



सत्यमेव जयते

Government of India

Joint Statement



Tamil Nadu is already a pioneer state in implementing 24X7 Power to all sectors. The state has already achieved 100% village electrification level.

The state had witnessed peak surplus in financial year 2016 and has continued to move with adequate plans for the surplus power for forthcoming years.

In addition, The State Government is also providing free electricity of 100 units bi-monthly to all category of domestic consumers.

Thus, the Government of Tamil Nadu is continuously supporting the power sector through subsidy schemes aimed at supporting poor and marginal consumers and elimination of regional disparities in the state.

The State has made significant progress in expanding access and availability of electricity over the past. This is complemented by the fact that the state is one of the leading states in the country in renewable capacity addition.

This roadmap is prepared with the efforts of Ministry of Power, CEA and Tamil Nadu utilities (TANGEDCO and TANTRANSCO). The targets provided in this roadmap are developed by

dovetailing and utilizing the existing master plan proposals of Tamil Nadu utilities for infrastructure addition and capacity development in Generation, Transmission, Distribution, Energy Efficiency/DSM and Renewable Energy sectors to achieve the objectives of the 24X7 Power For All program for the period FY17 to FY19.

The State Government will put in place appropriate State level governance those listed in this document.

The Ministry of Power, GoI would support the efforts of State on various issues to be dealt with at the Central Government level including those listed in this document.

The MoP, GoI shall also endeavor to support the State in availing concessional financing arrangements for power utilities in the State.

Though the state has already achieved the objective of the program, the Central and State Governments would meet regularly over the next three years to review and monitor the progress on the rollout plan for enhancing the infrastructure facilities and to maintain the satisfaction levels of the consumers and improve the quality of life of people through 24x7 power supply.

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List of Abbreviations

Abbreviation	Full Form
ARR	Aggregate Revenue Requirement
AT&C	Aggregate Technical & Commercial
BOBRN	Bogie Open Bottom Release
BPL	Below Poverty Line
CAGR	Compound Annual Growth Rate
CKM	Circuit Kilometers
CoD	Commercial Operation Date
DDG	Decentralized Distributed Generation
DDUGJY	Deendayal Upadhyaya Gram Jyoti Yojana
DPR	Detailed Project Report
DSM	Demand Side Management
DT/ DTR	Distribution Transformer
EBIDTA	Earnings Before Interest Depreciation Taxes and Amortization
ECBC	Energy Conservation Building Code
EE	Energy Efficiency
EPC	Engineering, Procurement and Construction
EPS	Electric Power Survey
ER	Eastern Region
FY	Financial Year
GoI	Government of India
GSS	Grid Substation
GWp	Giga Watt Peak
HH	Household
IPDS	Integrated Power Development Scheme
IPP	Independent Power Producer
ISTS	Inter State Transmission System
JICA	Japan International Cooperation Agency
LED	Light-emitting Diode (LED in this context is for LED lighting)
LILO	Loop In Loop Out
LT	Low Tension
MNRE	Ministry of New and Renewable Energy
MoC	Ministry of Coal
MoEF	Ministry of Environment & Forests, Government of India



Abbreviation	Full Form
MoP	Ministry of Power, Government of India
MU	Million Unit of Electricity (in kWh)
MVA	Mega Volt Ampere
MW	Mega Watt
MWp	Mega Watt Peak
NESCL	NTPC Electric Supply Company Limited
NHPC	National Hydroelectric Power Corporation
NTPC	National Thermal Power Corporation
O&M	Operation & Maintenance
PAT	Profit After Taxes
PBT	Profit Before Taxes
PFA	Power For All
PFC	Power Finance Corporation
PGCIL	Power Grid Corporation Of India Limited
PLF	Plant Load Factor
PMA	Project Monitoring Agency
PPA	Power Purchase Agreement
PPP	Public-private Partnership
R&M	Renovation & Modernization
RE	Renewable Energy
REC	Rural Electrification Corporation
RGVY	Rajiv Gandhi Grameen Vidyutikaran Yojana
ROW	Right of Way
RPO	Renewable Energy Purchase Obligation
SCADA	Supervisory Control and Data Acquisition
SHR	Station Heat Rate
SLDC	State Load Dispatch Center
SPV	Special Purpose Vehicle
S/s, SS	Sub-station
TANGEDCO	Tamil Nadu Generation and Distribution Corporation Limited
TANTRANSCO	Tamil Nadu Transmission Corporation Limited
TNEB	Tamil Nadu Electricity Board
TNERC	Tamil Nadu Electricity Regulatory Commission
TNIPP	Tamil Nadu Investment Promotion Programme
T&D	Transmission & Distribution
TBCB	Tariff Based Competitive Bidding
TPS	Thermal Power Station
ULDC	Unified Load Dispatch Centre
UMPP	Ultra Mega Power Project
USTDA	US Trade & Development Agency
VGf	Viability Gap Funding
YoY	Year on Year



1. Executive Summary

1.1. Introduction

24x7 Power for All is a Joint Initiative of Government of India and State Government with an objective to strengthen the power supply infrastructure and make 24X7 reliable and quality power available to all households, industry, commercial businesses, public needs, agriculture and any other electricity consuming entity. This roadmap document aims to meet the above objectives for the state of Tamil Nadu which is already implementing 24X7 power supply to all sector.

As per 2011 census, Tamil Nadu had higher Household (HH) level electrification of 93.4% as compared to national average of 67.2%.

There has been significant infrastructure addition in all the areas of the power sector during the past few years. As a result of the capacity additions made towards meeting the demand, the peak deficit for FY16 was zero and this trend is continuing in FY17.

1.2. Connecting the unconnected

The state has made significant advances in extending distribution network to un-electrified households in the last few decades. Due to these efforts The State has achieved almost 100% village and HH electrification level as on March 2016, barring some remote households (5,787) which are planned to be electrified using off grid solutions.

Growth in demand and 24X7 supply

The state has been maintaining almost 24 hours power supply to all categories of consumers. The average supply to agriculture sector is about 24 hours per day. Load shedding prior to 01.06.2014 has been totally withdrawn for all categories of consumers and continuous power supply is being extended to all areas of Tamil Nadu. Growth in demand is expected to be 7%. TANGEDCO

envisages peak demand to touch 17,651 MW by FY19.

1.3. Generation Plan

The state has an installed capacity of 24,433 MW as on 31.03.2016. Tamil Nadu has one state owned generation company – TANGEDCO. In addition there are various central and private generating companies. By FY17 the installed capacity is expected to increase by about 2,509 MW from thermal sources including 165 MW from Co-generation sources & another 5,100 MW from Renewable energy sources (Wind, Solar and other Sources). The expected capacity additions are in line with the anticipated peak demand projections.

The projects under implementation are on track. Bottlenecks and constraints of the available linkage of coal for existing plants have also been addressed to some extent.

During February 2016 Chandrabilla coal block was allotted to TANGEDCO for ETPS Expansion project, Ennore SEZ project and Udangudi Stage I.

TANGEDCO has already signed MOU with MMTC for imported coal for following projects:

- ETPS Expansion project (2 MTPA, date of signing :23.7.2012),
- Ennore SEZ project (4.549 MTPA, date of signing : 26.06.2012),
- NCTPP Stage III (2.51 MTPA, date of signing 25.05.2015),
- Uppur Thermal power project (5.01 MTPA, date of signing: 25.05.2015) and
- Udangudi Stage I (3.87 MTPA, date of signing: 19.11.2012).

It may be noted that, TANGEDCO is awaiting coal block allotment from indigenous sources for NCTPP Stage III and Uppur Thermal Power Plants. Expected CoD is beyond FY19 for these two plants.

1.4. Transmission plan



As on 31.03.2016, the existing intra state transmission network comprises of 908 EHV grid substations with 59,953 MVA capacity along with 30,331.6 ckm associated transmission lines. Further, the transmission system owned by PGCIL consists of 8,127 ckm of lines and 9,300 MVA of transformation capacity. By FY19 the intra-state transformation capacity is proposed to be enhanced to 94,217 MVA (which includes additional 8,640 MVA for Renewable Corridor) and 33,768 ckm of intra-state transmission lines.

The state transmission utility TANTRANSCO has proposed investments for meeting its anticipated demand as well as providing connectivity to the upcoming renewable energy corridors. In this endeavor, TANTRANSCO has outlined a total capital expenditure layout of Rs. 20,309 Cr. These projects are funded by various agencies like PFC, REC, NABARD, TNIPP, JICA, etc. Further, some projects for providing evacuation of Renewable Energy projects are being executed under KfW funding schemes.

1.5. Distribution plan

The state distribution utility TANGEDCO is in advanced stages of completing the RGGVY scheme. Further, the utility has already started implementing R-APDRP schemes across the state. In addition to these centrally sponsored schemes, the utility is also adding network under ADB funded schemes.

For meeting the network requirement of existing consumers and extending the distribution network to the newly constructed HHs, the utility has proposed enhancement of network by means of addition in HT network, LT network and additional power and distribution transformers and various other improvement works. This plan will increase the number of DTs from 2,64,029 in FY16 to 320,681 in FY19, similarly the LT network will increase from 6,09,544 kms in FY16 to 644,603 kms in FY19. These network additions are proposed with an investment of Rs. 9,348 Cr.

1.6. Renewable energy and energy efficiency

The state has RE installed capacity of 9,687 MW (Sep 2016). The RE installed capacity is mostly contributed by wind (7,642 MW) followed by solar (1,155.4 MW). The state has planned off-grid renewable solutions to cater to the growth in demand in far-flung areas with poor accessibility.

This includes 5,787 standalone solar solutions. Future plans for renewable capacity addition includes addition of 5,265 MW of renewable energy through investments by private sector.

State's energy efficiency plan is already in place. In the past the utility had provided 8.75 lakh CFLs in exchange of incandescent bulbs across the state under various schemes, further schemes include distribution of energy efficient pump sets.

Load survey for identification of energy saving potential in various sectors (domestic, commercial, industrial, agricultural, etc.) across the state is in progress. Based on the report on load survey, a DSM action plan will be formulated for maximizing the use of energy efficient appliances under various sector wise schemes. TANGEDCO will take up the schemes for implementation, one by one, subject to financial viability.

1.7. Financial turnaround

Considering TANGEDCO is able to achieve AT&C loss reduction targets, a tariff hike of 5.52% will help the utility to operationally turnaround by FY19.

The State Government is continuously extending financial assistance to TANGEDCO over the past 5 years. Further, the quantum of subsidy was also increased from Rs.2,071 Cr. during FY12 to Rs.6,695 Cr in FY16. In order to compensate differential cost of supply for the free supply to agricultural consumers, the Government of Tamil Nadu has revised the subsidy from Rs.250/HP/p.a. to Rs.2,875/HP/p.a.

With respect to the restructuring of loans, the Government of Tamil Nadu has already approved FRP during FY13 and taken over Rs.6,353.49 Cr. of loans of TANGEDCO and its interest liability. Under the FRP, TANGEDCO has restructured remaining Rs.5,951 Cr. of loan liability with banks for a tenure of 10 years including 3 years moratorium. TANGEDCO is also taking various measures for swapping of high interest loans to low interest loan for considerable savings in interest cost.

The Government of Tamil Nadu is also converting the Electricity Tax recovered by TANGEDCO from the consumers about Rs.800 crores p.a. so as to partially help in the financial management of TANGEDCO.



2. Background

2.1. The State of Tamil Nadu

Tamil Nadu is situated in the southern peninsula of Indian subcontinent and is surrounded on the north by Andhra Pradesh and Karnataka, on the west by Kerala, on the east by the Bay of Bengal and on the south by the Indian Ocean. With a population of over 7 Crore and an area of 130,058 sq.km, it is the 7th largest in terms of population and 11th largest State in India in terms of area. The state contributes nearly 8.4% to India’s GDP making it the 2nd largest contributor, only after Maharashtra.

Urbanization in Tamil Nadu is highest in the country with urban areas accounting for as high as 48.4% of State’s population, as against national average of 31.2%. In terms of households (HHs), Chennai is the largest district with 11,06,567 HHs. The State witnessed high HH level electrification in rural areas, as per Census 2011 90.8% rural HHs have access to electricity, which gradually increased to an impressive 100%.

The State has as an area of 1.3 Lakh sq.km with a gross crop area of around 63,000 sq km (63 Lakh

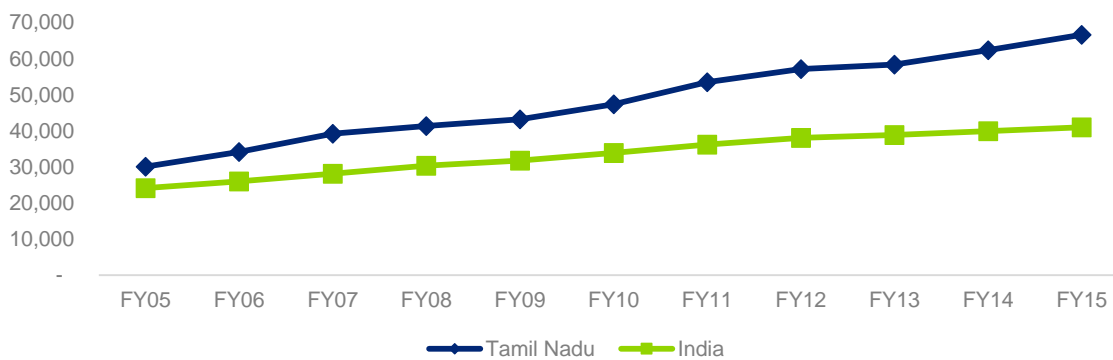
Ha). The state provides free electricity to agricultural consumers to boost the primary sector output of the state.

The State’s mineral reserves and major minerals include limestone, bauxite, gypsum, lignite, magnetite, and iron metal. The opencast lignite mines at Neyveli, in the north-center part of the state, are amongst the largest in India, and are utilized to fuel power stations of Neyveli project that contributes a significant part of the state’s power.

Tamil Nadu has a strong presence of manufacturers of engineering and auto components, textiles, leather, sugar etc. The state’s industrial policy (1992) laid the foundation for the rapid growth of new industries that facilitated the electronics and automobile industry revolution in Tamil Nadu by attracting major projects from industrial giants.

The software exports from the State during FY14 have been at USD 12.38 Bn with an impressive growth rate of more than 18% over the last 3 years.

Figure 1: State vs National Per Capita Income (Rs.)



Source: MoSPI

Table 1: About the state

Parameter	Information
Year of Creation	Established on August 15, 1947, Statehood conferred as Madras State on 26 Jan 1950, Re-organized in 1956, Renamed as Tamil Nadu in 1969
Population & Demographics	Total Population at 7,21,47,030 as per 2011 census 51.6% Rural, 48.4% Urban Decadal population growth: 15.6%
Area	1,30,058 square kilometers (3.95 % of country) Forest cover – 22,877 sq kms (2.95% of country)
Administrative Set-up	32 Districts 85 revenue divisions 15,979 Revenue Villages (as per census 2011)
Natural Resources	Vast Forest Resources with diverse range of Flora & Fauna Rivers : Kaveri, Palar, Ponnaiyar, Bhavani, Vaigai Other Resources: Lignite, Vermiculite, Titanium Magnetite, Dunite, Rutile, Garnet, Molybdenum And Ilmenite
HHs	Urban 89,29,104 (96.1% Electrified) Rural 95,63,899 (90.8% Electrified) Total 1,84,93,003 HHs (93.4 % Electrified) (2011 census) Presently, Aug 2016 100% electrified (approx.)

Backed with high industrial and commercial activity, the State's per capita electricity consumption of 1,280 kWh (FY16) ranks among the top ten states in the country.

A significant part of Tamil Nadu's energy is contributed by thermal stations. The hydroelectric plants particularly along the Kaveri River and its tributaries provide options of Hydro Energy. The state is also a leader in wind-power and solar generation. A brief overview of the power sector of Tamil Nadu is discussed in the following sub-section.

2.2. Tamil Nadu Power Sector At a Glance

Formed in 1957, Tamil Nadu Electricity Board was constituted as a vertically integrated entity responsible for power generation, transmission and distribution. In line with the requirement of Electricity Act 2003, the entity was restructured into one holding and two subsidiary companies with TNEB Ltd. as holding company. The subsidiary TANTRANSCO Ltd. was created to undertake transmission in the State, while the generation and distribution was vested into TANGEDCO Ltd.

Notably, Tamil Nadu is one of the early achievers of 100% village electrification and has the largest wind and solar power generation capacity across the country. Over the past few years, the utility has

incurred significant capital expenditure to improve access and reliability of supply in the State. With the continued commitment of State Government and enormous efforts of utilities, the state has overcome obstacles in generation, transmission and distribution. A brief snapshot of the state power sector is discussed in Table 2. In compliance of the Electricity Act, 2003, the state has restructured the erstwhile Tamil Nadu Electricity Board (TNEB) with effect from November 01, 2010 into three entities TNEB Limited (holding company) and its subsidiaries:

- Tamil Nadu Generation and Distribution Corporation Limited (TANGEDCO) which is responsible for electricity generation and distribution within the state.
- Tamil Nadu Transmission Corporation Limited (TANTRANSCO) which is responsible for electricity transmission of the state

The State Regulator- Tamil Nadu Electricity Regulatory Commission (TNERC) was established and became operational from July 2, 1998. TNERC carries out its function and roles in accordance with applicable provisions of the Electricity Act, 2003.

Table 2: Tamil Nadu Power Sector at a glance

Aspect	Key Highlights						
Demand Supply Position	As compared to national figures, the State's demand supply is better than the National Average (2.1% Energy Deficit and 3.2% Peak Deficit). The FY16 power supply position is shown in the table below (TANGEDCO Figures):						
		Peak (MW)				Energy (MU)	
	Peak Demand	14,533			Requirement	1,00,319	
	Peak Available	14,533			Availability	99,691	
	Surplus/(Deficit)	0%			Surplus/(Deficit)	(0.63)%	
Per Capita Consumption (kWh)	Per capita consumption (At generation busbar including all losses) in kWh for last five years (Source: TANGEDCO)						
		FY11	FY12	FY13	FY14	FY15	FY16
	Tamil Nadu	1,040	1,065	1,011	1,196	1,228	1,280
Generation	The total installed power generation capacity in the state as on 31.03.2016 was 24,432.9 MW with the following break-up:						
	Sector	Thermal	Hydro	Hydro (RE)	Other RE	Total	
	State	5,176.0	2,185.2	122.7	17	7,500.9	
	Central	5,464.0	0	0	0	5,464.0	
	Private (incl CPP)	1,839.0	0	0	9,629.0	11,468.0	
	Total	12,479.0	2,185.2	122.7	9,646.0	24,432.9	
<i>(TANGEDCO, April 2016)</i>							
Transmission	TANTRANSCO is responsible for the intra state transmission of electricity and the CTU (PGCIL) manages the Inter-state transmission of power. The total inter and intra-state transmission capacities in the state are listed below:						
	Category		No. of EHV Substations	Transformation Capacity (MVA)	Line Length (ckt kms)		
	Intra-state (66 kV and above)		908	59,953	30,331.6		
	Inter- State		11	9,300	8,127.0		
Distribution	TANGEDCO is responsible for distribution of power in the state.						
	Licensee		License Area		Consumers Served		
	TANGEDCO, Tamil Nadu		Entire State		2.70 Cr (2016)		
Finance	The erstwhile Tamil Nadu Electricity Board has been bifurcated into two subsidiary companies viz., TANGEDCO & TANTRANSCO and operational w.e.f. 1.11.2010. The entire carried forward losses of erstwhile Tamil Nadu Electricity Board has been adjusted against the revaluation reserve created out of the assets revalued to the extent of Rs.34,741.31 crs under transfer scheme.						
	Subsequently, TANGEDCO has started with NIL accumulated loss and incurred loss of Rs.5,634 crs in FY11 (5 months). Consequent to the several revenue augmentation and cost control measures taken up such as replacement of static meters, prompt disconnection of defective services, stoppage of high cost power purchase from independent power producers, effective negotiation of power purchase rates under long term contracts as well as import coal rates, TANGEDCO could be able to considerably reduce financial loss from Rs.12,756.60 crs during FY15 to Rs.5,787 Crs for FY16.						



3. Power Supply Scenario

3.1. Power Supply Position

Tamil Nadu is the 3rd largest consumer of electricity accounting for nearly 9% of total energy consumption in India (during FY16). Over the last 5 years, the State has benefited by the significant capacity additions and allocations, resulting in decrease in peak deficit from 6.38% in FY11 to 0% in FY16. The utility has undertaken several measures with focus on reduction of T&D losses and considerable capacity addition which have led to the improvement in power supply. The peak demand met in state has increased at a CAGR of 6.4% over the last five (5) years leading to steep decline in the peak deficit (Nil in FY16). In terms of energy requirement and availability, It may be noted that, the Power Supply Position figures in this document have been provided by TANGEDCO, these figures vary from CEA figures due to non-inclusion of state's own generation injected at STU, the energy requirement is derived by adjusting the estimated energy lost due to scheduled outages and the available energy.

Monthly data for peak and energy shows that during April'15 to May'15, deficit of the order of ~1% was observed. However, from Jun'15 onwards there is no shortage in peak and from Sep'15 onwards there is no shortage of peak and energy. The seasonal trend of peak and energy shortages for the period of April'15 to March'16 is illustrated in Figure 2

TANGEDCO has been able to maintain 24 hours of supply to both urban and rural areas since June 2014. In the current financial year, TANGEDCO has so far been able to provide reliable supply to its consumers. During the current year, TANGEDCO has embarked on supplying 24 hours supply to all rural and urban consumers. It can be said that TANGEDCO has already achieved key objectives of PFA program, i.e. to provide 24X7 electricity to all its consumers. The other objective of ensuring electricity access to all consumers has been already achieved by the State as all HHs in the State are already connected to the electricity network.

Figure 2: Monthly Demand and Supply (Peak- MW and Energy-MU, source: TANGEDCO)



Table 3: Peak Demand and Energy Availability FY11 to FY16 (Source: TANGEDCO)

Particulars	FY11	FY12	FY13	FY14	FY15	FY16
Peak demand and supply						
Peak Demand (MW)	11,397	11,622	12,261	13,444	13,771	14,533
Peak Met (MW)	10,670	10,811	11,283	12,764	13,771	14,533
Surplus/ (Deficit) (%)	(6.38%)	(6.98%)	(7.98%)	(5.06%)	0.00%	0.00%
Energy requirement and availability						
Energy Requirement (CEA) (MUs)	81,949	87,909	91,044	91,284	97,026	100,319
Energy Available (TANGEDCO) (MUs)	74,845	77,102	74,872	85,830	94,128	99,691
Energy Shortage (%)	(8.67%)	(12.29%)	(17.76%)	(5.97%)	(2.99%)	(0.63%)

The PFA program, thus focuses on maintaining adequate generation capacity with commensurate transmission capacity and strengthening of distribution infrastructure to continue supply of 24X7 reliable electricity to all connected consumers, including industrial and commercial consumers.

