulative capacity of 2.5 MW during the period FY 14-19. As of now, 11 projects have been sanctioned with a total capacity of 0.7 MW at an estimated cost of Rs 15 Cr. These projects will be executed on VGF basis and 90% of the funding is proposed to be provided by Central Government. Details of project is provided in Table 45.

As per MNRE's targets for 175 GW of RE capacity for India by 2022. Sikkim's share of RE is 86 MW by 2022. In this plan the state is expected to add 36 MW of solar power and 50 MW of SHPs by 2022. SREDA is currently pursuing installation of 7.5 MW of Solar Roof Top and 10 MW of ground based Solar power projects. SREDA/EPDS will make revisions, in the RE capacity addition targets for the period up to by FY19 in consultation with the MNRE, within 3 months of signing of this Roadmap.

7.4. Projected Energy Generation from RE sources

Renewable energy penetration is expected to reach 8.5% of the energy purchased in FY19. It is expected that the state will consider increasing its

share of RE in the overall quantum of power purchase in the coming years, given the high potential of RE sources in the State.

7.5. Fund Requirement of Renewable Energy Plan

The total fund requirement for the RE investments proposed by EPDS, SPDC and SREDA till FY22 is estimated at about Rs. 1611 Crs. The agencies are still evaluating the extent of support that can be received from available capital subsidy schemes of the MNRE for a large proportion of the proposed investments. The respective agencies will finalize the funding plan for the proposed investments within 3 months of signing of this document, including consideration of alternative mechanisms such as PPP etc.

7.6. Action Plan & Support Required

Action Plan	State to finalize RE capacity addition plan for FY16 to FY19 in consultation with MNRE by July, 2016. Plans for achieving solar power purchase target of 8% by 2022 as per the latest amendment of Tariff Policy SPDC, EPDS and SREDA to finalize the funding plan till FY19 for the proposed capacity additions within 3 months of signing of this document, including consideration of alternative mechanisms such as PPP etc.
Support Required	MNRE, GoI to support proposed solar plant development through 90% VGF support to eligible projects on priority.

Table 45: Details of existing Solar Powered Projects

Sl.	Project	Capacity (MW)	District	Estimated Cost (Rs. Cr.)
1	20 kWp at State Assembly	0.02	East	0.42
2	30 kWp at Raj Bhawan	0.03	East	0.63
3	51 kWp at Namchi District Hospital	0.051	South	1.071
4	64 kWp at Samman Bhawan	0.064	East	1.344
5	100 kWp at Govt College, Tadong	0.1	East	2.1
6	100 kWp at Govt College, Kamrang	0.1	South	2.1



Sl.	Project	Capacity (MW)	District	Estimated Cost (Rs. Cr.)
7	100 kWp at SICB, Karfectar	0.1	South	2.1
8	100 kWp at SIRD, Karfectar	0.1	South	2.1
9	100 kWp at IHM	0.1	East	2.1
10	2 kWp at Tumlong	0.002	North	0.42
11	2 kWp at Lalchen	0.002	North	0.42

Table 46: Proposed Solar Power Plants

Sl.	Solar Power Plants	Capacity (MW)	Amount (Rs. Cr.)
1	Roof top Scheme on Government Building & Municipal Areas	7.5 MW	60
2	Ground Based Projects	10 MW	80
Total		17.50 MW	140

8. Energy Efficiency Plan

8.1. Energy Efficiency Plan

To promote energy efficiency and conservation measures in the State, Government of Sikkim is conducting awareness programs among all categories of consumers. The State is planning to study the system peak demand to assess the potential of energy efficiency programs.

The EPDS has been declared as the State Designated Agency (SDA) to co-ordinate, regulate and enforce the Energy Conservation Act, 2001 within the State of Sikkim. The role of SDA is to create general awareness among masses on benefits of energy conservation measures and to institutionalize energy efficiency project implementations in domestic, commercial and industrial segments.

The State has planned following measures for DSM implementation:

- LED Village program: Penetration of LEDs lights and metering of all subsidized rural domestic consumers and LED Street lighting.

- Mandating use of star rated equipment like transformers, motors, and pumps etc.
- Use of LEDs in public lighting, advocating use of LED bulbs in domestic, commercial and government establishments.
- Installation of capacitors have been made compulsory for all industries.
- Metering of all consumers with electronic energy meters.

Government of Sikkim has created a State Energy Conservation Fund which will be used for creating awareness, promotion and implementation of energy conservation measures in the State. The State also seeks 90% Central Government contribution in the fund so as to properly initiate the plan. It also seeks subsidy support for LED street lights, LED village program, DSM studies and energy awareness, training and IT implementation. Details of the fund requirement by the State under DSM/ EE initiatives is outlined in Table 47

Table 47: Fund Requirement for Energy Efficiency Programs

Sl.	Program	Fund Requirements (Rs. Cr.)			
		FY16	FY17	FY18	FY19
1	LED Village Campaign				
	West District & North District (5 Village / district)	0.5	0.5	0.5	0.5
	East District & South District (5 Village / district)	0.5	0.5	0.5	0.5
2	Replacement of 90 & 250 watt Sodium vapour lamp by LED (urban areas of all four district)	5	5	5	5
3	DSM study program in Distilleries & Pharmaceuticals, Sikkim supreme etc. in all the four districts		0.5		
4	Information Technology Support		0.05	0.05	0.05



PFA Roadmap - Sikkim



Sl.	Program	Fund Requirements (Rs. Cr.)			
		FY16	FY17	FY18	FY19
5	Training of SDA personal for energy conservation		0.1	0.1	0.1
6	Energy Conservation awareness program to general public and distribution of LED bulbs		0.25	0.25	0.25
7	Establishment of Energy Clubs in school in all four districts		0.1	0.1	0.1
Total		6	7.00	6.50	6.50

9. Financial Position of Utility(EPDS)

9.1. Introduction

The Department of Power (EPDS) is functioning as a vertically integrated utility in Sikkim. As it is State Govt. department, it does not maintain commercial accounts. Thus the true financial position of the sector is difficult to evaluate. Expenditure is incurred against the grants as approved by the state Legislative. All accounting formats, registers etc. used are as per Government Accounting norms. Since it does not operate accounts under Double Entry System as followed in Commercial Accounting by Boards / Corporations, the Balance Sheet, Profit & Loss Accounts statement etc. are not prepared.

Further, the commercial performance of the utility shows that the current level of AT&C loss is about 44% which is much higher than the national average. Most of these losses are due to the low billing efficiency and low collection efficiency in the state.

To improve the financial and operational performance the state has proposed investment of Rs. 1,704 Cr. for expanding access, improving quality and reducing losses. Based on the investments, the state has projected AT&C losses to reduce to 24% by FY 19 in this roadmap.

