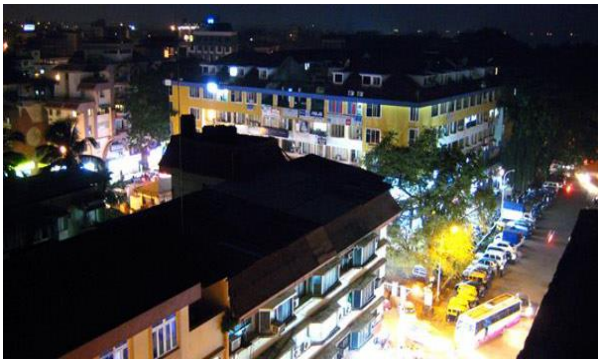
24 X 7 POWER FOR ALL GOA

A Joint Initiative of Government of India and Government of Goa



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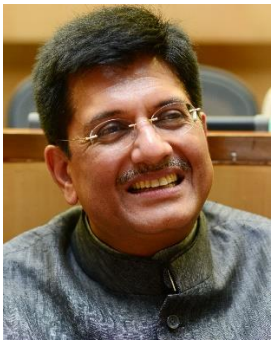
Government of India



Piyush Goyal

Union Minister of Power of State (IC)
Power, Coal, New & Renewable Energy

Foreword

Electricity consumption is one of the most important indices that decide the development level of a nation. The Government of India is committed to improving the quality of life of its citizens through higher electricity consumption. Our aim is to provide each household access to electricity, round the clock. The 'Power for All' programme is a major step in this direction.

Goa is already one of the better performing states in Power Sector.

This joint initiative of Government of India and Government of Goa 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.

I compliment the Government of Goa and wish them all the best for implementation of this programme. The Government of India will complement the efforts of Government of Goa in bringing uninterrupted quality power to each household, farmer and establishment in the state.

Government of Goa

Laxmikant Parsekar

Chief Minister of Goa

Foreword

It is a matter of great satisfaction that the state of Goa has already achieved almost 100% village electrification and is poised to achieve 100% electrification of all households in the state toward our objective of 24x7 'Power For All'.

The state is able to provide 24 hours of power to all its consumers, except for occasional load restrictions due to supply constraints. However, with the planned additional link connecting South Goa to the Western Grid, we will be able to source additional power from the Western Grid in case of any shortage from the Southern region to overcome intermittent supply problems.

There are certain highlights of the power sector in Goa, including higher per capita electricity consumption in comparison to other states in the Country, continuously meeting more than 99% of our demand and offering one of the lowest tariffs nationally for almost all categories of customers. Also, given the present performance of the sector, I am confident that we will certainly accomplish the target level of 10% AT&C losses earlier than the timeframe of F.Y. 2018-19.

I am optimistic that this 24x7 "Power For All" document prepared after several rounds of rigorous meetings and focused negotiations between the State and the Centre will play a pivotal role and pave the way forward for strengthening our preparedness towards maintaining Goa's status as a power-cut free state and accomplishing my Government's commitment toward providing every citizen access to 24x7 reliable, quality and affordable power supply.

On the momentous occasion of the signing and adoption of the document, I would like to sincerely thank Government of India for selecting Goa as a partner state for implementation of 24x7 "Power For All" and congratulate all concerned in making the programme a reality in the shortest possible time.

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Government of India

Government of Goa

Joint Statement

Goa is fourth state in the country selected for '24x7 Power for All' (PFA) programme. This programme will be implemented by Government of Goa (GoG) with active support from Government of India with the objective to ensure 24x7 quality, reliable and affordable power supply to all Domestic, Commercial Agriculture and Industrial consumers within a fixed time frame.

Government of Goa is attaching highest priority to power sector and power supply position is been reviewed by the State Cabinet on periodic basis and is committed to provide full support to all utilities for ensuring quality power supply.

Government of Goa would ensure that all the necessary steps outlined in the PFA document are taken up in terms of power procurement, strengthening the required transmission and distribution network, encouraging renewables, energy efficiency measures, undertaking customer centric initiatives, reduction of AT & C losses, bridging the gap between ACS & ARR, and following good governance practices in implementation of all central and state government schemes.

Government of India (GoI) would supplement the efforts of Government of Goa by providing additional allocation from central pool, expediting the additional interstate connectivity and ensuring optimum allocations in various distribution schemes (as per provisions of applicable policies).

It is envisaged to cover the entire state under PFA programme in a phased manner and provide 24x7 power supply to all domestic, agriculture industrial and commercial consumers for all connected households from FY 16 itself.

However, Government of Goa would endeavor to implement the programme much earlier than the above targeted dates.

The central and state governments would meet regularly to review the progress of the programme over the next 4 years and would strive to achieve the objectives of the programme by taking the necessary steps as envisaged in the PFA document.

Jyoti Arora, IAS

Joint Secretary
Ministry of Power (GoI)

Arun Goyal, IAS

Principal Secretary, Energy
Government of Goa

EXECUTIVE SUMMARY

24 x 7 Power for All (24x7 PFA) is a Joint Initiative of Government of India (GoI) and State Governments with the objective to make power available to all households, industry, commercial businesses, public needs, any other electricity consuming entity and adequate power to agriculture farm holdings by FY 2018-19.

This roadmap document aims to meet the above objectives for the state of Goa.

Goa is one of the few states having electrification at 98% in urban and 96% in rural area based on 2011 census. Apart from higher level of electrification, the state also has one of the highest per capita consumption of electricity. Some of the agendas which have been dealt for preparing the roadmap has been discussed below.

24 X 7 POWER SUPPLY

The state is already supplying 24 hours of power to all its consumers, except for few load restrictions due to supply constraints. However, with planned additional link connecting South Goa to the Western Grid, the state will not have to resort to load restrictions and it can source additional power from Western Grid in case of any shortage from Southern Grid.

GROWTH IN DEMAND

The demand for electricity from households in Goa will increase marginally since power is already being supplied 24 hours in the state. However, Goa may see an incremental maximum demand of 70 MW in case mining in the state picks-up again, which is at present banned since September 2012. Therefore, to cater such incremental load and plan its power procurement programme, Goa has factored-in mining load from FY 2016-17 for demand assessment upto FY 2018-19. In order to achieve the objective of 24 x 7 power supply the state, it would see an increase in peak demand from 540 MW in FY 2013-14 to 934 MW in FY 2018-19.

SUPPLY ADEQUACY

The energy requirement and maximum demand based on the current exercise is in line with the projections made in 18th Electric Power Survey (EPS) by CEA for the state of Goa. As per the 18th EPS of CEA, the projected energy requirement of Goa is 5,572 MU by FY 2018-19, and the anticipated peak demand of the state has been projected at 949 MW. However, as per the current exercise the total energy requirement for the state has been assessed as 5,480 MU and the maximum demand as 934 MW in FY 2018-19.

The present availability for the state is 471 MW which includes power from private generation entities in the state and excluding share from unallocated-quota which varies from 50 MW to 65 MW. In order to meet the increasing demand, the state has signed Power Purchase Agreements (PPAs) with central generating stations. However, power available from these plants will not suffice to meet the incremental demand. Therefore, Goa has planned to request for additional allocation from central generating stations and also go ahead with competitive based power purchase after undertaking a detailed study on Long/Medium/Short term power requirement.

ADEQUACY OF TRANSMISSION NETWORK

The existing Inter State Transmission System (ISTS) line's capacity and transformation capacity is adequate for meeting the present requirements. Further, based on the load projections for the FY 2018-19, the inter-state and intra-state transmission system augmentation would be required.

The planned intra-state transmission schemes would increase the present capacity by 765 MVA by FY 2018-19 resulting in an overall capacity of 1755 MVA. The existing intra-state transmission system with the planned investment of Rs 789 Crores towards capacity addition would meet the requirement as envisaged for 24 x 7 PFA. However, based on the load flow study, establishment of 400 kV substation at Xeldem will be essential to provide reliable power in the state at projected load.

ADEQUACY OF DISTRIBUTION NETWORK

The state has proposed an investment of Rs 1576 Crores towards the development of distribution network. Out of Rs 1576 Crores, the investment of Rs 956 Crores is proposed to be executed through Integrated Power Development Scheme (IPDS) and Rs 320 Crores through Deen Dayal Upadhyaya Gram Jyoti Yojana (DDUGJY) schemes of Government of India (GoI).

To meet the increasing demand, the above investment has been proposed towards additional capacity of 245 MVA along with other equipment's (lines, capacitors, meters, etc) at sub-transmission level. This will also help in bringing the AT&C losses in the state to 10% by FY 2018-19 from the present level of 22% in FY 2013-14. The distribution network planned by FY 2018-19 is adequate to meet the required demand. However, Goa will have to improve upon its collection efficiency, comply with regulatory requirements and Standard of Performance (SoP) for meeting its operational standards.

FINANCIAL TURNAROUND

Goa has planned to undertake Rs 2,365 Crores of investment towards network addition and augmentation in transmission and distribution system. Goa has also planned to undertake a part of this investment i.e. Rs 956 Crores, through IPDS and Rs 320 Crores through DDUGJY schemes of GoI.

Further, the above investment would also require additional debt of about Rs 972 Crores which will affect the existing financials of the utility which is already in poor state due to gap in Average Billing Rate (ABR) and Average Cost of Supply (ACS). Goa may see a cumulative loss of Rs 1,367 Crores by the end of FY 2018-19, which can be recovered if Goa gets a weighted average tariff increase on ABR for all consumers of 14%, 13% in FY 2016-17 and FY 2017-18 and 11% in FY 2018-19.

Therefore, it is important for Electricity Department of Goa to analyse its losses after segregating its transmission and retail business and meet regulatory requirement for benefiting from approval of required tariff. This will help the utility in putting concentrated efforts to improve on the weak areas. One of them is due to non-approval of its gross fixed asset due to non-availability of audited fixed asset register and accounts which impacts it's ARR approved for tariff formulation. Therefore, segregation of utility and financial audit will help Goa in planning towards financially viable power distribution business.

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

Contents

CHAPTER 1. INTRODUCTION

Power sector is a critical infrastructure element for growth of an economy. The availability of reliable, quality and affordable power is vital for rapid growth in agriculture, industry and for overall economic development of a state. For this an efficient, resilient and financially healthy power sector is an essential requirement for growth of the country and economic empowerment of the common man.

Under the Indian Constitution, electricity is a concurrent subject. As per the Electricity Act, 2003, it is the duty of a distribution licensee to develop and maintain an efficient, coordinated and economical distribution system in the mandated area of supply as well as to supply electricity in accordance with the provisions contained in the Act. The State Electricity Regulatory Commission (SERC), as per the provisions of the Act, specifies and enforces the standards with respect to quality and reliability of supply by licensees and also monitors the performance of distribution companies (Licensees) on the basis of notified Standard of Performance.

OBJECTIVES AND KEY OUTCOMES OF THE 24X7 POWER FOR ALL – JOINT INITIATIVE

The 24x7 Power for All (24x7 PFA) is a Joint Initiative of Government of India (GoI) and Government of Goa (GoG) with the objective to make 24x7 power available to all households, industry, commercial businesses, public needs, any other electricity consuming entity and adequate power to agriculture farm holdings.

Towards this goal the 24x7 PFA initiative seeks to:

i. Ensure reliable 24x7 supply to consumers within a period of four years of commencement of the program. The hours of supply for agriculture consumers will be decided by the State Government as per requirement.

ii. Ensure that all unconnected households are provided access to electricity in a time bound manner in the next four years i.e. by end of FY 19.

iii. Ensure adequate capacity addition planning and tie ups for power from various sources at affordable price to meet the projected power demand in future.

iv. Strengthen the transmission and distribution network to cater to the expected growth in demand of existing as well as future consumers.

v. Assess the financial measures including optimizing investments and undertaking necessary balance sheet restructuring measures to ensure liquidity in the finances of the utility.

vi. Put in place a strategy to ensure reduction of Aggregate Technical & Commercial (AT&C) losses as per the agreed loss reduction trajectory and methodology and steps required to be taken at every level.

vii. Identify steps for implementation and adoption of modern technologies to monitor reliable supply.

viii. Identify steps for monitoring timely commissioning of various generating plants, transmission and distribution infrastructure to meet the expected growth in demand.

ix. To take measures for meeting the performance standards as laid down by Joint Electricity Regulatory Commission (JERC).

An Action plan has been drawn to achieve the above aims and objectives. The plan will be executed by the State Government with the support of Government of India, wherever necessary, as per their approved plans, schemes and policies.

METHODOLOGY FOR PREPARATION OF ROAD MAP FOR 24X7 POWER FOR ALL

The plan aims at the following:

(1) Bridging the gap between the demand and supply for the already identified/registered consumers and other consuming entities,

(2) Connecting the unconnected households and unconnected farm holdings.

Accordingly the methodology adopted to prepare the 'Action Plan' for 24x7 PFA includes inter-alia:

1) Projection of average per day consumption of rural and urban households based on respective historical Compounded Annual Growth Rates (CAGR) during the past four/five years.

2) Projection of demand of commercial, industrial, agriculture and other consumer categories based on past data and historical CAGR recorded during the past four/five years.

3) Assess the power requirement of un-electrified households and draw up a time bound plan for electrification of all households.

4) Project the annual energy requirement and maximum demand by aggregating the requirement of all consumer categories and applying an appropriate load factor.

5) Draw up a broad plan to meet power demand in future through

   - ✓ State's own upcoming generation resources.
   - ✓ Allocation from upcoming central sector power plants
   - ✓ Procurement of additional power.

6) Assess the additional energy requirement for providing 24x7 power supply to all households in the state as well as other consumer categories, financial implications on utilities for procuring additional energy and per unit implication on tariff.

7) Assess the adequacy of the network - both inter-state and intra state transmission as well as distribution so as to meet the projected power requirement of the state.

8) Conduct sensitivity analysis for cost of service and resulting Financial Gap under multiple scenarios on various parameters namely, tariff hike, reduction in power procurement cost, and increase in interest rate and moratorium period, AT&C loss reduction, etc.

9) Set monitorable targets to achieve the goal of "24x7 Power for All" in a cost effective manner to the consumers of the State.

CHAPTER 2. GOA AT GLANCE

Statistics	
Area	3,702 Sq. Km.
No of villages	383
Households	3,43,611 (Census 2011)
Population	14.59 Lakhs
Literacy	87% (census 2011)
Gross State Domestic Product (GSDP) % (Const. Prices)	4.1% in FY 2012-13 20.21% in FY 2011-12
Number of Industrial estates	20
Ports	1 Major (Mormugao) and 5 Minor
Tourists visited	40,58,226 (*35,44,634 Domestic and 5,13,592 foreign*) in 2014
Power demand	540 MW (FY 2013-14)
Number of consumers	5,83,286 (FY 2013-14)
Number of domestic consumers	4,69,371 (FY 2013-14)

Goa is one of the smallest states in India on the west coast with an area of **3,702 sq. km**. It was carved out from the Union Territory of Goa, Daman, and Diu on 30th May 1987 to form a separate state.

Administratively, the state is organized into two districts, North Goa comprising **6 talukas** with a total area of 1,736 sq. km and South Goa comprising **5 talukas** with an area of 1,966 sq. km. In all, there are 383 villages, of which 233 are in North Goa and 150 are in South Goa.