3.2. Consumer and Sales Mix

TANGEDCO is the sole distribution licensee in Tamil Nadu. At the end of FY16, it had a consumer base of over 2.6 crores. Substantial quantum of sales is contributed by subsidized consumer categories including domestic (30%) and agricultural supply (15%). This sales mix offers limited advantage to the utility, as the share of subsidizing industrial sales is about 35% in overall retail sales during FY16

This must be seen in light of Tamil Nadu being a highly industrialized State and a manufacturing hub for numerous industries. The utility has encouraged the utilization of open access and various industrial consumers have shifted to sourcing power through open access or setting up their own captive

generation units. In FY16 the share of open access energy in Industrial and commercial sales was about 29.29%.

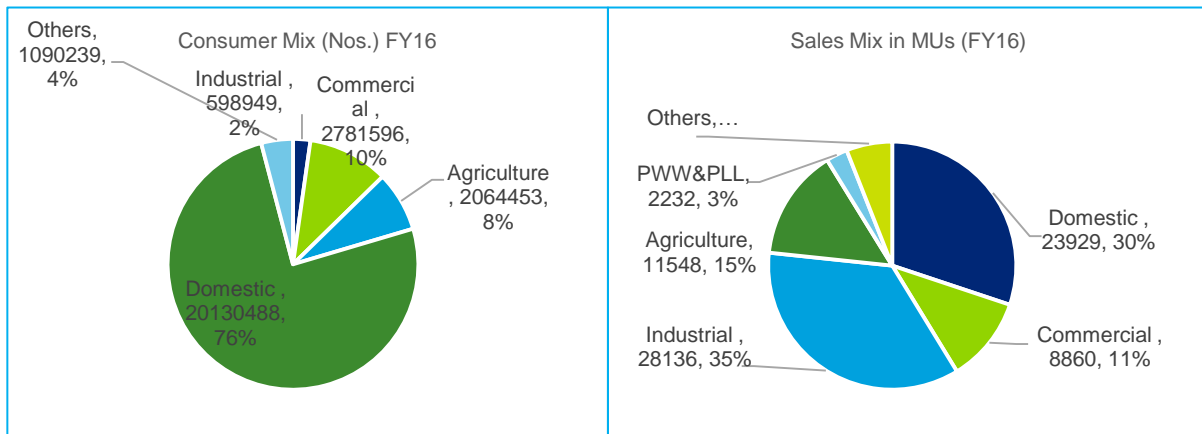
Industrial consumers are about 2% of total consumers, these consumers have the highest contribution towards energy sales with total share of 35% as can be seen in Figure 3 . There has been significant addition in the consumer base across the categories as inferred from the category wise consumers and sales growth trend. In terms of consumers, domestic consumers account for highest share of 76%, contributing around 30% of total energy sales.

TANGEDCO has high share of agricultural sales (15%) contributed by 20 Lac unmetered agriculture consumers out of total 32 Lacs unmetered consumers in the State.

3.3. Methodology for Demand Projections

In line with the objective of PFA program, to provide 24X7 power to all HHHs, the demand projection has been calculated separately for rural and urban HHHs. whereas, for rest of the consumer categories a

Figure 3: Consumer and Sales Mix (FY16)





growth rate based on TANGEDCO's estimation of the expected growth along with a review/ validation with the past trend has been considered. The following steps detail out the approach adopted for estimation of energy requirement for the State.

Estimation of Rural and Urban electrified and un-electrified HHs

Based on the available census data for 2011, extrapolated with past 10 years CAGR Estimation of number of rural and urban HHs are done.

In addition to the level of electrification in rural areas as per 2011 census data, the actual rural HHs electrified since 2011 has been considered to arrive at the present level of electrification. In case of urban areas, the same level of access as in 2011 census (in percentage terms) has been assumed on the estimated HH numbers to arrive at the number of existing un-electrified HHs. Also actual data of electrification is considered into the calculation. It is noteworthy that the state has already achieved 100% electrification of both urban and rural households. Therefore, there is no additional energy demand from the electrification of un-electrified HHs in the State.

Estimation of Energy Requirement from HHs

The energy requirement from domestic category consumers (HHs) has been estimated using the end use method under the following categories:

- a) Latent demand from existing HHs on account of increase in specific consumption (kWh/HH/day) for each of the electrified HH due to life style advancements and natural growth;
- b) Additional energy requirement due to construction of new urban and rural HHs;

Latent demand growth from already electrified HHs has been estimated based on expected increase in

consumption levels in accordance with the objectives of the PFA program. Accordingly it is expected that the daily HH consumption in urban areas will increase from 4.54 kWh in FY16 to 5.10 kWh by FY19. Similarly, daily rural HH consumption will increase from 1.97 kWh in FY16 to 2.22 kWh by FY19 as illustrated in Table 4.

Table 4: Per HH per day consumption (kWh)

Particulars	FY16	FY17	FY18	FY19
Urban	4.54	4.72	4.91	5.10
Rural	1.97	2.05	2.13	2.22

Since HHs in the state are 100% electrified, no additional energy requirement will be realized due to electrification of un-electrified HHs.

However, TANGEDCO has identified 115 nos. un-electrified remote habitation with a total of 5,787 households. The electrification of these HHs by conventional mode is not feasible. These households are proposed to be electrified through off-grid solutions as they are located in remote/forest areas. Accordingly, demand arising out of these HHs is not considered in the overall demand estimation.

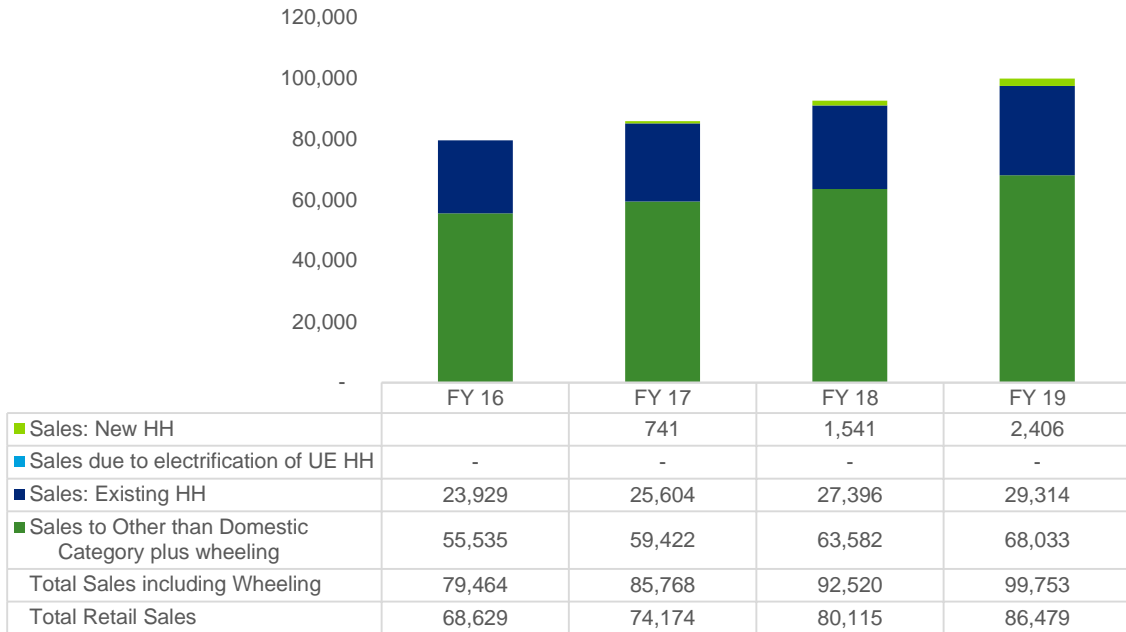
In order to estimate the energy requirement for newly constructed HHs, the expected number of newly constructed HHs has been estimated to be 300,000 HHs each per year for both Rural and Urban areas.

Estimation of Energy Requirement from Other Consumer Categories

The energy requirement projections from other consumer categories have been done factoring the expected natural growth considering the past trend and current consumption in accordance with the PFA Roadmap.

The projected demand for different consumer categories is discussed in the following sub-section.

Figure 4: Projected Energy Sales in MU (FY 16 to FY19)



3.4. Demand Projections – TANGEDCO

Based on above steps, the total energy sales for TANGEDCO is expected to increase by about 7.9% CAGR from 79,464 MUs in FY16 to 99,753 MUs in FY19, as presented above in Figure 4. Even with the expected addition of new HHs and increase in specific consumption, the percentage share of energy sales to domestic consumers is expected to remain stable at nearly 30-40%.

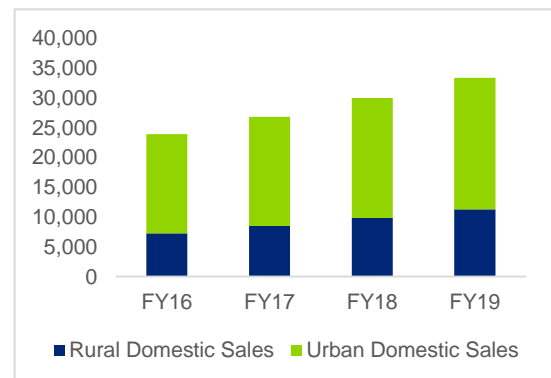
Increase in total energy sales is also attributable to other than domestic sales, which is expected to grow at a CAGR of 7% during the period. It can also be observed from Figure 4, that in line with the sales to domestic category, the share of energy sales to other than domestic category consumers is expected to remain in the range of 60-70%. TANGEDCO had wheeling sales of about 10,835 MU in FY16. While estimating the future sales from other than domestic category the wheeling energy is projected to be 24.3% (FY16 share) of other than domestic sales. Consequently, the wheeling sales is expected to increase from current level of 10,835 MUs FY16 to 13,273 MUs in FY19. Accordingly, the peak required for the wheeling sales have been projected to increase from 2,007 MW to 2,458 MW (based on FY16's estimated peak required for wheeling sales) for the period FY17 to FY19.

The share of energy requirement from both urban and rural HHs is projected to grow significantly in the future. The share of rural HH sales in the sales

to domestic consumers which is about 30% in FY15 is expected to remain almost same in FY19 as can be seen in Figure 5.

In order to estimate the energy input requirement at the state periphery, distribution losses and intra-state transmission losses have been considered. The energy consumption estimated above translates into energy requirement at state periphery, as can be seen in Table 5. It may be noted that export to Puducherry (about 187 MU) is included in sales.

Figure 5: Rural and Urban Sales in MU



The energy requirement at the State periphery (for retail sales) is likely to increase from 85,926 MU in FY16 to nearly 1,04,214 MU in FY19. Peak demand for power has been derived using the actual load factor for FY16. Accordingly, Peak Demand for retail sales is expected to grow by about 17% from



12,526 MW in FY16 to 15,192 MW in FY19. The peak demand due to wheeling consumption is estimated by using the corresponding wheeling demand using FY16 values, Total peak of the state including wheeling energy is expected to increase from 14,533 MW in FY16 to 17,651 MW in FY19.

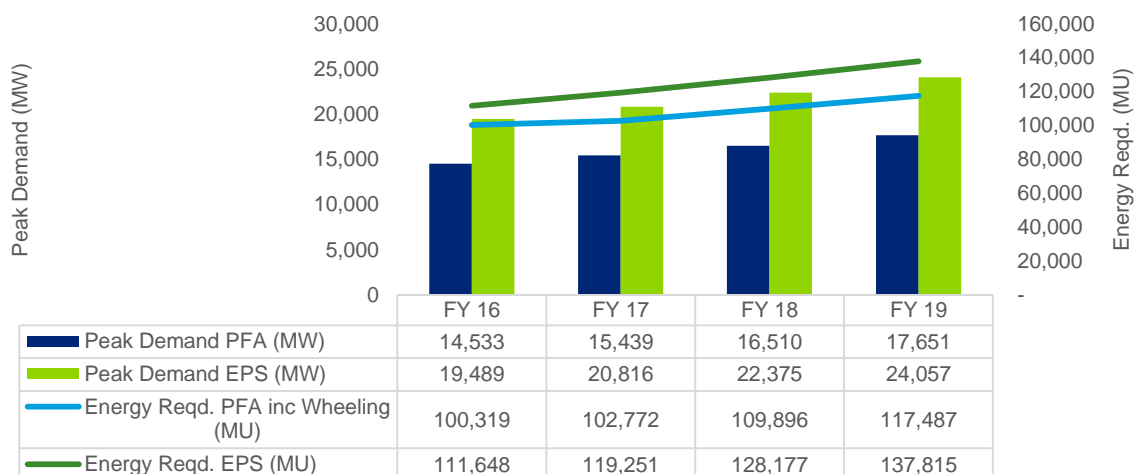
Projected energy requirement including wheeling sales in MU (1,17,487 MU) terms is expected to fall short of the 18th EPS estimates (1,37,815 MU). Similarly, the projected peak demand in MW is

expected to fall short of the 18th EPS estimates. The difference in the peak demand projections is due to the load factor used in the 18th EPS (65% in FY16) vis-à-vis the actual load factor witnessed (78.3 % in FY16). The projected energy requirement and the peak demand projections up to the period FY19 are expected to remain much lower than the 18th EPS projections. A comparison of the projected figures under the PFA Roadmap vis-à-vis the 18th EPS is shown in Figure 6.

Table 5: Energy Requirement and Peak Demand Projection - TANGEDCO

Particulars	Units	FY16	FY17	FY18	FY19
Retail Energy sales (Incl. Puducherry)	MU	68,629	74,174	80,115	86,479
AT&C losses (excluding Transmission loss)	%	17.52%	16.09%	15.24%	14.41%
Collection Efficiency	%	99.02%	99.02%	99.02%	99.02%
Distribution losses	%	16.71%	15.26%	14.40%	13.56%
Intra-state Transmission Loss	%	4.11%	4.00%	4.00%	4.00%
Energy Input Requirement for retail sales	MU	85,926	91,179	97,492	104,214
Load Factor	%	78.31%	78.31%	78.31%	78.31%
Peak Demand -Retail Sales	MW	12,526	13,292	14,212	15,192
Peak Demand Including Wheeling Sales	MW	14,533	15,439	16,510	17,651

Figure 6: PFA Projected Energy Req. & Demand vs 18th EPS Projections



4. Generation Plan

4.1. Generation Sector in Tamil Nadu

Tamil Nadu Generation and Distribution Corporation (TANGEDCO) Limited, a company owned by the Government of Tamil Nadu, is entrusted with the goal to carry on the business of power generation and distribution in the state. The state draws power from its generating stations, private producers including renewable energy generators and has allocation from Central Generating Stations. The details of existing installed state owned generating capacity and PLF for FY16 is provided in Table 7.

The total installed capacity in the state, (including own generating stations, IPPs and central allocation) is 24,433 MW. Table 6 shows the sector wise break-up of the installed capacity. The share of thermal stations in the installed capacity stands at 51%. The State sources contribute to 31% of installed capacity (51% excluding RE Sources), whereas the private sector comprising of mostly RE sources contributes 39% of the installed capacity. Break-up of the installed capacity by ownership and source is provided in Table 6.

During the period FY16 to FY19 the peak demand (including wheeling demand) and energy requirement (including wheeling sales) is expected to increase from 14,533 MW and 1,00,319 MU in FY16 to 17,651 MW and 1,17,487 MU in FY19. In order to meet this increase in demand, the state needs to plan for either development of its own generation capacity or tie up with central generating stations/ IPPs. This chapter describes the readiness of the state for meeting the projected power demand scenario and highlights the future

plans and forward in view of the gaps and issues identified therein.

Tamil Nadu's power demand is mostly met by TANGEDCO and Private Players in the state (78% of the total installed capacity). The State's own generation sources (TANGEDCO) contribute to more than 31% of the total installed capacity in the state.

Table 7 contains details of the plants owned by TANGEDCO. The capacity includes approx. 5,176 MW of thermal sources including 516 MW from gas based stations. TANGEDCO's hydel generation sources contribute 2,308 MW of capacity including 123 MW of small hydro plants (SHPs). These SHPs are discussed in the renewable energy plan chapter of this document.

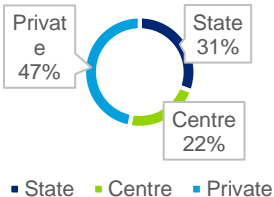
4.2. Generation Plan

The generation plan for the state envisages the proposed capacity additions by the state along with the allocated share of upcoming central and IPP generating stations. The generation capacity addition and power procurement plans have been aligned with the energy requirement and power demand assessed in the earlier sections of this report.

Inter-State/ Central Sector Projects

The state is expecting capacity additions of about 2,509 MW from thermal sources including co-generation plants and Central sector's plants such as NTPC, NLC and NPCIL. The details of these plants are shown in Table 10. Further, the existing allocation from Central sector plants are provided in Table 8.

Table 6: Installed Capacity (MW) as on 31.03.2016 (Source: TANGEDCO)

Share	Sector	Thermal	Hydro	Hydro (RE)	Other RE	Total
 <p>State 31% Private 47% Centre 22%</p> <p>■ State ■ Centre ■ Private</p>	State	5,176	2,185	123	17	7,501
	Central	5,464	0	0	0	5,464
	IPP+CPP	1,839	0	0	9,629	11,468
	Total	12,479	2,185	123	9,646	24,433



In addition to the above, the state draws power from the unallocated shares of central stations. As on April 2016, 469 MW of unallocated share of central stations was available to Tamil Nadu

Intra-State/ State Sector Projects

TANGEDCO is undertaking construction of following four Thermal Power Projects,

- 660 MW ETPS Expansion project,
- 1,320 MW Ennore SEZ project,
- 800 NCTPP Stage III and
- 1,600 MW Uppur Thermal power project

ETPS Expansion project is expected to achieve COD by FY19. Ennore SEZ plant is expected by FY20 (May 2019). Work in respect of NCTPP Stage

III and Uppur Thermal power projects are under progress and are expected to achieve COD by 2019-20.

In addition to the above, Kundah HEP (500 MW) is also being developed by TANGEDCO. As EPC contract for Kundah HEP is yet to be awarded, the name does not find a place in the above list and the planned COD for this project is 2020-21. Brief status update on these projects is as mentioned hereunder:

1X660 MW ETPS Expansion Project: Imported coal MOU is already signed between MMTC & TANGEDCO for 2.0 MTPA. Civil, Electrical and Mechanical works of the project are under progress. This project is expected to be commissioned in Jan 2018.

Table 7: Existing State Owned Plants

Name of Plant	Fuel	Installed Capacity (MW)	PLF (FY16)	Remarks
Ennore Thermal Power Station	Thermal	340 (2x60+2X110)	14.81%	Unit V capacity 110 MW has been excluded from the installed capacity of 450 MW and all parameters for station are calculated for 340MW. The Board of TANGEDCO has approved to keep the unit V under shut down condition till de-commissioning of the station.
Mettur Thermal Power Station I	Thermal	840 (4X210)	81.01%	R&M works proposed up to 2018-19
North Chennai Thermal Power Station – Station I	Thermal	630 (3X210)	80.39%	R&M works proposed up to 2018-19
Tuticorin Thermal Power Station	Thermal	1,050 (5X210)	76.80%	R&M works proposed up to 2018-19
Mettur Thermal Power Station II	Thermal	600 (1X600)	74.49%	Commissioned during 2013-14
North Chennai TPS - Station II	Thermal	1,200 (2X600)	61.65%	Commissioned during 2014-15
Hydro Plants Existing	Hydro	2,185.2	-	Details provided in the annexure
Hydro Plants Existing (RE)	Hydro	122.7	-	Details provided in the annexure
Basin Bridge Gas Turbine Power Station-BBGTPS	Naptha	120 (4X30)	1.52%	Only during emergencies the units at BBGTPS are being operated to maintain grid stability as real power generation at BBGTPS is not allowed by Hon'ble TNERC under Merit Order Dispatch due to higher fuel cost. However, Units are being operated under Synchronous condenser mode to improve the voltage profile of the grid.
Kuttalam Gas Turbine Power Station-KGTPS	Natural Gas	101	63.54%	Inadequate gas supply (70-75% on an average)
Thirumakottai Gas Turbine Power Station-T(K)GTPS	Natural Gas	107.88	42.12%	Inadequate gas supply (55 to 60% on an average)
Valuthur Phase-II Gas Turbine Power Station-VGTPS-II	Natural Gas	92.2		Unit is working with 85% gas supply on an average with effect from 11.10.16 after rectification of major breakdown from 23.1.15 to 26.9.16.



Valuthur-Phase-I Gas Turbine Power Station-VGTPS-I	Natural Gas	95	86.42%	Unit is working with 85% gas supply on an average.
Total		7,484		

It may be noted that Chandrabila coal block (indigenous coal) was allotted in February 2016 for TANGEDCO's ETPS Expansion project, Ennore SEZ project and Udangudi Stage I projects.

Projects having CoD beyond FY19

2X660 MW Ennore SEZ Supercritical Power Plant: EPC cum debt finance contract has been issued. MoU signed with MMTC by TANGEDCO on 25.06.2012 for 4.549 MTPA 100% import coal. Chandrabila coal block (indigenous coal) was allotted in February 2016 for TANGEDCO's ETPS Expansion project, Ennore SEZ project and Udangudi Stage I projects. The EPC contractor M/s BHEL has to arrange funds through lender M/s.PFC as this is an EPC cum debt finance project.

It may be noted that a court case was ongoing with regard to this project due to which the works were stalled. However, on 18.10.16, The Honorable Supreme Court gave its judgement in favor of TANGEDCO stating that the contract with BHEL (EPC contractor) is in order. Work on the project site has resumed on 19.10.16. The expected COD for this plant is May 2019.

1,600 MW Uppur Thermal power project: EPC contract for BTG package and allied civil works have been issued to M/s BHEL. Civil work is under progress. MoU with MSTC Ltd for 100% imported coal linkage (5.01 MTPA) for Uppur Thermal power project has been signed. Coal block allotment for this plant is yet to be received for indigenous coal. Techno-commercial bid for BOP was opened on 19.9.16 and is under evaluation. Notice Inviting Tender (NIT) for sea water intake and outfall system opened on 26.10.16 and under evaluation. Expected COD for this plant is FY20.

1X800 MW North Chennai Thermal Power Plant- Stage III: LOA for BTG package and allied civil works has been issued to BHEL. With regard to fuel, MoU with MSTC Ltd for 100% imported coal linkage (2.51 MTPA) has been signed. It may be noted that Coal block allotment for indigenous coal is yet to be received. Civil works are under progress. LOI was issued on 28.10.16 for BOP package to M/S BGRESL and work has commenced. The expected COD for this plant is by FY20.

2X660 MW Udangudi Project (Stage I): The EPC contract for the project is yet to be awarded. TANGEDCO has signed MOU with MMTC for 4.5 MMTPA for supply of imported coal. The plant is expected to be available by FY21.

4X125 MW Kundah Pumped Storage Hydro Electric Plant: The plant is expected to be operational by FY21. TANGEDCO has availed loan for this plant from REC.

The financing details and the funding options for the above plants are provided in Table 14.

Generation Plan of IPPs

TANGEDCO has sources from various private generating stations, this include generators, Pillaiperumalnallur GTPP, Madurai Power Corporation, TAQA Neyveli Power Company, LANCO Tanjore Power Company, Pioneer power limited.