9.2. Commercial Viability

As per the tariff order issued by Sikkim State Electricity Regulatory Commission (SSERC), for FY 16, the approved Average Billing Rate (ABR) of EPDS is Rs.4.28/kWh and the Average Cost of Supply (ACS) is Rs.4.54/kWh. It is important to

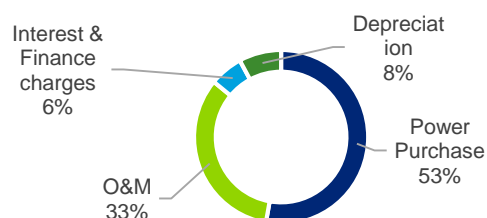
mention here that the ACS approved by SSERC is post disallowances and may not be reflective of the actual ACS. As per the recently submitted APR for FY16, the ACS has been estimated by EPDS to be Rs. 8.80/kWh.

This indicates that EPDS will need to reduce AT&C losses and simultaneously develop a plan to offset the losses by managing the additional power available to the state. The utility has planned activities under IPDS which will help in bringing down the losses of the utility.

9.3. Present Financial Performance

The latest APR filing by the utility suggests that the gap between the ACS and ABR has increased the losses of the utility. As per the provisional annual accounts for FY 15, O&M costs account for about 33% of the total expenses, this is on account of low consumer density and geographical constraints requiring higher O&M expenditure.

Figure 15: Share of expenses for EPDS FY 2014-15



The share of expenses in total capital expenditure is presented in Figure 15.

9.4. Financial Projections

In order to estimate the impact of PFA program on the financials of a utility, it is pertinent to assess the incidental cost of the program vis-à-vis the potential of generating additional revenue due increase in energy sales. As the utility progresses on achieving

reduction in AT&C losses, the gap between average cost of supply and average realization is expected to shrink. In line with above, an analysis has been carried out to assess the cost impact of the PFA program on tariff as well as financials of the utility. Table 48 presents the assumptions which form the basis for such projections.

Table 48: Key Common Assumptions underlying financial analysis

Particulars		Assumptions														
Power purchase	<ul style="list-style-type: none">The firm allocation from the Central Generating Stations shall remain stable at current levels (July 2015) over the period of projection (FY16 to FY19)Commissioning of new plants in State sector assumed as per State's projectionsCommissioning of new plants of central sector as per CEA's monitoring reports															
Power Purchase Rate	<ul style="list-style-type: none">The present stations have been projected at current PP Rate as per the tariff petition of EPDSRate of power purchase from new generating stations are projected at Rs.4.5/kWh for CGS and Rs. 4.00/kWh for upcoming Hydro IPPs, as estimated by EPDS.Allocation from un-allocated capacity of CGS has not been considered.															
Surplus power purchase and sale	<ul style="list-style-type: none">Energy available beyond the requirement has been considered to be sold outside State at the input cost for base caseA separate scenario has been prepared considering the base case assumptions to assess the impact of power purchase portfolio optimization, whereby surplus power is sold at expected market rates of Rs.3.50/kWh.															
Revenue and Sales growth	<ul style="list-style-type: none">Revenue calculations based on average billing rate projected by EPDS for FY16 for domestic, BPL and other than domestic & BPL consumers, based on the Annual Performance Review submitted to SSERC.Sales growth of domestic consumer and BPL consumers is as per projections in Power Supply Scenario (Chapter 3)Energy sales growth of other than domestic consumers is 22.5% (YoY)															
AT&C Losses (%)	<ul style="list-style-type: none">AT&C Loss projections as per following trajectory: <table><tr><th>Particulars</th><th>FY16</th><th>FY17</th><th>FY18</th><th>FY19</th></tr><tr><td>AT&C Loss (%)</td><td>39.56%</td><td>34.53%</td><td>29.50%</td><td>24.00%</td></tr></table>						Particulars	FY16	FY17	FY18	FY19	AT&C Loss (%)	39.56%	34.53%	29.50%	24.00%
Particulars	FY16	FY17	FY18	FY19												
AT&C Loss (%)	39.56%	34.53%	29.50%	24.00%												
Capex & capitalization	<ul style="list-style-type: none">Capex as per budgeted plans and requirement to fulfill PFA targets of EPDSCapitalization based on capitalization plan provided by EPDS															
Employee cost, R&M, A&G costs	<ul style="list-style-type: none">Employee cost: Based on employee cost for FY15 with escalation of 10% YoY over the period of projection (FY 16 to FY19) considering the CPI, while only for FY17, 15% escalation has been considered to factor the proposed pay revision (7th Pay Commission)A&G cost: Based on A&G cost for FY15 with escalation of 6% p.a. over the period of projection (FY 16 to FY19)R&M cost is estimated as 1% of GFA, in line with SSERC Tariff Regulations															
Depreciation	<ul style="list-style-type: none">For existing assets: Based on the existing rate of depreciationFor new assets: SSERC approved rate of depreciation															

Particulars	Assumptions
Funding of capital expenditure and financing terms	<ul style="list-style-type: none"> Capital expenditure to be funded through grant, debt & equity based on schemes under which it has been proposed. Under DDUGJY and IPDS, the capital expenditure is funded through mix of grant, debt and equity in the ratio of 85%, 10% and 5%, respectively. An additional grant of 5% is also considered to be available after 2 years, considered to be utilized towards retiring debt. Unapproved capital expenditure under proposed schemes to be funded through debt equity in the ratio of 70:30. For other ongoing schemes, funding is based on the tied up debt, equity and envisaged grant portion. For any untied expenditure, debt and equity in the ratio of 70:30 has been considered. Repayment schedule of 10 years Interest on existing debt is considered to be based on weighted average existing interest rate, estimate to be 10% Interest on new debt considered to be 12.25%, Debt to Equity ratio assumed at 70:30 under no grants scenario, only for schemes under which funds have already not been tied up, such as DDUGJY and IPDS
Working capital and cash deficit loan	<ul style="list-style-type: none"> Working capital requirement has been estimated as per regulatory provisions Working capital loan assumed at 13.5% Cash deficit during the year is assumed to be funded from short term loan @ 13.5%p.a.
Miscellaneous Expenses	<ul style="list-style-type: none"> For FY 16 to FY 19 miscellaneous expenses considered in proportion to the O&M cost Other prior period expenses have not been considered in the financial projections
Regulatory parameters	<ul style="list-style-type: none"> No disallowance in power purchase or any other cost element No regulatory assets of past have been considered

Table 49: Impact of Asset addition (Rs Cr.)