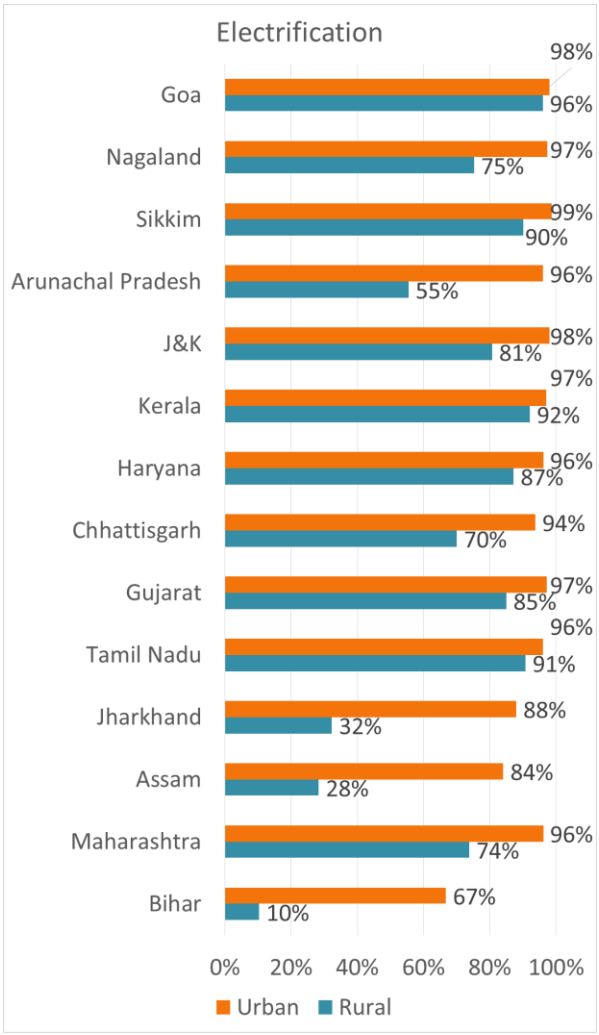
As per 2011 census, Goa has a population of **14.59 Lakhs**, an increase of 0.79% (CAGR) from **13.48 Lakh in 2001** census. The year on year population growth has continuously declined from 3.03% (CAGR) in 1971 to 0.79% (CAGR) in 2011. During this period, urban population had grown at a higher rate compared to rural population. Also, as per the census of 2001 the number of rural population has dropped from 6.9 lakh in 1991 to 6.77 lakh in 2001. This indicates increasing urbanization in the state as a whole and a possible relocation of the rural population to urban centers within each taluka.

CHAPTER 3. GOA POWER SECTOR

ELECTRIFICATION

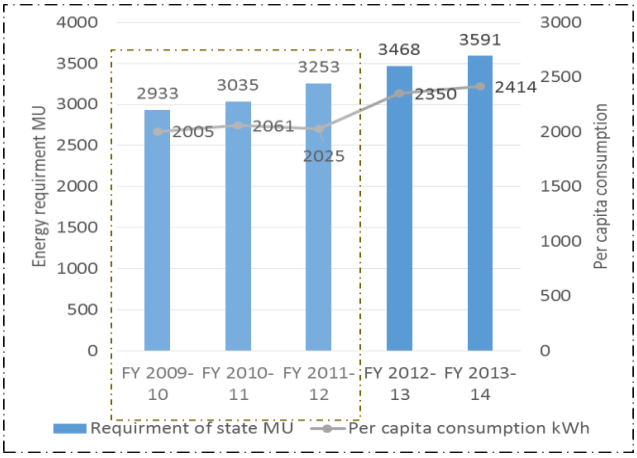
Goa has one of the highest electrification coverage in India. State level electrification at rural and urban area has been compared with other states based on the census 2011, which shows that Sikkim is the only state above Goa having higher **urban electrification** at 99% compared to Goa's 98%**.** In case of rural electrification**,** Goa has the highest electrification at 96%. However, the state can be considered having 99% electrification, except some households which are in forest reserve areas where accessibility is an issue.

Figure 1: Electrification in India (*As per Census 2011*)



Apart from higher electrification, Goa also has one of the highest per capita consumption of electricity. Based on the consumption of electricity in Goa and population as per the census, the per capita electricity consumption in **FY 2013-14** was registered at **2414 kWh**. Historically, Goa has always ranked higher in the per capita consumption just after Daman & Diu and D&N Haveli which are predominantly industrial zones. The per capita electricity consumption for India in FY 2011-12 was recorded at 884 kWh which is way below than Goa's **2025 kWh**. Historical per capita consumption pattern has been shown below *(Per capita consumption base on Planning Commission till FY 2011-12 and information submitted by EDG from FY 2012-13*):

Figure 2: Per capita electricity consumption in Goa

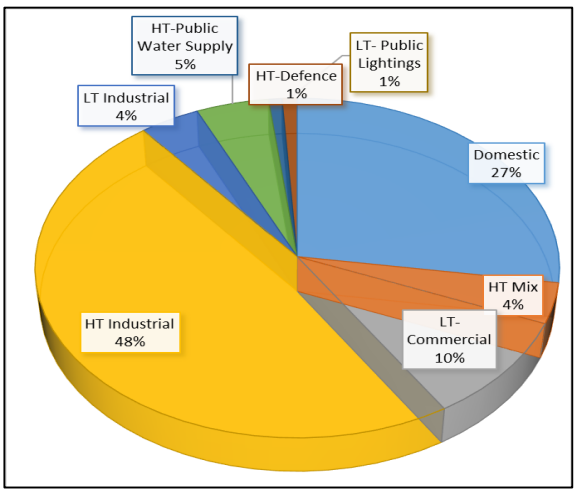


CONSUMPTION MIX

The state has around 5,83,286 registered consumers, of which 4,69,371 (80%) are domestic consumers with an annual energy consumption of about 804 MU in FY 2013-14. Out of these around 11,387 (2%) consumers are covered in the tariff category of 'low income group', 853 consumers are covered under 'Domestic Mixed' category. The number of consumers in case of high tension supply are just 792 while there consumption is above 57% of the

total sales at 1699 MU. The consumption mix of consumers in the state of Goa is shown below:

Figure 3: Consumption mix (FY 2014)



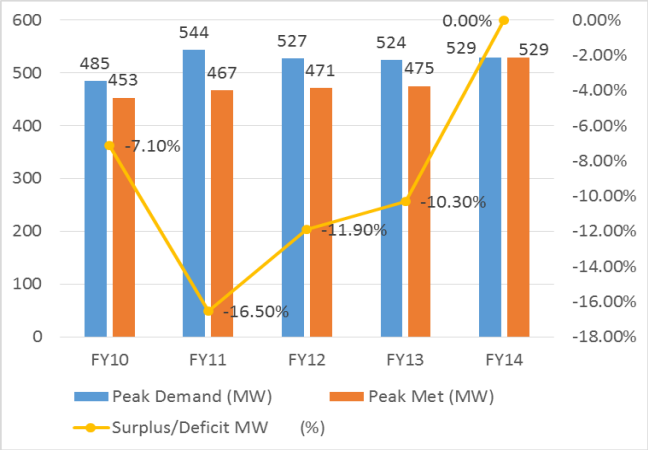
Industrial consumers contribute to about 52% of the total consumption which is a positive mix for the utility. Since industrial consumers have higher network usage compared to domestic consumers, Goa is in a better position to recover its existing financial losses if the energy needs of these industries are met in full.

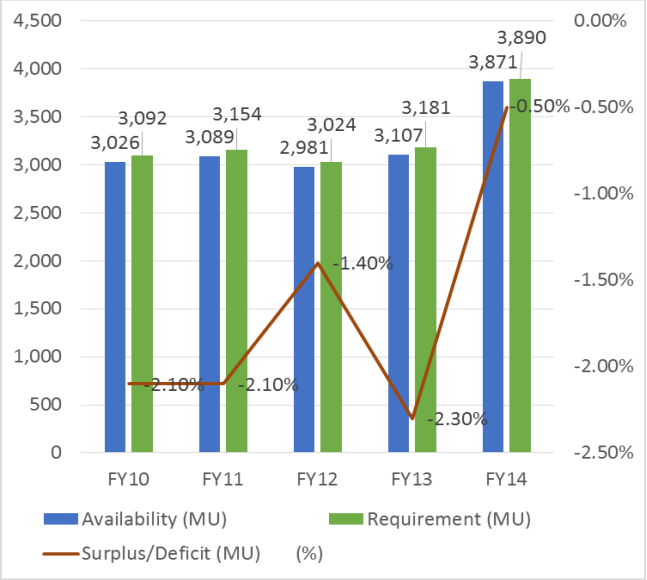
POWER SUPPLY POSITION

The majority of power for the state is allocated through central power generating stations with 81% contribution from coal-based power plants. The state has 449 MW of firm power allocated from central generating stations. Apart from firm allocation, Goa has allocation from unallocated quota of 50 MW during peak hours and 65 MW during off peak hours. Presently, Goa has no state power generating stations, except for three private co-generators, viz., Goa Energy Private Ltd of 30 MW, Goa Sponge Private Ltd of 12 MW and Sesa Sterlite Ltd.

The energy availability and peak demand in the state in comparison to requirement since FY 2009-10 is shown below.

Figure 4: Power supply position[1]





Goa has one of the highest electrification coverage and highest per capita electricity consumption in India. However, there has been a reduction in peak demand in the state from FY 2011-12, which can be attributed to reduction in mining load.

[1] *As per the monthly reports of CEA*

CHAPTER 4. ESTIMATION OF DEMAND

The energy requirement for the state of Goa was recorded at 3,932 MU in FY 2014-15 [2]. Introduction of 24 × 7 supply across the state is likely to increase the electricity consumption marginally as the state already provides 24-hour power supply to all consumers, except for industrial consumers who face load restriction due to supply constraints, where the utility had lost an opportunity to sell ~28 MU of energy during FY 2014-15. The state of Goa is strongly in favour of providing 24 x 7 power for all its consumers. Therefore, demand projection till FY 2018-19 has been bifurcated into three segments:

I. Demand estimation for domestic consumers
II. Demand estimation of other than domestic consumers
III. Estimation of upcoming known loads

DEMAND ESTIMATION FOR DOMESTIC CONSUMERS

As per Census 2011 data, there were about 3.23 lakh households in the state with 97% electrification. The increase in number of households has mainly been in urban areas where urban households have increased at 43% (DECADAL GROWTH) during 2001 to 2011, while rural area showed a negative growth of -11%. A comparative of households as per census 2001 and 2011:

Table 1: Households in Goa

Particulars	Census 2001	Census 2011	Decadal Growth
Total Households	2,79,216	3,22,813	15.61%
Rural Households	1,40,755	1,24,674	-11.42%
Rural Percentage Share	*50.41%*	*38.62%*	
Urban Households	1,38,461	1,98,139	43.10%
Urban Percentage Share	*49.59%*	*61.38%*	
Total Electrified Households	2,61,273	3,12,761	19.71%
Rural Electrified	1,30,105	1,19,208	-8.38%
Rural Percentage Share	*49.80%*	*38.11%*	
Urban Electrified	1,31,168	1,93,553	47.56%
Urban Percentage Share	*50.20%*	*61.89%*	
% of Electrification	**94%**	**97%**	

The number of households in the state in FY 2014 based on Census 2011 data and compound annual growth rate (CAGR) for 10 years (census of 2001 and 2011) works out to be 3.34 lakhs. However, as per the actual records of Electricity Department of Goa, as on 1st April 2014, there were about 4.69 lakh households already. This shows that there are more number of consumes in the records of EDG compared to households in the state. Therefore, estimation of demand from domestic consumers for Goa has been done considering no un-electrified households are left except for 5028 households which shall be electrified in two years periods since they are scattered and electrification of these households will required higher investment.

[2] *CEA report for March 2015*

Table 2: Electrified Household

	Households	Projection Based on Census 2011	FY 2013-14 (Goa Records)	Final Consideration
Rural	Electrified	1,17,141	1,23,427	1,23,427
	Un-electrified	4,545	-	-
	Sub-Total	**1,21,685**	**1,23,427**	**1,23,427**
Urban	Electrified	2,09,216	3,45,944	3,45,944
	Un-electrified	3,646	-	-
	Sub-Total	**2,12,862**	**3,45,944**	**3,45,944**
Total	Electrified	3,26,356	4,69,371	4,69,371
	Un-electrified	8,191	-	-
	Grand Total	**3,34,548**	**4,69,371**	**4,69,371**

Therefore, the number of electrified consumers as on 1st April 2014 actually available in the records of the Electricity Department of Goa (EDG) has been used for projection purpose as shown in the table above. The daily consumer consumption as per the number of consumers is shown in the table below:

Table 3: Actual daily energy consumption (kWh/day)

Domestic	Actuals			
	FY 2010-11	FY 2011-12	FY 2012-13	FY 2013-14[3]
Rural	4.09	4.08	4.90	4.53
Urban	4.29	4.29	5.15	4.75

To compute the demand from new electrified consumers, following steps have been adopted:

I. The Number of consumers as on 1st April 2014 have been taken as per actual records of the utility and projected based on four year historical growth rate of 2.34%.
II. Urban and rural consumption has been considered based on FY 2013-14 data.
III. The number of rural consumers have been kept constant and growth has been shifted to urban consumer as seen historically and also confirmed by EDG.
IV. Rate of growth in energy consumption per household per day has been taken as 3.50% based on the historical growth rate. This is based on the growth rate observed based on past four years data.

Table 4: Projected consumption per consumer per day (kWh)

Domestic category	Projections				
	FY 2014-15	FY 2015-16	FY 2016-17	FY 2017-18	FY 2018-19
Rural	4.69	4.85	5.02	5.20	5.38
Urban	4.92	5.09	5.27	5.45	5.64

DEMAND ESTIMATION OF OTHER THAN DOMESTIC CONSUMERS

The demand estimation of other than domestic consumers in case of Goa is very important since majority of sales is driven by industrial and commercial consumers who contribute 61% of total sales. The estimates used for projecting the future demand from these consumers is shown below:

I. Growth rate for non-domestic consumers and industrial consumes has been based on the CAGR of past 3-4 years (FY 2009-10 to FY 2013-14).
II. In case of HT-Industrial consumers, CAGR of past 3-4 years has been considered, however Goa has started to supply power to approximately 55 industrial consumers on account of expiry of PPA with Reliance IPP on 13th August 2014, which will result into higher sales from FY 2014-15 onwards. Therefore, growth in sales to HT consumers has been considered at 6%

[3] *The decrease in unit consumption per day is due to billing related issues in FY 2013-14*

compared to 5% seen historically to cater the additional consumer's demand.

ESTIMATION OF UPCOMING KNOWN LOADS

In order to prevent mineral excavation, the mining activity in Goa was curtailed in September 2012. In case the mining activity in the state again picks ups in future, the demand may increase drastically which needs to be factored in for planning purpose. Therefore, the demand from the below mentioned known loads have been included:

- ✓ Mining activities which is estimated at 100 MW,
- ✓ Mopa Airport (20 MW),
- ✓ IT Park (20 MW), and
- ✓ Electronic city (60 MW).

A summary of additional load is shown below:

Table 5: Additional Demand (MW)

Source	Additional Load (MW)		
	FY 2016-17	FY 2017-18	FY 2018-19
Electronic city	-	60	-
Mopa Airport	-	20	-
IT Park	-	20	-
Mining	*100*	-	-

Assumptions:

- ✓ The losses have been considered based on actual loss values in FY 2013-14 and approved by Regulatory Commission (JERC) for FY 2014-15 and for future years the demand projections have been made considering the loss reduction trajectory targeted by the state from FY 2015-16 to FY 2018-19.
- ✓ Load factor has been considered at 67% based on the 18th EPS for Goa.

Figure 5: Per Capita Consumption[4]

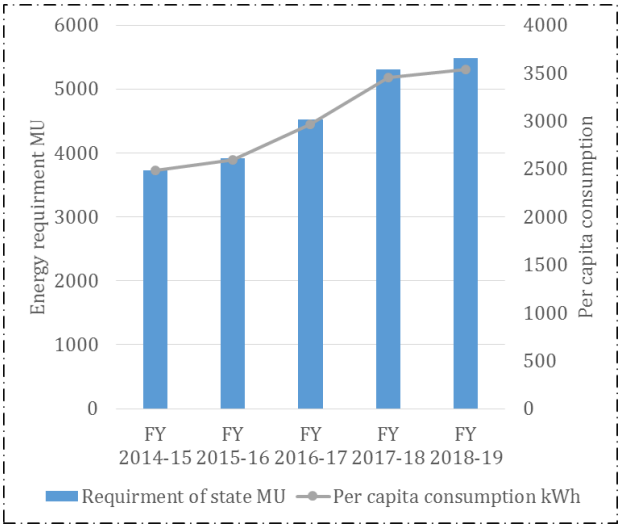


Table 6: Projected Sales (In MU)

Categories	CAGR Considered	Projections				
		FY 2014-15	FY 2015-16	FY 2016-17	FY 2017-18	FY 2018-19
Domestic		852	903	956	1013	1073
HT-Mixed	2%	115	118	120	123	125
LT- Commercial	0.44%	288	290	291	292	293
HT Industrial	6%	1499	1589	1684	1785	1892
LT Industrial	11%	129	142	158	175	194

[4] *Based on assumptions and population growth seen in 2001 and 2011*

Categories	CAGR Considered	Projections				
		FY 2014-15	FY 2015-16	FY 2016-17	FY 2017-18	FY 2018-19
HT-Agriculture	5%	6	7	7	7	8
HT-Public Water Supply	5%	147	155	163	172	181
HT-Defence	0%	26	26	26	26	26
LT Agriculture	18%	25	29	34	40	47
LT- Public Lightings	0%	29	29	29	29	29
LT- Public Water Works	37%	10	13	18	25	34
LT- Temporary	4%	16	16	17	17	18
Additional Load from mining, airport, IT Park, etc.	-	-	-	350	823	823
Total		**3141**	**3316**	**3853**	**4527**	**4743**

Table 7: Demand projections

Source	Demand Projections				
	FY 2014-15	FY 2015-16	FY 2016-17	FY 2017-18	FY 2018-19
Energy Requirement to ultimate consumers					
Sale within State (MU)	3141	3316	3853	4527	4743
AT&C losses (%)	18.58%	12.39%	11.89%	11 %	10%
T&D Losses (%)	11.50%	11.50%	11%	11%	10%
Collection Efficiency (%)	92%	99%	99%	100%	100%
Transmission losses (%)	*4.68%*	*4.46%*	*4.23%*	*4.02%*	*3.82%*
Total Energy Requirement within state (MU)	**3724**	**3922**	**4521**	**5300**	**5480**
Load Factor (%)	-	*67.00%*	*67.00%*	*67.00%*	*67.00%*
Maximum Demand (MW)	**-**	**668**	**770**	**903**	**934**

Goa may observe an incremental maximum demand of about 70 MW in case mining in the state picks-up, which has been factored in the above demand projections in addition to the other factors impacting the load growth. Therefore, Goa based on the above study will experience a maximum demand of 934 MW (FY 2018-19) from 540 MW in FY 2013-14, which is an increase of 400 MW in coming 4 years.