Total of 3,830 MW from LTOA (Long term open access) and MTOA (Medium term open access) are available from various privately owned thermal power plants.

Table 8: Plant wise allocated capacity from CGS (April 2016)

Name of Plant	Plant type	Installed Capacity (MW)	Allocated Capacity (MW)
Ramagundam St. I,II and III	Thermal	2,600	663
Talcher St. II	Thermal	2,000	490
Simhadri STPS St.II U#1,2	Thermal	1,000	223

Name of Plant	Plant type	Installed Capacity (MW)	Allocated Capacity (MW)
NLC TPS-I	Thermal	600	475
NLC TPS-II St. I	Thermal	630	190
NLC TPS-II St. II	Thermal	840	284
NLC TPS-I Exp.	Thermal	420	228
NLC TPS-II Exp. U#1,2	Thermal	500	271
Vallur STPS U# 1, 2 & 3	Thermal	1,500	1,067
NTPL Tuticorin U# 1,2	Thermal	1,000	415
Madras APS	Nuclear	440	331
Kaiga APS U# 1 & 2	Nuclear	440	228
Kudankulam NPP U# 1	Nuclear	1,000	563
ER plants	Thermal		35
		12,970	5,463

Table 9: Plants under Construction (State)

Name of Plant	Proposed Capacity (MW)	Remarks
ETPS Expansion Project	660	LOI for Construction was issued on 30.5.14. Expected COD is during 2018-19. Funding through PFC (80%) and TANGEDCO (20%) Imported coal MoU signed between MMTC & TANGEDCO (2.0 MTPA) Chandrabila coal block allotment given to TANGEDCO for ETPS Expansion project, Ennore SEZ project and Udangudi Stage I)
Ennore Sez Supercritical Thermal Power Project	1,320	Judgment has been received on 18.10.16 from Supreme court in favour of TANGEDCO stating that the contract placed on M/s BHEL is in order. Work has resumed on 19.10.16. and M/s BHEL will arrange funds through lender M/s.PFC as this is an EPC cum debt finance project.
Kundah Pumped Storage Hydro Electric Project	500	The tenders for EPC Packages I & II were opened on 10.11.2016.and are currently under evaluation. Tender for E&M works EPC Package III is proposed to be floated by 02/2017. Funding is arranged from REC. Administrative approval for Phase II and Phase III was accorded by the Board of TANGEDCO. This is to be taken up after 6 months from floating Tenders for Package III of Phase I. This Project is programmed to be commissioned in 2020-21.
Uppur Thermal power project	1,600	EPC contract for BTG package and allied civil works issued to M/s BHEL. Civil work under progress. Techno-commercial bid for BOP opened on 19.9.16 and under evaluation. Notice Inviting Tender for sea water intake and outfall system opened on 26.10.16 and under evaluation. Funding to be arranged from PFC. Expected COD 2019.-20
NCTPP Stage III	800	LOA for BTG package and allied civil works has been issued to BHEL. Civil work under progress. LOI for BOP was issued on 28.10.16 to M/s BGRESL and works have commenced. Funding arranged from REC. Expected COD 2019-20..

Table 10: Capacity addition MW (State and Central Sources)

Project	Capacity Installation/Share	EXP COD
Kudankulam APS (Unit 2 -1000MW)	562	FY 17
Kudgi STPP Units-I (2x800MW)	100	FY17
Cogeneration Power Projects	165	FY17
PFBR Kalpakkam (1x500MW)	167	FY18
Neyveli New TPP at Neyveli (2x500 MW)	327	FY18
Kudgi STPP Unit II &III (2x800 MW)	201	FY18
ETPS Supercritical Expansion Project	660	FY19
Neyveli New TPP at Neyveli Unit-II 2x500 MW)	327	FY19
Total	2,509	

4.3. R&M Program

As seen from Table 11, TANGEDCO is undertaking R&M of TTPS, MTPS, and NCTPS thermal power stations. The company has availed funds from PFC and REC for implementing the R&M Projects in the state. The R&M works undertaken by TANGEDCO for thermal and hydro projects as depicted below in Table 11 and Table 12 respectively.

TANGEDCO owns around 3,000 MW of thermal generating stations which are at least 25 years old. The utility would benefit from another R&M program directed towards these stations. TANGEDCO has requested GoI to evolve specific schemes for R&M measures to augment generation by providing financial assistance as grants instead of loan. This would benefit the consumers as it would help in reduction in generation cost along with improvement in efficiency.

During FY16 to FY19 TANGEDCO is expecting capacity additions of 2,509 MW through thermal (conventional and nuclear) sources of TANGEDCO and CGS (NPCIL, NLC) including 165 MW from Co-generation sources & another 5,100MW from Renewable energy sources (Wind, Biomass and Solar Sources). The contribution of Renewables is higher than conventional sources as 5,265 MW is expected by FY19. Major share of energy is expected from thermal sources (85% of the total volume available) while 15% is expected from renewables.

Based on the capacity additions as discussed above, the installed capacity is expected to increase to 35,855 MW by FY19 (including medium and long term procurements). The peak demand expected in FY19 is 17,651 MW. The available capacity for the state is expected to be sufficient and shortages are not expected.

4.4. Anticipated Power Availability Position- TANGEDCO

Table 11: R&M work of thermal power plants

Name of Plant	Fuel	Installed Capacity (MW)	Remarks
Mettur Thermal Power Station_I	Thermal	840	R&M works proposed up to 2018-19
North Chennai Thermal Power Station I	Thermal	630	R&M works proposed up to 2018-19
Tuticorin Thermal Power Station	Thermal	1,050	R&M works proposed up to 2018-19

Table 12: R&M work of Hydro projects

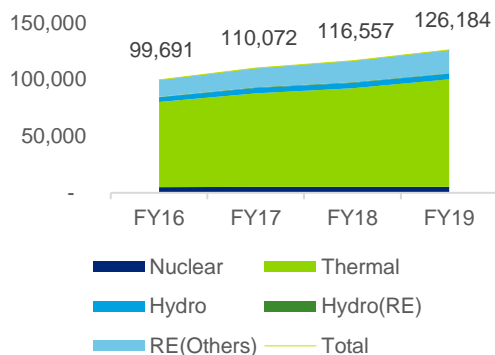
Name of the Hydro Power House	Unit no.	Details of RMU works			
		Date of commencement	Date of completion	Funding arrangement	Remarks
Periyar PH 4x35 MW to 4x42 MW	Unit 1	6.3.2009	14.7.2011	Total value of contract: Rs.161.18 cr. Total value of contract with IDC (Interest During Construction): Rs.191.64 cr 80% of contract value with IDC is funded by Power Finance Corporation Ltd., New Delhi and the balance amount is met out by Board's resources	Machines are running satisfactorily. Unit 4 -30 day trial run including continuous full load test is pending for want of water.
	Unit 2	14.7.2011	11.9.2012		
	Unit 3	11.9.2012	8.1.2014		
	Unit 4	5.4.2014	23.03.2016		

Name of the Hydro Power House	Unit no.	Details of RMU works			
		Date of commencement	Date of completion	Funding arrangement	Remarks
Sholayar PH I 2x35 MW to 2x42 MW	Unit 1 and 2	RMU works contract has been awarded to M/s.Andritz Hydro Pvt. Ltd.(AHPL) during May 2015 Machine has been handed over to AHPL for carrying out reverse engineering works on 23 Dec 2015. The works have been completed in April2016.		Total value of contract: Rs.90.45 cr. Total value of contract with IDC: Rs.110.94 cr. 80% of contract value with IDC is to be availed from Power Finance Corporation Ltd., New Delhi and the balance amount is to be met out by Board's resources	

While estimating the energy available, existing PLF of thermal units of TANGEDCO and CGS were used. TANGEDCO's own hydro plants are projected at actual PLF. For new Central and Private Thermal Generating Stations average PLF of 85% is used. Hydro stations are projected at 50% PLF whereas the RE (Solar and Wind) units are projected at 7% PLF.

TANGEDCO's own thermal units have been projected as per the estimates provided by TANGEDCO.

Figure 7: Energy available from various sources (MU)



Further, plants which have high power purchase cost have not been considered. For estimating the peak available, NEP norms were used.

Auxiliary energy consumption of all state thermal and hydro stations including pumping energy for Kadamparai Pumped Storage Plant is estimated at 8.4% (FY16 value).

It can be seen that the due to addition of plants in the state the renewable energy share is expected to remain at the level of 15-16% during FY17 to FY19.

4.5. Key Issues

Coal Allocations and Availability.

As per the terms of the FSAs the linkages from indigenous coal fields are to the order of 19.55 MMTPA for FY2015-16. Against this linkage, TANGEDCO has received about 15.50 MMTPA in FY2015-16. This shortage between linkage and actual availability is due to multiple reasons. TANGEDCO has requested The Ministry of Coal and Ministry of Railways to arrange for suitable solution to resolve the issues in supply and transportation of full quantum of indigenous coal as per FSA.

TANGEDCO is allocated BOBRN (Bogie Open Bottom Release) type wagons for transporting coal from Talcher mines to Paradip Port. Allocation of wagons by Railways is not sufficient to cater to the requirements of TANGEDCO resulting in less realization of coal against the linkage quantity.

TANGEDCO has periodically taken up the short supply of rakes issue with top officials of East Coast Railways (ECoR)/Bhubaneswar. As per daily programme, ECoR has to allot approx. 10 BOBRN rakes/day from Talcher coal fields.

Further, TANGEDCO has also been allocated approximately 2 BOXN rakes for supply of coal to MTPS II (FSA 2012) from Talcher mines. This type of wagon is suitable for unloading via wagon tippler, however due to various reasons the wagons are unloaded manually which causes delays and ultimately lesser realization of coal against the linkage quantity. Since the landed cost of coal received from Talcher is cheaper than the landed cost of coal received from ECL/Haldia and MCL/IB Valley, TANGEDCO requested CIL to supply the full linkage quantity from Talcher sidings. TANGEDCO received only 105.24 Lakh Tonnes (LT) of coal



against the linkage of 152.24 LT form Talcher sidings for the FY2015-16, with realization of 69% only.

of 87.28 from Talcher Sidings. This is about 50% of the total linkage.

Further, for FY17 (upto Oct 2016), TANGEDCO has received only 43.35 LT of coal against the linkage

Table 13: Energy Available for TANGEDCO (Including Wheeling and Aux consumption) MU

	Nuclear	Thermal	Hydro	Hydro (RE)	Other RE	Total
FY16						
Central	4,999	24,158	-	-	37	29,194
Private	-	20,957	-	-	14,831	35,788
State	-	30,069	4,174	459	7	34,709
Total	4,999	75,184	4,174	459	14,875	99,691
Aux						2,871
Wheeling and losses						10,899
Net Available						85,926
FY17						
Central	5,233	32,826	-	-	37	38,097
Private	-	16,666	-	-	16,851	33,517
State	0	33,043	4,950	459	7	38,458
Total	5,233	82,535	4,950	459	16,895	110,072
Aux						2,770
Wheeling						11,593
Net Available for retail sales						95,709
FY18						
Central	5,233	37,096	-	-	37	42,367
Private	-	16,666	-	-	18,851	35,517
State	-	33,260	4,950	457	7	38,674
Total	5,233	87,022	4,950	457	18,895	116,557
Aux						2,788
Wheeling						12,405
Net Available for retail sales						1,01,364
FY19						
Central	5,233	41,157	-	-	37	46,427
Private	-	16,666	-	-	20,416	37,082
State	-	37,260	4,950	457	7	42,674
Total	5,233	95,082	4,950	457	20,460	126,184
Aux						3,794
Wheeling						13,273
Net Available for retail sales						1,09,787

Figure 8: Anticipated Energy Availability for Retails Sales (MU) for TANGEDCO

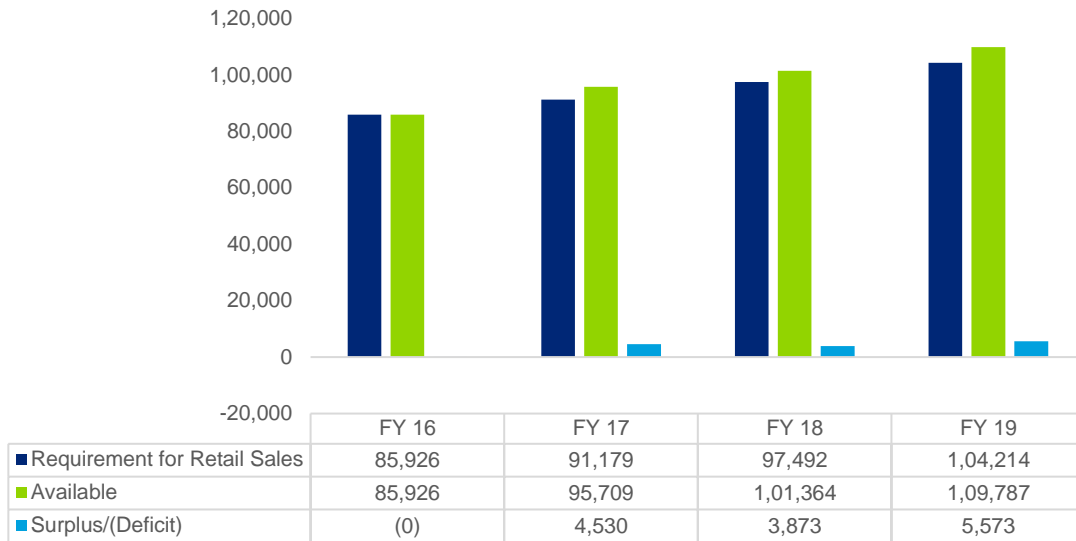
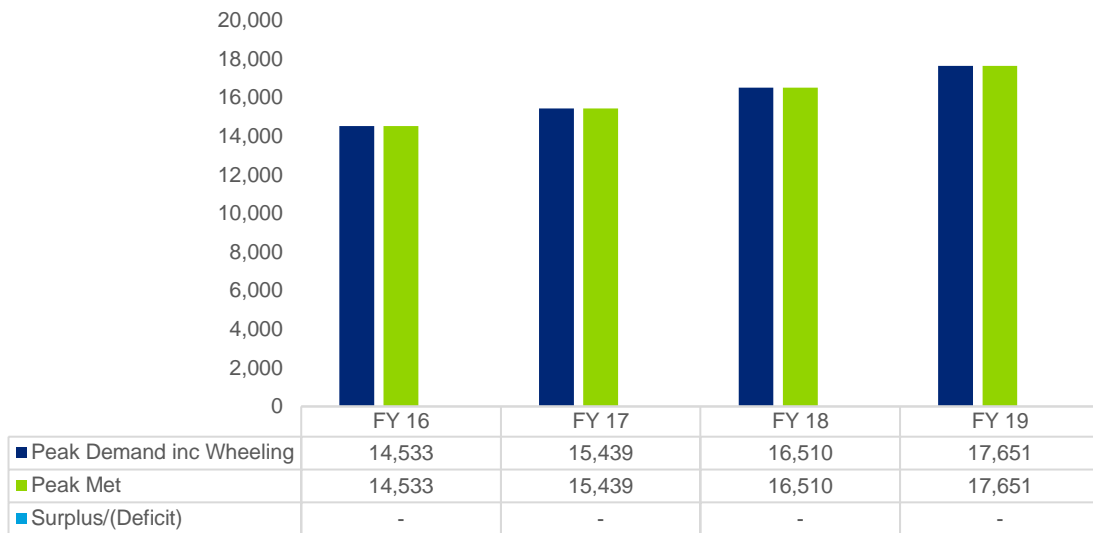


Figure 9: Anticipated Peak Availability Position of TANGEDCO (MW)



4.6. Fund Requirement

The State Generation Company TANGEDCO has tied up funds for new and R&M projects in the state. Since the upcoming projects are executed by PPP mode, the majority of funds are arranged by the EPC contractor. Brief on investment plans in the

state in the near future is tabulated in Table 14 & Table 15 below. Financial tie up of State's Generation utility for R&M of old plants as well as for new Projects is in the form of loan assistance for capital and R&M works for Thermal stations availed from PFC/REC.

Table 14: Investment Plan in (Rs. Cr.)

Project	FY16	FY17	FY18	FY19	Beyond FY19	Total	Funding Agency
ETPS Expansion Project (1x660 MW- Super –Critical)	500	1,200	1,200	700	321	3,921	PFC
Ennore SEZ Thermal Power Projects (2x660 MW)	441	2,303	5,292	1,764	0	9,800	EPC cum Debit Finance Contract
NCTPS Stage-III (1x800 MW)	0.25	800	1607.71	1607.71	1343.6	5359.27	REC
Uppur Thermal Power Project (2x800 MW)	7.75	89.74	3133.57	4178.10	3133.57	10542.73	PFC
Kundah Pumped Storage HEP	140	315	375	600	315	1,745	REC
Total	1,089	4,708	11,608	8,850	5,113	31,368	

Table 15: R&M Plan Thermal (Rs.Cr.)

Sl.	Description	Amount in Rs. Cr.
I. Tuticorin Thermal Power Station		
1	2015-16	23.76
2	2016-17	111.62
3	2017-18	176.32
4	2018-19	87.56
	Total	399.26
II. Mettur Thermal Power Station –I		
1	2015-16	62.39
2	2016-17	106.84
3	2017-18	98.13
4	2018-19	78.77
	Total	346.13
II. North Chennai Thermal Power Station –I		
1	2015-16	2.48
2	2016-17	1.87
3	2017-18	20.95
4	2018-19	21.61
	Total	46.91
	Grand Total for 3 Plants	792.3

4.7. Action Plan & Support Required

As discussed in the previous sections, TANGEDCO would need funding support for the generation plan as well as the R&M plan. In addition, some issues

like water cess and allocation of wagons by Indian Railways may need Central Government's interventions. A summary of these action points and support requirements for generation plan are covered in Table 16 below:

Table 16: Action points for Generation Plan

Agency	Action Plan
TANGEDCO	Funding arrangements for R&M of older plants (which are being arranged through REC/PFC loans)
CEA	Review R&M program of TANGEDCO and develop appropriate scheme for carrying out these works.
Railways	Address the allocation of wagons for TANGEDCO at the Paradeep port



Agency	Action Plan
	(Periodically the ECoR is addressed for the allocation of BOBRN wagons for TANGEDCO from Talcher sidings to Paradeep Port)
CIL	Increase in FSA quantity to 25 MMTPA for the existing plants of TANGEDCO Periodical request for allocation of coal to existing and new projects to be raised by the respective wings (Coal/Mines/Project Wings) of TANGEDCO
MoP/Gol/MoEF	Support in solving issue with MoC in respect of arranging full quantum of indigenous coal as per FSA Allocation of wagons for TANGEDCO in Paradeep port Suitable amendment in Water Cess Act, 1977 to exclude Thermal Power Stations from its purview. Alternatively levy water cess on actual consumption (net consumption) of sea water only (=sea water drawn-sea water discharged back into the sea) Introduce R&M Schemes to be funded through Grants to revive the ageing thermal units of TANGEDCO

5. Transmission Plan

5.1. Transmission capacity requirement

The planning and development of intra-state transmission system in the state is undertaken by Tamil Nadu Transmission Corporation (TANTRANSCO). A well planned and strong transmission system will ensure not only optimal utilization of transmission capacities but also of generation facilities and would further facilitate achieving ultimate objective of cost effective delivery of reliable power to end consumers.

The requirement of electricity in energy and peak demand (Including wheeling energy) for the State is expected to increase from the present level of 1,00,319 MU and 14,533 MW in FY16 to 1,17,487 MU and 17,651 MW in FY19.

The state's generation plan as detailed in previous Chapter of this report outlines the upcoming projects in the state in addition to the allocation from central stations and other licensees. A total of 7,609 MW is expected to be added to the existing system by FY19 for meeting the peak demand requirement of 17,651 MW. The existing transmission system is adequate for evacuation and transmission of power and the transmission plan proposed in this chapter aims at ensuring adequacy of transmission infrastructure for evacuation of such power from the inter-state boundary and proposed generating plants within the State to the end consumers located across various geographies of the State.

5.2. Existing Transmission System

Intra-State Transmission System

The intra-state system is maintained and operated by TANTRANSCO, which is a subsidiary of TNEB Limited. The company was formed when the erstwhile Tamil Nadu Electricity Board was restructured in Nov, 2010 into corporate entities.

As on 31.03.2016, TANTRANSCO operates and maintains a transmission network of 30,331.6 ckm of Extra High Voltage Transmission lines along with 908 sub-stations (400/230/110/66 kV) having total transformation capacity of 59,953 MVA, spread over the entire stretch of the State of Tamil Nadu. The existing transformation capacity and line length (400kV, 230 kV, 110 kV, 66 kV) of TANTRANSCO network is summarized in Table 17.

The availability of TANTRANSCO's transmission system is at par with other leading state transmission utilities in the country. However, the existing capacity of intra-state transmission system is enhanced year by year for meeting the demand in the State.

Inter-State Transmission System

The interstate transmission system is operated and maintained by PGCIL. The present inter-state network consists of 8,127 ckm of lines and 9,300 MVA Substations.

Table 17: Intra-state Transmission System, March 2016

Voltage level	Ckt km lines	No of SS	MVA
400 kV	2,700.53	6	6,010
230 kV	9,084.61	89	20,140
110 kV	17,463.49	807	33,750
66 kV	1,082.96	6	53.75
Total	30,331.6	908	59,953.75

Table 18: Inter- state Transmission System (owned by PGCIL)

Voltage	Transformation Capacity (MVA)	Line Length (cKM)
765 kV	3,000	710
400 kV	6,300	6,857
220 kV	0	560
Total	9,300	8,127

The inter- state power systems in the Southern region connect the various Central Sector Generating Stations located in different states in the Southern region to the rest of the states within the region. The inter-state links connecting Tamil Nadu to various nearby states are listed in Table 20. Further, Table 19 shows the inter-state and intra – state sub-stations at 400 kV and above level in Tamil Nadu. Augmentation of transformation capacity at substations with 1x500 MVA transformers each is being implemented at Arasur, Karaikudi, Madurai, Melakottaiyur (Kalivanthapattu), Pugalur, Tirunelveli & Trichy substations. The augmentation works at Trichy, Madurai and Pugalur is expected to complete by February 2017. Whereas Melakottaiyur (Kalivanthapattu) is expected by December 2016. The remaining three SS (Arasur, Karaikudi and Tirunelveli) are expected by FY20 (April 2019)

The following two new EHV substations are under planning/construction:

- 400/230 Tirunelveli PS with 2x500 MVA transformers
- 765/400 kV Dharmapuri (Salem New) PS. This PS is initially proposed to be charged at 400 kV and will act as a pooling station.

5.3. Intra-state Transmission Plan

Ongoing schemes

TANTRANSCO is working on a number of intra – state transmission projects with the financial assistance from Government of India and financial institutions such as JICA, KfW, REC and PFC to improve the network infrastructure and to ensure reliability and quality of supply to end consumers.