Particulars	FY 16	FY 17	FY 18	FY 19
Capital expenditure	456	510	680	58
Grants	268.7	323.0	440.1	67.6
Debt	130.1	130.1	164	-9.4
Equity	57.1	57.1	76.1	0.0
Depreciation on additional assets	3.65	11.81	22.18	23.31
Interest on debt – corresponding to PFA capex	8.62	22.05	35.76	39.98
Return on equity - corresponding to PFA capex	4.43	13.28	23.60	29.50
Total capex related Cost	16.69	47.13	81.54	92.79

Table 50: Parameters for base case

Particulars	Units	FY 16	FY 17	FY 18	FY 19
Energy related parameters					
Sales	MUs	352.35	411.89	483.76	557.42
Energy required	MUs	536.3	585.1	645.0	696.8
Energy available	MUs	1,067.7	2,273.3	2,656.5	2,760.7

Particulars	Units	FY 16	FY 17	FY 18	FY 19
Energy surplus /(shortage)	MUs	531.4	1,688.2	2,011.5	2,063.9
T&D losses	%age	34.3%	29.6%	25.0%	20.0%
AT&C Losses	%age	39.6%	34.5%	29.5%	24.0%
Power purchase cost (inc transmission charges)	Rs./kWh	1.72	0.81	0.69	0.70
Revenue & expenditure parameters					
Tariff Increase	%age	0%	0%	0%	0%
Collection efficiency	%age	92%	93%	94%	95%
Average billing rate - Domestic	Rs./kWh	2.46	2.46	2.46	2.46
Average billing rate - Other than domestic (weighted avg.)	Rs./kWh	5.71	5.71	5.71	5.71
Employee cost escalation	%age	10.0%	15.0%	10.0%	10.0%
A&G cost escalation	%age	6.0%	6.0%	6.0%	6.0%

The likely impact of PFA program in terms of cost incurred due to asset additions is detailed in Table 49. The key parameters considered for developing the base case scenario are discussed in Table 50 and the likely impact of PFA program on tariff is reflected in Table 51. This impact is due to existing gap of incidental cost of providing additional power and revenue generated due to increase in energy sales, as well as the incidental cost related to capital expenditure. The tariff impact is expected to remain in the range of Rs. 2.06/kWh in FY16 to Rs.1.39/kWh in FY19 as can be seen in Table 51. The key reason behind the reduction in tariff impact is the overall reduction in power purchase cost due to availability of free power. The power purchase rate is expected to reduce to 0.7 Rs./kWh as the state utility is expecting large quantum of free power (12% royalty) from the IPPs coming up during the period.

Therefore, in the base case, the financial statements of EPDS have been prepared considering that the per unit power purchase cost and tariff shall remain at the

present levels, while the impact of other incidental cost is accounted.

As can be seen in profit & loss statement provided in Table 52, the utility is able to book positive PAT during the period FY 17 to FY 19, as the reduction in overall power purchase cost positively impacts the profitability. It is important to mention here that a significant part of surplus power being procured by utility shall be at zero cost, however the surplus power being sold outside state is assumed to be sold at average power purchase rate, thus generating additional revenue for utility against which there is no cost that has been incurred. Hence, due to higher quantum of sales outside state, higher sales in the subsidizing category of consumers (Commercial and Industrial) and lower power purchase cost the utility's finances show a positive PAT from FY17 onwards. This can be observed from the fact that projected profit in FY 19 is Rs 14 Cr., higher than the projected losses of Rs 39 Cr. in FY 16.

Table 51: Tariff Impact of PFA

Particulars	Derivation	FY 16	FY 17	FY 18	FY 19
Additional recovery due to incremental energy sales (Rs. Cr.)	A	45	74	109	149
Incremental power purchase cost (inc. transmission charges and incremental transmission cost due to PFA program (Rs. Cr.)	B	24	15	17	21

Particulars	Derivation	FY 16	FY 17	FY 18	FY 19
Add: Cost related to capital expenditure (interest, depreciation and equity return, Rs. Cr.)	B1	21	46	80	92
Add: Incremental O&M cost & Working capital cost		72	87	101	114
Gap of additional cost and additional recovery	C=(B+B1-A)	73	74	89	78
Energy sales (MU)	D	352	412	484	557
Cumulative Impact on tariff (Rs./kWh)		2.06	1.80	1.84	1.39

Table 52: Projected profit and loss statement – Base Case (Rs. Cr.)

Particulars	FY16	Projected FY17	FY18	FY19
Revenue				
Revenue from Sale of Power within State	151	181	216	256
Revenue from Sale of Power Outside State	92	136	139	145
Total revenue	243	317	355	401
Expenditure				
Power Purchase cost	184	184	184	194
O&M Cost	69	81	94	105
Employee cost	56	65	71	79
A&G expenses	3	3	3	3
R&M expenses	9	13	19	23
EBIDTA	(10)	52	78	102
Depreciation	12	20	30	31
Interest and finance charges	18	28	43	49
Interest on Working Capital	4	6	7	9
Interest on Cash deficit Loan	5	-	-	-
Interest – Long Term	9	22	36	40
Miscellaneous	-	-	-	-
PBT	(39)	5	5	22
Provision for tax	-	2	2	7
PAT	(39)	3	3	14

9.5. Scenario Analysis

Any change in tariff or under achievement of AT&C losses considered for the base case or non-availability of funding in form of grants will translate into additional impact on the financial position of the utility. The impact of existing accumulated losses of EPDS or the impact of purchase and sale of surplus power available to EPDS also need to be evaluated. Therefore, analysis under following scenarios have been carried out:

1. Increase in tariff to ensure that utility becomes viable by FY19.
2. Non-Availability of grants under the schemes where DPRs are not finalized (available only to the extent approved as per DPR) to fund the capital expenditure.
3. Under achievement of AT&C loss targets: Considering same T&D loss level as in FY15, till FY19.

4. Impact of trading: Impact on utility's finances in case the utility is able to tie up its surplus capacity through medium term PPAs.

Scenario 1: Increase in tariff required for the utility to become viable

As power purchase cost is likely to decline from Rs. 1.72/kWh to Rs. 0.70/kWh from FY 16 to FY19 and utility shall generate additional revenue from sale of surplus power outside state at average power purchase rate against which there is no cost is being incurred, the utility is expected to remain viable from FY17 onwards.

Thus, in such a scenario, no tariff hike may be required as the utility is expected to be financially viable having positive PAT (YoY) by FY17.

Scenario 2: Non-Availability of grants (funding of capital expenditure through grants under various government schemes)

The dependence of utility on funding of the proposed investments through various State and Central Government schemes can be assessed by the impact on utility's finances under a scenario where grant funding is not available. Under this scenario, the grant availability for the upcoming Central Government schemes including IPDS and DDUGJY, where the DPRs have not been finalized, has been considered to be nil. While, for the ongoing schemes where the funds have already been committed by the State or Central Government, the grants are considered to be as envisaged in the respective schemes.

Table 53 on the following page summarizes the key parameters underlying the analysis and the impact on tariff has been detailed in Table 54

The impact of availability of grants for funding the capital expenditure on the P&L accounts of EPDS, is summarized in Table 54.