CHAPTER 5. SUPPLY PLAN

EXISTING SOURCES

Goa has no power generating stations of its own in the state. The majority of power comes from coal-based central power generating stations, which contribute to 81% of the total power procured. Power is also procured from co-generation plants, viz., Goa Energy Private Ltd and Goa Sponge Private Ltd of capacity 30 MW and 12 MW respectively and power from Sesa Sterlite Ltd of ~3 MW which is expected from FY 2015-16.

Further, more than 70% demand of Goa is met from two major sources viz. Korba Super Thermal Power Station (STPS) and Ramagundam STPS. **If there is any forced outage/ event in any of these power stations, it severely affects the power position in Goa.**

Table 8: Source of Power

Source	Firm Allocation (MW)
Korba STPS	210
Korba STPS Unit 7	4.5
Vindhyachal STPS - I	35
Vindhyachal STPS - II	12
Vindhyachal STPS – III	10
Vindhyachal STPS – IV	11.2
Sipat Stage-I	20
Sipat Stage-II	10
Mouda STPS	11.2
Kakrapar APS	15
Tarapur unit 3 & 4	11
Ramagundam STPS (Southern Region)	100
Total	**449**

Note: Only firm power shown in the above table, inform power is not considered

POWER PURCHASE COST

The average power purchase cost for Goa during FY 2013-14 was recorded at 2.67 Rs/kWh, having major contribution from NTPC plants. It can be seen in the table presented, that power from IPP-Reliance and Ratnagiri Gas & Power Private Limited (RGPPL) is very high. This is on the account of fixed charges being levied to the state while energy is not being supplied as per the allocated quantum in case of RGPPL. Further, PPA with the EDG and IPP-Reliance has already expired on 13th August 2014. The power purchase share from different sources is shown in the table:

Table 9: Power purchase Cost (FY 2013-14)

Sources	Quantum (MU)	Cost (Rs Crores)	Average Cost (Rs /kWh)
NTPC	3,181.02	717.28	2.25
RGPPL	13.94	21.82	15.65
NPCIL	200.55	51.98	2.59
Over-Drawl	32.34	14.27	4.41
Co- Generation	74.03	17.65	2.38
IPP-Reliance Infra	115.39	*144.35*	12.51
Total	**3,617.28**	**967.33**	**2.67**

NEW SOURCES OF POWER

As discussed in the previous section, Goa had met peak demand of 540 MW during FY 2013-14 which is expected to grow to 934 MW by the year FY 2018-19. As on date there is no power project under construction or planned in the state of Goa. However, to meet the future demand in the state, Government of Goa (GoG) has signed PPAs with NTPC and NPCIL which will translate into ~65 MW of additional power by FY 2018-19.

Table 10: Allocation of power from central generating stations

Source	Total Capacity	Allocation
NPCIL- KAPP U3&4 (Gujarat)	2x700=1400 MW	16 MW (FY 2016-17)
NTPC-Solapur STPS (Maharashtra)	2x660 MW	13.7 MW (FY 2016-17)
NTPC-Mauda STPS-II (Maharashtra)	2x660= 1320 MW	13.7 MW (FY 2016-17)
NTPC-Vindhyachal STPS-V (Madhya Pradesh)	500 MW	5.2 MW (FY 2015-16)
NTPC-Lara STPS-I (Chhattisgarh)	2x800 MW	8.7 MW (FY 2016-17)
NTPC-Khargone STPP[5] (Madhya Pradesh)	***2x660 MW***	***8.2 MW (FY 2019-20)***
NTPC-Gadarwara STPP-I (Madhya Pradesh)	2x800 MW	9.9 MW (FY 2017-18)

Renewable Energy Sources

At present Goa has no renewable energy source of power generation in the state. To meet the Renewable Energy Purchase Obligation (RPO) targets given by JERC, Government of Goa has signed PPA with NTPC Vidyut Vyapar Nigam Limited (NVVNL) on 22nd August 2014 for the supply of solar power for a period of 5 years at Rs. 7.99 per unit for 6 MW and an additional LOI has also been issued for supplying 10 MW of non-solar power for FY 2015-16. Further, Goa has received allocation of 25 MW solar power from Solar Energy Corporation of India (SECI) at Rs. 5.50 per unit for a period of 25 years from FY 2015-16 once the power sale agreement (PSA) is signed.

Table 11: RPO Target and planned (MU)

RPO Targets	Non-solar (MU)		Solar (MU)	
	Target	Planned	Target	Planned
FY 2015-16	89	15	28	46
FY 2016-17	108	-	44	46
FY 2017-18	127	-	68	46
FY 2018-19	133	-	88	46

However, even with the above plans the state will not be able to meet its renewable energy targets of both solar and non-solar. Since, there is no renewable energy generation in the state, Goa has planned to meet its obligation through purchase of Renewable Energy Certificates (REC).

ADEQUACY OF POWER SUPPLY

The targeted energy availability is based on the assumption that 90% of the energy needs shall be met from firm allocation for the state, while the state will meet its remaining 10% of the energy needs through short-term arrangements such as from power exchanges and traders. The 10% of the electricity need has been left for short-term sources so that utility can plan the sourcing of power based on their needs in an optimum manner.

The utility would be in energy deficit from FY 2015-16 with shortage of 154 MU, which will increase to 1,153 MU by FY 2018-19 based on 90% target of long term firm tie-ups. This will translates into short fall in power by 165 MW by FY 2018-19 (on RTC bases with plant having 80% PLF) if Goa plans to provide 24 x 7 Power Supply in the state.

[5] *Power from this plant expected in FY 2019-20*

Table 12: Adequacy of power supply

Particulars	Adequacy of Energy Availability (MU)			
	FY 2015-16	FY 2016-17	FY 2017-18	FY 2018-19
Total Energy Requirement (A)	**3922**	**4521**	**5300**	**5480**
Proposed Energy Availability from Long Term Firm Tie-ups **(B)**	3375	3711	3779	3779
Targeted Energy Availability from Long Term Firm Tie-ups **(C) = (A) * 90%**	3529	4069	4770	4932
Adequacy of Energy Supply	**Inadequate**	**Inadequate**	**Inadequate**	**Inadequate**
Power supply				
Additional Energy Required on Long Term Basis (in MU) **(D) = (C) – (B)**	154	357	991	1,153
Additional Firm Tie-up Required (80% PLF) on RTC Basis (in MW) ***(D1) = (D)/8.76/0.80***	22	51	141	165
Additional Energy Required on Short Term Basis (in MU) ***(E) = (A) – (C)***	*394*	*452*	*530*	*548*

ACTION PLAN – STATE

1. The Government of Goa has planned action plan as shown below:
   A) Initiation of process of competitive bidding (timeline: by March 2016)
   B) Assessment of peak demand for the state on regular basis for procurement through medium/short-term sources (e.g., power exchanges, traders, banking, etc.) (timeline: half-yearly basis)
   C) Development of in-house capacity to take-up demand and supply analysis (Timeline: Training on half yearly basis)
2. While there is allocation of 19.67 MW from Ratnagiri Gas & Power Project Limited to the state, there is practically nil availability of power from this plant because the plant is not operational on the account of lack of the minimum technical load required for operating the plant as Maharashtra (principal beneficiary with 95% share) is not scheduling power from this station. Therefore, the Government of Goa has planned to take up this issue with RGPPL and look for better options such as surrendering of PPA.

SUPPORT REQUESTED FROM GOVERNMENT OF INDIA

Additional Power Allocation

a) Goa relies majorly on the Central Government allocation for its energy needs. It has signed many PPAs with central generating stations which translates into 65 MW by FY 2018-19. Since there is a shortfall in the energy requirement even with the above additional allocation, Government of Goa request's Government of India to provide some more additional allocation to Goa till there is an alternative.

Coal Block Allocation

a) The state of Goa was allotted coal block in Chhattisgarh for generating power by way of private partnership. In first phase 200 MW and later additional 200 MW in phase – II was to be allotted as Goa share. As per Supreme Court Order dated 24th September 2014 where all the coal block

allotments were cancelled including state of Goa. Goa requests the concerned Ministry to allocate a coal block to the state of Goa for power generation as it was done previously.

The energy requirement and maximum demand based on the current exercise is in line with the projections made in 18th Electric Power Survey (EPS) published by CEA for the state of Goa. As per the 18th EPS of CEA, the projected energy requirement of Goa is 5,572 MU by FY 2018-19, and the anticipated peak demand of the state has been projected at 950 MW. However, as per the current assessment the total energy requirement for the state is 5,480 MU and the maximum demand is 934 MW in FY 2018-19. Even though Goa has signed many PPAs with central generating stations, power available from these plants will not suffice to meet the incremental demand which will fall short by 165 MW in FY 2018-19. Therefore, Goa has planned to go ahead with competitive based power purchase after undertaking a detailed study on Long/Medium/Short term power requirement. Goa will also request for additional allocation from central generating stations.

CHAPTER 6. TRANSMISSION PLAN

The total energy requirement for Goa based on the analysis done in the previous sections for the FY 2018-19 is 5,480 MU and the maximum demand comes out to be 934 MW. Since, nearly all the power comes from central generating stations which are located outside Goa, with local generation by the private sector co-generating stations contributing a meagre 40 MW, the adequacy of interstate transmission network is very important. Further, intra-state transmission network, which further distributes this power to the required areas and load centres, requires strengthening along with strengthening of the interstate transmission network.

INTER-STATE TRANSMISSION SYSTEM

Power from the central power plants is wheeled into the state from the Western region through the following lines and substations:

- ✓ Double circuit 400kV line from Kolhapur Maharashtra State Electricity Transmission Co. ltd (MSETCL) 400kV substation to the Colvale (Mapuso) 400kV substation owned by PGCIL.
- ✓ Single circuit 220kV line from Tillari substation of MSETCL to Amona 220kV substation.
- ✓ Single circuit 220kV line from Kolhapur substation of MSETCL to Amona 220kV substation.

Goa also receives power from Southern region through the following lines:

- ✓ Double circuit 220kV line from Ambewadi substation of KPTCL to Xeldem and Ponda 220/110/33kV substation.
- ✓ Double circuit 110kV line from Supa substation of KPTCL to 110kV bus of Ponda 220/110/33kV substation (CURRENTLY NOT IN OPERATION).

The inter-state transmission lines serving Goa have an aggregate capacity (Surge impedance loading) of 1,558 MW and under "n-1" contingency (400kV line) it translates into 1093 MW.

The above inter-state transmission capacity is adequate for meeting the present drawl requirement of Goa from the inter-state grid. However, there are frequent and long breakdowns in the 220 kV Link with Southern Grid. The 100 MW allocated to Goa from Ramagundam STPS is fed through Ambewadi – Ponda 220kV double circuit line. The O&M works of 30 km stretch of this line lying within Goa is done by EDG while that of the 60 km stretch lying in Karnataka is done by KPTCL. Frequent tripping and long breakdowns happens on this line resulting in loss of supply in Southern part of Goa. Also during outage of this line, Goa's share of power from Ramagundam STPS is wheeled via Western regional grid and that results in higher transmission losses.

INTRA-STATE TRANSMISSION SYSTEM

The intra-state transmission network of Goa is mainly at 220 kV and 110 kV level. At present intra-state network of Goa consists of 138 ckm of 220 kV lines and 129 ckm of 110 kV lines. The total transformation capacity at 220/33 kV and 110/33 kV level is 990 MVA. Details of existing intra-state network of Goa is at Annexure D. Presently, Goa transmission system is split into two parts. North Goa load is catered from Western grid and South Goa load is catered from Southern grid in radial mode. Almost all the substations in Goa are being operated as single bus system and in case of faults in transmission system power supply failure is caused in large areas.

PRESENT REQUIREMENT AND CAPACITY

In Goa, except for six industrial consumers (Binani Industries, Cipla, MPL, MSL, Nestle, MRF) which are supplied directly at 110 kV level, the remaining consumers are supplied at 33 kV or below. Hence, the transmission network at 33 kV level must be adequate to meet the full projected demand of Goa in 2018-19 less the demand met at 110 kV.

The existing 220/33 kV and 110/33 kV transformation capacity is 990 MVA which is presently adequate to meet the peak demand of about 550 MW minus load directly fed at 110 kV.

Load restrictions which are imposed by EDG are not on account of transmission constraints but on account of supply constraints. The load restriction was applied by EDG in the evening hours for 122 days during the period March 2014-February 2015. The maximum cut was of 135 MW between 7 PM to 11 PM on 22nd August 2014, during which the demand met was 350 MW, which means the unrestricted maximum demand was 485 MW. Conversely, on the day the maximum demand met recorded the highest level at 540 MW, i.e., 13th March 2014, there was no load restriction. Following conclusions can be drawn from the data on demand met and load restriction applied in the last 12 months:

- ✓ While the maximum demand met was 540 MW, the maximum load restriction applied was 135 MW. Since, these events occurred on different dates, the unrestricted demand remained within 600 MW.
- ✓ Load restriction was applied on industrial load in the evening hours not because industrial load peaked in the evenings, but because domestic and commercial load did so.
- ✓ Load restrictions had to be applied not because of any constraints in transmission and distribution networks, but because sufficient power was not available to meet the natural unrestricted demand.

SHORT TERM AND LONG TERM SOLUTION PERTAINING TO INTER-STATE TRANSMISSION NETWORK

To address the present issues regarding frequent outage of the inter-state transmission lines connecting Goa from SR a committee comprising of representatives from CEA, SRLDC, PGCIL, KPTCL and EDG visited three substations in Karnataka (Ambewadi 220/110kV, Anamod 110/11kV & Supa HEP) and two substations in Goa (Xeldem and Ponda) between 9th & 10th April 2015 to ascertain the problems in the transmission lines feeding Goa from Karnataka and to explore the possibility of handing over these lines to PGCIL for O&M. The key findings of the committee and the action plan agreed upon are as follows:

A. Temporary Solution: Presently south Goa load is fed through Ambewadi-Xeldem 220 kV S/C line (AP-1) only. The other line, namely, AP-2, is in charged condition from Karnataka but kept open at Ponda end. Therefore, in case of fault on AP-1 line, supply to south Goa from SR is lost and restoration of the power supply is possible only after the fault on this is rectified. To reduce the outage time in case of fault on AP-1 line, EDG to take into service the Ambewadi-Ponda line-2 (AP-2), which is idle charged from Ambewadi end up to the Gantry point of Bus-II at Ponda.

B. Permanent solution:

i. Utilization of both Ambewadi-Ponda 220 kV D/C line simultaneously will improve the reliability of feed from SR to South Goa. For this LILO of AP-2 line at Xeldem needs to be established by GED, which in turns would require construction of 220kV D/C line for a distance of about 18 km length from the LILO point to Xeldem S/S. With this, Ambewadi-Ponda 220 kV D/C line would be reconfigured as Ambewadi- Xeldem 220 kV D/C line and Xeldem- Ponda 220 kV D/C line.

ii. At Ponda 110 kV switchyard, the dead end towers of Ponda –Supa 110 kV D/C line and Ponda – Xeldem 110 kV D/C line

(one direct ckt. and other ckt LILOed at Verna) are adjacent to each other. Ponda – Xeldem 110 kV line is idle charged from Xeldem end. With restoration of Supa (KPTCL) - Ponda 110 kV line-1, it could be connected with Ponda – Xeldem 110 kV line to form Supa-Xeldem 110 kV S/C line thus providing an additional feed from Karnataka.