TANTRANSCO has identified such projects in order to meet the following requirements

Table 19: Inter- state Network Connection TN to CGS & other States (400 kV and above)

Name of sub-station	Ownership	Transformation ratio (kV)	Capacity (MVA)
Trichy(Alundur)	PGCIL	400/230	2 X 315
Udumalpet (Myvadi)	PGCIL	400/230	3 X 315
Chekkannurani (Madurai)	PGCIL	400/230	2 X 315
Hosur	PGCIL	400/230	3 X 315
Neyveli TS-II	PGCIL	400/230	2 X 315
Abishekapatty	PGCIL	400/230	2 X 315
Kalivanthapattu	PGCIL	400/230	3 X 315
Pugalur	PGCIL	400/230	2 X 315
Karaikudi	PGCIL	400/230	2 X 315
Arasur	PGCIL	400/230	2 X 315
Sunguvarchatram	TANTRANSCO	400/230	2x315+2x200
Sriperumbudur(Madras)	TANTRANSCO	400/230	3x315+2x200
Salem	TANTRANSCO	400/230	2x315+2x200
Thiruvalem	PGCIL	765/400	2x1500
Tuticorin PS	PGCIL	765/400	Initially charged at 400kV
Ariyalur	TANTRANSCO	765/400	2X1500 (Owned by TANTRANSCO)- Tender under process
Nagapattaniam PS	PGCIL	765/400	Initially charged at 400 kV
Alamathy	TANTRANSCO	400/200	1X200, 1X200, 3X315
Total			9,300 MVA for PGCIL, 7,435 MVA for TANTRANSCO (3,000 MVA under construction)



Table 20: Inter and intra state lines in Tamil Nadu (PGCIL)

Name of transmission line	Ckt kms	Voltage (kV)	Inter/intra
Kurnool - Thiruvalem 765kV D/c line	710	765	Inter
SubTotal	710		
Almathy - Vallur 400kV D/c line	72	400	Intra
Vallur - Kalivandapattu 400kV D/c line	267	400	Intra
Hosur - Salem 400kV D/c line	250	400	Intra
Tiruvelam – Sriperumbudur 400kV S/c line	85	400	Intra
Madurai – Thirunelveli 400kV D/c line	324	400	Intra
Neyveli TS-I Exp – Nagapattinam 400kV S/c line	57	400	Intra
Nagapattinam – Trichy 400kV D/c line	320	400	Intra
Neyveli TS-II - Neyveli TS-I Exp 400kV S/c line	14	400	Intra
Neyveli TS-II – Nagapattinam PS 400kV S/c line	50	400	Intra
Neyveli – Puducherry 400kV S/c line	68	400	Intra
Puducherry - Sunguvarchatram 400kV S/c line	136	400	
Sunguvarchatram - Madras 400kV S/c line	18	400	Intra
Neyveli – Salem 400kV D/c line	354	400	Intra
Salem – Udumalpet 400kV D/c line	289	400	Intra
Trichy – Madurai 400kV S/c line	130	400	Intra
Trichy – Karaikudi 400kV S/c line	98	400	Intra
Karaikudi – Madurai 400kV S/c line	130	400	Intra
Udumalpet – Madurai 400kV S/c line	127	400	Intra
Pugalur - Madurai 400kV D/c line	248	400	Intra
Neyveli TS II - Pugalur 400kV D/c line	398	400	Intra
Udumalpet - Thirunelveli 400kV D/c line	530	400	Intra
Udumalpet - Arasar 400kV D/c line	130	400	Intra
Thirunelveli – Kudankulam 400kV D/c line	144	400	Intra
Thirunelveli – Kudankulam 400kV D/c line	160	400	Intra
Tuticorin - Coastal Energen 400kV quad S/c line	36	400	Intra
Tuticorin PS - Madurai 400kV quad D/c line	190	400	Intra
Coastal Energen - Tuticorin PS 400kV quad S/c line	36	400	Intra
Tuticorin - Tuticorin PS 400kV quad S/c line	62	400	Intra
Tiruvalem - Kalivandapattu 400kV quad D/c line	228	400	Intra
Nellore – Tiruvellum 400kV quad D/c line	346	400	Inter
Tiruvelam - Chittoor 400kV quad D/c line	42	400	Inter
Nellore – Sriperumbudur 400kV D/c line	378	400	Inter
Chittoor – Sriperumbudur(Chennai) 400kV line	95	400	Inter
Bangalore(Somanhalli) – Hosur 400kV S/c line	80	400	Inter
Kolar – Tiruvelam 400kV S/c line	153	400	Inter
Kolar – Hosur 400kV D/c line	138	400	Inter
Thirunelveli – Thiruvananthpuram 400kV D/c line	320	400	Inter
Udumalpet - Pallakad 400kV D/c line	190	400	Inter
Thirunelveli - Edamon 400kV D/c line (Charged at 220 kV)	164	400	Inter
SubTotal	6,857		
Kalpakkam - Sirucher 220kV D/c line	72	220	Intra
Kalpakkam - Arni 220kV D/c line	212	220	Intra
Kalpakkam – Kanchipuram 220kV D/c line	160	220	Intra
Neyveli – Bahoor 220kV S/c line	53	220	Intra
Neyveli - Villianur / Pody 220kV S/c line	63	220	Intra
Udumalpet –Idukki	133	220	Intra

Name of transmission line	Ckt kms	Voltage (kV)	Inter/intra
Sub-Total	693		
Kuzhithurai-Parasala 110Kv	4.75	110	inter
Grand Total	8,371.75		

- Meeting demand for power arising from existing and future end-consumers in various load centers/ pockets in the state;
- Providing connectivity for evacuation of power from various upcoming intra and inter-state power plants and for onward delivery of such power to load centers/ drawl points;
- Improving the availability and reliability of the intra-state transmission systems in the State; and
- Improving availability of intra-state transmission systems to integrate existing and upcoming renewable energy sources in the state.

The plan covers system for intra-state transmission network strengthening as well as evacuation of power from State owned generating stations. The summarized list of ongoing, approved and proposed capacity additions at various voltage levels is summarized in Table 21.

The substation and line wise details of ongoing, approved and proposed intra-state transmission systems have been provided in the annexures (8-11).

Out of the 136 proposed substations, the ongoing schemes for 50 sub-stations and 2,516 kms of transmission lines were scheduled to be completed by FY17. While about 86 Substations are scheduled to be completed in the period FY18 to FY19. This includes two substations of 765 kV with total

Table 21: Proposed capacity additions in SS and Lines by TANTRANSCO

Parameter	FY 17	FY 18	FY 19	Total
Substations (Numbers)				
765 kV			2	2
400 kV	10	1	2	13
230 kV	16	11	18	45
110 kV	30	30	73	133
Total	56	42	95	193
A. Lines (Ckt kms)				
765 kV			320	320
400 kV			800	800

transformation capacity 7,500 MVA is expected to be available by FY19. Apart from the above, under Renewable Energy category 8 Nos. of substations of 8,640 MVA capacity are expected to be available by FY19. About 7,205 ckt km of lines are expected to be added to the system by FY19. This investment plan is rolling in nature and is subject to change on account of variations in load flows through the transmission network elements that may result from deviations in load growth projection vis-a-vis actual load growth.

TANTRANSCO is focusing on efficient operation and maintenance practices to provide stable and quality power with maximum transmission system availability and minimum transmission system losses.

5.4. Inter-state Transmission System Plan

Ongoing schemes

PGCIL is executing the following inter-state /inter-regional transmission projects with an objective to ease the transmission constraints faced in transfer of power.

- Salem (Dharmapuri) – Madhugiri 765 kV 2xS/C lines (To Be Charged Initially at 400 kV)
- Salem (Dharmapuri) – Somanhalli 400kV Quad D/c line
- LILO of Kurnool – Thiruvalam 765kV D/c line at Cuddapah
- Raigarh – Pugalur ±800kV 6000 MW HVDC Bipole link

Parameter	FY 17	FY 18	FY 19	Total
230 kV	470	500	400	1,370
110 kV	600	630	800	2,030
Total	1,070	1,130	2,320	4,520
For Renewable Energy (Substations- Included in the total numbers above)				
400 kV	6	1	0	7
230 kV	1	0	0	1
Total	7	1	0	8
B. For Renewable Energy (Lines in Circuit Km)				
400 kV	1,315.5	532	0	1,847.5
230 kV	130	710	0	840
110 kV	0	0	0	0
Total	1,445.5	1,242	0	2,687.5
Total A+B	2,515.5	2,372	2,320	7,205
Transformation capacity (MVA)				
765/400 kV	0	0	7,500	7,500
400/230 kV	3,465	945	3,150	7,560
400/110 kV	1,200	0	1,400	2,600
230/110 kV	2,600	1,800	1,200	5,600
230/33 kV	100	800	200	1,100
110/33 kV and 110/33 kV	461	436	420	1,317
Total	7,826	3,981	13,870	25,677
FOR renewable Energy				
Transformation capacity (MVA)				
400/230 kV	2,890	630		3,520
400/110 kV	3,000	400		3,400
230/110 kV	1,720	0		1,720
Total	7,610	1,030		8,640

* Subject to the approval of TNERC for the year 2018-19

Other Projects under implementation

Transmission lines planned/under implementation by PGCIL are as follows:

- Salem pooling station – Madhugiri pooling station 765 kV S/c initially charged at 400 kV
- Tuticorin Pooling station – Salem Pooling station 765 kV D/c line initially charged at 400 kV.
- Salem pooling station – Salem 400 kV D/c (quad) line.
- Salem New – Somanahalli 400kV Quad D/c line.
- Installation of STACOM of +200/-200 MVAR with MSC of 2x125 MVAR Reactor & 1x125 MVAR Capacitor at Udumalpet and Trichy substations of POWERGRID
- Extension of Kudankulam APP – Tirunelveli 400kV Quad D/c line to Tuticorin Pooling Station.
- Establishment of Pugalur HVDC Stn ± 800 kV with 6000 MW HVDC terminal.
- ± 800 kV Raigarh (HVDC Stn) – Pugalur (HVDC Stn) HVDC Bipole link with 6000 MW capacity.
- Pugalur HVDC Station – Pugalur (Existing) 400kV (quad) D/c line.
- Pugalur HVDC Station – Arasur 400kV (quad) D/c line.
- Pugalur HVDC Station – Thiruvalam 400kV (quad) D/c line.
- Pugalur HVDC Station – Edayarpalayam 400kV (quad) D/c line.
- Edayarpalayam – Udumalpet 400kV (quad) D/c line.
- NLC-Karaikal 230kV D/c line (through LILO of the 230kV Neyveli- Bahour S/c line at Karaikal)
- LILO of existing Neyveli TS-II – Pondy cherry 400 kV S/c at NNTPS generation switchyard.
- NNTPS switchyard – Ariyalur (Villupuram) 400 kV D/c line.



- 17) Tirunelveli – Edamon – Cochin 400kV quad D/c line.

In addition to the above the following lines are being constructed under TBCB route:

- 1) Nagapattinam - Salem 765kV D/c line initially charged at 400 kV.
- 2) Salem pooling station – Madhugiri pooling station 765 kV S/c initially charged at 400 kV.

5.5. Renewable Energy integration schemes

The state has made significant achievements in addition of renewable energy sources in to the grid. With such large capacities of renewable power, especially wind energy, there is an ever increasing demand for network connectivity. While most of the connectivity requirements are of intra-state corridors, the inter-state network also needs to be strengthened in view of the demand for inter-state open access for the RE plants in the state.

In view of this the following projects are being under taken to strengthen the inter-state network:

- 400 KV SS at Samugarengapuram with 400kV DC line from Samugarengapuram to Udangudi Pooling station proposed during FY20.
- Three more 230/110 kV Substations with a capacity of 3X100 MVA each are proposed in Muppandal, Poolavady and Kongalnagaram. These are expected to be operational by FY20.

Further, DPR for REMC has been prepared. The tender for REMC in southern region has been floated by PGCIL. Tenders were invited under 2 stage bidding. Stage-1 technical discussion is proposed during the first week of December.

5.6. Adequacy of Transmission Planning:

The intra-state transmission plan prepared by TANTRANSCO is adequate to meet the projected demand by FY19. The total capacity (including existing GSS and Lines) after implementation of all schemes is shown in Table 21

With the total anticipated demand for power reaching 17,651 MW in FY19, the ongoing/ proposed projects for capacity additions and augmentations will be adequate to cater to the increasing load and also improve reliability of the

system by building in redundancies in the system. With the proposed capacity additions it is envisaged that there should not be any bottlenecks in transmitting power from various generating stations up to 110 kV network of TANTRANSCO, provided the identification of sub-station locations has been done in accordance with the detailed district/ area wise load growth assessments prepared by TANTRANSCO.

5.7. Fund Requirement (Intra-state only)

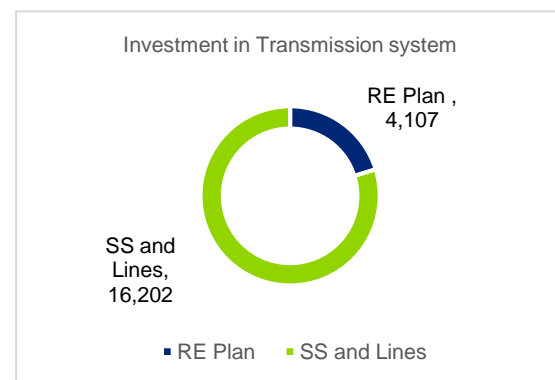
TANTRANSCO has made a layout of Rs. 20,309 Cr. This amount includes investments of Rs 4,107 Cr. on connecting RE projects in the state to the grid. TANTRANSCO has projected investments of Rs. 16,202 Cr. for extending the transmission network in the state to cater to the growing demand in the state. The year wise fund requirement is shown in Table 22 below.

An amount of Rs. 6,104 Cr. is expected as loan from REC, Rs. 5,424 Cr. from PFC, Rs. 3,257 cr. from JICA, Rs. 1,698 Cr. from KfW, Rs. 1,192 Cr. from Other agencies such as TNIPP, NABARD etc. It will be ensured that the balance amount of Rs. 2,633.41 Cr. will be tied with funding agencies before taking up the work.

Table 22: Year-wise fund requirement for Ongoing & Planned Intrastate Transmission System (Rs. Crs.)

Item	FY17	FY18	FY19	Total
RE plan	2,505	1,602	0	4,107
SS and Lines	4,443	2,119	9,640	16,202
Total	6,948	3,721	9,640	20,309

Figure 10: Share of investments





5.8. Action Plan & Support Required

In line with the proposed transmission plan, the action points shown in Table 23 have been identified for respective stakeholders to be able to

make suitable arrangements for making adequate power transmission systems available for the State in accordance with the requirements of the PFA Roadmap:

Table 23: Action Points & Timelines

Stakeholder	Action Points
TANTRANSCO	Project monitoring and execution of the network addition plan. Ensure timely setting up of REMC. (Tenders are expected to be opened during Feb 2017)
Government of India	For schemes which are taken up under international funding viz., JICA and KfW, taxes and duties are not eligible for reimbursement. The taxes and duties for schemes funded by JICA and KfW works out to approx. Rs. 1,000 crores and this may be considered for financial support from Govt.
PGCIL	Ensure completion of the inter-state projects as per the timeline proposed in this roadmap

6. Distribution Plan

6.1. Objectives of the distribution plan

Distribution of electricity in the state is managed by the state distribution utility – TANGEDCO. It is the sole distribution licensee in the state. The company was formed in 2010 when the erstwhile TNEB limited was restructured into corporate entities.

During the period FY16 to FY19 the peak demand (including wheeling demand) and energy requirement (including wheeling sales) is expected to increase from 14,533 MW and 1,00,319 MU in FY16 to 17,651 MW and 1,17,487 MU in FY19. This is due to increase in natural demand from the present consumer base and more importantly because of the initiatives proposed under this PFA Roadmap which aims to maintain 24X7 supply to all consumers in the state. This would require commensurate investments in the sub-transmission and distribution infrastructure.

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

- Maintaining 24X7 supply to all connected consumers through capacity augmentations and building redundancies in the upstream network for improving reliability of supply;
- Maintaining 24X7 supply to cater to increase in demand from existing consumers and increase in demand owing to new consumer growth in the State;
- Provision of investments for improvement in Quality of Supply for all categories of consumers
- Making system improvements for reducing AT&C losses in accordance with the targets agreed with MoP; and
- Adopting appropriate technologies and systems to support RE integration and EE/ DSM measures in the State.

6.2. Existing Distribution System- TANGEDCO

The distribution network of TANGEDCO comprises of 66 kV, 33 kV, 22 kV and 11 KV sub-transmission system. This forms the distribution backbone at the district level and LT distribution systems and delivers electricity to majority of the end consumers. An overview of department's network infrastructure in terms of installed transformation capacity and line lengths of feeders at various voltage levels is provided in Table 24 below.

Table 24: Existing Distribution Network of TANGEDCO

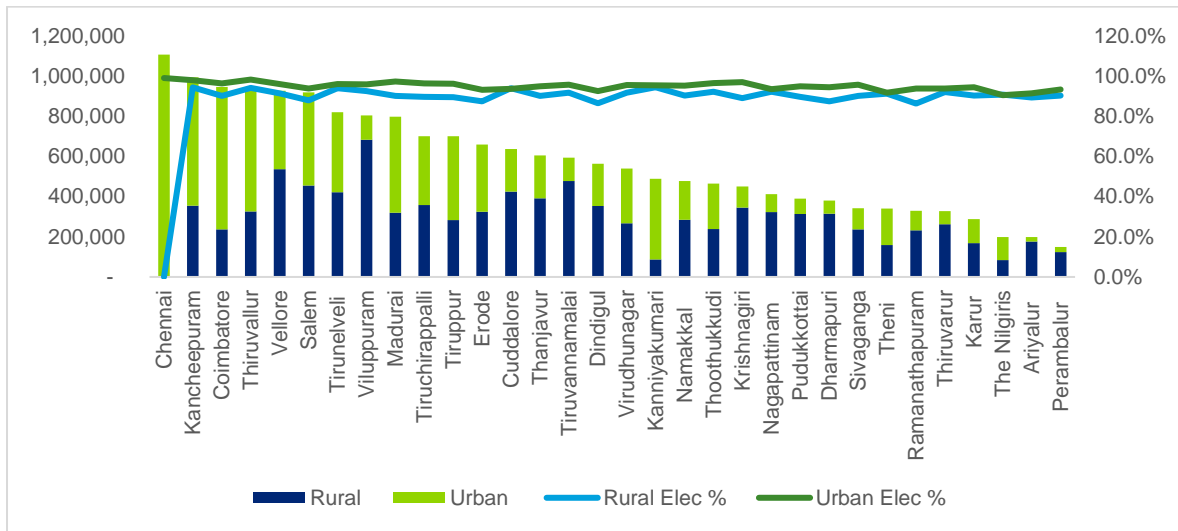
Particulars	Unit	Capacity (as on 31.03.16)
33/11 kV	Nos	593
33/11 kV	MVA	8,806
Distribution Transformers	Nos	264,029
Lines		
HT Lines (33,22,11 kV)	Ckt. Kms	169,409
LT Feeders	Ckt. Kms	609,544

Tamil Nadu has made significant improvement in village level electrification as the state was one of the primary states in India to achieve 100% village electrification level. This is further fortified by the fact that the HH electrification in 2011 was 93.4%

DTR Failure rates

TANGEDCO's Distribution failure rate for FY15 was 4.27%. A part of the investments in network are planned to bring down the DTR failure in the state.

Figure 11: District wise Rural & Urban HH Electrification Levels – Tamil Nadu (2011 Census)



Metering

TANGEDCO has 31.97 Lakhs unmetered consumers as on March 2016. This corresponds to 12% of the total consumers of 2.70 Crores. All of the 31.97 lakhs consumers belong to only two categories

- Agriculture and Govt. seed farm etc.
- Huts in Village panchayats, TAHDCO etc.

TANGEDCO is preparing a metering plan at DTs associated with unmetered consumers to estimate the sales to these consumers.

TANGEDCO is aiming for introduction of modern metering technology for all its consumers. A quantum of consumers have been included under DDUGJY and IPDS for replacement of meters. TANGEDCO seeks Gol support for meeting the financial requirements for upgrading/replacing meters for the remaining consumers.

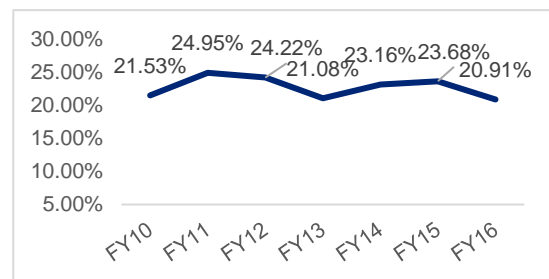
SAIFI SAIDI

TANGEDCO is monitoring SAIFI and SAIDI values of the R APDRP towns in the state. As per the latest (Aug 2016) report covering 63 towns and 273 feeders, SAIDI is 2:20 hrs/month (Rank 1 in India as per URJA app) and SAIFI is 3.47. It may be noted that the systems of monitoring are still being updated and the values may not represent the actual status in the towns. Town wise SAIFI and SAIDI values are provided in Annexure 19.

AT&C Loss

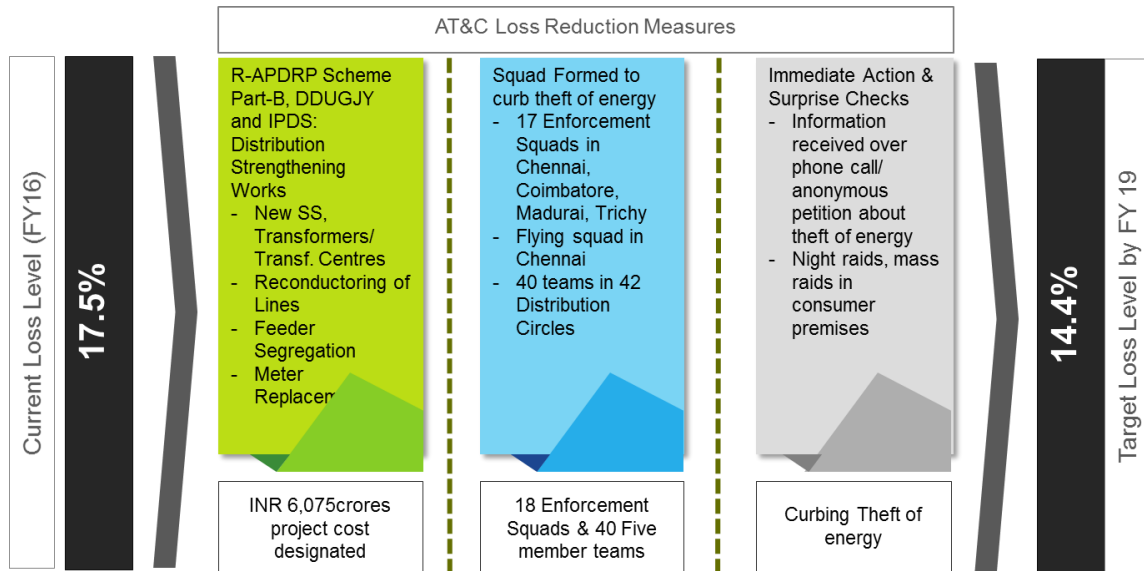
AT&C loss including ~4% Transmission Loss for the state during FY10 to FY16 suggests that losses had increased in FY11 to 24.95% from 21.53% in FY10, however due to AT&C loss reduction measures taken up by the utility the present AT&C loss in FY16 is 20.91%. (Losses are aggregate of distribution and transmission system in the state)

Figure 12: AT&C Loss trend for FY10 to FY16



TANGEDCO further is taking full efforts to reduce the AT&C Loss to a target level of below 15% by FY19 through distribution strengthening works under the R-APDRP Scheme (Part B) and by ensuring formation of enforcement squads to curb theft of energy. Action is also being planned to be undertaken on any information received about theft of energy followed by conducting surprise checks, raids, etc. on consumer premises.