Table 53: Parameters for Scenario 2 (Non-Availability of grants)

Particulars	Units	FY 16	FY 17	FY 18	FY 19
Energy related parameters					
Sales	MUs	352.35	411.89	483.76	557.42
Energy required	MUs	536.3	585.1	645.0	696.8
Energy available	MUs	1,067.7	2,273.3	2,656.5	2,760.7
Energy surplus /(shortage)	MUs	531.4	1,688.2	2,011.5	2,063.9
T&D losses	%age	34.3%	29.6%	25.0%	20.0%
AT&C Losses	%age	39.6%	34.5%	29.5%	24.0%
Power purchase cost	Rs./kWh	1.72	0.81	0.69	0.70
Revenue & expenditure parameters					
Tariff Increase	%age	0%	0%	0%	0%
Collection efficiency	%age	92%	93%	94%	95%
Average billing rate - Domestic	Rs./kWh	2.46	2.46	2.46	2.46
Average billing rate - Other than domestic (weighted avg.)	Rs./kWh	5.71	5.71	5.71	5.71
Employee cost escalation	%age	10.0%	15.0%	10.0%	10.0%
A&G cost escalation	%age	6.0%	6.0%	6.0%	6.0%

Table 54: Impact on tariff due to PFA – Scenario 2

Particulars	Derivation	FY 16	FY 17	FY 18	FY 19
Additional recovery due to incremental energy sales (Rs. Cr.)	A	45	74	109	149
Incremental power purchase cost (inc. transmission charges and incremental transmission cost due to PFA program (Rs. Cr.)	B	24	15	17	21
Add: Cost related to capital expenditure (interest, depreciation and equity return, Rs. Cr.)	B1	37	95	170	206
Add: Incremental O&M cost & Working capital cost	B2	72	87	101	114
Gap of additional cost and additional recovery	C=(B+B1+B2 - A)	89	124	179	192
Energy sales (MU)	D	352	412	484	557
Cumulative Impact on tariff (Rs./kWh)		2.53	3.01	3.70	3.44

Table 55: Profit and Loss statement - Scenario 2 (Rs. Cr.)

Particulars	FY16	Projected FY17	FY18	FY19
Revenue				
Revenue from Sale of Power within State	151	181	216	256
Revenue from Sale of Power outside State	92	136	139	145
Total revenue	243	317	355	401
Expenditure				
Power Purchase cost	184	184	184	194
O&M Cost	69	81	94	105
Employee cost	56	65	71	79
A&G expenses	3	3	3	3
R&M expenses	9	13	19	23
EBIDTA	(10)	52	78	102
Depreciation	15	32	55	67
Interest and finance charges	26	51	84	96
Interest on Working Capital	4	6	7	9
Interest on Cash deficit Loan	6	2	3	1
Interest – Long Term	16	44	74	86
Miscellaneous	-	-	-	-
PBT	(51)	(31)	(61)	(61)
Provision for tax	-	-	-	-
PAT	(51)	(31)	(61)	(61)

As can be seen in Table 54 the impact on tariff is expected to increase due to non-availability of grants to fund the capital expenditure. The tariff impact for in

such scenario is estimated to range between Rs.2.53/kWh to Rs.3.44/kWh as against the range of Rs. 2.06/kWh to Rs.1.39/kWh in base case scenario.

Table 55 presents the projected profit and loss statement of EPDS under this scenario.

As can be seen above, the annual financial losses of EPDS are expected to increase to Rs. 61 Cr. in FY19 as against the profit of Rs. 14 Cr. under the base case.

Further, as the utility's cost of funding increases due to non-availability of grants, the required tariff increase to achieve the financial viability is likely to increase to 7.8% p.a. as against 0% tariff increase required in base case.

Scenario 3: Under achievement of AT&C loss reduction trajectory

Base case analysis, scenario 1 and scenario 2 assumes the achievement of AT&C loss trajectory by the utility. However, in case the utility misses the T&D loss reduction targets and it remains at 1% higher than the MoP targets till FY19, the impact on financial position is analyzed under this scenario. Table 56 summarizes the key parameters underlying the

analysis in scenario 3. Similar to base case and scenario 1, there is no requirement to increase the tariff for attaining financial viability, as the 1% higher T&D losses are not expected to have adverse impact on the financial position of the utility.

However, the impact on tariff is expected to increase slightly and be in the range of Rs.2.11/kWh to Rs.1.48/kWh, as against Rs. 2.06/kWh to Rs.1.39/kWh under the base case. Despite the additional cost and under-achievement of T&D loss trajectory there is no adverse impact on the financials of the utility, as presented in Table 57. As can be seen in Table 58 the annual financial profit of utility is expected to be nearly Rs. 11 Cr. in FY 19 vis-à-vis profit of Rs. 14 Cr. in FY19 under base case due to lower purchase cost. However the need to focus on reduction in AT&C losses is still recommended.

It may also be important to note that in this scenario, the funds available as grants under centrally sponsored schemes (IPDS, DDUGJY) are restricted to 85% of project value.

Table 56: Parameters for Scenario 3 (Under-achievement of T&D losses)

Particulars	Units	FY 16	FY 17	FY 18	FY 19
Energy related parameters					
Sales	MUs	352.35	411.89	483.76	557.42
Energy required	MUs	544.6	593.5	653.7	705.6
Energy available	MUs	1,067.7	2,273.3	2,656.5	2,760.7
Energy surplus /(shortage)	MUs	523.2	1,679.8	2,002.7	2,055.1
T&D losses	%age	35.3%	30.6%	26.0%	21.0%
AT&C Losses	%age	40.5%	35.5%	30.4%	25.0%
Power purchase cost (inc. transmission charges)	Rs./kWh	1.72	0.81	0.69	0.70
Revenue & expenditure parameters					
Tariff Increase	%age	0%	0%	0%	0%
Collection efficiency	%age	92%	93%	94%	95%
Average billing rate - Domestic	Rs./kWh	2.46	2.46	2.46	2.46
Average billing rate - Other than domestic (weighted avg.)	Rs./kWh	5.71	5.71	5.71	5.71
Employee cost escalation	%age	10.0%	15.0%	10.0%	10.0%
A&G cost escalation	%age	6.0%	6.0%	6.0%	6.0%

Table 57: Scenario 3: Impact on tariff

Particulars	Derivation	FY 16	FY 17	FY 18	FY 19
Additional recovery due to incremental energy sales (Rs. Cr.)	A	45	74	109	149
Incremental power purchase cost (inc. transmission charges and incremental transmission cost due to PFA program (Rs. Cr.)	B	26	16	18	22
Add: Cost related to capital expenditure (interest, depreciation and equity return, Rs. Cr.)	B1	21	46	81	96
Add: Incremental O&M cost & Working capital cost	B2	72	87	101	114
Gap of additional cost and additional recovery	C=(B+B1+B2 -A)	74	75	90	83
Energy sales (MU)	D	352	412	484	557
Cumulative Impact on tariff (Rs./kWh)		2.11	1.82	1.87	1.48

Table 58: Profit and Loss statement - Scenario 3 (Rs. Cr.)

Particulars	Projected			
	FY16	FY17	FY18	FY19
<i>Revenue</i>				
Revenue from Sale of Power within State	151	181	216	256
Others	90	136	138	144
Total revenue	242	316	355	400
<i>Expenditure</i>				
Power Purchase cost	184	184	184	194
O&M Cost	69	81	94	105
Employee cost	56	65	71	79
A&G expenses	3	3	3	3
R&M expenses	9	13	19	23
EBIDTA	(11)	51	77	101
Depreciation	12	20	30	34
Interest and finance charges	18	28	43	50
Interest on Working Capital	4	6	7	9
Interest on Cash deficit Loan	6	-	-	-
Interest – Long Term	9	22	36	41
Miscellaneous	-	-	-	-
PBT	(40)	4	4	17
Provision for tax	-	1	1	6
PAT	(40)	3	2	11

Scenario 4: Impact of Power Trading

In this scenario, the impact of power trading opportunity at higher margins is analyzed. It is seen that the utility will have adequate surplus power. One of the key parameters for the profitability of the utility is to ensure economic price for offloading this surplus power. Scenarios 1 to 3 assume that the surplus power is sold at the input cost. In this scenario it is assumed that the utility will be able to sell the power through long term and medium term arrangements to trading entities and distribution utilities. The surplus power is expected to be sold at average price of Rs.3.50 /kWh.