Further, EDG with the help of CEA has undertaken load flow study for transmission network in the state which has identified some of the issues and relevant solutions:

Solutions to the issue related to the transmission:

I. **Short Term Solutions:** Short term solutions that address the two issues include effective utilization of the existing 110 kV and 220 kV links of Goa with Karnataka and Maharashtra by better maintenance and improved relaying.

II. **Long Term Solutions:** Long term solution is to build a transmission network that can handle roughly double of the existing demand in the next five years. It may be achieved by setting up a second 400 kV substation in Goa along with associated interconnecting transmission lines with an implementation timeframe of four-five years. This is discussed in the following section.

As a follow up to the above CEA and CTU carried out a study to assess the future requirement of Goa considering the load growth which is anticipated to take place in the future. They have proposed following interstate transmission network to take care of the future demands of Goa and also to address the issues being faced by Goa under outage of the present 220 kV lines connecting Goa with SR.

1. Establishment of a 400/220 kV substation at Xeldem in South Goa.
2. 400 kV D/C Narendra (existing) Xeldem with quad conductor.
3. 400 kV D/C Xeldem – Mapusa with quad conductor.

It needs to be noted that the above proposed inter-state network is yet to be discussed in the Standing Committee on Power System Planning of WR and may undergo some changes based on discussions. After approval in SCM the same would also need to be ratified by the WRPC.

The above proposed inter-state network would be adequate to meet a demand of the order of 1000 MW in Goa with n-1 contingency

PLANNED INTRA-STATE NETWORK

In addition to the inter-state transmission network which has been planned by CEA/CTU, the responsibility of planning and building the underlying 220 kV and 110 kV network is that of EDG. The following intra-state network has been planned by EDG to meet their growing requirements in the future.

Table 13: Planned Network

Sr. No.	Name of Transmission Line / Substation	Schedule
1	Erection of 220/110 kV Multi-circuit lines on narrow based towers from Ponda to Verna	FY 2019-20
2	Erection of 220 kV lines from Colvale to Verna LILO at Kadamba and extension up to Cuncolim from Verna	FY 2018-19
3	Erection of 220 kV D/C line from Colvale to Tuem	FY 2018-19
3	Erection of 110 kV line from Tivim to Saligao	FY 2018-19
4	Erection of 110 kV line Verna to Sancoale	FY 2018-19
5	Erection of 110 kV line from Pulsare to Kundaim Industrial Estate (KIE)	FY 2017-18
6	Erection of 110 kV line from MSL to Margao	FY 2018-19
7	220/110 kV, 2 × 100 MVA GIS substation at Kadamba	FY 2018-19
8	220/110 kV, 2 × 160 MVA GIS substation at Verna	FY 2016-17
9	110/33 kV, 2 × 50 MVA GIS substation at Sancoale	FY 2018-19
10	110/33 kV, 2 × 50 MVA GIS substation at Margao	FY 2018-19
11	110/33 kV, 2 × 50 MVA GIS substation at Saligao	FY 2018-19

Sr. No.	Name of Transmission Line / Substation	Schedule
12	110/33 kV, 2 × 50 MVA GIS substation at KIE	FY 2017-18

The above planned network would be adequate to take care of a load demand of about 950 MW anticipated by 2019.

ACTION PLAN – STATE

CAPITAL EXPENDITURE PLAN

1. The new substation proposed at Margao of capacity 2 × 50 MVA shall be advanced by one year, so that it is available by FY 2018-19.
2. While already planned by EDG and included under the caption Proposed, Intra-State Schemes and benefits, it is worth highlighting here that the 220kV Colvale (Mapusa) - Kadamba-Verna-Cuncolim double circuit link is vital for the Goa intra state transmission system. It should be established by FY 2018-19 so that the transmission system is able to meet the increased demand of the state till the proposed 400 kV substation at Xeldem becomes available. Further, Mapusa – Kadamba 220kV D/c line, may be implemented with high capacity conductor.

BETTER UTILIZATION OF TRANSMISSION LINES FEEDING GOA FROM SOUTHERN REGION (KARNATAKA)

1. A committee comprising of representatives from CEA, SRLDC, PGCIL, KPTCL and EDG visited three substations in Karnataka (Ambewadi 220/110kV, Anamod 110/11kV & Supa HEP) and two substations in Goa (Xeldem and Ponda) between 9th & 10th April 2015 to ascertain the problems in the transmission lines feeding Goa from Karnataka and to explore the possibility of handing over these lines to PGCIL for O&M. The key findings of the committee and the action plan agreed upon are as follows:
   a. **Temporary Solution**: Presently south Goa load is fed through Ambewadi-Xeldem 220 kV S/C line (AP-1) only. The other line, namely, AP-2, is in charged condition from Karnataka but kept open at Ponda end. Therefore, in case of fault on AP-1 line, supply to south Goa from SR is lost and restoration of the power supply is possible only after the fault on this line is rectified. To reduce the outage time in case of fault on AP-1 line, EDG to take into service the Ambewadi-Ponda line-2 (AP-2), which is idle charged from Ambewadi end up to the Gantry point of Bus-II at Ponda.
   b. **Permanent solution**:
      i. Utilization of both Ambewadi-Ponda 220 kV D/C line simultaneously will improve the reliability of feed from SR to South Goa. For this LILO of AP-2 line at Xeldem needs to be established by GED, which in turns would require construction of 220kV D/C line for a distance of about 18 km length from the Loop-In-Loop-Out (LILO) point to Xeldem S/S. With this, Ambewadi-Ponda 220 kV D/C line would be reconfigured as Ambewadi-Xeldem 220 kV D/C line and Xeldem- Ponda 220 kV D/C line.
      ii. At Ponda 110 kV switchyard, the dead end towers of Ponda –Supa 110 kV D/C line and Ponda – Xeldem 110 kV D/C line (one direct ckt. and other ckt LILOed at Verna) are adjacent to each other. Ponda – Xeldem 110 kV line is idle charged from Xeldem end. With restoration of Supa (KPTCL) - Ponda 110 kV line-1, it could be connected with Ponda – Xeldem 110 kV line to form Supa-Xeldem 110 kV S/C line thus providing an additional feed from Karnataka.
2. Setting up of State Load Dispatch Centre (SLDC) for Goa shall be fast-tracked.
3. Capacity building activities to be undertaken to strengthen technical expertise.

SUPPORT REQUESTED FROM GOVERNMENT OF INDIA

ESTABLISHMENT OF NEW 400 KV SUBSTATION

1. As per the load flow study discussed in Annexure-B, a long term solution has been proposed where in establishment of a new 400 kV substation has been proposed at Xeldem and the associated transmission lines as an Inter-State Transmission System scheme: A New 400 kV Substation for Goa.

FUNDING OF CAPITAL EXPENDITURE

The funding of the new schemes has been proposed through loans from financial institutions like REC/PFC. The tentative cost of these projects is to the tune of Rs. 789 Crores; however, the same is subject to revision on preparation of the detailed cost estimates. It is also proposed to award some of the works on Tariff Based Competitive Bidding (TBCB) route.

Table 14: Capital Expenditure Plan (Rs Crores)

Particulars	Debt	Equity	Total
Erection of lines	126	54	180
Substations	426	183	609
Total	**552**	**237**	**789**

The capacity addition planed at 33kV (765 MVA) is sufficient to meet the load projected for FY 2018-19. However, based on the load flow study, establishment of 400 kV substation at Xeldem will be essential to provide reliable power supply in the state at projected load.

CHAPTER 7. DISTRIBUTION PLAN

In the previous section, transmission network adequacy has been discussed and it has been observed that planned network is adequate to meet the maximum demand of 934 MW. Since, consumers are connected to the distribution network at different voltage levels in the distribution network, adequacy of the same also needs to be assessed.

Currently, consumers in Goa are provided with 24 hours of supply which shows that existing system in the state is adequate to meet the power demand of about 5.8 lakh consumers. However, some of the major issues which needs to be addressed for providing quality power in future in the state are, lower collection efficiency, faulty electromechanical meters, frequent disruption of network in monsoon season, augmentation of old network, etc. In order to continue quality power supply in the state, these issues needs to be addressed and Goa has planned to take-up this work under different schemes.

EXISTING DISTRIBUTION SYSTEM

The distribution network of Goa as on 31st March 2014, consisted of ~12,000 ckt km of low tension lines, 3,059 ckt km of 11 kV lines, and 1,782 ckt km of 33 kV line. There are 52 Nos. of 33 kV Substations and 6,104 Nos. of 11/0.4 kV distribution transformers.

The agricultural consumers in the state constitute a miniscule number and are supplied with power supply round the clock. In essence, the state provides 24 × 7 power supply. However, the distribution system is susceptible to frequent unscheduled breakdowns and tripping as the lines are quite old. To provide 24 × 7 power supply to the state, there is an urgent need to augment/strengthen the 11 kV feeders and LT lines and enhance the capacity at 33 kV substations.

Table 15: Existing Infrastructure in Goa

S. No.	Item	Unit	Quantity
1	33/11 kV SUB-STATION	MVA	691
2	33 kV feeders	Ckt.km	1782
3	11 kV feeders	Nos	275
		Ckt.km	3059
4	Distribution Transformer	Nos	6,104
		MVA	846
5	LT Line (Overhead line)	Ckt.km	11,264
	LT Line (Underground)	Ckt.km	1,427
6	Capacitor Bank	MVAR & No.	-
7	Aerial Bunched Cables	Ckt.km	-
8	Metering - Feeder/Boundary Point/DT/Consumer	Nos	5,83,000

SCHEMES UNDER IMPLEMENTATION

R-APDRP

In Goa under Part A, one project (4 project towns) had been sanctioned by the Ministry of Power (MoP). MoP had sanctioned a total loan of Rs. 110.73 Crores for 4 project towns in Goa. Tenders were called from System Integrators (SI) shortlisted by the ministry, and after finalization, the work was awarded for an amount of Rs. 84.99 crores. The SI took up the work, but the same was stalled suddenly and thus conversion of the Central Government loan to grant was under threat, since the deadline for completion of the project was fast approaching. In order to avail the benefits of the grants, the government first got the project completion date extended and then awarded the work on nomination basis to REC Power Distribution Company Ltd. (RECPDCL) for speedy execution. The work was awarded at a

cost of Rs. 116 Crores. The scope of work includes all the works awarded to the earlier executing agency. The work has been taken up and is progressing as anticipated. The project completion date is March 2016.

PROPOSED SCHEMES AND ADEQUACY

A load flow analysis has been undertaken by EDG during preparation of Detailed Project Report (DPR) for strengthening of sub-transmission and distribution network.

As per available records, Goa sub-transmission power infrastructure has witnessed a peak load of 540 MW in April 2014. Further, HT consumers contribute to 80 MW of the peak load who maintain their own transformers. Thus, the 33/11 kV power transformers experienced a net load of 460 MW at peak.

Presently, there are 52 sub-stations at 33/11 kV level having a consolidated capacity of 691.15 MVA. For the purpose of designing sub-transmission network, 80% optimum loading of Power Transformer has been considered for the efficient use and reliability purposes. On the 5 year time horizon a net capacity required at 80% transformer loading would be approx. 937 MVA. To meet the same additional capacity of 245 MVA has been considered at the Sub-Transmission level. The above capacity augmentation is adequate to meet the demand in FY 2018-19.

CAPACITY ADDITION-SUB-TRANSMISSION NETWORK (33 kV)

The new sub-station shall enhance the operational flexibility, system reliability and transformation capacity after becoming a part of the network. Following arrangements has been considered at the Sub-Transmission level.

Table 16: New Sub Stations proposed

Sr. No.	Particulars	Nos.	Capacity (MVA)
1	New 33/11kV Sub-Stations GIS	4	57.8
2	New 33/11kV Sub-Station, AIS	9	104
3	Augmentation of 6.3 MVA to 10MVA Transformer of 33/11kV Sub-Station	9	33.3
4	Addition of 6.3 MVA Transformer 33/11kV Sub-Station	8	50.4

To feed the new proposed sub Stations new 33 kV new lines have been considered with mix of underground cables and overhead network as per the demographic conditions. Strengthening of 33 kV network has been considered for the substations where augmentation of the power transformer capacity has been considered.

NEW 11KV FEEDERS

To meet the incremental demand, 87 Nos. of new 11 kV feeders have been proposed. Out of 87 Nos, 16 Nos. of 11 kV industrial feeders are proposed to meet the existing and upcoming loads. These feeders will emanate from new and existing 33/11kV substations and will be dedicated to cater load of Industrial consumers. This will also increase reliability of supply.

CONVERSION OF OVERHEAD LINE TO UNDERGROUND

Overhead to underground network of length 295 Ckt.km has been considered at 11 kV voltage level for increasing reliability of supply. To optimize the high costs involved in use of underground cables, use of Ariel Bunch Cables (ABC) has been planned and use of underground network is recommended only in view of tourism in urban areas or any other special case. The underground system will also enhance public safety and aesthetic appearance.

AB (AERIAL BUNCH) CABLE

The length of 11 kV feeders in rural areas are very long (15 to 60 km) and is routed through the forest areas. The number of tripping and faults are frequent as compared to other feeders. This is due to transient tripping occurring account of tree touching, falling of trees on the lines, especially in monsoon season. The long feeders result in more time to patrol the line and locate the fault. Hence splitting of very long feeders into multiple feeders of 10 to 15 Ckt.km has been planned.

Table 17: Proposal – 11kV Network

Sr. No.	Particulars	Units	Quantity
1	No of New Proposed 11kV Feeders	No	87
2	Total Ckt Length of New Proposed 11kV Feeders	Ckt.km	215
3	Total Ckt Length of New Proposed 11kV Underground Cables (3Cx300 Sqmm)	Ckt.km	77
4	Total Ckt Length of New HT ABC	Ckt.km	138
5	**Total Ckt length of overhead line to cable conversions:**	Ckt.km	
(i)	*Underground Cable*	Ckt.km	*295*
(ii)	*HT ABC*	Ckt.km	*945*
6	Reconductoring/ Re-routing of 11kV Lines	Ckt.km	68

DISTRIBUTION TRANSFORMER

In line with the Sub-Transmission Lines, Distribution Transformer capacity has been proposed. It is proposed to replace all existing 16/25/63 KVA transformers with minimum 100 KVA transformers as a standardization practice.

ELECTRICITY METERS

For conducting energy audit, ring fencing meters have been considered to reduce the commercial loss well as for better energy accounting. For government consumers below 45 kW, pre-paid meters have been considered for replacing existing meter. Apart from this, there are many small establishments like schools, medical dispensaries, parks, pump house etc. which are located in remote locations where regular metering and billing can be ensured by pre-paid meters in a better way. All electro mechanical meters has been considered to be replaced with electronic meter.

Table 18: Metering Planned

Particulars	Units	Quantity
Boundary meters for ring fencing	No	134
AMR for feeders, Distribution transformer	No	2210
Old EM Meter Replacement along with with Service Line O/H	No	2,78,000
Prepaid / smart meters in Govt. establishment	No	1525

SMART GRID IN GOA

In order to achieve 24 × 7 power supply, apart from a robust transmission and distribution network, sufficient level of automation needs to be built into the system. Undertaking the projects under Part-A of R-APDRP will help create the IT infrastructure primarily required for automating the metering and billing systems, while the implementation of IPDS and DDUGJY will help strengthen the sub-transmission and distribution system, but the issue of automation will still need to be addressed.

Goa intents to make itself a 24 × 7power supply model state for the rest of the country to emulate. A prerequisite in that direction would be to build sufficient level of automation and undertake smart grid initiatives. The state requires Government of India support and funding for taking up smart grid projects.