The activities to be undertaken are detailed in the following figure.



6.3. Central and State Government Schemes

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

RGVY

RGVY XI plan: TANGEDCO has completed field works in 26 districts of Tamil Nadu and financial closure of the total approved amount has been achieved.

REC has accorded sanction for the implementation of the RGGVY scheme in balance 3 districts viz., Nilgiris, Tirunelveli and Dharmapuri districts on 23.12.2011 at a total cost of Rs.37.27 Cr. under XI plan phase-II. Works under the phase II of XI Plan are being carried out and 31% (Rs. 11.47 Cr) of the approved DPR cost (Rs. 37.27 Cr) have been disbursed.

Based on the increase in award cost from the sanctioned cost, approval accorded by REC on 10.10.2013 for an amount of Rs.41.46 crores. About 640 Nos. of 16 and 25 KVA Distribution Transformers and about 2,654 Kms of HT/LT

distribution lines are sanctioned by REC for effecting service connections to 24,369 BPL households in these 3 districts and above works are under progress.

Remote Village Electrification

Currently 115 Nos. un-electrified remote habitations with a total of 5,787 households have been identified for electrification through RE sources. Due to the remote location of these habitations, conventional mode of electrification through TANGEDCO grid is not feasible

These habitations are being included in the Remote village electrification program of the State Government Scheme. These households are proposed to be electrified through standalone Rooftop Solar PV systems. Contracts have been awarded and works are in progress.

R-APDRP- Part A and SCADA

The total approved amount for RAPDRP Part A is Rs.417 Crores. The proposed investments are in the field of Information Technology implementation. Part A schemes covers 110 towns (with 30,000 population as per 2001 census) and Rs.182.17 Crores for SCADA / DMS implementation in 7 towns (having a population of 4 Lakhs consumers and annual consumption of 350 MUs) have been sanctioned and the works are expected to be completed by March 2017 and December 2016 respectively.



Under R APDRP Part A, AMR compatible meters have been installed in 50,163 Distribution Transformers, 2,193 Feeders and 2,990 HT consumers.

GIS Survey has been completed for Consumer Indexing of 85.89 Lakhs consumers and Assets Mapping.

SCADA/DMS, Control Centre equipment have been commissioned in all the 7 towns viz. Chennai, Madurai, Salem, Tiruppur, Tirunelveli, Trichy & Coimbatore. Installation & commissioning of SCADA field equipment and DMS is likely to be completed by December 2017.

As per the data from R-APDRP website, about Rs.562 Cr . have been disbursed; TANGEDCO has sent utilization certificate for an amount of Rs.218.61 Crores for Part-A (IT) and awaiting for second tranche of Rs. 125/-crores.

RAPDRP-Part B

RAPDRP Part-B schemes have been sanctioned in 88 towns, which have population above 30,000 as per Census 2001 and having AT&C losses of more than 15%. The total value of proposed investments are Rs. 2,841.21 Crores. The proposed investments includes the following works are a measure to bring down losses and improve reliability of the network:

- (i) Establishment of new substations and Augmentation of existing substations,
- (ii) Extension of new HT/LT distribution feeders / feeder bifurcation / conductor augmentation works for improving voltage profile,
- (iii) HVDS implementation to improve HT:LT ratio,
- (iv) Replacement of existing Electromechanical consumer energy meters with tamper proof Static meters to reduce losses,
- (v) Provision of Automatic Power Factor Correction panels to improve power factor in distribution,
- (vi) Extension of Aerially Bunched Cables in theft prone area and densely populated area and
- (vii) Provision of wedge connectors in distribution network to reduce contact resistance.

Further projects worth Rs. 754.13 Crores (under R-APDRP) proposed to be implemented by TANGEDCO in 15 towns have been cancelled as the towns were having AT&C losses of less than 15%.

Integrated Power Development Scheme (IPDS) TANGEDCO

Under Integrated Power Development Scheme (IPDS) 37 Nos. Detailed Project Reports (DPRs) for strengthening of sub transmission and distribution system works including metering and rooftop solar panels, covering 522 towns across 37 Nos. EDCs for a total value Rs.1,561.31 crores has been sanctioned by MoP/Gol and formal sanction has been obtained on 07.03.2016. The works are to be completed by 06.09.2018. For successful completion of the scheme works within 60% of project cost i.e Rs.936.8Cr. will be provided by MoP/Gol as grant.

Table 25: Proposed investments -IPDS

Proposed Works	Planned Amount (Rs. Cr.)
33/11 kV SS (New and capacity Enhancement)	158
HT Feeders and Bay (New and Bifurcation)	484
LT Feeders and Bay (New and Bifurcation)	194
Distribution Transformers	12
HVDS	328
Others	385
Total	1,561

Deen Dayal Upadhyaya Gram Jyoti Yojana-TANGEDCO

Under the DDUGJY scheme, TANGEDCO has proposed various network extension, strengthening and augmentation works in order to develop a robust sub-transmission and distribution infrastructure, including provision for providing access to APL & BPL consumers. The project covers 27 districts of Tamil Nadu having a total layout of Rs. 919.52 Cr. The abstract of the proposed plan is provided in the Annexure 16.

The main objectives of the investments under the DDUGJY scheme is to strengthen the existing network in rural areas and improve reliability of system while improving the quality of supply

Further as a part of feeder segregation plan under DDUGJY, TANGEDCO proposes to take a pilot



study of around 29 feeders in the Villupuram, Kallakuruchi, Tiruvannamalai and Cuddalore areas, where agriculture loads are predominant. The total cost works out to Rs.125.94 Crores.

The total proposed network addition for TANGEDCO is shown in Table 26.

6.4. Funding Plan- TANGEDCO

The following Table 27 shows the funding requirement for the distribution plans described above.

The total fund requirement for the distribution system works in the state is about Rs. 9,348 Cr, 15% of which is expected to be funded through the Central Government Schemes (R-APDRP, RGGVY, DDUGJY and IPDS). The remaining funds are expected in the form of loans through REC/PFC and State Government grants.

The Monitoring Committee/MoP for DDUGJY schemes has approved the DDUGJY proposals on 05.01.2016 and in principle approval has already been obtained for IPDS.

Table 26: Infrastructure addition program under various schemes for TANGEDCO

Particulars	FY 17	FY 18	FY 19	Total
Enhancement/Addition of 110 kV S/s	61	48	24	133
Enhancement/Addition of 33 kV S/s	100	81	77	258
Enhancement/Addition of 110 kV S/s Power Transformer	30	28	23	81
Enhancement/Addition of 33 kV S/s Power Transformer	21	19	19	59
Additions of DTR	18,059	18,872	19,721	56,652
HT Lines (ckm)	3,654	3,764	3,877	11,295
LT Lines (ckm)	11,399	11,684	11,976	35,059

Table 27: Fund Requirement in Rs. Cr. under various schemes

Scheme	FY17	FY18	FY19	Total
Planned 33 KVSS	666	583	620	1,869
Planned Enhancement of 33 KV SS	25	25	28	78
Planned Enhancement of 110 KV SS	73	75	67	215
Distribution Transformers (in Cr.)	1,292	1,485	1,707	4,484
HT Lines (in Cr.)	204	231	262	697
LT Lines (in Cr.)	590	665	750	2,005
Total	2,850	3,064	3,434	9,348

6.5. Other initiatives

IT Initiatives

The IT initiatives proposed by TANGEDCO are mostly covered under the R-APDRP Part A schemes. TANGEDCO has proposed construction of a Data Centre (DC) at Chennai and Disaster Recovery Centre (DRC) at Madurai. Data Centre (DC) has been commissioned at Chennai. DRC Works are under progress in Madurai. Around 100 towns have been made “Go-Live” and are connected to DC over MPLS-VPN.

Further various upgradation works for expanding the VPN/LAN/WAN facility are being planned. Software modules for billing, meter data acquisition, and various other commercial processes are being proposed. A brief snapshot of the IT initiatives are shown in Figure 13

Technology up gradation and modernization schemes

TANGEDCO proposed various works for upgradation of ULDC and communication network amounting to Rs. 87.87 Cr these works will be carried out in the period FY16 to FY19. Works related to establishment of fibre optic network worth Rs 30 Cr already been completed. The following table shows the total layout of the proposed works.

Table 28: Investments for upgradation of ULDC

Description	Value
ULDC Revamping under progress	19.07
Automatic meter reading infrastructure MODEM & data concentrators	13.05
Establishing of fibre network	55.75
Total	87.87

6.6. Rollout Plan

Table 29 shows the infrastructure roll-out plan for TANGEDCO.

Figure 13: Proposed works under IT capacity addition plan for TANGEDCO

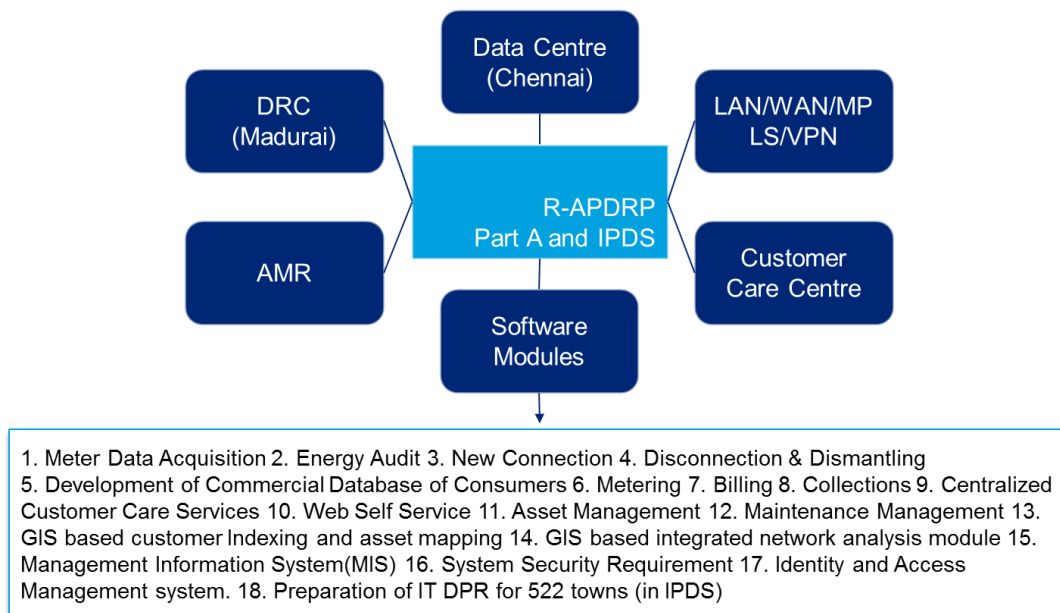


Table 29: Distribution Infrastructure rollout plan for TANGEDCO

Item (units)	Capacity at the end of FY16	Additions				Total
		FY17	FY18	FY19		
DTS (Nos)	2,64,029	18,059	18,872	19,721	3,20,681	
HT Line (ckt kms)	1,69,409	3,654	3,764	3,877	1,80,704	

Item (units)	Capacity at the end of FY16	Additions			Total
		FY17	FY18	FY19	
LT Line (ckt kms)	6,09,544	11,399	11,684	11,976	6,44,603
Substations					
Enhancement/Addition of 110 kV Substation (Nos)		61	48	24	133
Enhancement/Addition of 33 kV Substation (Nos)		100	81	77	258
Power Transformers					
Enhancement/Addition of 110 kV Substation (Nos)		30	28	23	81
Enhancement/Addition of 33 kV Substation (Nos)		21	19	19	59

Table 30: Action Points for Distribution Plans

Stakeholder	Action Points
TANGEDCO	Prepare a plan for replacement of existing meters with advanced meters. Plan for metering of Distribution transformers associated with unmetered consumers
MoP	Funding arrangement for metering plan of TANGEDCO

7. Renewable Energy Plan

7.1. Introduction

The state of Tamil Nadu is blessed with various forms of renewable energy sources viz., Wind, Solar Biomass, Biogas, Small Hydro etc. The state has emerged as a major hub for development of renewable energy in the last few years and presently approx. 40% of the total installed capacity in the state is from RE sources.

The Govt. of Tamil Nadu set up the Tamil Nadu Energy Development Agency (TEDA) in 1985 to promote the use of new and renewable energy sources and promote energy conservation activities in the state. The credit for such large capacity additions is attributable to the enabling policy framework promulgated by the state govt. and effective implementation of projects.

The Hon'ble TNERC notified the RPO obligations for the state in 2010 providing the framework for the obligated entities to meet their renewable requirements through RE sources and/or RE certificates. On similar lines, the state govt. issued the Solar Energy Policy -2012 outlaying its vision of solar development in state and the targets over the coming years in addition to providing incentives and promotions to solar technologies and R&D in solar industry. The Renewable Purchase Obligations (RPO) and Solar Purchase Obligations (SPO) for the distribution licensee for the last five (5) years are shown in Table 31 below:

Table 31: RPO Targets for Tamil Nadu

Year	RPO	SPO
FY 12	9.00%	0.05%
FY 13	9.00%	0.05%
FY 14	9.00%	0.05%
FY 15	9.50%	0.5%
FY 16	11.50%	2.50%
FY 17	14.00%	5.00%

Note: RPO targets are inclusive of SPO

The state has an estimated potential of 15,000 MW in Solar and 14,000 MW in wind (as per NIWE-CWET). The renewable energy addition proposed over the next five years is shown in Table 32. It is envisaged that the proposed investments on solar and wind shall be from the private sector only.

Based on the Tamil Nadu Solar Energy Policy 2012, Solar Net Metering concept has been implemented in the state of Tamil Nadu. TANGEDCO is encouraging establishment of HT/LT grid – interactive roof top solar power plants for captive use. Solar pumps for Agriculture connections are also being implemented by TEDA and agricultural department. Further, under preferential tariff route for solar power, so far, TANGEDCO has executed power purchase agreements (PPA) with 86 developers for a combined capacity of 1,484 MW for the year 2015-16. Out of 1,484 MW, 948 MW have been commissioned under this scheme as on 01.09.2016. Under Rooftop scheme a combined capacity of 54.97 MW have been commissioned. Under REC scheme, 66 solar plants having a total capacity of 120.152 MW have been commissioned.

Table 32: Planned Capacity Addition in Renewables (2014-19)

Source	Capacity (MW)
Wind Power	2,000
Solar	3,000
Biomass/Biogas	100
Co-generation	165
Total	5,265

The details on state transmission infrastructure required to be augmented for absorption of renewable energy were already discussed in Section 4 of this report.

7.2. Existing sources

Presently the state has total RE based installed capacity of 9,687 MW which includes 1,155 MW of solar energy (including 54.97 MW of solar rooftop)



based projects and 7,642 MW of wind based capacity. The details of total RE based installed capacity (as on 01 Sep 2016) are provided in Table 33 below.

Table 33: RE Installed Capacity

Plant Name	Capacity (MW)
Solar	1,155.38
Wind	7,642
Bagasse based co-generation plant	659.40
Biomass	230.00
Total	9,686.78

The state has some ambitious schemes for promotion of RE based energy sources viz. CM's

Solar Powered Green House Scheme, CM's Solar Rooftop Capital Incentive Scheme, Wind Solar Hybrid System and small hydro/micro hydel projects. Under the state's REC scheme, 66 Solar Plants having total capacity of 120.152 MW have been commissioned so far. Under the state preferential tariff scheme, solar PV projects are allowed to be set up at a tariff of Rs. 7.01 (without AD) and Rs. 6.28/kWh (with AD) during the control period. Similarly solar thermal projects shall attract a tariff of Rs. 11.03/kWh (without AD) and Rs.9.88/kWh (with AD). Details of the existing Solar and wind capacity in the state is provided in Table 34 and Table 35 below respectively. It is observed that the entire solar capacity in the various districts is privately owned.

Table 34: Existing Solar Capacity

Sl.	Name of District	Installed Capacity (MW)	Private/ State Owned
1	Sivagangai	11.55	Private
2	Nagapattinam	1.0	Private
3	Madurai	1.0	Private
4	Thoothukudi	28.0	Private
5	Coimbatore	7.0	Private
6	Tirupur	37.26	Private
7	Erode	1.0	Private
8	Virudhunagar	199.4	Private
9	Dindigul	59.6	Private
10	Tirunelveli	9.36	Private
11	Gobi	3.0	Private
12	Trichy	166.0	Private
13	Vellore	5.0	Private
14	Karur	151.49	Private
15	Krishnagiri	0.75	Private
16	Ramnad	348.0	Private
17	Perambalur	10.0	Private
18	Cuddalore	10.0	Private
19	Tiruvannamalai	30.0	Private
20	Pudukottai	20.0	Private
21	Kanyakumari	1.0	Private
	Total	1100.412	

In addition to the above of there is 55 MW of Roof Top Solar PV.

Table 35: Existing Wind Capacity

Sl.	Name of the Project	Capacity MW
1	Tirunelveli District	3,700
2	Tuticorin District	245.970
3	Kanyakumari District	118.815
4	Ramnad District	2.150
5	Coimbatore District	355.250
6	Tirupur District	2,264.980
7	Dindigul District	420
8	Theni District	534.700
9	Chennai	0.225
Total		7,642.09

7.3. Capacity Additions – RE Plan

Table 36 below depicts the capacity addition plans in the renewable energy categories for the years FY17 to FY19. As per the projected figures, 5,265 MW is expected to be added through RE Sources.

7.4. Funding requirement

It is observed that most of the RE capacity additions shall be done by private entities. Based on the information available from the state, the proposed investments on solar and wind sectors shall be from private sector only. Fund requirement details for development of intrastate transmission infrastructure for evacuation of upcoming

renewable energy sources is discussed in Section 3 of this report.

7.5. RE plan-Issues

The state is not facing major issues related to renewable energy projects. This is seen from the recent developments in installed capacity of RE projects. Most of the projects are being funded through private participation so there is limited financial involvement from state owned agencies. It may also be noted that the regulatory provisions for promotion of Renewable projects are in place and no major policy related intervention is identified.

Table 36: Renewable Power Addition

Year	Wind (MW)	Solar PV/Solar Thermal (MW)	Bio Mass (MW)	Bagasse based Co.Gen (MW)	Total (MW)
FY 17	500	1,000	-	165	1,665
FY18	750	1,000	50	-	1,800
FY 19	750	1,000	50	-	1,800
Total	2,000	3,000	100	165	5,265

Table 37: RE Action Plan

Stakeholder	Action Points
TANGEDCO/TEDA	Promotion of Solar PV under net metering scheme
TANTRANSCO/SLDC	Operationalization of REMC



8. Energy Efficiency Plan

8.1. Energy Efficiency Plan

As per the provisions of the Energy Conservation Act 2001, the State Designated Agency (SDA) i.e the Tamil Nadu Electrical Inspectorate (TNEI) has been nominated by the Bureau of Energy Efficiency (BEE) in consultation with the state govt. to carry out schemes on energy conservation and other allied activities in the state of Tamil Nadu. The role of SDA is to create general awareness among masses on benefits of energy conservation measures and to institutionalize the energy efficiency project implementation in domestic, commercial and industrial segments.

TANGEDCO, being the state's utility, is engaged in various energy conservation activities and awareness programs for ensuring energy efficiency in all segments.

The Energy Department vide orders in 2008 and 2010 have mandated implementation of energy conservation measures in all govt. buildings and offices including local bodies and public sector undertakings and have banned the usage of incandescent bulbs. Further during 2012, the Government has ordered usage of LED lamps in locations such as path ways, entrances, corridors, rest rooms etc. and Electrical equipment and appliances with minimum 3 star rating label to be procured and installed in the Government offices and buildings.

Energy Conservation day is celebrated on December 14th of every year and Energy Conservation week from December 14th to December 20th in order to create awareness to the public on the importance of Energy Conservation.

The following schemes were taken up by TANGEDCO as a part of its initiative for energy efficiency measures.

- Distribution of about 8.75 lakh nos. CFLs to hut services in exchange of Incandescent bulbs (ICBs) across the state.

- Distribution of 149 nos. of Energy Efficient Pump Sets (EEPS rated 4 star & above) to willing agricultural consumers in replacement of existing inefficient old pump sets.
- Have mandated the use of EEPS (4 star & above) for new agricultural service connection.

8.2. Energy Efficiency Action plan

TANGEDCO has been selected under BEE's Capacity building of DISCOMs program to establish the energy saving potential in various sectors by conducting load research across the state. The selection of consultant for conducting the load research has been completed. The Load Survey in all consumer categories including domestic, commercial, industrial, educational institutions etc have been completed. The draft report of this load survey is under preparation by the appointed consultant.

Based on the report on load survey, a DSM action plan will be formulated for maximizing the use of energy efficient appliances under various sector wise schemes. TANGEDCO will take up the schemes for implementation, one by one, subject to financial viability.

Distribution of 1 crore LEDs comprising of 2 LEDs per household at a subsidized rate of Rs.10/- per LED to all metered domestic services (consuming less than 500 units bimonthly) in five cities viz. Chennai, Coimbatore Madurai, Trichy and Tirunelveli is under consideration. Based on the outcome, this scheme will be extended to other parts of the state.

Under EESL's UJALA program, institutional distribution of LED lights have been done by EESL. In this program 61,018 LEDs have been distributed to Railways in Tamil Nadu. LED distribution for all the HHs in the state would be carried out after finalization of the load research and approval of The State Government.

The state government has undertaken a scheme to replace all the street lights under municipal



corporation and municipalities in the state with LED street lights. This will reduce the street light demand by 35%. The total cost of this project is about Rs. 300 Cr.

Based on the schemes to be taken up for implementation, fund requirement can be established.

Action plan for roll out of Energy Efficiency measures are provided in Table 38

8.3. Fund Requirement and action plan

On receipt of the draft report from the consultant, suitable schemes can be formulated under the DSM action plan.