Since there is a substantial volume of free power expected in the period FY 17 to FY 19. The utility is

expected to recover the losses in the distribution business. It can be seen from the profit and loss statement depicted in Table 61 that the PAT of the utility increases to Rs. 387 Cr as compared to profit of Rs 14 Cr in the base case. The impact on tariff is expected to be negative in the range of Rs.1.04/kWh to Rs.2.09/kWh, which implies that the benefit of additional revenue generated through sale of power shall not only provide cushion against the additional costs, but also create surplus for the utility. This impact on tariff compares well as against the tariff impact of Rs. 2.06/kWh in FY16 to Rs.1.39/kWh in FY19 under the base case.

It may also be important to note that in this scenario, it is assumed that the IPPs are operational as per the latest schedule.

Table 59: Parameters for Scenario 4 (Impact of Trading)

Particulars	Units	FY 16	FY 17	FY 18	FY 19
Energy related parameters					
Sales	MUs	352.35	411.89	483.76	557.42
Energy required	MUs	544.6	593.5	653.7	705.6
Energy available	MUs	1,067.7	2,273.3	2,656.5	2,760.7
Energy surplus /(shortage)	MUs	523.2	1,679.8	2,002.7	2,055.1
T&D losses	%age	34.3%	29.6%	25.0%	20.0%
AT&C Losses	%age	39.6%	34.5%	29.5%	24.0%
Power purchase cost (inc. transmission charges)	Rs./kWh	1.72	0.81	0.69	0.70
Revenue & expenditure parameters					
Tariff Increase	%age	0%	0%	0%	0%
Collection efficiency	%age	92%	93%	94%	95%
Average billing rate - Domestic	Rs./kWh	2.46	2.46	2.46	2.46
Average billing rate - Other than domestic (weighted avg.)	Rs./kWh	5.71	5.71	5.71	5.71
Employee cost escalation	%age	10.0%	15.0%	10.0%	10.0%
A&G cost escalation	%age	6.0%	6.0%	6.0%	6.0%

Table 60: Scenario 4: Impact on tariff

Particulars	Derivation	FY 16	FY 17	FY 18	FY 19
Additional recovery due to incremental energy sales (Rs. Cr.)	A	231	665	813	872

Particulars	Derivation	FY 16	FY 17	FY 18	FY 19
Incremental power purchase cost (inc. transmission charges and incremental transmission cost due to PFA program (Rs. Cr.))	B	50	67	88	106
Add: Cost related to capital expenditure (interest, depreciation and equity return, Rs. Cr.)	B1	15	46	80	92
Add: Incremental O&M cost & Working capital cost	B2	74	97	113	127
Gap of additional cost and additional recovery	C=(B+B1+B2 -A)	(92)	(455)	(532)	(547)
Energy sales (MU)	D	884	2,100	2,495	2,621
Cumulative Impact on tariff (Rs./kWh)		(1.04)	(2.17)	(2.13)	(2.09)

Table 61: Profit and Loss statement - Scenario 4 (Rs. Cr.)

Particulars	Projected			
	FY16	FY17	FY18	FY19
<i>Revenue</i>				
Revenue from Sale of Power within State	151	181	216	256
Revenue from Sale of Power outside State	186	591	704	722
Total revenue	337	771	920	978
<i>Expenditure</i>				
Power Purchase cost	184	184	184	194
O&M Cost	69	81	94	105
Employee cost	56	65	71	79
A&G expenses	3	3	3	3
R&M expenses	9	13	19	23
EBIDTA	85	507	643	679
Depreciation	12	20	30	31
Interest and finance charges	14	38	55	62
Interest on Working Capital	6	16	20	22
Interest on Cash deficit Loan	-	-	-	-
Interest – Long Term	9	22	36	40
Miscellaneous	-	-	-	-
PBT	59	449	557	586
Provision for tax	20	153	190	199
PAT	39	296	368	387

10. Other Initiatives

10.1. Institutional arrangement for Monitoring of PFA 24X7

A strong monitoring framework is essential to ensure the success of “Power for All” scheme. The

following structure shown in Table 62 is being proposed to undertake regular monitoring of the progress of all initiatives being undertaken in this Roadmap.

Table 62: Institutional arrangement for monitoring 24x7 PFA scheme

Sl.	Institutional arrangement	Responsibilities	Monitoring frequency
1	Government of India (GOI) Committee	It is proposed that this committee will review the overall progress of the scheme and provide necessary support to ensure a coordinated response from Central Government – where necessary. This committee may be constituted with the following members – PFC, REC, CEA, SECI, EESL, BEE, Ministry of Coal, MNRE, MoPNG and Ministry of Power.	Quarterly
2	State Government Level Committee	It is proposed that a state level committee headed by the Secretary (Power) will be formed to review the progress of the scheme. This Committee will monitor the progress of the works undertaken as a part of the scheme and issue directions to enable faster execution.	Quarterly
3	Department Level Committee	It is proposed that a department level committee headed by Nodal Officer will be formed which shall undertake steps required to ensure the projects are progressing as per the action plan.	Monthly
4	Circle Level Committee	It is proposed to constitute a circle level committee headed by GM to take action that is necessary to ensure the projects are completed in a timely manner.	Monthly
5	Project Monitoring Unit (PMU)	A PMU shall be set up for monitoring the progress of works being undertaken under this scheme. The PMU will operate under Secretary (Power) and shall be operated by an independent agency.	Weekly

11. Roll Out Plan

Particular	Unit	Existing ending		Year wise addition			Total
		FY 15	FY 16	FY 17	FY 18	FY 19	Till FY19
GENERATION							
State Projects	MW	41	0	0	0	0	41
Central Sector Allocations	MW	159	0	0	0	57	216
IPP	MW	99	246	246	246	1195	2032
Total IC including Allocation	MW	299	246	246	246	1252	2289
Peak Demand	MW	100	114	125	137	148	148
TRANSMISSION							
Grid Substations (Nos)	No.		NA	NA	NA	NA	
Intra-State Lines addition			NA	NA	NA	NA	
DISTRIBUTION							
66 /33/11 KV Substations (MVA)	MVA	405	24	21	31	41	116
66 /33/11 KV Substations Nos	Nos	72	28	56	85	113	282
11 KV/ LT Distribution Transformers (MVA)	MVA	469	18	35	53	71	176
11 KV/ LT Distribution Transformers (Nos)	Nos	5,726	79	158	237	316	791
HT (33kV and 11 kV) Feeders (ckt kms.)	ckt kms	7,427	159	318	477	635	1,589
LT Feeders (ckt kms.)	ckt kms	13,837	223	445	668	891	2,226