ACTION PLAN – STATE

PERFORMANCE IMPROVEMENT

1. To improve billing efficiency, Goa has planned to develop a computerized billing system. The system will help in undertaking consumer billing on a monthly basis (Timeline: By the end of March, 2016).
2. To improve collection efficiency in the state, Goa is planning to provide options such as:
   - Online payment facility to all consumers (Timeline: By the end of March, 2016)
   - Spot billing in remote areas (Timeline: By the end of March, 2016)
   - Monitoring arrears and disconnecting regular defaulters (Timeline: On quarterly basis)
   - Prepaid metering for government institutions (Timeline: By the end of March, 2016)
3. In the past, the regulator has been disallowing any true-up and associated cost of fixed assets due to non-availability of audit account and asset register. This is leading to short recovery of tariff on account of disallowances. Therefore, the following shall be expedited for necessary approvals and impact to be considered in the tariff:
   I. Preparation of asset register for the utility (Timeline: By March, 2016)
   II. Accounts audited for assessing the actual financial status of the utility (Timeline: By March, 2016)
4. Energy Audit of the distribution system for assessing the actual technical losses in the system. (Timeline: By March, 2016)
5. Consumer grievances cell in each division (Timeline: By the end of March, 2016)
6. To implement the capital expenditure plan as envisaged in a timely manner.
7. All pending connections shall be released as per the notified SoP.
8. All prospective consumers demanding connection will be provided as per SoP.
9. Voltage regulation that be with in permissible limits.
10. Optimum utilisation of resources shall be made.

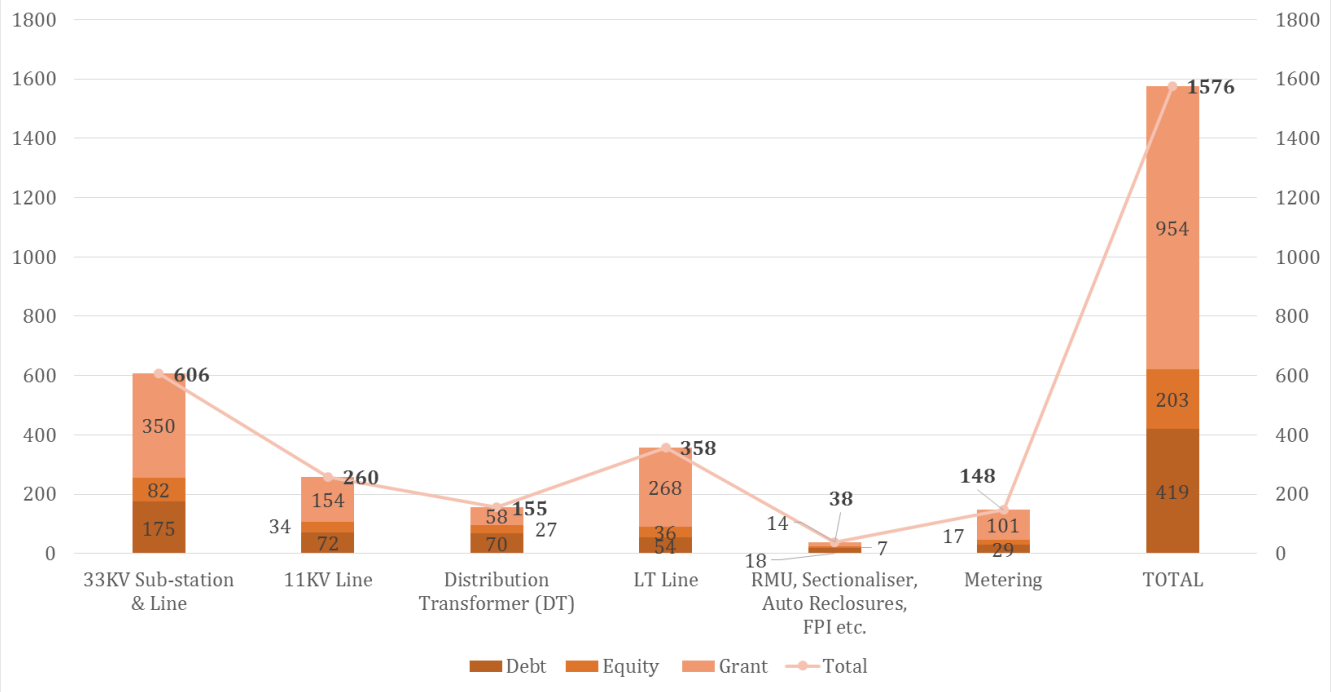
SUPPORT REQUESTED FROM GOVERNMENT OF INDIA

1. State requests that the schemes under IPDS and DDUGJY needs to be sanctioned expediently by PFC and REC respectively.
2. The request of Government of Goa would be considered by Government of India as per its policies/ frameworks or otherwise Government of Goa would make arrangements for funding from other sources.

FUND REQUIREMENT

EDG has planned to undertake Rs 1576 Crores of investment towards the network expansion and strengthening. Out of Rs 1576 Crores, the investment of Rs 1272 Crores is proposed to be executed through central sponsored schemes (IPDS and DDUGJY). IPDS/ DDUGJY, which is being funded to the extent of 75% by the Ministry of Power, Government of India, has been proposed to be taken up. The 15% funding for this scheme is proposed to be arranged from the debt raised from institutions and 10% as equity. The remaining capital expenditure is proposed to be commercially funded with a debt equity ratio of 70:30.

Figure 6: Fund Requirement



CHAPTER 8. ENERGY EFFICIENCY

Energy sector is reeling under shortage. The planning efforts for the energy sector have mainly been supply focused. Though the potential and cost effectiveness of energy efficiency has been recognized by planners for more than a decade, the actual outlays haven't taken off at the required scale.

Demand Side Management (DSM) and implementation of energy efficiency measures in various sectors such as agriculture, municipalities, buildings, domestic consumers, and industries are some of the options available, which are well tested and efficient. Electricity Department of Goa (EDG) has planned to implement some of the energy efficiency measures with the help of Energy Efficiency Services Limited (EESL) in Goa.

SAVINGS POTENTIAL

A study of demand-side electricity saving potential is being undertaken by EESL in collaboration with the EDG, the same has been listed below:

Table 19: Project under study in Goa

Sector	Consumption in FY 2014 (MU)	Techniques to be incorporated
Agriculture	27	Replacement with energy efficient pump
Commercial Buildings	287	Retrofitting of energy efficient equipment's, ECBC adoption
Public Water Works	147	Replacement with energy efficient pump sets
Industries and others	1683	PAT, ECBC, Energy Audit

PROJECTS UNDERTAKEN

Goa has already undertaken two successful projects targeted towards reduction of peak demand through adoption of DSM by replacement of 5,000 streetlights of 250 W HPSV by 98 W T5 lights and replacement of 506 streetlights of 250 W by 90 W LEDs.

Table 20: Saving achieved (MU)

No.	Parameters	Projects	
		HPSV To T5	HPSV To LEDs
1.	No. of Lights Replaced	5000	506
2.	Annual energy savings achieved (MU)	3.05	0.32

PROJECTS UNDER PIPELINE

DSM-based Efficient Lighting Programme

LED bulbs being more energy efficient, having longer life and not having mercury, are yet to make an impact in the household sector. The retail price of LEDs at Rs. 400-500 per bulb is the single biggest barrier that has limited their penetration. The DSM-based Efficient Lighting Programme (DELP) proposes to overcome this cost barrier to promote LEDs by using the basic architecture of Bachat Lamp Yojana (BLY) that was implemented by Bureau of Energy Efficiency (BEE) in the XI plan (2007 to 2012). The scheme proposes to provide up to 3 LED bulbs to household consumers at a cost of Rs. 20 each bulb as replacements to incandescent bulbs. DELP, taking note of the fact that carbon finance is no longer available, seeks to leverage energy savings to distribution companies to recover investment.

Under DELP, three high-quality 7 W LED bulbs will be provided as replacements to 60 W ICLs or

14 W CFLs, at a cost of Rs. 20 each, to domestic consumers of the Electricity Department of Goa. The distribution of 11.20 lakh LED bulbs would result in savings of 31.32 MU per annum of energy, thereby avoiding the power procurement cost of about Rs. 8.5 crores annually to the Electricity Department of Goa on the basis of the average power procurement rate of Rs. 2.74 per kWh.

EFFICIENT LED STREET LIGHTING PROGRAMME

In India, the street lighting sector offers a significant potential for energy efficiency and cost savings. Retrofitting the conventional streetlights with LEDs has the potential to save about 50% of energy, amounting to approximately 4,300 MU annually at the national level. It is also possible to optimize the operational performance through twilight switching control and dimming and voltage optimization, leading to additional savings. This usually leads to additional 15-20% savings over and above the savings achieved by lamp replacement.

It is evident from the technology demonstration results that, on an average, 55% energy savings could be achieved through up-gradation of conventional fixtures with energy efficient LED fixtures at demonstration sites. In a similar path, Goa has planned to replace its streetlights with LEDs as per the given below plan which can save almost 35 MU of energy every year.

Following are the existing streetlights to be replaced with LEDs:

Table 21: Potential for EE

Description	Units	Total
Streetlight inventory	Nos.	1,66,614
Existing scenario		
Connected load	MW	14.54
Energy consumption	MU	58.33
Post LED retrofits		
Connected load	MW	6.04
Energy consumption	MU	23.05
Savings		
Connected load	MW	8.5
Energy	MU	35.28

FUND REQUIREMENT

With increasing importance being given to low carbon growth these days, the cheapest and more affordable option to overcome the energy deficit is Demand Side Management and implementation of energy efficiency measures in various sectors such as agriculture, municipalities, buildings, domestic, industries etc. The demand side energy savings potential that exist in Goa, investments and fund requirement has been discussed in the below table:

Table 22: Saving Potential

Year	Units	FY 2015-16	FY 2016-17	FY 2017-18	FY 2018-19
Energy Efficiency projects					
Replacement of all type St. light fixtures by LED	MU	35.28	35.28	35.28	35.28
DELP Programme	MU	31.32	31.32	31.32	31.32
Total Saving	**MU**	**66.6**	**66.6**	**66.6**	**66.6**
Cost of project					
Replacement of all type St. light fixtures by LED in State of Goa	Rs crores	102.91			
DELP Programme	Rs crores	10.94			
Total cost	Rs crores	113.85	0	0	0
Power purchase cost	*Rs /kWh*	*2.60*	*2.80*	*2.98*	*3.01*
Opportunity cost saved	**Rs crores**	**17.30**	**18.66**	**19.84**	**20.06**

CHAPTER 9. FINANCIAL VIABILITY

FINANCIAL POSITION OF DISTRIBUTION UTILITY

The Electricity Department of Goa had higher average revenue realization compared to average cost of supply in FY 2009-10 and also booked a profit of Rs 16 crores. However, since FY 2010-11 the utility had started to incur losses to the tune of 0.22 Rs/kWh which had increased to 0.78 Rs/kWh in FY 2012-13. This has resulted into a cumulative losses of Rs 620 crores which is almost 40% of its Annual Revenue Requirement.
The above losses are on accrual basis, and in case, we consider its collection efficiency, the losses would further shoot up due to higher interest cost. However, the above losses have been committed to be bridged by adequate budgetary support by Government of Goa on annual basis. The reference has been drawn from the tariff order issued for FY 2015-16 by Joint Electricity Regulatory Commission. Accordingly no carryforward gap has been considered upto FY 2014-15 for analyzing its financial sustainability.

In order to control the degrading financials of the utility, some very basic solutions need to be implemented, one of which is to increase its collection efficiency from 90% to 100%. The utility could have saved interest on ~Rs. 100 crores by increasing its collection efficiency from 90% to 100% in FY 2013-14 based on the projections. This improvement will require regular billing and focusing on timely collection of dues from consumers through some innovative steps.
Secondly, the Average Cost of Supply and Average Billing Rate at has a difference of more than 0.78 Rs/kWh for FY 2012-13, which is another reason for these losses.

SCENARIO ANALYSIS

A detailed scenario analysis has been done to measure the performance in coming 4 years. The calculations have been based on the assumption that utilities should function without any subsidy granted from the state government in future.
The following scenarios have been worked out:

A. At targeted growth rate as per "24x7 Power for All" Road Map (Base case).
B. At targeted growth rate as per "24x7 Power for All" - Financial Turnaround.
C. At Targeted Growth Rate as per 24x7 Road Map plus Financial Turnaround- Proposed investments funded through loan only.

Common Assumptions

a) Escalation towards O&M cost considered at 6% based on year-on-year increase in WPI inflation index in FY 2014.
b) No escalations in Power Purchase Cost as any change in the power purchase cost will be taken care by the Fuel and Power Purchase Cost Adjustment mechanism.
c) Since, power from RGPPL is not available as per the requirement and PPA with IPP-Reliance has expired, power from these sources has not been considered during the assessment.
d) Power from Non-firm sources considered at an average rate of Rs 4 per unit based on the power purchase trend for past 6 months of EDG through bilateral arrangement.
e) Asset Additions (capitalization schedule) through IPDS and DDUGJY schemes has been considered as 30%, 40% and 30% from FY 2016 to FY 2018
f) Grant: Loan: Equity ratio is 75:15:10 for centrally sponsored schemes (IPDS and DDUGJY)

g) Interest computations has been done based on the following considerations:
   a. Opening loan has been considered based on existing loan of FY 2013-14
   b. Interest rate of 12.50% has been considered based on EDG loan profile.
   c. Loan for Extra High Voltage (EHV) schemes by the Goa considered at debt equity ratio of 70:30
h) Similarly, addition to GFA, Depreciation etc. have been done considering the funding pattern (i.e. through equity, loan or grant) of individual schemes. Opening GFA has been considered based on MYT petition submitted by Goa.
i) Category-wise average billing rate for computation of revenue for FY 2014-15 has been taken as per the tariff order dated 15th April, 2014.
j) Category-wise average billing rate for computation of revenue for FY 2015-16 and onwards has been taken as per the latest tariff order dated 6th April, 2015.
k) Transmission charges have been escalated in proportion to the increase in power purchase quantum and allocation.
l) Depreciation has been computed at 5.28% as approved by JERC for EDG.
m) Non-tariff Income has been projected to increase at 5% annually.
n) The average cost of supply has been computed after deducting non-tariff income from the expenses.
o) The capital expenditure pertaining to energy efficiency measures has not been considered as either these schemes are primarily funded through grant or have short payback period, thus having negligible impact on the financials of the distribution company.

SCENARIO A: AT TARGETED GROWTH RATE AS PER 24X7 ROAD MAP (BASE CASE)

ASSUMPTIONS

- ✓ No tariff hike
- ✓ AT&C losses and collection efficiency as per the MoP targets.
- ✓ No subsidy from FY 2015-16

	FY 2015-16	FY 2016-17	FY 2017-18	FY 2018-19
AT&C losses	12.39%	11.89%	11 %	10%
T&D Losses	11.50%	11%	11%	10%
Collection Efficiency	99%	99%	100%	100%

Table 23: Assumptions for Scenario A

Year	Units	FY 2015-16	FY 2016-17	FY 2017-18	FY 2018-19
Energy Demand	MU	3,922	4,521	5,300	5,480
Sales	MU	3,316	3,853	4,527	4,743
Power purchase cost	Rs /kWh	2.58	2.70	2.89	2.92
Revenue	Rs crores	1,310	1,551	1,855	1,938
Average Billing Rate	Rs /kWh	3.93	4.01	4.08	4.07

Table 24: Existing matrices (Base case)

	FY 2015-16	FY 2016-17	FY 2017-18	FY 2018-19
Revenue	1,310	1,551	1,855	1,938
Total Expense	1,514	1,843	2,280	2,414
PBT	-203	-287	-415	-463
ABR	3.93	4.01	4.08	4.08
ACS	4.55	4.75	5.00	5.05
O&M cost per unit	0.68	0.62	0.56	0.57
R&M cost per unit	0.09	0.08	0.07	0.07
Employee cost per unit	0.57	0.52	0.47	0.48

Table 25: P&L under scenario A

P&L (Rs crores)	FY 2015-16	FY 2016-17	FY 2017-18	FY 2018-19
Net Sales	*1,304*	*1,544*	*1,848*	*1,931*
Other Income	6	6	7	*7*
Total Income	**1,310**	**1,551**	**1,855**	**1,938**
Expenditure				
Transmission Charges	169	194	228	236
Power purchase cost	1,011	1,221	1,530	1,602

P&L (Rs crores)	FY 2015-16	FY 2016-17	FY 2017-18	FY 2018-19
Employee Cost	189	201	213	225
R&M cost	29	30	32	34
Admin Expenses	9	9	10	11
Total Expenses	**1,407**	**1,656**	**2,013**	**2,108**
PBDIT	-96	-105	-158	-170
Interest	38	84	129	146
PBDT	*-135*	*-189*	*-287*	*-316*
Depreciation	68	97	128	147
Profit Before Tax	*-203*	*-287*	*-415*	*-463*
Accumulated losses by end of the year	**-203**	**-490**	**-904**	**-1,368**

- ✓ It is important to note that the revenue mix from FY 2015-16 increases due to increase in Average Billing Rate on the account of higher share of industrial consumers due to additional load envisaged. Also, due to increase in share of power purchased from plants having higher rate, the rate of power purchase has also increased.
- ✓ Therefore, from the above assumptions, it is evident that Goa will incur losses amounting to Rs. 203 crores in FY 2015-16 and continue to do so with an incremental impact on its profitability. From the table above, it is evident that Goa may incur cumulative losses of ~Rs. 1,368 crores if the as-is situation persists in the state from FY 2015-16 to FY 2018-19 (*Losses from only FY 2015-16 to FY 2018-19 have been considered*). The repayment of its power purchase cost towards central generating stations will also come under pressure from FY 2016-17 with cumulative losses amounting to Rs. 490 crores. Further, return on equity, which is required for capital infusion to undertake regular capex for proving reliable services, will also get affected.
- ✓ From the above scenario, it is evident that improvement in collection efficiency, increase in tariff, energy efficiency savings etc., will play an important role in driving the financial condition of the utility.