Table 38: Action plan for Energy Efficiency Measures

Stakeholder	Action Points
TANGEDCO	Prepare DSM action plan based on the Load Survey Prepare funding options for implementing the DSM projects/schemes

9. Financial Position of Utility (TANGEDCO)

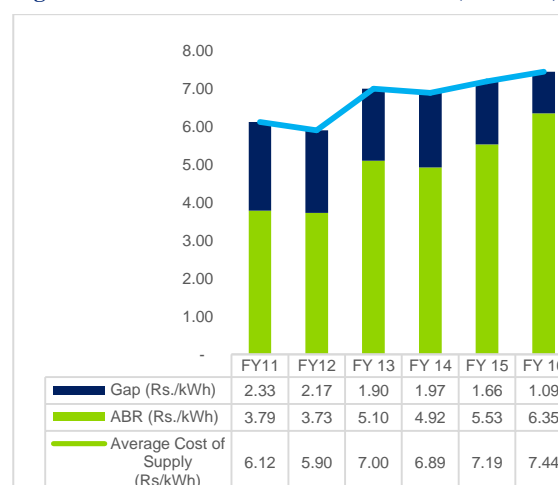
9.1. Introduction

The restructuring of erstwhile Tamil Nadu Electricity Board (TNEB) was completed in year 2010 with establishment of a holding company, TNEB Ltd and two subsidiary companies, namely Tamil Nadu Transmission Corporation Ltd (TANTRANSCO) and Tamil Nadu Generation and Distribution Corporation Ltd (TANGEDCO). Unlike other States, the restructuring plan provided a restated balance sheet for both TANTRANSCO and TANGEDCO. The accumulated losses of erstwhile TNEB to an extent of Rs.34,741.35 Crs has now been adjusted in the final transfer scheme notified vide GO MS No.49/13.08.15 by revaluation of assets to an extent of Rs.54,658.71 Crs. and the excess revaluation reserve of Rs.12,265.99 crs., Rs.7,163.58 crs., and Rs.487.79 Crs. transferred to TANGEDCO, TANTRANSCO and TNEB Ltd., respectively.

Owing to a long haul of non-revision in tariffs, subsequent increases in tariff, even though significant, weren't adequate enough to revive the dwindling finances of the utility and TANGEDCO continued to post significant losses. As an impact of above, the ratings of TANGEDCO have taken a severe hit and the utility has been rated as "B" by ICRA, indicating "Below Average Operational and Financial Performance Capability". This is based from the past performance of the utility, wherein it has reported net losses of Rs 13,985 Cr. These ratings derive their support from the high financial risk profile arising from cash losses, poor capital structure and debt protection measures. Dependence on tariff subsidy from state government has increased substantially. However, the tariff hike announced by TNERC in December, 2014 and implementation of Financial Restructuring Plan (FRP) have been the

key areas of support for TANGEDCO to start addressing the pain areas.

Figure 14: ABR Vs. ACS for TANGEDCO (Rs./kWh)



9.2. Commercial & Financial Viability

The operational and financial performance of distribution utilities often determine the health of power sector in a State. One of the key indicators of commercial health and resultant financial position of a distribution utility is the gap between average cost of supply (ACS) and average billing rate (ABR).

In case of TANGEDCO, gap between ACS and ABR has decreased to Rs.1.09/kWh in FY16 from Rs. 2.33/kWh in FY11. This reduction of gap has been possible only with the tariff increase over the last 3-4 years. There is substantial dependence of state utility on the State Government, which is bound to increase, if timely corrective measures are not adopted. The government support in form of revenue subsidy has increased over three folds to Rs. 6,695 Cr. in FY16.

Figure 15: Accumulated Losses in Rs. Cr.

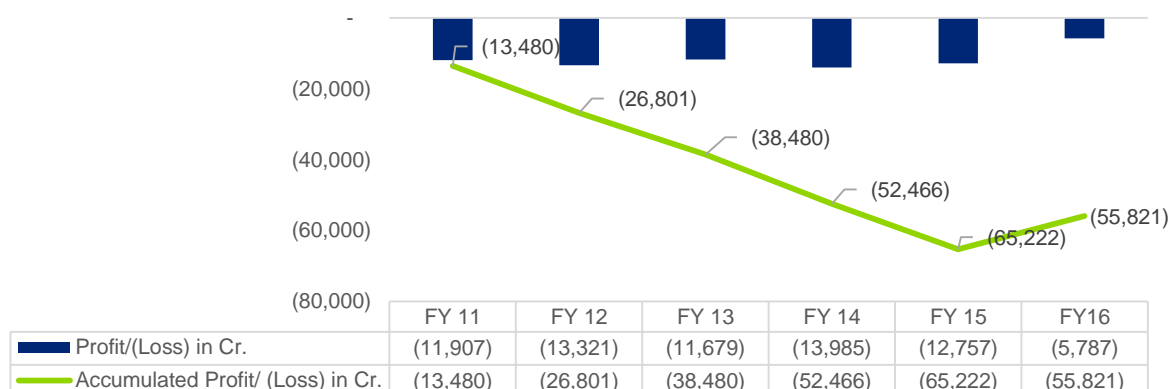
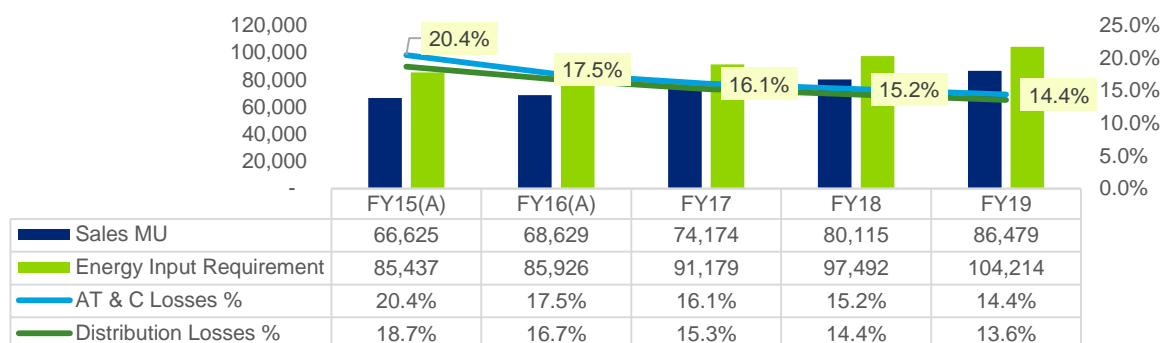


Figure 16: Projected AT&C Loss trajectory (%) and energy input (MU) - TANGEDCO



Some of the key factors contributing to the commercial and financial situation of TANGEDCO are a weary consumer mix and looming AT&C losses. The consumer mix of TANGEDCO is skewed towards agricultural and domestic consumers which are highly subsidized. Together these two consumer categories account for over 46% of its annual sales. The share of subsidizing consumers, especially industries is lower than 10% of annual sales, thus leaving a wide gap between the ACS and ABR of the utility.

AT&C losses is another crucial parameter affecting a utility's financial performance. In case of TANGEDCO, the high levels of distribution losses has led to increase in gap between ACS and ABR. During the last 4 years the AT&C losses have been in the range of 24% to 25%(including Transmission losses), which have reduced to 20.91% in FY16. Going forward, the utility has planned to achieve target of reducing AT&C losses to 14.4%(excluding transmission losses) by FY19, from the existing level. Figure 16 presents the existing and projected AT&C losses and corresponding energy requirements of

TANGEDCO. It may be observed that the AT&C losses in FY16 had reduced considerably to nearly 17%(excluding transmission losses).

TANGEDCO has undertaken distribution strengthening works under the Government of India Scheme of R-APDRP Part B with a total project cost of Rs. 3445.10 crores. Part-B Schemes cover New SS, Transformers /Transformer Centers, Re-Conducting of lines at 11/22 kV level and below, Load Bifurcation, Feeder Bifurcation, HVDS, RMUs, APFC Panels, Sectionalisers, installation of capacitor banks and consumer meter replacement etc., in order to reduce the AT&C losses to the target level of 15% in the eligible project towns (with AT&C losses of above 15%).

TANGEDCO is taking full efforts to curb theft of energy and the following squads have been formed for detection of theft:

- Seventeen Enforcement squads, headed by Executive Engineer in 4 divisions in Chennai,



Coimbatore, Madurai and Trichy are functioning throughout the State.

- b) A flying squad is functioning in Chennai under the control of Enforcement Wing.
- c) Forty (40) teams comprising Ex-Serviceman (5 members per team) are also functioning along with the existing 18 Enforcement squads in all the 42 distribution circles.
- d) Immediate action is being taken on information received over phone call (or) anonymous petitions about theft of energy.
- e) Further surprise check, night raids and mass raids are also conducted in the consumer premises to curb theft of energy.

With widening of gap between ACS and ABR, increased AT&C losses and non-revision of tariffs, the financial position of TANGEDCO has worsened over the years. The reported financial losses of TANGEDCO have been growing consistently during the last few years from Rs. 5,634 Cr. in FY11 to Rs. 12,757 Cr. in FY15. TANGEDCO commenced its operation without any accumulated losses, as the entire accumulated losses had been wiped out through the re-valuation results created in the process of final transfer scheme. However, in FY15, the accumulated losses have multiplied from Rs 18,955 Cr in FY12 to Rs. 55,821 Cr in FY16. The YoY profits recorded and rising accumulated losses of TANGEDCO are presented in Figure 15.

In addition, during the past few years, TANGEDCO has committed significant capital expenditure for its network expansion. In the past five (5) years, a total of Rs. 9,425 Cr. has been undertaken as capital expenditure investments. In order to fund its investment requirements and to a large extent the losses as well, the utility has resorted to significant market borrowings. The long term debt of TANGEDCO has increased from Rs.19,412 Cr. in FY11 to Rs.67,194 Cr. in FY15. On account of higher reliance on long term as well as short term funds to meet capital and revenue account deficits, there has been a sharp rise in interest burden, resulting in weakening of debt service indicators.

Considering the precarious financial position, with surmounting losses, heavy dependence on debt to fund the operations and significant burden on the state government for subsidy, the utility has already

gone for a Financial Restructuring Plan (FRP) in 2012. The details of FRP are discussed below.

9.3. Financial Restructuring Plan

Owing to degrading financial health of the state distribution companies, the Government of India constituted an expert committee to suggest a strategy for financial Restructuring Plan (FRP) of utilities. The guidelines were framed stipulating takeover of 50% of short term liabilities (STL) as of March 31st 2012 by the State Governments and balance 50% of short term liabilities to be rescheduled by lenders and serviced by the DISCOMS.

In line with above, TANGEDCO prepared a FRP with an objective to improve its financial sustainability, which was finalized and approved by the state government in December 2012. The key aspects of FRP were as below.

- As per the FRP, the GoTN has issued special securities of Rs.1,000 crores during 2014-15 and Rs.1,000 crores during 2015-16 and also redeemed to the Banks.
- The remaining FRP to the extent of Rs.4,353.49 crs. is expected to be taken over before the end of FY2017-18. During the current financial year 2016-17, the GoTN has provided a sum of Rs.2,000 crs. for this purpose.
- As per FRP, 25% of the loss taken over by GoTN has to be contributed as Grant from GOI and the same was not so far released from GOI. Similarly the cash loss funding from certain banks was not yet sanctioned and released to TANGEDCO to the extent of Rs.160.37 crs. Since the banks are committed to fund the projected loss for the years 2012-13' 2013-14 and 2014-15 under FRP, the delay by the banks is not agreeable. Further the banks are not extending any loan to TANGEDCO from 2015-16 onwards, due to the restructuring process implemented under FRP.
- Under FRP, the commercial banks will not extend any further short term loan to TANGEDCO to meet operational commitments caused by gap in ABR and ACS from FY16 onwards. Though there is a provision to fund the losses beyond projections by the state Government. However, the Government of Tamil Nadu could not accommodate the loan assistance in view of the Fiscal Responsibility and Budget Management (FRBM) restrictions.
- TANGEDCO has submitted a proposal seeking the following relaxations and modifications in

FRP for the long term financial improvement of the Power Sector in the state

- Funding differential loss for the year 2013-14 and 2014-15.
- Extension of funding period from 2015-16 to 2018-19
- All the new loans may be sanctioned with a tenure of 15 years with an initial moratorium of 5 years.
- However the Reserve Bank of India in its recent letter dated 14.8.2015 has expressed concern on TANGEDCO's huge outstanding loans of Rs.17,818 crores with banks as on 31.3.2015 and urged the GoTN to take over the loans of TANGEDCO by relaxing FRBM restrictions as a special measure.

Thus, going forward TANGEDCO not only faces a challenge of managing its high level of debt burden

but also achieving high levels of efficiency to minimize disallowances and adequately meet its ACS. It is imperative that these factors may be considered carefully for the financial projections of TANGEDCO which are discussed in the following sub-section.

9.4. Financial Projections

In order to estimate the impact of PFA program on the financials of a utility, it is pertinent to assess the incidental cost of the program vis-à-vis the potential of generating additional revenue due increase in energy sales. As the utility progresses on achieving reduction in AT&C losses, the gap between average cost of supply and average realization is expected to shrink. In line with above, an analysis has been carried out to assess the cost impact of PFA program on tariff as well as financials of the utility. Table 40 presents the assumptions which form the basis for such projections.

Table 39: FRP Particulars

Particulars	Amount	Share	Eligible	Released	Share	Eligible & Released
Cash loss for 2012-13	8,183	100%	8,183.0	8,183.00	0%	-
Operating loss for 2013-14	3,849	75%	2,887.0	2,887.00	25%	962.0
Operating loss for 2014-15.	2,060	50%	1,030.0	1,030.00	50%	1,000.0

Table 40: Key Common Assumptions underlying financial analysis

Particulars	Assumptions
Power purchase	<ul style="list-style-type: none"> • The firm allocation from the Central Generating Stations shall remain stable at current levels (July 2016) over the period of projection (FY16 to FY19) • Commissioning of new plants in State sector assumed as per State's projections • Commissioning of new plants of central sector as per CEA's monitoring reports • Transmission charges for FY16 considered at 0.17 Rs/kWh and escalated at 5% from FY17 to FY19. • Inter-state Transmission charges are included in the overall power purchase rate. • Power procurement volume is as per projections in generation chapter
Power Purchase Rate	<ul style="list-style-type: none"> • The present stations have been projected at current Power purchase rate as per the Annual Accounts • New power stations are projected at Rs. 4.50/kWh • Solar power is projected at Rs. 6.5 /kWh • Allocation from un-allocated capacity of CGS has not been considered
Surplus power sale	<ul style="list-style-type: none"> • Power available beyond the requirement has been considered to be sold outside State at 3.0 Rs./kWh
Wheeling Energy	<ul style="list-style-type: none"> • Total Wheeling energy 10,835 MU for FY16, projected to be 24.3% of the other than domestic sales. • Wheeling Charge at FY16 rate (0.16 Rs./kWh) for the period FY16 to FY19
Revenue and Sales growth	<ul style="list-style-type: none"> • Revenue calculations based on average billing rate based on annual accounts for FY16, for domestic and other than domestic consumers



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Particulars	Assumptions															
	<ul style="list-style-type: none"> Sales growth of domestic consumer is as per projections in Power Supply Scenario (Chapter 3) Energy sales growth of other than domestic consumers is 7% (YoY) 															
Losses (%)	<ul style="list-style-type: none"> Losses projections as per following trajectory proposed by TANGEDCO: <table border="1"> <thead> <tr> <th>Particulars</th> <th>FY16</th> <th>FY17</th> <th>FY18</th> <th>FY19</th> </tr> </thead> <tbody> <tr> <td>AT&C Loss (%)</td> <td>17.5%</td> <td>16.1%</td> <td>15.2%</td> <td>14.4%</td> </tr> <tr> <td>Intra State transmission loss</td> <td>4.11%</td> <td>4.0%</td> <td>4.0%</td> <td>4.0%</td> </tr> </tbody> </table>	Particulars	FY16	FY17	FY18	FY19	AT&C Loss (%)	17.5%	16.1%	15.2%	14.4%	Intra State transmission loss	4.11%	4.0%	4.0%	4.0%
Particulars	FY16	FY17	FY18	FY19												
AT&C Loss (%)	17.5%	16.1%	15.2%	14.4%												
Intra State transmission loss	4.11%	4.0%	4.0%	4.0%												
Capex & capitalization	<ul style="list-style-type: none"> Capex as per budgeted plans and requirement to fulfill PFA and own internal targets of TANGEDCO One generation plants –Ennore Expansion project is projected to be capitalized in FY19 															
Generation Cost	<ul style="list-style-type: none"> Generation cost at Rs. 8,744.22 Cr for FY16 (Based on FY16 annual accounts figure) For FY17 to FY19 the Average rate of Generation cost (FY16 cost / Total State generation = 2.52 Rs./kWh) is used 															
Employee cost, R&M, A&G costs	<ul style="list-style-type: none"> Employee cost: Based on employee cost for FY16 with escalation of 10% YoY over the period of projection (FY 17 to FY19) considering the CPI. Additional 7% escalation in FY17 only to accommodate pay commission revision A&G cost: Based on A&G cost for FY16 with escalation of 6% p.a over the period of projection (FY17 to FY19) R&M cost: <ul style="list-style-type: none"> For existing assets: Based on the actual R&M cost as percentage of GFA (Past 2 years Average has been considered) For New Assets – 1% of GFA 															
Depreciation	<ul style="list-style-type: none"> For existing assets: Based on the existing rate of depreciation 2.96% For new assets: based on the TNERC rate of 5.28% 															
Funding of capital expenditure and financing terms	<ul style="list-style-type: none"> Capital expenditure to be funded through grant, debt & equity based on schemes under which it has been proposed. Under DDUGJY and IPDS, the ratio of grant debt and equity is 75%, 15% and 10%, whereby 60% grants out of 75% would be available in the same year while additional 15% after 2 years, utilized towards retiring debt Unapproved capital expenditure under proposed schemes to be funded through debt equity in the ratio of 70:30. For other ongoing schemes, funding is based on the tied up debt, equity and envisaged grant portion. For any untied expenditure, debt and equity in the ratio of 70:30 has been considered. Repayment schedule of 10 years Interest on existing debt is considered to be based on weighted average existing interest rate, estimate to be 13.1% Interest on new debt considered to be 11.5%, considering the present rating of TANGEDCO and corresponding lending rates of PFC. Debt to Equity ratio assumed at 70:30 under no grants scenario, only for schemes under which funds have already not been tied up, such as DDUGJY and IPDS 															
Working capital and cash deficit loan	<ul style="list-style-type: none"> Working capital as per regulatory provisions Working capital loan assumed at 12.25% Cash deficit during the year is assumed to be funded from short term loan @ 11.5%p.a. 															
Other income	<ul style="list-style-type: none"> Based on values for FY15 with escalation of 5% YoY over the period of projection (FY16 to FY19) 															
Capitalization of Expenses	<ul style="list-style-type: none"> Based on FY16 value of Rs. 1,171.57 Cr. (Interest capitalized), the amount of interest capitalized is projected in the same proportion of long term interest for FY17 to FY19. Other expenses are not projected to be capitalized. 															
Miscellaneous Expenses	<ul style="list-style-type: none"> For FY17 to FY19 miscellaneous expenses considered in proportion to the O&M cost Other prior period expenses/income have not been considered in the financial projections 															
Regulatory parameters	<ul style="list-style-type: none"> No disallowance in power purchase or any other cost element No regulatory assets of past have been considered Revenue subsidy from GoTN is projected as per TANGEDCO's approved figures. GoTN's subsidies for regulatory asset recovery as per TANGEDCO's projections 															

Table 41: Impact of Asset addition (Rs Cr.)

Particulars	FY 17	FY 18	FY 19
Capital expenditure	2,850	3,064	16,834
Grants	1,132	744	1,439
Debt	1,554	1,976	10,345
Equity	163.7	344.3	5050.2
Incidental cost of capital expenditure			
Depreciation on additional assets	45.14	168.92	688.06
Interest on debt – corresponding to PFA capex	80.43	254.16	862.53
Return on equity - corresponding to PFA capex	25.38	53.37	782.78
Total capex related Cost	150.95	476.45	2,333.37

Table 42: Parameters for base case

Particulars	Units	FY16	FY 17	FY 18	FY 19
Energy related parameters					
Retail Sales	MUs	68,629	74,174	80,115	86,479
T&D losses	%age	16.7%	15.3%	14.4%	13.6%
AT&C Losses	%age	17.52%	16.09%	15.24%	14.41%
Power purchase cost (inc transmission charges)	Rs./kWh	6.15	6.04	6.06	6.10
Energy Required	MUs	85,926	91,179	97,492	104,214
Energy Available	MUs	85,926	95,709	101,364	109,787
Surplus/Shortage	MUs		4,530	3,873	5,573
Revenue & expenditure parameters					
Tariff Increase	%age	0.0%	0.0%	0.0%	0.0%
Collection efficiency	%age	99.0%	99.0%	99.0%	99.0%
Average billing rate - Domestic (w/o Subsidy)	Rs./kWh	2.82	2.82	2.82	2.82
Average billing rate - Other than domestic (weighted avg.)	Rs./kWh	7.74	7.74	7.74	7.74
Employee cost escalation	%age	10.00%	17.00%	10.00%	10.00%
A&G cost escalation	%age	6.00%	6.00%	6.00%	6.00%

The impact of PFA program on the Tariff structure prevalent in the state is reflected in Table 43 as below. This impact is due to per kWh gap of incidental cost of providing additional power and revenue generated due to increase in energy sales. The impact on tariff due to PFA capital expenditure is expected to remain in the range of Rs. 0.29/kWh in FY17 to Rs.0.53/kWh in FY19.

The key reason behind the marginal increase in tariff impact is the reduction in overall average realization as the share of domestic category sales increases, but the constituents of ACS, other than power

purchase cost continue to increase. The additional cost on account of capital expenditure accounts for a considerable increase in ACS.

Therefore, in the base case, the financial statements of TANGEDCO have been prepared considering that the per unit power purchase cost and tariff shall remain at the present levels, while the impact of other incidental cost is accounted.

As can be seen in the P&L statement, the financial losses of Rs. 5,787 Cr. in FY16 are likely to increase to Rs.10,312 Cr.in FY19.