12. Annexure

DDUGJY Plan – North

North DDUGJY		New		Augmentation/Replacement	
Particulars	Numbers	Capacity	Numbers	Capacity	
Transformation Capacity					
66 / 33 KV Substations (MVA)	1	8			
66 / 11 KV Substation (MVA)					
33 KV / 11 KV Substations (MVA)	3	9.45			
11 KV/ LT Distribution Transformers (MVA)	201	7.173	4	0.1	
Lines					
33 KV Feeders (ckt kms.)		65			
11 KV Feeders (ckt kms.)		458			
LT Feeders (ckt kms.)		479.2		42.4	

DDUGJY Plan – South

South DDUGJY		New		Augmentation/Replacement	
Particulars	Numbers	Capacity	Numbers	Capacity	
Transformation Capacity					
66 / 33 KV Substations (MVA)	3	15			
66 / 11 KV Substation (MVA)					
33 / 11 KV Substations (MVA)	3	15			
11 KV/ LT Distribution Transformers (MVA)	157	4.65	134	6.921	
Lines					
33 KV Feeders (ckt kms.)		38			
11 KV Feeders (ckt kms.)		420.88		233	
LT Feeders (ckt kms.)		397.36		30.8	

DDUGJY – West

East DDUGJY Covered		New		Augmentation/Replacement	
Particulars	Numbers	Capacity	Numbers	Capacity	
Transformation Capacity					
66 / 33 KV Substations (MVA)	1	16			
66 / 11 KV Substation (MVA)			2	10	
33 KV / 11 KV Substations (MVA)	21	12.6			
11 KV/ LT Distribution Transformers (MVA)	202	5.05	320	25.347	
Lines					
33 KV Feeders (ckt kms.)		50			
11 KV Feeders (ckt kms.)		525.10		329	
LT Feeders (ckt kms.)		598.85		57.7	

DDUGJY – East

West DDUGJY		New		Augmentation/Replacement	
Particulars	Numbers	Capacity	Numbers	Capacity	
Transformation Capacity					
66 / 33 KV Substations (MVA)	1	8			
66 / 11 KV Substation (MVA)			1	5	
33 KV / 11 KV Substations (MVA)	1	6.3			
11 KV/ LT Distribution Transformers (MVA)	172	7.959	187	21.241	
Lines					
33 KV Feeders (ckt kms.)		8			
11 KV Feeders (ckt kms.)		1017.7		162	
LT Feeders (ckt kms.)		570.1		449.07	

IPDS – Gangtok (Municipal Corporation)

Gangtok (Municipal Corporation) IPDS Particulars	Numbers	New Capacity	Augmentation/Replacement Numbers	Augmentation/Replacement Capacity
Transformation Capacity				
66 / 33 KV Substations (MVA)	1	16	0	0
66 / 11 KV Substations (MVA)	0	0	0	0
33 KV / 11 KV Substations (MVA)	2	15	0	0
11 KV/ LT Distribution Transformers (MVA)	57	21.35	60	15.24
Lines				
33 KV Feeders (ckt kms.)	12	-	0	-
11 KV Feeders (ckt kms.)	41.2	-	9.3	-
LT Feeders (ckt kms.)	124.35	-	42.05	-

IPDS – Namchi (Municipal Council)

Namchi (Municipal Council) IPDS Particulars	Numbers	New Capacity	Augmentation/Replacement Numbers	Augmentation/Replacement Capacity
Transformation Capacity				
66 / 33 KV Substations (MVA)	0	0	0	0
66 / 11 KV Substations (MVA)	0	0	0	0
33 KV / 11 KV Substations (MVA)	0	0	0	0
11 KV/ LT Distribution Transformers (MVA)	67	5.23	0	0
Lines				
33 KV Feeders (ckt kms.)	0	-	0	-
11 KV Feeders (ckt kms.)	17	-	5	-
LT Feeders (ckt kms.)	10	-	5	-

IPDS – Jorethang (Nagar Panchayat)

Jorethang (Nagar Panchayat) IPDS Particulars	Numbers	New Capacity	Augmentation/Replacement Numbers	Augmentation/Replacement Capacity
Transformation Capacity				
66 / 33 KV Substations (MVA)	0	0	0	0
66 / 11 KV Substations (MVA)	0	0	0	0
33 KV / 11 KV Substations (MVA)	0	0	0	0
11 KV/ LT Distribution Transformers (MVA)	13	1.256	0	0
Lines				
33 KV Feeders (ckt kms.)	0	-	0	-
11 KV Feeders (ckt kms.)	9	-	7	-
LT Feeders (ckt kms.)	14	-	2	-

IPDS – Gyalshing (Nagar Panchayat)

Gyalshing (Nagar Panchayat) IPDS Particulars	Numbers	New Capacity	Augmentation/Replacement Numbers	Augmentation/Replacement Capacity
Transformation Capacity				
66 / 33 KV Substations (MVA)	0	0	0	0
66 / 11 KV Substations (MVA)	0	0	0	0
33 KV / 11 KV Substations (MVA)	0	0	0	0
11 KV/ LT Distribution Transformers (MVA)	4	0.252	5	1.30
Lines				
33 KV Feeders (ckt kms.)	0	-	0	-
11 KV Feeders (ckt kms.)	9	-	7	-
LT Feeders (ckt kms.)	15	-	16.25	-

IPDS – Nayabazar (NTA)

Nayabazar (NTA) IPDS Particulars	Numbers	New Capacity	Augmentation/Replacement Numbers	Augmentation/Replacement Capacity
Transformation Capacity				
66 / 33 KV Substations (MVA)	0	0	0	0
66 / 11 KV Substations (MVA)	0	0	0	0
33 KV / 11 KV Substations (MVA)	0	0	0	0
11 KV/ LT Distribution Transformers (MVA)	10	0.85	0	0
Lines				
33 KV Feeders (ckt kms.)	0	-	0	-
11 KV Feeders (ckt kms.)	3	-	4.5	-
LT Feeders (ckt kms.)	2.5	-	5	-

IPDS – Mangan (Nagar Panchayat)

Mangan (Nagar Panchayat) IPDS Particulars	Numbers	New Capacity	Augmentation/Replacement Numbers	Augmentation/Replacement Capacity
Transformation Capacity				
66 / 33 KV Substations (MVA)	0	0	0	0
66 / 11 KV Substations (MVA)	0	0	0	0
33 KV / 11 KV Substations (MVA)	0	0	0	0
11 KV/ LT Distribution Transformers (MVA)	3	1.50	5	1.63
Lines				
33 KV Feeders (ckt kms.)	0	-	0	-
11 KV Feeders (ckt kms.)	14.5	-	10	-
LT Feeders (ckt kms.)	14	-	7	-

IPDS – Singtam (Nagar Panchayat)

Singtam (Nagar Panchayat) IPDS		New		Augmentation/Replacement	
Particulars	Numbers	Capacity	Numbers	Capacity	
Transformation Capacity					
66 / 33 KV Substations (MVA)	0	0	0	0	0
66 / 11 KV Substations (MVA)	0	0	0	0	0
33 KV / 11 KV Substations (MVA)	0	0	0	0	0
11 KV/ LT Distribution Transformers (MVA)	0	0	0	0	0
Lines					
33 KV Feeders (ckt kms.)	0	-	0	-	-
11 KV Feeders (ckt kms.)	0	-	0	-	-
LT Feeders (ckt kms.)	0	-	0	-	-