SCENARIO B: AT TARGETED GROWTH RATE AS PER 24X7 ROAD MAP PLUS FINANCIAL TURNAROUND

ASSUMPTIONS

- ✓ Weighted average tariff hike to bridge the financial losses on latest category wise average billing rates approved by Joint Electricity Regulatory Commission (14% in FY 2016-17, 13% in FY 2017-18 and 11% in FY 2018-19)
- ✓ No subsidy
- ✓ AT&C losses and collection efficiency as per the targets given by MoP.

Table 26: Assumptions for Scenario B

Year	Units	FY 2015-16	FY 2016-17	FY 2017-18	FY 2018-19
Energy Demand	MU	3,922	4,521	5,300	5,480
Sales	MU	3,316	3,853	4,527	4,743
Power purchase cost	Rs /kWh	2.58	2.70	2.89	2.92
Revenue	Rs crores	1,310	1,736	2,305	2,671

Table 27: Performance as per Scenario B

	Units	FY 2015-16	FY 2016-17	FY 2017-18	FY 2018-19
Revenue	Rs Crores	1,310	1,736	2,305	2,671
Total Expense	Rs Crores	1,507	1,831	2,263	2,394
PBT	Rs Crores	-203	-101	35	271
ABR	Rs /kWh	3.93	4.49	5.08	5.62
ACS	Rs /kWh	4.55	4.75	5.00	5.05
O&M cost per unit	Rs /kWh	0.68	0.62	0.56	0.57
R&M cost per unit	Rs /kWh	0.09	0.08	0.07	0.07
Employee cost per unit	Rs /kWh	0.57	0.52	0.47	0.48

Table 28: P&L under Scenario B

P&L (Rs crores)	FY 2015-16	FY 2016-17	FY 2017-18	FY 2018-19
Net Sales	*1,304*	*1,730*	*2,298*	*2,664*
Other Income	6	6	7	*7*
Total Income	**1,310**	**1,736**	**2,305**	**2,671**
Expenditure				
Transmission Charges	169	194	228	236
Power purchase cost	1,011	1,221	1,530	1,602
Employee Cost	189	201	213	225
R&M cost	29	30	32	34
Admin Expenses	9	9	10	11

P&L (Rs crores)	FY 2015-16	FY 2016-17	FY 2017-18	FY 2018-19
Total Expenses	**1,407**	**1,656**	**2,013**	**2,108**
PBDIT	-96	80	292	564
Interest	38	84	129	146
PBDT	*-135*	*-4*	*163*	*417*
Depreciation	68	97	128	147
Profit Before Tax	*-203*	*-101*	*35*	*271*
Accumulated losses by end of the year	-203	-304	-270	1

- ✓ From the above assumptions, it is evident that Goa will still incur losses amounting to Rs. 204 crores in FY 2015-16. However, from FY 2017-18, the utility will start showing some profitability and will be able to provide a positive return on equity as desired for improving its infrastructure.
- ✓ The profitability of the utility will vary based on its future increase in tariff in later years as well. The surplus, which is seen from FY 2017-18, can be used for funding the losses of previous year. If tariff hike is not given in time and the utility fails to maintain its AT&C losses as targeted by MoP, it will continue to incur losses.

SCENARIO C: AT TARGETED GROWTH RATE AS PER 24X7 ROAD MAP PLUS FINANCIAL TURNAROUND-PROPOSED INVESTMENTS FUNDED THROUGH LOAN

ASSUMPTIONS

- ✓ The proposed investments under IPDS and DDUGJY are funded through loan and equity (70:30) in place of grant.
- ✓ T&D losses as per targeted trajectory.

Table 29: Performance as per Scenario C

	Units	FY 2015-16	FY 2016-17	FY 2017-18	FY 2018-19
Revenue	Rs Crores	1,310	1,767	2,409	2,817
Total Expense	Rs Crores	1,517	1,875	2,353	2,512
PBT	Rs Crores	-213	-115	50	298
ABR	Rs /kWh	3.93	4.57	5.31	5.92
ACS	Rs /kWh	4.58	4.87	5.20	5.30
Interest Cost	Rs Crores	45	112	185	218
O&M cost per unit	Rs /kWh	0.68	0.62	0.56	0.57
R&M cost per unit	Rs /kWh	0.09	0.08	0.07	0.07
Employee cost per unit	Rs /kWh	0.57	0.52	0.47	0.48
Interest cost per unit	Rs /kWh	0.14	0.29	0.41	0.46

Table 30: Changes in parameter with respect to scenario B

	FY 2015-16	FY 2016-17	FY 2017-18	FY 2018-19
Total Expense	1%	2%	3%	4%
Interest Cost	14%	25%	33%	37%
Asset Turnover Ratio	-9%	-16%	-21%	-21%
Cumulative Losses with Scenario-B revenue (Rs Crores)	-231	-359	-414	-261

Table 31: P&L under Scenario C

P&L (Rs crores)	FY 2015-16	FY 2016-17	FY 2017-18	FY 2018-19
Net Sales	*1,304*	*1,760*	*2,402*	*2,810*
Other Income	6	6	7	*7*
Total Income	**1,310**	**1,767**	**2,409**	**2,817**
Expenditure				
Transmission Charges	169	194	228	236
Power purchase cost	1,011	1,221	1,530	1,602
Employee Cost	189	201	213	225
R&M cost	29	30	32	34

P&L (Rs crores)	FY 2015-16	FY 2016-17	FY 2017-18	FY 2018-19
Admin Expenses	9	9	10	11
Total Expenses	**1,407**	**1,656**	**2,013**	**2,108**
PBDIT	-96	111	396	710
Interest	45	112	185	218
PBDT	*-141*	*-1*	*212*	*492*
Depreciation	72	114	162	193
Profit Before Tax	*-213*	*-115*	*50*	*298*
Accumulated losses by end of the year	-213	-328	-278	20

- ✓ From the above assumptions it is evident that, in case debt (From FI/ World Bank) is being availed in place of grant, Goa will see an increase in total expense by 4% which will lead to a accumulated burden of Rs ~261 Crores by FY 2018-19. To bridge the impact of this additional burden, Goa will require weighted average increase in tariff of 16%, 16% and 12% (On average billing rate) in FY 2016-17, FY 2017-18 and FY 2018-19 respectively.

It is important for the EDG to analyze its losses after segregating its transmission and retail business and meet regulatory requirement for benefiting from approval of required tariff. This will help the utility in targeting the weak areas due to which it is incurring losses. One of them is due to non-approval of its gross fixed asset due to un-availability of audited fixed asset register and accounts which impact its ARR approved for tariff formulation as observed in tariff orders issues in past 3 years. Therefore, segregation of utility and financial audit will help Goa in planning towards financially viable power distribution

CHAPTER 10. OTHER INITIATIVES

COMMUNICATION

Successful implementation of the 24 × 7 power supply scheme requires clear communication among all the stakeholders across the value chain, including the consumers. In order to avoid potential roadblocks in implementation due to poor communication and flow of information, a core team following with the primary responsibility of each stakeholder and the corresponding method in which it will be carried out has been formulated.

The utilities would clearly communicate their plans on implementing the reliable 24 × 7 power supply scheme along with the other reliability and efficiency improvement measures.

Table 32: Communication strategy

Communication Objective	Responsibility	Frequency
" Power For All" - Rollout Plan	Nodal Officer	Quarterly
Energy Savings & Conservation	Nodal officer Executive Engineer, (SDA)	Monthly
Planned Outages & Disruption	Executive Engineer, DIV III- PONDA	Daily
Real-time feeder-wise Information	----Do----	Daily
Status update on Deliverables	Secretary, Energy	Quarterly
Renewable Power	GEDA	Quarterly
Transmission Projects – Physical Progress and Achievements	Executive Engineer (PLG)	Monthly
Distribution – Progress, Achievements, Losses, Consumer Initiatives, etc.	Executive Engineer (PLG)	Monthly

INSTITUTIONAL ARRANGEMENT

A strong monitoring framework is essential to ensure the success of the "Power For All" scheme. The following structure is proposed for regular monitoring of the progress of all initiatives being undertaken through this scheme.

a) **Government of India (GOI) Level Committee**: It is proposed that this committee will review the overall progress of the scheme on quarterly basis and provide the necessary support to ensure a coordinated response from the Central Government – where necessary. The committee may be constituted with the following members: PFC, REC, CEA, PGCIL, EESL, Ministry of Power, Ministry of Coal, and MNRE.

b) **State Government Level Committee**: It is proposed that a state level committee, headed by the Secretary Power, Goa, be formed to review the progress of the scheme on a quarterly basis. This committee will monitor the progress of the works undertaken as part of the scheme and issue directions to enable faster execution.

c) **Department Level Committee**: It is proposed that a department level committee, headed by the Nodal Officer, be formed. This committee shall take steps required to ensure that the projects are progressing as per the action plan. This committee will undertake progress reviews on a monthly basis.

d) **District Level Committee** – It is proposed to constitute a district level committee, headed by the S.E., to take necessary actions to ensure that the projects are completed in a timely manner and address any issues pertaining to land or other relevant

approvals.

The proposed committees require to be set up at the earliest to kick-start the whole scheme. It is important that the committees keep meeting on a regular basis as per the frequency/timelines mentioned above – to ensure that the objectives set out under the "Power For All" scheme are achieved.

CAPACITY BUILDING

At present there are 6,236 employee in EDG. Any increase in the use of IT applications in the transmission and distribution system to meet the expectations of 24 × 7 power supply for the consumers in the state will require a continued focus on capacity building of these employees for enhancement of technical know-how for latest technological developments and to increase the consumer satisfaction. The capacity building may also include consumer grievance redresal system, awareness regarding importance of working with safety, outage management system, demand side management etc. It is also imperative to state that for serving the consumers in a different way change of mind-set of the employees would be required. It is critical that Change Management initiatives are roll out and institutionalize throughout for achieving better results.

In view of the importance of training on new technologies, a human resource training programme needs to be developed and implemented so as to realize the dream of 24 × 7 power supply in the state in the true sense.

There is already a provision for DMS trainings under various programmes of Bureau of energy Efficiency (BEE), and the same should be implemented to achieve the goal of 24 × 7 power supply. The training for the class C & D employees are also being provided under R-APDRP Part C scheme. A state-level officers training institute need to be established in the state to meet the training requirements of the employees of EDG.

A provision of approximately Rs. 25 crores would be required for the same. This also helps for training of subordinate technical staff. Training programmes could be:

- Two-week training programmes for the technical staff including officers and engineers once in two years.
- One-week training programmes for non-technical officers every two years
- One week training for subordinate technical staff at each district headquarters every year.

CHAPTER 11. FUND REQUIREMENT

Electricity Department of Goa (EDG) plans to fund Rs 2365 Crores of its capital expenditure through mix of central Government grant, equity infusion and loan from financial institutions.

Transmission projects

EDG has planned to undertake Rs 789 Crores of its capex plan towards augmentation of transmission network by FY 2018-19 with a debt: equity ratio of 70:30.

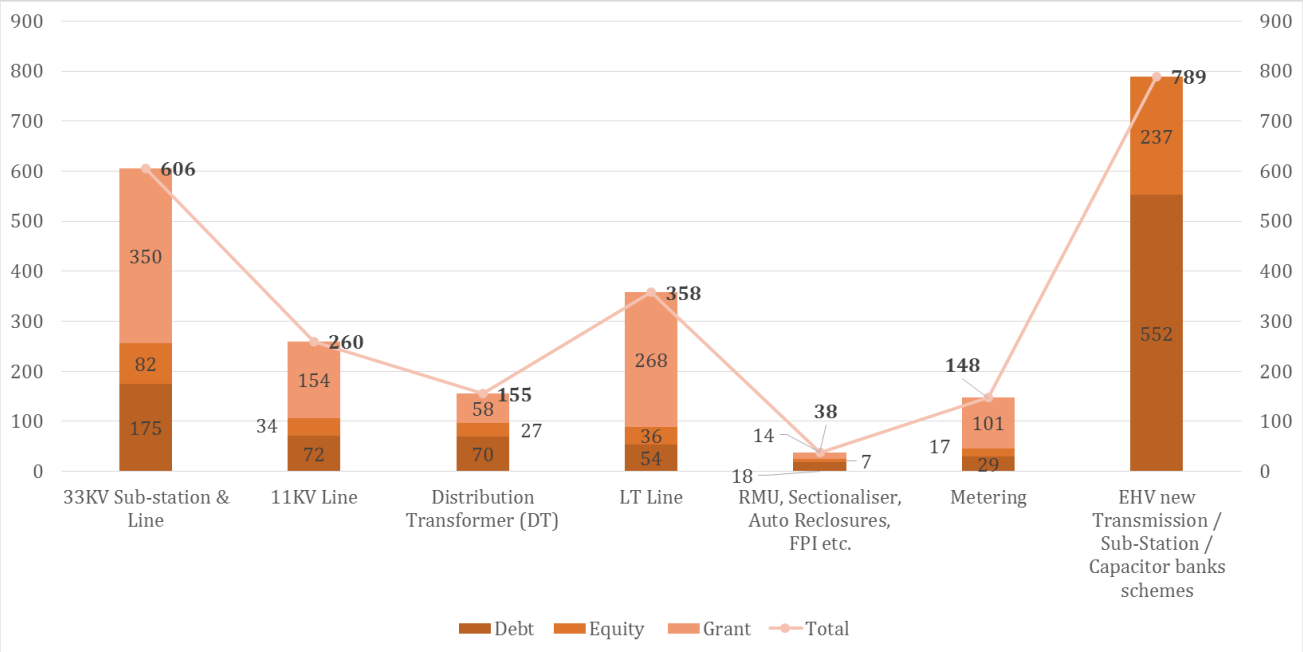
Distribution projects

EDG has planned to undertake Rs 1,576 Crores towards distribution system augmentation which will be funded by Central Government Grant (Rs 954 Crore), equity (Rs 203 Crore) and loan from financial institutions (Rs 419 Crores).

Currently, the disbursement from PFC has been availed against the scheme under R-APDRP Part A. As per the Central Government scheme the same may be converted into grant if the operational targets are achieved. In case of non-achievement of those operational targets the same disbursements will be considered as loan which may have an interest rate of 12% - 13%. Therefore this is an early stage at present to consider the PFC disbursement as loan or grant.