Table 43: Impact on tariff due to PFA

Particulars	Derivation	FY 17	FY 18	FY 19
Additional recovery due to incremental energy sales (Rs. Cr.)	A	3,115	3,335	3,571



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Particulars	Derivation	FY 17	FY 18	FY 19
Incremental power purchase cost (inc. transmission charges and incremental transmission cost due to PFA program (Rs. Cr.))	B	3,621	3,228	3,866
Add: Cost related to capital expenditure (interest, depreciation and equity return, Rs. Cr.)	B1	151	476	1,264
Add: Incremental O&M cost & Working capital cost		1,511	2,218	3,019
Gap of additional cost and additional recovery	C=(B+B1-A)	2,168	2,588	4,577
Energy sales (MU)	D	74,174	80,115	86,479
Cumulative Impact on tariff (Rs./kWh)		0.29	0.32	0.53

Table 44: Profit and Loss Account (Rs.Cr.) for Base Case

Particulars	FY16 (A)	FY17	FY18	FY19
Revenue				
Revenue from Sale of Power within State	41,516	44,631	47,967	51,538
Revenue Subsidy from GoTN	6,695	8,485	9,244	10,073
Revenue from Sale of Surplus Power	-	1,359	1,162	1,672
Subsidies and grants	1,000	2,000	2,363	-
Others	495	519	545	572
Total revenue	49,705	56,994	61,281	63,855
Expenditure				
Power Purchase cost	31,618	34,294	37,468	40,326
Generation Cost	8,744	9,689	9,743	10,751
O&M Cost	6,777	7,766	8,473	9,274
Employee cost	5,614	6,568	7,225	7,948
A&G expenses	426	451	478	507
R&M expenses	738	747	770	819
EBIDTA	2,566	5,246	5,596	3,504
Depreciation	1,626	1,653	1,716	1,880
Interest and finance charges	9,993	11,151	11,829	12,884
Interest on Working Capital	418	1,002	1,052	1,071
Interest on Cash deficit Loan	-	663	2,107	3,880
Interest – Long Term	9,575	9,486	8,670	7,933
Miscellaneous	17	19	21	23
PBT	(7,231)	(6,417)	(6,909)	(10,312)
Prior Period Charges	1,444	-	-	-
Capitalised Expenses	1,840	1,161	1,061	971
Provision for Tax	-	-	-	-
PAT	(5,787)	(6,417)	(6,909)	(10,312)

9.5. Scenario Analysis

Any change in tariff or under achievement of AT&C losses considered for the base case or non-availability of funding in form of grants will translate into additional impact on the financial position of the utility. The impact of existing accumulated losses of TANGEDCO or the impact of purchase and sale of surplus power available to TANGEDCO also need

to be evaluated. Therefore, analysis under following scenarios have been carried out:

1. Increase in tariff to ensure that utility becomes viable by FY19
2. Non-Availability of grants under the schemes where DPRs are not finalized (available only to the extent approved as per DPR) to fund the capital expenditure.



3. Under achievement of AT&C loss targets: considering same T&D loss level as in FY15, till FY19

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

As existing gap between average cost of supply and average realization is significant, an increase in tariff may be required immediately. Table 45

summarizes the underlying assumptions. In order to achieve financial viability by FY19, the utility requires an annual tariff increase of 5.52%, in addition to complete pass through of increase in power purchase cost. The assessed tariff impact is expected to recover the costs and the utility will be able to become financially viable having positive PAT (YoY) by FY19. The resultant P&L account under this scenario is presented in Table 46.

Table 45: Parameters for Scenario 1 (Tariff increase)

Particulars	Units	FY 16	FY 17	FY 18	FY 19
Energy related parameters					
Retail Sales	MUs	68,629	74,174	80,115	86,479
T&D losses	%age	16.7%	15.3%	14.4%	13.6%
AT&C Losses	%age	17.52%	16.09%	15.24%	14.41%
Power purchase cost	Rs./kWh	6.15	6.04	6.06	6.10
Energy Required	MUs	85,926	91,179	97,492	104,214
Energy Available	MUs	85,926	95,709	101,364	109,787
Surplus/(Shortage)	MUs		4,530	3,873	5,573
Revenue & expenditure parameters					
Tariff Increase	%age	0.0%	5.5%	5.5%	5.5%
Collection efficiency	%age	99.0%	99.0%	99.0%	99.0%
Average billing rate - Domestic	Rs./kWh	2.82	2.98	3.14	3.32
Average billing rate - Other than domestic (weighted avg.)	Rs./kWh	7.74	8.16	8.61	9.09
Employee cost escalation	%age	10.00%	17.00%	10.00%	10.00%
A&G cost escalation	%age	6.00%	6.00%	6.00%	6.00%

Table 46: Profit and Loss Account Scenario 1 (Tariff Hike) (Rs. Cr.)

Particulars	FY16 (A)	FY17	FY18	FY19
Revenue				
Revenue from Sale of Power within State	41,516	47,084	53,385	60,515
Revenue Subsidy from GoTN	6,695	8,485	9,244	10,073
Revenue from Sale of Surplus Power	-	1,359	1,162	1,672
Subsidies and grants	1,000	2,000	2,363	-
Others	495	519	545	572
Total revenue	49,705	59,448	66,699	72,832
Expenditure				
Power Purchase cost	31,618	34,294	37,468	40,326
Generation Cost	8,744	9,689	9,743	10,751
O&M Cost	6,777	7,766	8,473	9,274
Employee cost	5,614	6,568	7,225	7,948
A&G expenses	426	451	478	507
R&M expenses	738	747	770	819
EBIDTA	2,566	7,699	11,015	12,481
Depreciation	1,626	1,653	1,716	1,880
Interest and finance charges	9,993	11,056	11,311	11,511
Interest on Working Capital	418	1,052	1,163	1,254

Particulars	FY16 (A)	FY17	FY18	FY19
Interest on Cash deficit Loan	-	517	1,479	2,324
Interest – Long Term	9,575	9,486	8,670	7,933
Miscellaneous	17	19	21	23
PBT	(7,231)	(3,868)	(972)	38
Prior Period Charges	1,444	-	-	-
Capitalised Expenses	1,840	1,161	1,061	971
Provision for Tax	-	-	-	13
PAT	(5,787)	(3,868)	(972)	25

The projected cash flow statement till FY19 and projected balance sheet is provide in Annexure 21 & 22. It can be observed from the cash flow statement that with 5.52% tariff increase, TANGEDCO is expected to post positive YoY cash-flows by FY19.

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

The dependence of utility on funding of the proposed investments through various State and Central Government schemes can be assessed by the impact on utility's finances under a scenario

where grant funding is not available. For the ongoing schemes where the funds have already been committed by the State or Central Government, the grants are considered to be as envisaged in the respective schemes. Table 47 on the following page summarizes the key parameters underlying the analysis and the impact on tariff has been detailed in Table 48. As can be seen in Table 48, the impact on tariff is expected to increase due to non-availability of grants to fund the capital expenditure. The tariff impact for in such scenario is estimated to range between Rs.0.30/kWh to Rs.0.54/kWh. Table 49 presents the projected profit and loss statement of TANGEDCO under this scenario.

Table 47: Parameters for Scenario 2 (Non-Availability of grants)

Particulars	Units	FY 16	FY 17	FY 18	FY 19
Energy related parameters					
Sales	MUs	68,629	74,174	80,115	86,479
T&D losses	%age	16.7%	15.3%	14.4%	13.6%
AT&C Losses	%age	17.52%	16.09%	15.24%	14.41%
Power purchase cost	Rs./kWh	6.15	6.04	6.06	6.10
Energy Required	MUs	85,926	91,179	97,492	104,214
Energy Available	MUs	85,926	95,709	101,364	109,787
Surplus/(Shortage)	MUs		4,530	3,873	5,573
Revenue & expenditure parameters					
Tariff Increase	%age	0.0%	0.0%	0.0%	0.0%
Collection efficiency	%age	99.0%	99.0%	99.0%	99.0%
Average billing rate - Domestic	Rs./kWh	2.82	2.82	2.82	2.82
Average billing rate - Other than domestic (weighted avg.)	Rs./kWh	7.74	7.74	7.74	7.74
Employee cost escalation	%age	10.00%	17.00%	10.00%	10.00%
A&G cost escalation	%age	6.00%	6.00%	6.00%	6.00%

Table 48: Impact on tariff due to PFA – Scenario 2

Particulars	Derivation	FY 17	FY 18	FY 19
Additional recovery due to incremental energy sales (Rs. Cr.)	A	3,115	3,335	3,571

Particulars	Derivation	FY 17	FY 18	FY 19
Incremental power purchase cost (inc. transmission charges and incremental transmission cost due to PFA program (Rs. Cr.))	B	3,621	3,228	3,866
Add: Cost related to capital expenditure (interest, depreciation and equity return, Rs. Cr.)	B1	215	589	1,365
Add: Incremental O&M cost & Working capital cost	B2	1,511	2,218	3,019
Gap of additional cost and additional recovery	C=(B+B1+B2-A)	2,232	2,700	4,678
Energy sales (MU)	D	74,174	80,115	86,479
Cumulative Impact on tariff (Rs./kWh)		0.30	0.34	0.54

Table 49: Profit and Loss Statement (Rs. Cr.) Scenario 2

Profit & Loss Statement	FY16(A)	FY17	FY18	FY19
Revenue				
Revenue from Sale of Power within State	41,516	44,631	47,967	51,538
Revenue Subsidy from GoTN	6,695	8,485	9,244	10,073
Revenue from Sale of Surplus Power	-	1,359	1,162	1,672
Subsidies and grants	1,000	2,000	2,363	-
Others	495	519	545	572
Total revenue	49,705	56,994	61,281	63,855
Expenditure				
Power Purchase cost	31,618	34,294	37,468	40,326
Generation Cost	8,744	9,689	9,743	10,751
O&M Cost	6,777	7,766	8,473	9,274
Employee cost	5,614	6,568	7,225	7,948
A&G Expenses	426	451	478	507
R&M Expenses	738	747	770	819
EBIDTA	2,566	5,246	5,596	3,504
Depreciation	1,626	1,665	1,782	1,965
Interest and finance charges	9,993	11,181	11,922	13,029
Interest on working capital	418	1,002	1,052	1,071
Interest on cash deficit loan	-	667	2,127	3,924
Interest - Long term	9,575	9,512	8,744	8,034
Miscellaneous	17	19	21	23
PBT	(7,231)	(6,456)	(7,059)	(10,529)
Prior Period Charges	1,444	-	-	-
Capitalised Expenses	1,840	1,164	1,070	983
Provision for tax	-	-	-	-
PAT	(5,787)	(6,456)	(7,059)	(10,529)

As can be seen above, the annual financial losses of TANGEDCO are expected to increase to nearly Rs. 10,529 Cr. in FY19 as against Rs. 10,312 Cr. under the base case.

Further, as the utility's cost of funding declines due to availability of grants, the required tariff increase to achieve the financial viability is likely to increase

to 5.63% p.a. as against 5.52% tariff increase required in base case.

The projected cash flow statement till FY19 is provided in Annexure 23 & 24.

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



Base case analysis, scenario 1 and scenario 2 assumes the achievement of AT&C loss trajectory by the utility. However, in case the utility misses T&D loss reduction and is higher by 1% every year, the impact on financial position is going to be significant. Table 50 summarizes the key parameters underlying the analysis in scenario 3. There is an impact on tariff and is expected to be in the range of Rs. 0.29/kWh to Rs.0.53/kWh. Due to additional cost and under-achievement of T&D loss trajectory there is an adverse impact on the financials of the utility, as presented in Table 51. As can be seen in Table 52 the annual financial losses

of utility are expected to increase to nearly Rs. 10,809 Cr. in FY19 vis-à-vis Rs. 10,312 Cr. in FY19 under base case, this indicates that TANGEDCO needs to focus on AT&C loss trajectory.

It may also be important to note that in this scenario, the funds available as grants under centrally sponsored schemes (IPDS, DDUGJY) are restricted to 60% of project value.

The required tariff increase to achieve the financial viability by FY19 is higher at 5.78% as compared to 5.52% in base case.

Table 50: Parameters for Scenario 3 (Under-achievement of T&D losses)

Particulars	Units	FY 16	FY 17	FY 18	FY 19
Energy related parameters					
Sales	MUs	68,629	74,174	80,115	86,479
T&D losses	%age	16.7%	16.3%	15.4%	14.6%
AT&C Losses	%age	17.52%	17.09%	16.24%	15.41%
Power purchase cost (inc. transmission charges)	Rs./kWh	6.15	6.04	6.06	6.10
Energy Required	MUs	85,926	92,278	98,656	105,446
Energy Available	MUs	85,926	95,709	101,364	109,787
Surplus/(Shortage)	MUs		3,431	2,709	4,341
Revenue & expenditure parameters					
Tariff Increase	%age	0.0%	0.0%	0.0%	0.0%
Collection efficiency	%age	99.0%	99.0%	99.0%	99.0%
Average billing rate - Domestic	Rs./kWh	2.82	2.82	2.82	2.82
Average billing rate - Other than domestic (weighted avg.)	Rs./kWh	7.74	7.74	7.74	7.74
Employee cost escalation	%age	10.00%	17.00%	10.00%	10.00%
A&G cost escalation	%age	6.00%	6.00%	6.00%	6.00%

Table 51: Scenario 3: Impact on tariff

Particulars	Derivation	FY 17	FY 18	FY 19
Additional recovery due to incremental energy sales (Rs. Cr.)	A	3,115	3,335	3,571
Incremental power purchase cost (inc. transmission charges and incremental transmission cost due to PFA program (Rs. Cr.)	B	3,621	3,228	3,866
Add: Cost related to capital expenditure (interest, depreciation and equity return, Rs. Cr.)	B1	151	476	1,274
Add: Incremental O&M cost & Working capital cost	B2	1,511	2,218	3,019
Gap of additional cost and additional recovery	C=(B+B1+ B2 -A)	2,168	2,588	4,587
Energy sales (MU)	D	74,174	80,115	86,479
Cumulative Impact on tariff (Rs./kWh)		0.29	0.32	0.53

Table 52: Profit and Loss statement - Scenario 3 (Rs. Cr.)

Profit and Loss Statement	FY16 (A)	FY17	FY18	FY19
Revenue				



सत्यमेव जयते
Government of India

Power for All – Tamil Nadu



Profit and Loss Statement	FY16 (A)	FY17	FY18	FY19
Revenue from Sale of Power within State	41,516	44,631	47,967	51,538
Revenue Subsidy from GoTN	6,695	8,485	9,244	10,073
Revenue from Sale of Surplus Power	-	1,029	813	1,302
Subsidies and grants	1,000	2,000	2,363	-
Others	495	519	545	572
Total revenue	49,705	56,665	60,931	63,485
Expenditure				
Power Purchase cost	31,618	34,294	37,468	40,326
Generation Cost	8,744	9,689	9,743	10,751
O&M Cost	6,777	7,766	8,473	9,274
Employee cost	5,614	6,568	7,225	7,948
A&G Expenses	426	451	478	507
R&M Expenses	738	747	770	819
EBIDTA	2,566	4,916	5,247	3,134
Depreciation	1,626	1,653	1,716	1,892
Interest and finance charges	9,993	11,164	11,885	13,001
Interest on working capital	418	995	1,045	1,063
Interest on cash deficit loan	-	682	2,170	3,995
Interest - Long term	9,575	9,486	8,670	7,943
Miscellaneous	17	19	21	23
PBT	(7,231)	(6,760)	(7,313)	(10,809)
Prior Period Charges	1,444	-	-	-
Capitalised Expenses	1,840	1,161	1,061	972
Provision for tax	-	-	-	-
PAT	(5,787)	(6,760)	(7,313)	(10,809)

Action Points for improvement in financial positions of TANGEDCO

TANGEDCO's cost structure needs to be revamped in order to achieve financial independence and improvement in profitability margins. This may be achieved by reducing the input costs and increasing the revenue. The following action points describe the areas in which TANGEDCO may need to work:

1. **Reduction in input costs:** The input costs for the utility are effected by the following items:
 - a. **Own generation cost:** One of the main components is the cost of coal. A part of TANGEDCO's coal requirement is met through imported coal. This puts additional pressure on TANGEDCO as they have to bear additional cost to ensure that power is available from its own stations. Further, non-availability of cheaper power in the market also adds to the woes of the utility. To reduce dependence on imported coal, for receipt of full linkage quantity from the Coal Companies against the available FSAs and increase of FSA quantum to 100% of the requirement for its existing and upcoming plants, TANGEDCO may highlight these issues regularly with appropriate authority such as MoC/Railways/Paradip Port.
 - b. **Financing and Interest Cost:** In FY15 TANGEDCO's interest cost was about Rs.8,000 Cr. This amount is attributable to long term and short loans taken by the utility to meet its financing requirements. In view of the huge interest burden of TANGEDCO, measures to decrease interest cost through availing refinances at reasonable rate of interest are being explored. The Tamil Nadu Power Finance Corporation (TNPFC) being one of the Government of Tamil Nadu owned utility extending loan assistance at cheaper rate of interest. Government of Tamil Nadu has advised various state owned public sector undertaking to divert their unutilised funds and matured deposits to invest in TNPFC for further funding to TANGEDCO, so that the power utility will save huge interest charges, besides managing the cash flow. Similarly, among the various loans with TNPFC, higher rate of interest bearing loans were pre-closed and further steps are also being taken up to prepay loans in the descending order of rate of interest. The utility may undertake an exercise of refinancing all or part of its debt. The utility may pursue authorities to seek reduction in interest amount of loans by PFC and REC. Further, the utility may also explore ways to increase the repayment period of loans. This may be instrumental in reducing the interest cost borne by the utility.
 - c. **Reducing Power Purchase Cost:** TANGEDCO has allocations from various central generating stations and private stations besides operating its own station in order to meet the requirement of the state. The utility may be able to bring down its power purchase costs by efficiently managing the sources. TANGEDCO has already taken steps to replace the costlier sources of power by cheaper sources especially in case of private generating stations. Further, the utility buys power from some CGS with very high variable costs. The utility may explore means to replace such stations with medium or short term power from the open market in order to reduce the overall power purchase costs.
 - d. **Availability of Hydro Stations:** The current constraints in the inter-regional transfers have restricted the utility's ability to draw cheaper hydro power from surplus states. Once the inter-regional capacity is adequate, the utility may explore means for replacing the costly generation sources (own/private/central) with cheaper power available elsewhere in the country.
2. **Increasing revenue:** The gap between average billing rates is one of the major concern. TANGEDCO may consider the following options for improving its revenue stream:
 - a) **Increase in targeted Subsidy:** Currently, the subsidy declared by the government is at a fixed rate. This amount is not sufficient to recover the cost of supply especially for the Agricultural consumers. TANGEDCO and GoTN may work towards providing subsidy at the cost of supply. This will help the utility to manage the cross subsidy requirement and help in rationalising the tariff structure for the state.
 - b) **Increase in tariff:** The scenarios in this chapter provide evidence that the utility may need sustained tariff hikes across every consumer category. The utility may seek tariff hikes from the regulator based on its current deficit. Further, actions towards restructuring the tariff slabs will help in higher average tariff for the utility.
- **AT&C Loss reduction:** The utility must ensure adherence to the AT&C loss reduction trajectory proposed in this roadmap. Reduction in AT&C losses will help the utility to manage its financial gaps and further increase its revenue.

10. Other Initiatives

10.1. Capacity Building

For the training needs of the employees Tamil Nadu power sector has 4 training institute which cater to hydro, thermal, transmission and distribution, management and safety training needs to its employees. Ten Centers were established to cater the needs of Staff in Distribution Areas.

One Cable Jointing Training and development Centre has also been created to impart both the officers & work force of TANGEDCO & TANTRANSCO (formerly TNEB) in the field of UG Power Cables & Jointing Techniques and in both theory and practical.

Various initiatives taken by TANGEDCO are as below:-

- On Approval of Chairman cum Managing Director of TANGEDCO, Annual training programmes are being conducted to all the officers / staff of TANGEDCO/TANTRANSCO regularly throughout the year to enhance / upgrade their technical skills / functional skills / management skills.
- Memorandum of Agreement had been signed between Tamil Nadu Generation and Distribution Corporation (TANGEDCO) and Central Institute for Rural Electrification, a training institution under Rural Electrification Corporation (REC). Government of India has been financially supporting TANGEDCO through Central Institute for Rural Electrification (CIRE), Hyderabad to conduct training to the of C & D (class III & IV) employees of TANGEDCO.
- Transmission and Distribution Training & Development Institute / Madurai of Tamil Nadu Generation and Distribution Corporation (TANGEDCO) is empanelled as a Partner Training Institute (PTI) by Government of India. Ministry of Power, Government of India through Power Finance Corporation Ltd., New Delhi has

been financially supporting TANGEDCO to conduct training programmes under R-APDRP (part-C) for level C & D (class III & IV) employees.

Table 53: Training Centers and Institutes

Training Institute	Training Centres
Staff Training College / Chennai.	Cable Jointing and training centre , Chennai
Thermal Training Institute & Research Centre / North Chennai.	Technical Training and Development Centre (TTDC) ,Korattur
Hydro Training Institute & Research Centre / Kuthiraikalmedu	TTDC ,Mettur Dam
Transmission & Distribution, Training & Development Institute and Research Centre / Madurai	TTDC ,Pasumalai
	TTDC, Thanjavur
	TTDC,, Thiruvanna malai
	TTDC,, Tirunelveli
	TTDC, Trichy
	TTDC, Vellore
	TTDC, Virudhunagar
	TTDC, Coimbatore

11. Institutional Framework

A strong monitoring framework is essential to ensure the success of “Power for All” scheme. The following structure shown in following table is being proposed to undertake regular monitoring of the progress of all initiatives being undertaken in this Roadmap.