IPDS – Rangpo (Nagar Panchayat)

Rangpo (Nagar Panchayat) IPDS		New		Augmentation/Replacement	
Particulars	Numbers	Capacity	Numbers	Capacity	
Transformation Capacity					
66 / 33 KV Substations (MVA)	0	0	0	0	0
66 / 11 KV Substations (MVA)	0	0	0	0	0
33 KV / 11 KV Substations (MVA)	0	0	0	0	0
11 KV/ LT Distribution Transformers (MVA)	24	3.53	5	0.50	
Lines					
33 KV Feeders (ckt kms.)	0	-	0	-	-
11 KV Feeders (ckt kms.)	30.60	-	14	-	-
LT Feeders (ckt kms.)	52.30	-	26	-	-

Planned Distribution Works under NEC

Sl.	Name of Work	Amount
1	System Improvement and Modernization including Augmentation of Distribution system of Uttarey Bazaar, Dentam Bazaar, HEE Bazaar and Bermiok Bazaar in West Sikkim.	12.15 (Sanctioned)
2	System improvement and Modernization including Augmentation of Distribution system of Major Towns under Yangthang Constituency covering Darap Bazaar, Tikjuk Bazaar and Pelling Bazaar in West Sikkim.	14.85
3	System Improvement and Modernization including Augmentation of Distribution system of Rinchenpong Bazaar, Kaluk Bazaar, Reshi Bazaar and Mangalabria Bazaar.	10.36
4	Drawing of dedicated 11 KV HT Line to Sumbuk, South Sikkim with new 11/11KV Switching Sub-Station & Distribution network at Turuk Mangalbarey, South Sikkim	11.75
5	Upgradation of Transmission and Distribution Network with High Voltage Distribution system (HVDS) under Barfung Constituency, South Sikkim.	13.42
6	Conversion of Overhead LT/HT line to underground cable/ABC cable system I/C Providing street light with additional 2 Nos of 200 KVA S/S at Lachen & Chatten, North Sikkim.	7.42
7	Construction of closed conduit water conductor system from Ritchu Khola to Meyongchu Khola of Meyongchu HEP (2X2 MW) under Mangan Bazaar, North Sikkim.	5.5503
8	Strengthening, Modernization and Improvement of Transmission and Distribution system of Raj Bhavan, Mintokgang, High Court, VIP Colony and surrounding areas in Gangtok, East Sikkim.	9.8
9	Establishment of 11/11 KVA Sub-Station, Upgradation of the transmission and distribution network with High Voltage Distribution system under Namcheybong constituency in Pakyong Division II.	9.5
10	Remodelling of Power Transmission and Distribution system under the areas of 16 Tumin-Lingee Constituency in East and South Sikkim.	14.749
11	Construction of 11/11 KV switching sub-station including re-arrangement and drawing of 11 KV transmission line at Kongri and modernization of Tashiding Bazaar in West Sikkim.	10.57 (Sanctioned)
Total		97.40

Distribution Projects under CSSTDs

Transmission Lines		Voltage Level (kV)	Circuit	Length (In km)
1	Bermiok - Temi	66	S/c	12
2	Bermiok - Khamdong	66	D/c	18
3	Khamdong - Makha	66	S/c	20
4	Phodong - Samdong	66	S/c	15
5	Samardong - Namthong	66	S/c	15
6	Samardong - Mamring	66	S/c	6
7	Samardong - Kumrek	66	D/c	15
8	Kumrek - Rorathang	66	D/c	15
9	Singhik - Passingdong	66	S/c	20
10	Singhik - Mangan	66	S/c	10
11	Chungtang - Lachen	66	D/c	22
12	Chungthang - LILO point on Rabom - Maltin Line	66	D/c	4
13	Manpur - Rothak	66	D/c	20
14	Rothak - Sombaria	66	S/c	0
15	Namchi - Old Namchi	66	S/c	3
16	Namchi - New Namchi	66	S/c	5
17	Rinchenpong - LILO point on existing Namchi - Gayzing Line	66	D/c	2
18	Parbing - Sichey	66	S/c	7
19	Parbing - Tadong	66	S/c	12
20	Parbing - Pangthang	66	D/c	15
21	Rorathang - LILO point on Pakyong - Rongli Line	66	D/c	5
22	Rongli - Phadamchen	66	S/c	15
23	Pelling - Rellichu	66	S/c	25
Total				281

Substations under Comprehensive Scheme

Sl.	Substation	Voltage Level (kV)	No.s	MVA	Total (MVA)	Capacity
1	Rellichu	66/11	2	5		10
2	Phadamchen	66/11	2	5		10
3	Passingdong	66/11	2	5		10
4	Lachen	66/33	2	5		10
5	Rinchenpong	66/11	2	5		10
6	Sombaria	66/11	2	5		10
7	Temi	66/11	2	5		10
8	Makha	66/11	2	10		20
9	Khamdong	66/11	2	5		10
10	Kumrek	66/11	2	10		20
11	Namthang	66/11	2	5		10
12	Rorathang	66/11	2	10		20
13	Samdong	66/11	2	5		10
14	Pangtong	66/11	2	5		10
Total			28			170

Existing network – Transmisison

Sl.	Name of the Line	S/C / D/C	Voltage (kV)	Line Length (Ckt.-km)	Date of Commercial Operation
1	Sagbari to Melli	S/C	132	32	Feb-06
2	Chuzachen HEP to New Rangpo 400/220/132 KV Pooling S/S	D/C	132	29	2013
3	Sagbari to Gyalshing	S/C	132	14.8	2014
4	Namchi to Gyalshing	S/C	66	18	1990
5	Gyalshing to Pelling	S/C	66	4.96	2013
6	Melli-Mamring	S/C	66	20	2003
7	Sagbari to Ravangla	S/C	66	12	2011
8	Phodong-Meyong	S/C	66	32	1993
9	LLHP to Rongli	S/C	66	15.74	1994
10	Renock to Rongli	S/C	66	12	Dec-12
11	Sishney to Rongli	S/C	66	4.9	Apr-13
12	LLHP to URHP upto Balutar	D/C	66	33	1985
13	Tadong to LLHP	D/C	66	5.8	1980
14	Tadong to Sichey	S/C	66	4	1982
15	Bulbuley to LLHP	S/C	66	8	2009
16	Bulbuley to sichey	S/C	66	2.1	2009

Sl.	Name of the Line	S/C / D/C	Voltage (kV)	Line Length (Ckt.-km)	Date of Operation	Commercial
17	LLHP--Nimtar	S/C	66	9		1993-94
18	Nimtar-Topakhani	D/C	66	5		2003-04
19	Nimtar-NHPC	S/C	66	9		2004-05
20	Tadong to Phadong	S/C	66	18		1982