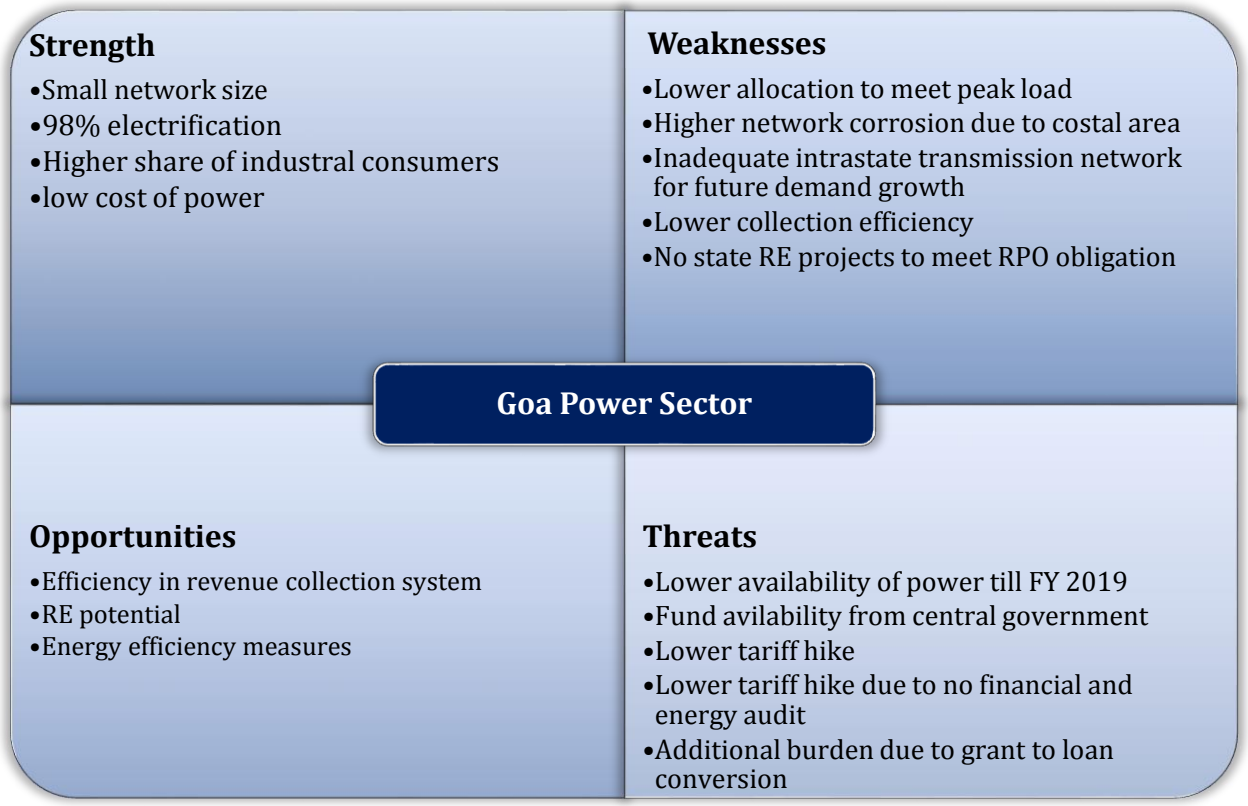
For IPDS / DDUGJY works EDG seeks to avail loan from PFC / REC and also to link some of the works with IPDS scheme to avail the loans from Central Government. The Integrated Power Development Scheme (IPDS) which is being funded to the extent of 75% by Ministry of Power, Government of India has been proposed to be taken up. The 15% funding for this scheme is proposed to be arranged from debt and 10% from equity. The break-up of fund requirement and source of funding is shown below:

Figure 7: Fund Requirement (Rs Crores)



CHAPTER 12. ROAD MAP

In the above sections, we have discussed in detail the existing power demand and supply situation in Goa and its future needs. In doing so, we have been able to identify some of the actionable targets, which will help Goa in achieving the given goal. Before structuring these targets, a SWOT analysis of the existing power sector in Goa has been discussed. The exercise has been done to bring out some of the risk drivers in Goa, which affect the overall market along with advantages present.



From the above analysis, it is evident that most of the threats are external factors, mitigation of which would need continued efforts from Government of Goa and Government of India. Further, the weakness tabulated above show that, with some stringent and bold measures, Goa will be able to attain the given targets.

Based on the above observations, a road map for Goa has been developed to mitigate the above mentioned weaknesses and threats.

Table 33: Road map for meeting supply constrains

Sl. No.	Category	Base year scenario (FY 2013-14)	Rollout Plan					Total expected capacity FY 2018-19
			FY 2015-16	FY 2016-17	FY 2017-18	FY 2018-19	Total	
GENERATION								
A	**Availability (MW):**							
	State Sector							
1	Hydro	**No Generation in the state**						
3	Thermal							
2	Renewable							
3	Private	26	3	-	-	-		29
	Central Sector							
4	Thermal-Gas	25	-	-	-	-	-	25
5	Thermal-Coal	421	5.2	36	9.9	-	51	472
6	Nuclear	26	-	16	-	-	16	42
7	Renewable	-	-	-	-	-	-	-
	Total Availability (MW)	**498**	**506**	**558**	**568**	**568**		**568**
B	**Peak Demand (MW):**							
1	**Peak Demand (MW)**	**540**	**668**	**770**	**903**	**934**		**934**

The Roll out plan for Transmission is summarized below:

Table 34: Roll out plan for transmission

S No.	Category	Base year scenario (Year 2014)	Rollout Plan						Total expected capacity as on March'19
			FY 2014-15	FY 2015-16	FY 2016-17	FY 2017-18	FY 2018-19	Total	
A	**Transmission Lines (Ckt.km):**								
1	Inter State	643	-	13	30	-	-	**43**	**686**
2	Intra-State	**267**	**-**	**-**	**-**	**-**	222	**222**	**489**
B	**Transformation Capacity (MVA):**								
1	Inter State	1787	-	-	315	-	-	**315**	**2102**
2	Intra State	1342	-	320	226	452	-	**998**	**2340**
	Total Transformation Capacity	**3129**	**-**	**320**	**541**	**452**	**-**	**1313**	

The Roll out plan for Distribution is summarized below:

Table 35: Roll out plan for Distribution

S No.	Category	Base year scenario (Year FY 2013-14)	Rollout Plan						Total expected capacity as on March'19
			FY 2014-15	FY 2015-16	FY 2016-17	FY 2017-18	FY 2018-19	Total	
A	**Connecting the Unconnected and supply hours**			*2011*	*3017*				5028
B	**Efficiency Improvement**								
	T&D Losses	13%	-	11.5%	11%	11%	10%	-	
	AT&C Losses	22%	-	12.39%	11.89%	11%	10%	-	
C	**Capacity Addition/Augmentation**								
	33 kV Substation (MVA Capacity)	691	-	36	86	86	36	245	936
	33 kV Lines (Ckt. Km)	1782	-	79	183	183	79	524	2,306
	11 kV Lines (Ckt. Km.)	3058	-	65	151	151	65	430	3,488
	LT Lines (CKT Km.)	11,264	-	218	509	509	218	1453	12,717

CHAPTER 13. SUMMARY OF GOVERNMENT OF INDIA INTERVENTIONS

POWER ALLOCATION FROM CENTRAL POOL:

Goa relies majorly on the Central Government allocation for its energy needs. It has signed many PPAs with central generating stations which still under planning stage. Since there is a shortfall in the energy requirement based on the existing allocation, the status of their existing PPAs are very important to assess the additional requirement to meet the incremental demand by FY 2018-19. Therefore, Government of Goa request's MoP to help Goa in getting some clarity on how much energy will be available for the state from these projects by FY 2018-19 for future planning. Also, as a short term solution, MoP may provide some additional allocation to Goa.

COAL BLOCK ALLOCATION:

The state of Goa was allotted coal block in Chhattisgarh for generating power by way of private partnership. In first phase 200 MW and later additional 200 MW in phase-II was to be allotted as Goa's share. As per Supreme Court Order all the coal block allotments were cancelled including state of Goa. Goa requests the concerned ministry to re-allocate the said coal block to the state of Goa for power generation.

ESTABLISHMENT OF A NEW 400 KV SUBSTATION:

Establishment of a new 400 kV substation proposed at Xeldem and the associated transmission lines as an Inter-State Transmission System scheme described under Long Term Solution after undertaking load flow study in Goa.

CENTRAL GRANT FOR NETWORK AUGMENTATION:

State requests that the schemes under IPDS and DDUGJY to be sanctioned expediently by PFC and REC respectively.

ANNEXURES

ANNEXURE A: CENSUS 2011 DATA

Area Name	Area	Electricity	Kerosene	Solar energy	Other oil	Any other	No lighting
Sub-District - Pernem	Total	16,372	427	28	12	-	58
	Rural	9,699	278	15	10	-	46
	Urban	6,673	149	13	2	-	12
Sub-District - Bardez	Total	50,164	697	77	17	23	117
	Rural	16,161	286	10	2	4	34
	Urban	34,003	411	67	15	19	83
Sub-District - Tiswadi	Total	38,425	716	86	11	21	86
	Rural	8,303	237	3	3	9	18
	Urban	30,122	479	83	8	12	68
Sub-District - Bicholim	Total	20,614	735	50	12	12	124
	Rural	11,628	481	44	12	9	81
	Urban	8,986	254	6	-	3	43
Sub-District – Satari	Total	13,091	597	10	4	3	97
	Rural	10,018	491	7	2	3	93
	Urban	3,073	106	3	2	-	4
Sub-District – Ponda	Total	35,285	854	50	34	69	107
	Rural	12,983	343	22	21	3	53
	Urban	22,302	511	28	13	66	54
Sub-District- Mormugao	Total	30,673	573	24	4	11	73
	Rural	5,271	105	-	-	2	8
	Urban	25,402	468	24	4	9	65
Sub-District - Salcete	Total	67,576	1,162	87	35	92	157
	Rural	19,782	361	32	10	5	53
	Urban	47,794	801	55	25	87	104
Sub-District- Quepem	Total	17,189	729	73	4	12	178
	Rural	7,176	475	49	4	8	142
	Urban	10,013	254	24	-	4	36
Sub-District- Sanguem	Total	13,589	879	61	12	9	189
	Rural	11,004	836	58	11	8	184
	Urban	2,585	43	3	1	1	5
Sub-District- Canacona	Total	9,783	428	30	5	4	87
	Rural	7,183	394	29	5	4	63
	Urban	2,600	34	1	-	-	24

ANNEXURE B: LOAD FLOW STUDY

1 **Load Flow Study:** Load flow studies were carried out by CEA, Goa and CTU to simulate the network conditions by the end of 13th plan (by 2021-22).

2 **Loading Conditions**: Load projections by the end of 13th Plan were finalised in a meeting held between CEA and the Goa Electricity Department at Panaji, Goa on 8th April, 2015.The existing and projected demands incident on the 220kV network are tabulated below

Table 36: Load Details

Sl. No.	Substation Name	Installed Capacity in MVA	Planned (P) /Existing (E)	Loading on 18.03.2014 at 17.30 hrs (MW)	Load expected by 2021-22 (MW)
1	Tivim	3x100, 220/110 kV	E	171	200
2	Amona	2x50, 220/33 kV	E	33	80
3	Xeldem	2x100, 220/110 kV + 1x50,220/33 kV	E	93	150
4	Ponda	3x100, 220/110 kV+ 1x50, , 220/33 kV 1X50,220/33KV	P	161	200
5	Cuncolim	3x50, 220/33 kV	E	50	100
6	Verna (GIS)	2x160, 220/110	P		160
7	Kadamba (GIS)	2x100, 220/110 kV	P		130
8	Tuem	3x63, 220/33 kV	P		100

3 **Findings:** In order to ensure reliable supply of power in Goa, establishment of a new 400 kV substation at Xeldem or at Ponda with 400 kV feed from Narendra (existing) 400/220 kV substation in Karnataka is required. As there is space constraint at Ponda, the new 400 kV substation may be established at Xeldame.

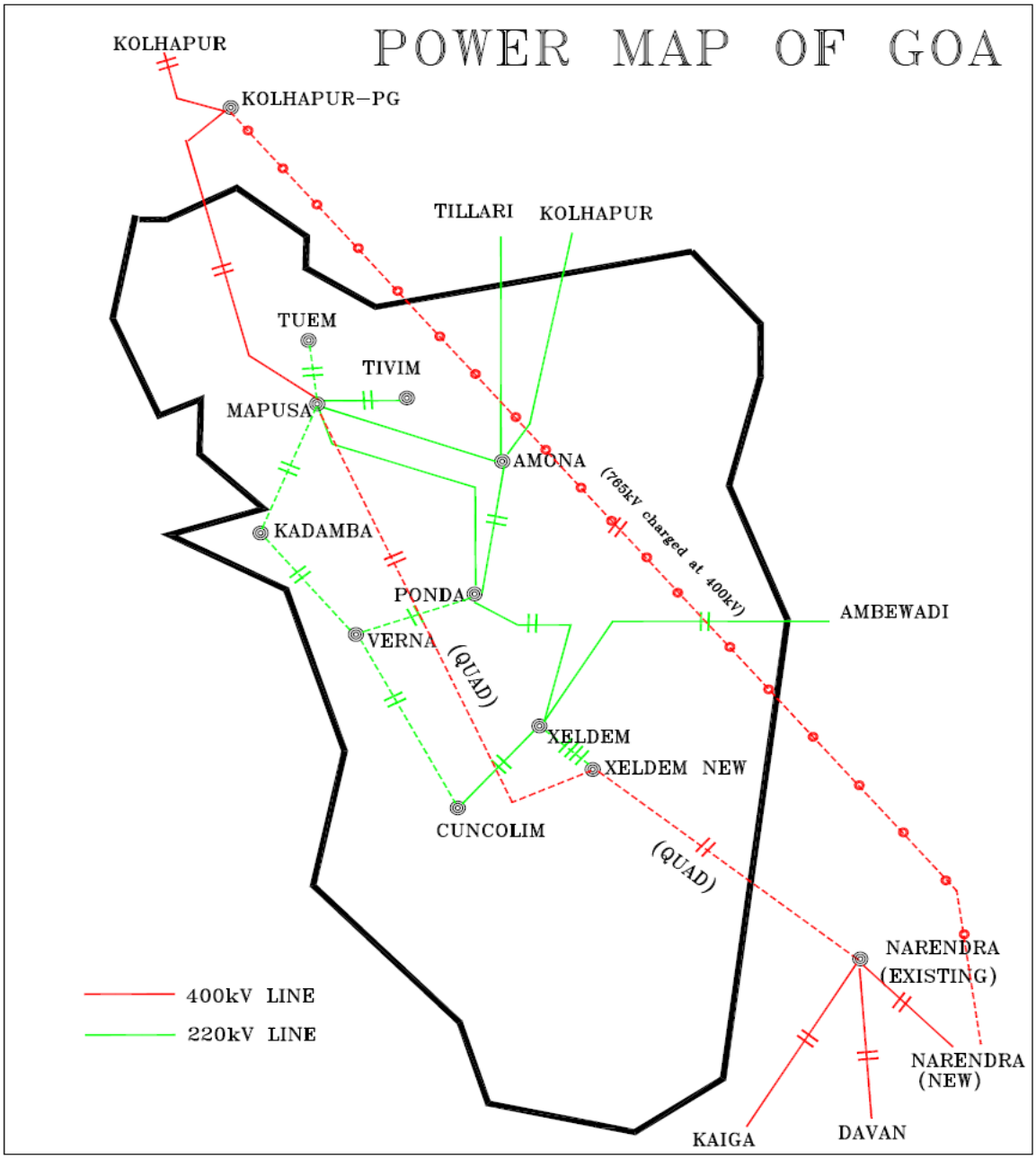
4 **Long term solution based on the study carried out by CEA, CTU and Goa:**

a) Establishment of 2X500 MVA, 400/220 kV substation at Xeldem and its interconnection with Narendra (existing) 400 kV substation through 400 kV D/C line with quad conductor. The interconnection between the existing 220 kV Xeldem substation and the proposed 400/220 kV Xeldem substation could be through bus extension or through 220 kV interconnecting lines, as the case may be.

b) 400kV (Quad) connectivity between the new substation at Xeldem and Mapusa is recommended to take care of any N-1-1 contingencies involving outage of any one 400kV infeed to Goa.

c) Mapusa – Kadamba 220kV D/c line, which has been planned by the state, is seen to get significantly loaded in several cases. Hence, the line may be planned with high capacity conductor.

Figure 8: Electric Map of Goa



ANNEXURE C: POWER PURCHASE AGREEMENTS

Sr. No.	Sources	State	Capacity	Expected Allocation	Start Date
1	Nuclear Power Corporation of India Ltd. for purchase of power from KAPP – 1 & 2 and TAPP 3 & 4	Gujarat and Maharashtra	2 × 700 = 1400 MW	16 MW	FY 2016-17
2	NTPC Ltd. for purchase of power from Barh Stage – II	Bihar	2x660 =1320 MW	-	-
3	NTPC Ltd. for purchase of power from Solapur STPS	Maharashtra	2X660 MW	13.7 MW	May/Nov-16
4	NTPC Ltd. for purchase of power from Mauda STPS – II	Maharashtra	2 × 660 = 1320 MW	15 MW	March/Nov -16
5	NTPC Ltd. for purchase of power from Vindhyachal STPS – V	Madhya Pradesh	500 MW	6 MW	August 2015
6	NTPC Ltd. for purchase of power from LARA STPS – I & II	Chhattisgarh	2X800 MW	8.7 MW	June/Oct - 16
7	RGPPL for purchase of power from RGPPL Stage – II	Maharashtra	2100 MW	-	-
8	NTPC Ltd. for purchase of power from Khargone STPP	Madhya Pradesh	2X660 MW	8.2 MW	June/Dec-19
9	NTPC Ltd. for purchase of power from Gadarwara STPP – I & II	Madhya Pradesh	2649 MW	9.9 MW	May/Sept - 17

ANNEXURE D: PROPOSED INTRA-STATE SCHEMES AND BENEFITS

Following transmission lines and substations have been planned which, while addressing the existing transmission constraints fit well into the long term measures planned to meet the power demand of Goa at the end of 13th Plan. The schemes and their benefits are narrated below:

1) **Erection of 220 kV double circuit line from 400/220 kV Colvale substation to the proposed 220 kV substation at Verna with LILO at 110 kV Kadamba substation to the existing 220/33 kV substation at Cuncolim.** By erecting the planned line, South Goa can draw the required power directly from the WR region from Colvale substation, thereby avoiding dependence on SR and power crisis in the event of failure of SR supply.
2) **Erection of 220/110 kV, 2 × 100 MVA GIS substation at Kadamba.** Presently, 110/33 kV Kadamba substation receives power supply from Ponda and Tivim substations. These lines have been erected almost 30 years ago and are prone to frequent breakdowns. The Kadamba substation supplies power to the capital city of Panaji and its associated substations. In the event of failure of 110 kV lines, the capital city suffers heavily, and the restricted loads are met from 33 kV feeders emanating from Ponda and Tivim, which again are prone to tripping due to overloading. In view of the above and to overcome the power supply constraints in the capital city of Panaji, it is proposed to erect a 220/110 kV GIS substation in or around Kadamba substation and feed the existing 110 kV substation from there to enhance reliability of power supply to Panaji and its vicinities. The 110 kV power supply can also be back fed to Ponda and Tivim substations as backup power supply.
3) **Erection of 110 kV D/C lines from Verna substation to the proposed 110/33 kV substation at Sancoale for a distance of 10 km by using the existing 33 kV line corridor and dismantling of the same.** Presently, the port town of Vasco and Marmugao receive power from 110/33 kV substation from Verna. These 33 kV lines travel from Verna to Sancoale on the tower lines. There are three 33/11 kV substations in the vicinity of the port town, and there are ten 33 kV feeders feeding the HT Consumers. The installed capacity of the substations at 33 kV line is to the tune of 100 MVA, which feed, inter-alia, the HT consumers to the tune of 45 MVA. In addition, two more substations are under construction. The total installed capacity shall be to the tune of 145 MVA.
4) **Erection of 110/33 kV, 2 × 50 MVA GIS substation at Sancoale.** The current carrying capacity of the existing 33 kV lines is not sufficient to accommodate these loads. In view of the above, it is planned to extend 110 kV lines from Verna up to Sancoale and erect

110/33 kV, 2 × 50 MVA GIS substation at Sancoale in order provide adequate capacity to meet the consumer demand under various contingencies.

5) **Erection of 110 kV D/C lines** from MSL substation to the proposed 110/33 kV substation at Margao for a distance of 8 km, and renovation of existing 110 kV S/C lines from Curtorim to MSL and converting the same in to Double circuit.
6) **Erection of 110/33 kV, 2 × 50 MVA GIS substation at Margao.** The commercial city of Margao receives 33 kV power supply from Ponda, Verna, and Xeldem substations. There are eight 33/11 kV substations in and around Margao with an installed capacity of 165 MVA. Any feeder failure from Ponda, Verna, and Xeldem leads to power interruption. Besides being a commercial city, it attracts lot of tourists, houses many star hotels, and is a premier venue for international events. In order to ensure better and stable power supply and to reduce the length of the 33 kV feeders, it is planned to erect 110/33 kV, 2 × 50 MVA GIS substation at Margao.
7) **Erection of 110 kV Double circuit lines from Tivim substation up to 33/11 kV Saligao substation for a distance of 20 km. Erection of 110/33 kV, 2 × 50 MVA GIS substation at Saligao.** The existing Tivim substation feeds the major cities from 33/11 kV substations of Mapusa, Nagoa, Nachonala, Porvorim, and Saligao. The installed capacity of these substations is to the tune of 130 MVA. The distance of 33 kV lines feeding these substations is approximately 30 km. These lines were erected over 30 years ago and are prone to breakdowns, thereby causing interruption. It is therefore proposed to extend 110 kV lines from Thivim to Saligao and establish 110/33 kV, 2 × 50 MVA GIS substation at Saligao.
8) Erection of 110 kV Double circuit lines from Pulsare to the proposed Kundai Industrial Estate substation for a distance of 5 km to ensure connectivity to the industrial area.
9) **Establishing of 110/33 kV, 2 × 50 MVA GIS substation at Kundaim Industrial Estate (KIE)**. Presently, Kundaim and Madkaim substations receive power supply from Ponda and Kadamba substations. Load to the tune of 50 MVA is imposed on these lines besides the two substations having an aggregate installed capacity of 27 MVA. The 33 kV lines from Ponda and Kadamba substations are quite old and are prone to frequent failures, thereby causing interruptions to the industrial city of Kundaim and Madkai. It is therefore proposed to extend 110 kV lines from Pulsare up to Kundaim Industrial Estate and establish 110/33 kV GIS substation at KIE.
10) Renovation of existing 220/110/33 kV Ponda substation with new Gas insulated Substation. The Existing 220/110/33 kV substation at Ponda is very old almost 40 years and no R& I works have been carried-out, since Ponda substation was the only source of power supply to entire Goa till alternate substation at Xeldem and Tivim are erected.

11) Establishment of 220/33 KV, 3X63 MVA substation for arranging power supply to electronic manufacturing cluster units and Mopa Airport.
12) Erection of 220KV Double circuit line from Colvale 400/220KV substation upto Tuem (proposed electronic manufacturing cluster units) for distance of 8 kms. .

Table 37: New transmission system planned (Rs Crore)

Plans	Estimated Cost
Erection of 220KV D/C line from 400/220KV substation at Colvale to the proposed 220KV substation at Verna with LILO at 110KV Kadamba Substation to the existing 220/33KV Substation at Cuncolim	95
Erection of 220/110KV GIS Substation at Kadamba	90
Erection of 110KV D/C lines from Verna Substation to the proposed 110/33KV Substation at Sancoale	9.5
Erection of 110/33 KV GIS Substation at Sancoale	65
Erection of 110KV D/C lines from MSL Substation to the proposed 110/33KV Substation at Margao for a Distance of 8 Kms and renovation of existing 110KV single circuit line from Curtorim to MSL and converting the same in to D/C line	13.5
Erection of 110/33KV GIS Substation at Margao	65
Erection of 110KV D/C lines from Thivim Substation up to the proposed 110/33KV Substation at Saligao	53
Erection of 110/33KV GIS Substation at Saligao. *(Up gradation of substation).*	65
Erection of 110KV D/C lines from Pulsare to the proposed Kundaim Industrial Estate Substation	8
Erection of 110/33KV GIS Substation at Kundaim Industrial Estate.	45
Renovation of existing 220/110/33KV ponda substation with new Gas insulated Substation	200
Erection of 220KV Double Circuit line from Colvale substation up to newly proposed 220KV Substation at Tuem	15
Erection of 220/33KV, 3x63MVA substation at Tuem	65
Total	**789**

Table 38: Capacity Addition (33 kV level)

Receiving Substation	Receiving Voltage	Capacity (MVA) at 33 kV Level		
		Existing	Additional Capacity Planned	Total Capacity after Augmentation
Amona	220 kV	2 × 50 = 100	-	100
Ponda	220 kV	2 × 40 + 2 × 30 + 1 × 50 = 190	1 x 50	190
Tivim	220 kV	3 × 40 + 1 × 50 = 170	-	170
Verna	110 kV	2 × 40 + 1 × 50 = 130	2 × 63 = 126	256
Xeldem		2 × 40 + 1 × 50 = 130	-	130
Kadamba	110 kV	3 × 40 = 120	-	130
Cuncolim	220 kV	3 × 50 = 150	-	150
Sancole			2 × 50 = 100	100

Receiving Substation	Receiving Voltage	Capacity (MVA) at 33 kV Level		
		Existing	Additional Capacity Planned	Total Capacity after Augmentation
Saligao			2 × 50 = 100	100
Aquem-Margao			2 × 50 = 100	100
Kundai Industrial estate			2 × 50 = 100	100
Tuem	220 kV		3 x 63 = 189	189
Total		**990 MVA**	**765 MVA**	**1755 MVA**

ANNEXURE E: LOAD FLOW STUDY AT 33/11 KV AND BELOW

For 33/11KV Substation: The loading condition of Power Transformers of each 33/11KV sub-stations were assessed. In the existing condition, 20% of the power transformers are above prescribed loading of 80% and this number is expected to increase to 60% by FY 2018-19 if existing power transformers are not augmented or no new capacities are added. The results captured are as below:

Table 39: Load flow results- 33/11 kV power transformers loading conditions

Snapshot of Loading Condition of Power Transformer, Existing Network							
Description	**% Load Band**						**Total**
	< 70	70-80	80-90	90-100	100-120	>120	
Count of PTR under existing Load	64	12	12	4	4		96
Count of PTR considering Load Growth for 5 Years	27	11	8	16	18	16	96

For 33 kV Feeder: The study of 33 kV feeders of all the substations were done. As seen in case of power transformers, loading on 33 kV feeders are also in the same condition. If no new feeders are added, ~35% of the existing 33 kV feeders are expected to get loaded beyond 80%.

Table 40: 33 kV feeder loading

Snapshot of Loading Condition of 33KV Feeders, Existing Network							
Description	**% Load Band**						**Total**
	< 75	75-80	80-90	90-100	100-120	>120	
Count of Feeder under Existing Load	71	2	1	1	2	3	80
Count of Feeder considering Load Growth for 5 Years	51	2	8	5	7	7	80
Count of Feeder considering Load Growth for 10 Years	35	4	6	3	8	24	80

Loading Condition of Distribution Transformers (DT): The existing network at 33/11 kV in Goa from the above analysis require capacity augmentation to meet the expected demand in FY 2018-19. Further, at DT level loading of transformers has also been analyzed which shows similar results seen at 33 kV and 11 kV. At existing load ~24% of the DT's are loaded beyond 80% and the number is expected increase in future to ~45% as shown below:

Table 41: Loading on Distribution Transformer

Snapshot of Loading Condition of Distribution Transformer (Existing Network)											
Description	% Load Band										Total
	> 70	70-75	75-80	80-85	85-90	90-100	100-130	130-150	<150	HTC	
Count of DT with Existing Load	3985	462	259	270	218	215	126	19	6	544	6104
Count of DTR with 5 Years Load Growth	2635	340	385	328	482	495	782	73	40	544	6104

Loading Condition of 11KV Feeders: Loading of 11kV feeder at existing load and future loading, considering the same number of feeders, has been analyzed. Which shows that ~20% of the feeders will be beyond 80% loading as shown below:

Table 42: Loading at 11kV feeders

Snapshot of Loading Condition of 11KV Feeders, Existing Network							
Description	% Load Band						Total
	< 70	75-80	80-90	90-100	100-120	>120	
Count of Feeders under Existing Load	260	5	7	2	0	1	275
Count of PTR considering Load Growth for 5 Years	222	4	20	12	7	10	275

ANNEXURE F: DISTRIBUTION CAPEX PLAN

Table 43: Detailed Capex Plan

Particulars	Units	FY 2015-16	FY 2016-17	FY 2017-18	FY 2018-19	(Rs Lakh)
33 kV Substation and line						
11KV Feeder to be Replaced	No	38	90	90	38	1792
11KVFeeder to be Retrofitting	No	15	34	34	15	485
33 kV CR Panel & Breaker	No	12	28	28	12	1200
33/11 kV Substation Earthing	No	4	8	8	4	56
33KV Bus Coupler Panel	No	6	15	15	6	645
33KVFeeder to be Replaced	No	14	34	34	14	912
33KVFeeders to be Retrofitting	No	16	37	37	16	525
Addition of PTR	No	1	2	2	1	1188
Augmentation of PTR	No	1	1	1	1	924
Civil Cost of SCADA Control Room	No	1	-	-	-	150
For SCADA implementation (software part)	No	1	-	-	-	2581
New 33KB Line Bay	No	7	15	15	7	1188
New Line with 3CX400sqmm XLPE Cable	Km	34	79	79	34	8089
New Substation	No	2	5	5	2	13792
New/Renovation of line with Wolf Conductor	Km	45	104	104	45	4835
Renovation of Line with Racoon Conductor	Km	10	22	22	10	361
Renovation of Substation	No	2	5	5	2	5906
Renovation of Sub-station + Augmentation	No	2	2	2	1	15982
11 kV Line						
Conversion of 11 kV feeder into HT ABC	Km	142	331	331	142	11121
Conversion of 11 kV feeder into UG 300	Km	44	103	103	44	7333
New Feeder HT ABC	Km	21	48	48	21	1830
New Feeder Racoon	Km	12	27	27	12	706
New Feeder U/G 300	Km	27	63	63	27	4505
Reconductoring/ Rerouting of 11 kV Feeder	Km	10	24	24	10	454
Distribution Transformer						
Addition of 100 KVA DT with DT recycled	No	7	17	17	7	181
Addition of 100 KVA DT with DT recycled	No	13	29	29	13	318
Addition of 100 KVA DT with New DT	No	69	162	162	69	2190

Particulars	Units	FY 2015-16	FY 2016-17	FY 2017-18	FY 2018-19	(Rs Lakh)
Addition of 200 KVA DT with DT recycled	No	4	9	9	4	102
Addition of 200 KVA DT with DT recycled	No	3	7	7	3	82
Addition of 200 KVA DT with New DT	No	5	12	12	5	190
Addition of 400 KVA DT with DT recycled	No	1	1	1	1	37
Addition of 400 KVA DT with New DT	No	28	66	66	28	2476
Addition of 630 KVA DT with New DT	No	19	45	45	19	2057
Aug to 100 KVA with recycled DT	No	25	59	59	25	475
Aug to 100KVA with New DT	No	17	39	39	17	427
Aug to 200 KVA with recycled DT	No	39	91	91	39	764
Aug to 200KVA with New DT	No	35	82	82	35	1058
Aug to 400 KVA with recycled DT	No	3	8	8	3	212
Aug to 400KVA with New DT	No	48	113	113	48	4254
Aug to 630 KVA with recycled DT	No	0	0	1	0	10
Aug to 630KVA with New DT	No	6	15	15	6	691
LT Line						
Conversion with -95 sqmm ABC	Km	210	490	490	210	10444
Conversion with Rabbit Conductor	Km	14	32	32	14	389
Conversion with U/G 300sqmm XLPE	Km	56	131	131	56	9571
New Feeder with LT UG	Km	33	77	77	33	5668
New LT line -70 sqmm ABC	Km	140	328	328	140	6813
New LT line -95 sqmm ABC	Km	52	122	122	52	2870
RMU, Sectionaliser, Auto Reclosures, FPI etc.						
11 kV Line Auto Reclosure & Sectionaliser (1+3)	No	11	27	27	11	2128
3 way Motorised O/D RMU for 11 kV Fdr	No	35	81	81	35	1178
3 way O/D RMU for 11 kV Fdr	No	17	40	40	17	541
Metering						
AMR for feeders, Distribution transformer	No	332	774	774	332	442
Boundary meters for ring fencing	No	20	47	47	20	335
Old EM Meter Replacement with Service Line O/H	No	41700	97300	97300	41700	13900
Prepaid / smart meters in Govt. establishment	No	1526	-	-	-	76
Capacitor Bank						
Reactive compensation(MVAR)	MVAR	7	17	17	7	1176

ABBREVIATIONS

ABR: Average Billing Rate

ACS: Average Cost of Supply

CEA: Central Electricity Authority

COD: Commercial Operation Date

CERC: Central Electricity Regulatory Commission

EESL: Energy Efficiency Services Limited

PFC: Power Finance Corporation

GoG: Government of Goa

GoI: Government of India

IPP: Independent Power Producer

MoP: Ministry of Power

MNRE: Ministry of New and Renewable Energy

NTPC: National Thermal Power Corporation

NHPC: National Hydro Power Corporation

PGCIL: Power Grid Corporation India Limited

PPA: Power Purchase Agreement

PFA: Power For All

SR: Southern Region