Existing Intra-state Substations

Sl. No.	Name of Sub-Station	Type of Sub-station Conventional / GIS	Voltage Ratio	No. of Transformers (with capacity)	Date of Operation	Commercial
1	Phodong	Conventional	66/11	1x5		2013-14
2	Mangan	Conventional	66/11	2x5		2008
3	Maltin	Conventional	66/11	2x5		Sep-11
4	Melli	Conventional	132/66	2x50		2006
5	Melli	Conventional	66/11	2x5		1980
6	Namchi	Conventional	66/11	2x2.5		2014
7	Namchi	Conventional	66/11	2x7.5		1994
8	Soreng	Conventional	66/11	2x5		1999
9	Rothak	Conventional	66/11	2x2.5		1994
10	Ravangla	Conventional	66/11	1x5		2011
11	Gyalshing	Conventional	132/66	20		2013
12	Gyalshing	Conventional	66/11	2x2.5		1990
13	Pelling	Conventional	66/11	1x5		2013
14	Nimtar	Conventional	66/11	4x2.5		1993-94
15	Topakhani	Conventional	66/11	1x5+1x7		2003-04
16	NHPC	Conventional	66/11	10		2005-06
17	Mamring	Conventional	66/11	1x15 1x10 1x7.5		8/1/2014 2007-08 2003
18	Ranipool	Conventional	66/11	2x7.5		1979
19	Rongli	Conventional	66/11	2x2.5		Oct-94
20	Rhenock	Conventional	66/11	1x5		Dec-10
21	Pakyong	Conventional	66/11	1x10		Apr-13
22	Gyalshing	Conventional	132/66			

Substations in Transmission system in Comprehensive scheme

Substation	Voltage Level (kV)	No.s	MVA	Total Capacity (MVA)
1 New Gangtok (Bermiok)	132/66	2	50	100
	66/11	2	5	10
2 Samardong (GIS)	132/66	2	50	100
	66/11	2	10	20
3 Singhik	132/66	2	25	50
	66/33	2	10	20
4 Chungthang	132/66	2	25	50
	66/11	2	10	20
5 Manpur (GIS)	132/66	2	25	50
	66/11	2	10	20
6 Namchi	132/66	2	25	50
7 Parbing (GIS)	132/66	2	50	100
Total		24		590

Status of IPPs in Sikkim

Sl.	Name of HEP Projects	Installed Capacity (MW)	Project Type	Implementing Agency	Original Completion	Revised Completion	Reasons for Delay
1	Teesta-III	1200	Joint Sector	TUL	2012-13	2015-16	1. Earthquake in Sikkim in 11 th September 2011. 2. Completion of balance works after Earthquake 3. Reconstruction of Bridge to carry Heavy Packages. 4. Financial crunch with the developer.
2	Teesta-VI	500	Joint Sector	LANCO	2012-13	2017-18	1. Poor geology in HRT 2. Contractual Issues 3. Land Acquisition 4. Funding Issues

Sl.	Name of HEP Projects	Installed Capacity (MW)	Project Type	Implementing Agency	Original Completion	Revised Completion	Reasons for Delay
3	Rangit- IV	120	Joint Sector	Jal Power Corp. Ltd.	2012-13	2017-18	1. Work hampered due to earthquake in September, 2011. 2. Poor geology in HRT. 3. Right bank slope failure at Dam site. 4. Funding issues.
4	Jorethang Loop	96	Private Sector	M/s DANS Energy	2013-14	2015-16	Poor geology in HRT.
5	Bhasmey	51	Private Sector	Gati Infrastructure	2014-15	2017-18	Slow progress of works
6	Tashiding	97	Private Sector	M/s Shiga Energy Pvt. Ltd.	2013-14	2017-18	1. Poor geology. 2. Local issues.
7	Dikchu	96	Private Sector	Sneha Kinetic Power Projects Pvt. Ltd.	2015-16	2015-16	1. Poor geology. 2. Local issues.
8	Rangit – II	66	Private Sector	Sikkim Hydro Power Limited	2016-17	2017-18	Slow progress of works
9	Panan	300	Joint Sector	Himagiri Hydro Energy Pvt. Ltd.	40878	2018-19	NWFB clearance not accorded
10	Rongnichu	96	Private Sector	Madhya Bharat Power Corporation Ltd.	2015-16	2017-18	1. Land acquisition. 2. Poor geology. 3. Funding issues.

Other projects

Sl.	Name of Transmission Line / sub stations (Voltage level wise)	Length in CKM/ MVA capacity of S/S
1	Pachey Khani 132/66/33 Kv pooling Sub-Station	132/66 KV 2 x 50 MVA 132/33 KV 2 x 20 MVA
2	Chuzachen to Pachekhani pooling S/S	D/C 132 KV 20 Kms (Zebra)
3	Bhasmey to Pachey khani pooling S/S	D/C 132 KV 8 Kms (Zebra)
4	Pachekhani to New Rangpo PGCIL 400/220/132 KVPooling S/S	D/C 132 KV 15 Kms (Twin Moose)
5	Details as per the comprehensive scheme for the strengthening of the Distribution & Transmission system for Sikkim	

List of Old Power House under R&M and Augmentation and New Micro Hydel Proposed (Small)

Sl.	Name of Work	Capacity	Amount (in Rs. Cr.)
A	RENOVATION, MODERNIZATION AND AUGMENTATION OF OLD POWER HOUSE		
1	Meyongchu HEP to 3 x 2 MW, North Sikkim	2x2 MW	2.00
2	Rabomchu HEP to 4 x 1.5 MW, North Sikkim	2X1.5 MW	25.00
3	Lachung stage-I to 2 x 500 KW, North Sikkim	2X100 KW	8.00
4	Rimbi State-I, West Sikkim	2X200 KW	1.00
5	Rimbi State-II, West Sikkim	2X500 KW	1.00
6	KKHEP, Dentam, West Sikkim	2X1000 KW	2.00
7	Jali Power House, East Sikkim	350X6 KW	0.50
8	Rongnichu State-II HEP, East Sikkim	500X5 KW	2.00
Total		15.2 MW	41.5
B	NEW MICRO HYDEL PROPOSED (Small)		
1	Rin Chu Small Hydel, North Sikkim	2X2.5 MW	75.00
2	Taram Chu Micro Hydel, North Sikkim	6X4 MW	240.00
3	Taryang Chu Micro Hydel, North Sikkim	2X2.5 MW	75.00
4	Lingza Chu Micro Hydel, North Sikkim	2X1.5 MW	45.00
5	Ringyang HEP, North Sikkim	0.5X2 MW	15.00
6	Kissim Khola HEP, South Sikkim	1X2 MW	30.00
7	Sarchokchu HEP, North Sikkim	1.5X2 MW	45.00
9	Hee Khola HEP, West Sikkim	0.5 MW	7.50
10	Dentam Khola HEP, West Sikkim	0.5 MW	7.50
11	Esanglay Khola HEP, West Sikkim	0.5X2 MW	15.00
12	Chuba HEP, East Sikkim	2X3.5 MW	105.00
13	Upper Rongli HEP, East Sikkim	2X2.5 MW	75.00
14	Upper Rimbi HEP, West Sikkim	4X3 MW	180.00
Total		69 MW	915



PFA Roadmap - Sikkim