Table 54: Institutional Arrangement for Monitoring

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



12. Rollout Plan

Particular	Unit	Existing ending	Year wise addition			Total Additions till	Total
			FY 16	FY 17	FY 18	FY 19	Till FY19
GENERATION							
State Sector	MW	7,501	0	0	660	660	8,161
Central Sector Allocations	MW	5,464	662	695	327	1,684	7,148
Private Sector	MW	11,468	1,665	1,800	1,800	5,265	16,733
Total IC including Allocation	MW	24,416	2,327	2,495	2,787	7,609	32,042
Peak Demand	MW	14,533	15,439	16,510	17,651		
TRANSMISSION							
Grid Substations (Nos)	No.						
765 kV	No.	0			2	2	2
400 kV	No.	6	10	1	2	11	17
230 kV	No.	89	16	11	18	33	122
110 kV	No.	807	30	30	73	90	897
		902	56	42	95	136	1038
Intra-State Lines addition							
765 kV	Ckm				320	320	320
400 KV	cKm	2,700			800	800	3,500
230 KV	cKm	9,085	470	500	400	1,370	10,455
110 KV	cKm	17,463	600	630	800	2,030	19,493
Total	cKM	29,248	1,070	1,130	2,320	4,520	33,768
Intra-State Capacity Addition							
765 KV	MVA	0	0	0	7,500	7,500	7,500
400 KV	MVA	6,010	4,665	945	4,550	10,160	16,170
230 KV	MVA	20,140	2,741	2,616	1,400	6,757	26,897
110 KV	MVA	33,750	420	420	420	1,260	35,010
Total	MVA	59,900	7,826	3,981	13,870	25,677	85,577
Capacity for RE/Green Corridor							
400/230 kV	MVA		2,890	630		3,520	
400/110 kV	MVA		3,000	400		3,400	
230/110 kV	MVA		1,720	0		1,720	
Total	MVA		7,610	1,030		8,640	
DISTRIBUTION							
DTS	Nos	2,64,029	18,059	18,872	19,721	56,652	3,20,681
DTs Capacity	MVA	35,750	4,515	4,718	4,930	14,163	49,913
HT Line	cKm	169,409	3,654	3,764	3,877	11,295	1,80,704
LT Line	cKm	609,544	11,399	11,684	11,976	35,059	6,44,603

13. Annexures

Annexure 1: List of Thermal Stations in the State- Total generation capacity

Sl.	Name of power house	Installed Capacity (MW)	Year of Commissioning	PLF (2015-16)
1.	Ennore TPS	2 X 60 MW 2 X 110 MW	I: 1970	14.81%
			II: 1971	
			III: 1972	
			IV: 1973	
2.	Tuticorin TPS	5 X 210 MW	I: 1979	76.80%
			II: 1980	
			III: 1982	
			IV: 1992	
3.	Mettur TPS –I	4 X 210 MW	I: 1987	81.01%
			II: 1987	
			III: 1989	
			IV: 1990	
4.	Mettur TPS –II	1 X 600 MW	2013-14	74.49%
5.	North Chennai TPS-I	3 X 210 MW	I: 1994	80.39%
			II: 1995	
			III: 1996	
6.	North Chennai TPS-II	2 X 600 MW	2014-15	61.65%

Annexure 2: R&M Plan

I. Tuticorin Thermal Power Station		
S.No	Year	Amount Rs. in Lakhs
1	2016-17	11,161.50
2	2017-18	17,632.0
3	2018-19	8,756.0

II. Mettur Thermal Power Station -I		
S.No	Year	Amount Rs. in Lakhs
1	2016-17	10,684.16
2	2017-18	9,812.74
3	2018-19	7,876.98

II. North Chennai Thermal Power Station -I		
S.No	Year	Amount Rs. in Lakhs
1	2016-17	187
2	2017-18	2,095

3	2018-19	2,161
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Annexure 3: List of Micro/Mini Hydro Project In The State

Sl.	Name of power house	Installed Capacity in MW	PF
1.	Mukurthy Micro	0.7	6.49
2.	Pykara Micro	2	28.88
3.	Maravakandy	0.75	14.76
4.	Punachi PH	2	19.38
5.	Sholayar PH II	25	25.91
6.	Thirumurthy PH	1.95	6.92
7.	Aliyar Mini PH	2.5	30.38
8.	Amaravathy PH	4	15.98
9.	Vaigai Mini PH	6	34.04
10.	Perunchani MPH	1.3	0.00
11.	Servalar PH	20	22.20
12.	Periyar Vaigai I	4	24.79
13.	Periyar Vaigai II	2.5	23.10
14.	Periyar Vaigai III	4	23.24
15.	Periyar Vaigai IV	2.5	72 Hrs Trail run yet to be conducted
16.	MHPH/B.S	8	40.15
17.	RBC PH	8	10.23
18.	Sathanur MPH	7.5	11.92
19.	Bhavani Barrage 2	10	9.35
20.	Bhavani Barrage 1	10	
	Total	122.7	

Annexure 4: List of Hydro Project In The State

Sl.	Name of power house	Installed Capacity in MW	PLF for FY16
1.	Aliyar	60	29.1
2.	Bhavani kattalai Barrage 1	30	24.2
3.	Bhavani kattalai Barrage 2	30	20.5

Sl.	Name of power house	Installed Capacity in MW	PLF for FY16
4.	Bhavani kattalai Barrage 3	30	18.1
5.	Kadamprai (PSS)	400	11.8
6.	Kodayar-I	60	36.57
7.	Kodayar II	40	24.43
8.	Kundah I	60	44.56
9.	Kundah II	175	40.97
10.	Kundah III	180	23.34
11.	Kundah IV	100	13.35
12.	Kundah V	40	10.42
13.	Kundah VI (Parson's valley)	30	9.78
14.	Lower Mettur I	30	15
15.	Lower Mettur II	30	23
16.	Lower Mettur III	30	24
17.	Lower Mettur IV	30	20
18.	Mettur Dam PH	50	17
19.	Mettur Tunnel	200	14
20.	Moyar	36	36
21.	Papanasam	32	41
22.	Periyar	168	45
23.	Pykara	59.2	10
24.	Pykara Ultimate (PUSHEP)	150	21.08
25.	Sarkarpathy	30	30.04
26.	Sholayar	70	33.77
27.	Suriliyar	35	30.09
Total		2185.2	

Annexure 5: EHV Substation with Transformation capacity

Sl.	Substation	Voltage Level	No. of Transformers	Total Transformation Capacity (MVA) [Existing]	Additional Transformation Capacity (MVA) (Year of Commissioning)
1	Arasur	400/230 kV	2X315	630	500 (FY20)
2	Hosur	400/230 kV	3X315	945	-
3	Karaikudi	400/230 kV	2X315	630	500 (FY20)
4	Madurai	400/230 kV	2X315	630	500 (FY17)
5	Madras	400/230 kV	3x315+2x200 = 1,345 MVA (ICTs owned by state)		
6	Malekottaiyur	400/230 kV	2X315	630	500 (FY17)
7	Pugalur	400/230 kV	2X315	630	500 (FY17)
8	Salem	400/230 kV	2x315+2x200 = 1,030 MVA (ICTs owned by state)		
9	Tirunelveli	400/230 kV	2X315	630	500 (FY20)
10	Trichy	400/230 kV	2X315	630	500
11	Udumalpet	400/230 kV	3X315	945	-
12	Thiruvalem	765/400 kV	2x1500	3,000	-

Sl.	Substation	Voltage Level	No. of Transformers	Total Transformation Capacity (MVA) [Existing]	Additional Transformation Capacity (MVA) (Year of Commissioning)
13	Tuticorin PS	765/400 kV			
14	Nagapattinam PS	765/400 kV			
Total				9,300*	3,500*

*ICTs owned by POWERGRID

Annexure 6: Existing 400 KV capacity of TANTRANSO as on 31.03.2016

Sl.	Name Of The SS	Volt Ratio In KV	Existing Capacity In MVA	EDS	Region	Owned by
1	Sriperumbudur	400 /230-110	1345 (3X315+2x200)	CGL	CNI/S	TANTRANSO
2	Alamathy	400 /230-110	1145 (3x315+1x200)	CNI/W	CNI/N	TANTRANSO
3	K.R.Thoppur	400 /230-110	1030 (2X315+2x200)	SLM	ERD	TANTRANSO
4	Sunguvarchatram	400 /230-110	1030 (2x315+2x200)	CGL	CNI/S	TANTRANSO
5	Kayathar	400/ 230-110	830 (2X315+1x200))	TIN	TIN	TANTRANSO
6	Thiruvalem	400 /230	630 (2x315)	VLR	VLR	TANTRANSO
Total			6,010			

Annexure 7: Year on Year Infrastructure Building Plan

Sl.	Description	Phasing year			TOTAL
		2016-17	2017-18	2018-19	
1.	Establishment of 400 kV SS	10	1	2	13
2.	Establishment of 230 kV SS	16	11	18	45
3.	Establishment of 110 kV SS	30	30	73	133
4.	Establishment of 33 kV SS	100	81	77	258
	TOTAL Sub Stations	181	156	112	449
5.	Upgradation/Conversion	19	3	3	25
6.	Introduction of Voltage Ratio	17	8	14	39
7.	Enhancement of Power Transformers	51	47	42	140

Annexure 8: Region Wise Infrastructure Building Plan

Sl.	Name of the Region	400 kV	230 kV	110 kV	33 kV	Upgradation	Introduction Voltage	Entranceme nt of Power Transformer
1	Coimbatore Region	3	5	18	9	1	3	8
2	Chennai /North Region	2	5	8	28	12	0	13
3	Chennai/South Region	1	2	21	38	3	6	14
4	Erode region	1	6	23	10	0	4	8
5	Madurai Region	2	5	16	29	0	5	12
6	Trichy Region	0	6	16	49	2	8	31
7	Tirunelveli Region	3	5	7	34	3	9	9
8	Vellore Region	1	6	11	32	0	2	20
9	Villupuram Region	0	5	13	29	4	2	25
Total		13	45	133	258	25	39	140

Annexure 9: Establishment of 400 kV SS

Sl.	Name of the Region	Unit	Phasing year			TOTAL
			2016-17	2017-18	2018-19	
1	Coimbatore Region	Nos	3	0	0	3
2	Chennai /North Region	Nos	2	0	0	2
3	Chennai/South Region	Nos	1	0	0	1
4	Erode region	Nos	0	0	1	1
5	Madurai Region	Nos	2	0	0	2
6	Trichy Region	Nos	0	0	0	0
7	Tirunelveli Region	Nos	1	1	1	3
8	Vellore Region	Nos	1	0	0	1
9	Villupuram Region	Nos	0	0	0	0
Total		Nos	10	1	2	13

Annexure 10: Establishment of 230 kV SS

Sl.	Name of the Region	Unit	Phasing year			TOTAL
			2016-17	2017-18	2018-19	
1	Coimbatore Region	Nos	1	1	3	5
2	Chennai /North Region	Nos	3	2	0	5
3	Chennai/South Region	Nos	2	0	0	2
4	Erode region	Nos	2	1	3	6
5	Madurai Region	Nos	1	1	3	5
6	Trichy Region	Nos	4	2	0	6

Sl.	Name of the Region	Unit	Phasing year			TOTAL
			2016-17	2017-18	2018-19	
7	Tirunelveli Region	Nos	2	0	3	5
8	Vellore Region	Nos	0	2	4	6
9	Villupuram Region	Nos	1	2	2	5
Total			16	11	18	45

Annexure 11: Establishment of 110 kV SS

Sl.	Name of the Region	Unit	Phasing year			TOTAL
			2016-17	2017-18	2018-19	
1	Coimbatore Region	Nos	6	4	8	18
2	Chennai /North Region	Nos	1	1	6	8
3	Chennai/South Region	Nos	0	6	15	21
4	Erode region	Nos	5	5	13	23
5	Madurai Region	Nos	4	1	11	16
6	Trichy Region	Nos	4	4	8	16
7	Tirunelveli Region	Nos	3	1	3	7
8	Vellore Region	Nos	4	7	0	11
9	Villupuram Region	Nos	3	1	9	13
Total		Nos	30	30	73	133

Annexure 12: Establishment of 33 kV SS

Sl.	Name of the Circle	Units	Phasing year			TOTAL
			2016-17	2017-18	2018-19	
1	Coimbatore Region	Nos	2	4	3	9
2	Chennai /North Region	Nos	13	6	9	28
3	Chennai/South Region	Nos	12	15	11	38
4	Erode region	Nos	4	2	4	10
5	Madurai Region	Nos	15	5	9	29
6	Trichy Region	Nos	17	15	17	49
7	Tirunelveli Region	Nos	13	13	8	34
8	Vellore Region	Nos	11	13	8	32
9	Villupuram Region	Nos	13	8	8	29
Total		Nos	100	81	77	258

Annexure 13: Upgradation of Sub Stations

Sl.	Name of the Circle	Units	Phasing year			TOTAL
			2016-17	2017-18	2018-19	
1	Coimbatore Region	Nos	1	0	0	1
2	Chennai /North Region	Nos	10	1	1	12
3	Chennai/South Region	Nos	1	1	1	3
4	Erode region	Nos	0	0	0	0
5	Madurai Region	Nos	0	0	0	0
6	Trichy Region	Nos	2	0	0	2
7	Tirunelveli Region	Nos	2	1	0	3
8	Vellore Region	Nos	0	0	0	0
9	Villupuram Region	Nos	3	0	1	4
Total		Nos	19	3	3	25

Annexure 14: Enhancement of Power Transformers

Sl.	Name of the Circle	Units	Phasing year			TOTAL
			2016-17	2017-18	2018-19	
1	Coimbatore Region	Nos	0	6	2	8
2	Chennai /North Region	Nos	4	4	5	13
3	Chennai/South Region	Nos	1	10	3	14
4	Erode region	Nos	3	2	3	8
5	Madurai Region	Nos	4	2	6	12
6	Trichy Region	Nos	14	9	8	31
7	Tirunelveli Region	Nos	5	1	3	9
8	Vellore Region	Nos	7	6	7	20
9	Villupuram Region	Nos	13	7	5	25
Total			51	47	42	140

Annexure 15: Integrated Power Development Scheme (IPDS)

SUMMARY Project Cost for 37 EDCs (Volume II a sheet of DPRs)				
Sl.	Particular	Unit	Quantity	Project Cost Rs. In Lac
A.	33/11 KV S/S : New	Nos.	55	12,035.59
B.	33/11 KV S/S : Additional Transformer	Nos.	18	2,276.47
C.	33/11 KV S/S : Transformer capacity enhancement	Nos.	18	1,432.59
D.	Renovation & Modernization of 33/11 kV SS	Nos.	1	29.89
E.	New 33 KV new feeders/Bifurcation of feeders:	Kms	461.275	3,689.95
F.	33 KV feeders Reconductoring/Augmentation	Kms	0.5	26.09



SUMMARY Project Cost for 37 EDCs (Volume II a sheet of DPRs)				
Sl.	Particular	Unit	Quantity	Project Cost Rs. In Lac
G.	33 kV Line Bay Extension at EHV station	Nos.	5	138.58
H.	22/11 kV Line : New Feeder/ Feeder Bifurcation	Kms	3,839.851	27,329.16
I.	11 kV Line : Augmentation/Reconductoring	Kms	25.96	407.07
J.	Arial Bunched Cable	Kms	249.482	2,295.97
K.	UG Cable	Kms	518.2717	13,620.09
L.	22/11 KV Bay Extension	Kms	61	934.06
M.	Installation of Distribution Transformer	Nos.	392	1,209.79
N.	LT Line : New Feeder/ Feeder Bifurcation	Kms	2,149.173	10,479.78
O.	LT Line : Augmentation/Reconductoring	Kms	2,701.801	8,934.66
P.	Capacitor Bank	Nos.	78	1,987.65
Q.	HVDS	Nos.	14,833	32,756.63
R.	Metering	Nos.	2,315,114	34,515.90
S.	Provisioning of solar panel	Nos.	1,972	1,380.40
T.	Others (Provision for new street light switch point, DPs, Railway Crossing etc.,)	Lot		650.88
GRAND TOTAL				156,131.27



Annexure 16: DDUGJY Scheme

S No	Description	Amount in crores
1	System Strengthening	
	a) Creation of new substation	617.18
	b) Augmentation of capacity of transformers	
	c) Renovation and modernization	
2	Replacement of energy meter to static meter	119.66
3	Feeder Segregation	125.94
4	Rural Electrification	
	a) APL Households	56.74
	b) BPL Households	
Total		919.52

Annexure 17: Existing Voltage Wise Capacity of TANTRANSCO Sub-Stations as on 31.03.2016

Sl.	Name of the Circle	400/230 KV		400/110 KV		230/110 KV		230/33 KV		110/33 KV		110/22 KV		110/11 kV		66/11 kV	
		No. of SS	MVA	No. of SS	MVA	No. of SS	MVA	No. of SS	MVA	No. of SS	MVA	No. of SS	MVA	Nof SSo	MVA		
1	COIMBATORE EDC/METRO	0	0	0	0	1	200	0	0	1	48	1	32	8	496	-	-
2	COIMBATORE EDC/NORTH	0	0	0	0	2	500	0	0	2	101	15	601	3	104	-	-
3	COIMBATORE EDC/SOUTH	0	0	0	0	2	700	2	400	6	341	8	344	4	104	-	-
4	NILGIRIS EDC	0	0	0	0	1	150	0	0	1	30	2	35	4	60	4	31.25
5	UDUMALPET EDC	0	0	0	0	2	500	0	0	0	0	18	618	-	-	-	-
6	TIRUPPUR EDC	0	0	0	0	3	800	0	0	9	514	2	48	17	518	-	-
7	CHENNAI EDC/CENTRAL	0	0	0	0	3	700	1	200	8	750	0	0	3	64	-	-
8	CHENNAI EDC/NORTH	1	315	1	200	5	1080	0	0	16	846	0	0	15	378	-	-
9	CHENNAI EDC/WEST	1	945	1	200	5	1200	0	0	5	520	3	500	0	0	8	274
10	CHENGALPATTU	2	1575	2	800	7	1450	0	0	4	816	0	0	13	230	-	-
11	CHENNAI EDC/SOUTH I	0	0	0	0	2	500	0	0	5	537	0	0	3	100	-	-
12	CHENNAI EDC/SOUTH II	0	0	0	0	4	1080	0	0	13	1186	0	0	0	0	-	-
13	KANCHIPURAM EDC	0	0	0	0	0	0	0	0	12	619	0	0	1	20	-	-
14	ERODE	-	-	-	-	2	500	0	0	4	230	9	332	6	130	-	-
15	GOBI	-	-	-	-	2	500	0	0	5	188	6	186	11	242	-	-
16	METTUR	2	1260	1	400	2	400	0	0	2	82	13	517	3	84	-	-
17	NAMAKKAL	-	-	-	-	2	400	0	0	0	0	16	602	3	68	-	-
18	SALEM	-	-	-	-	3	600	0	0	0	0	20	894	0	0	-	-
19	DINDIGUL EDC	0	0	0	0	2	500	0	0	5	164	24	684	9	164	-	-



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Sl.	Name of the Circle	400/230 KV		400/110 KV		230/110 KV		230/33 KV		110/33 KV		110/22 KV		110/11 kv		66/11 kv	
		No. of SS	MVA	No. of SS	MVA	No. of SS	MVA	No. of SS	MVA	No. of SS	MVA	No. of SS	MVA	Nof SSo	MVA		
20	MADURAI EDC	0	0	0	0	1	200	0	0	6	105	0	0	16	401.5	-	-
21	MADURAI METRO	0	0	0	0	1	200	0	0	13	524	0	0	5	76	-	-
22	RAMNAD EDC	-	-	-	-	2	430	0	0	6	171	1	10	5	60	-	-
23	SIVAGANGAI EDC	-	-	-	-	1	150	0	0	1	16	13	250	7	100	-	-
24	THENI EDC	0	0	0	0	1	300	0	0	1	41	16	473	0	0	-	-
25	KARUR EDC	0	0	0	0	1	300	1	200	4	188	0	0	12	244	-	-
26	NAGAPATTINAM EDC	0	0	0	0	1	200	0	0	9	360	0	0	3	56	-	-
27	THIRUVARUR EDC	-	-	-	-	1	300	-	-	4	190	-	-	5	108	-	-
28	PUDUKOTTAI EDC	0	0	0	0	1	200	0	0	9	342	5	123	5	80	-	-
29	PERAMBALUR EDC	-	-	-	-	2	300	0	0	3	140	7	144	2	30	-	-
30	TRICHY EDC/METRO	-	-	-	-	3	650	0	0	11	516	5	147	13	240	-	-
31	THANJAVUR EDC	-	-	-	-	2	400	0	0	11	581	2	40	13	288	-	-
32	KANYAKUMARI EDC	-	-	-	-	1	300	0	0	1	64	0	0	13	284	-	-
33	TIRUNELVELI EDC	1	630	1	200	1	300	5	850	16	997	0	0	25	432	-	-
34	TUTICORIN EDC	-	-	-	-	1	200	1	226	11	455.5	4	134	3	46	3	12.5
35	VIRUDHUNAGAR EDC	-	-	-	-	2	380	0	0	8	386	0	0	18	432	-	-
36	DHARMAPURI EDC	-	-	-	-	1	300	0	0	5	236	0	0	3	86	-	-
37	KRISHNAGIRI EDC	-	-	-	-	2	500	0	0	1	90	0	0	0	0	-	-
38	THIRUPPATHUR EDC	-	-	-	-	2	350	0	0	7	332	0	0	6	126	-	-
39	VELLORE EDC	1	630	0	0	2	600	0	0							-	-

Sl.	Name of the Circle	400/230 KV		400/110 KV		230/110 KV		230/33 KV		110/33 KV		110/22 KV		110/11 kV		66/11 kV	
		No. of SS	MVA	No. of SS	MVA	No. of SS	MVA	No. of SS	MVA	No. of SS	MVA	No. of SS	MVA	Nof SSo	MVA		
40	CUDDALORE EDC	-	-	-	-	1	200	0	0	10	452	1	48	10	266	8	146
41	T.V.MALAI EDC	-	-	-	-	2	440	0	0	14	651	2	26	3	50	-	-
42	KALLAKURICHI EDC					1	100	0	0	1	42	15	370	1	20	-	-
43	VILLUPURAM EDC	-	-	-	-	1	200	0	0	6	230	10	308	0	0	0	0



Annexure 18: SAIFI SAIDI values of R APDRP Towns (August 2016)

S. No.	Name of Town	Nos. of Feeder Covered	Number of Consumers	Town SAIFI	Town SAIDI
1	Coonoor	4	23443	11:04	8.7
2	Gudallur (Coimbatore)	2	14515	0	0
3	Palladam	5	9409	0	0
4	Vickramasingapuram	2	13023	0	0
5	Aruppukottai	2	23621	01:10	0.91
6	Rajapalayam	8	49880	0	0
7	Sattur	2	12682	0	0
8	Virudhunagar	4	31287	0	0
9	Attur	3	16382	0	0
10	Bhavani	5	41019	01:25	1.22
11	Gobichettipalayam	4	21604	04:06	6.71
12	Kadayanallur	2	28951	0	0
13	Tirunelveli	29	178093	00:01	0.29
14	Ambur	6	34394	00:22	0.3
15	Arni	4	21453	02:18	3.49
16	Aranthaangi	2	17497	08:33	2.53
17	Arcot	11	49214	03:28	7.52
18	Chengalpattu	6	27546	01:14	4.03
19	Chidambaram	4	29047	03:04	6.43
20	Chinnamanur	1	15529	00:13	1
21	Cuddalore	5	64788	00:33	1.89
22	Dharmapuri	3	17571	0	0
23	Edappady	3	8249	08:33	6.97
24	Erode	11	96360	02:17	1.84
25	Gudalooore (Madurai)	2	11421	0	0
26	Gudiyatham	6	35732	03:46	3.97
27	Jeyankondam	2	8501	07:39	8.52
28	Kallakurichi	4	23927	0	0
29	Kambam	1	22901	10:28	12
30	Karur	15	66079	02:13	3.31
31	Kodaikanal	1	11500	0	0
32	Krishnagiri	1	10816	0	0
33	Mallasamudram	4	7598	01:17	4.63
34	Maraimalainagar	11	34461	00:01	0.32



S. No.	Name of Town	Nos. of Feeder Covered	Number of Consumers	Town SAIDI	Town SAIFI
35	Melvisharam	2	9975	05:59	10.38
36	Mettupalayam	3	21943	7	7.42
37	Mettur	3	16664	00:11	0.99
38	Namakkal	2	29769	00:13	2
39	Nellikuppam	4	12545	00:02	0.04
40	Palani	1	26349	0	0
41	Panruti	4	21481	02:02	2
42	Perambalur	2	24949	0	0
43	Periyakulam	1	14484	01:05	5
44	Periyasemur	4	18201	03:28	12.48
45	Pernampattu	2	12657	18:29	12
46	Pollachi	8	48522	02:33	5.31
47	Pudukottai	2	53642	01:05	1.59
48	Rasipuram	1	20662	06:05	18
49	Sathyamangalam	4	16064	10:35	10.69
50	Sivagangai	2	19479	0	0
51	Sivagasi	1	11436	00:11	21
52	Thanjavur	5	28830	01:12	6.52
53	Theniainagaram	5	36440	00:02	1.01
54	Thuraiyur	1	15671	0	0
55	Tiruchengode	5	39836	02:32	14.45
56	Tirupathur	2	22069	03:20	9.82
57	Tiruttani	2	18632	00:26	10.26
58	Tiruvannamalai	11	50713	00:02	0.9
59	Tiruvettipuram	2	17126	00:05	3.43
60	Vaniyambadi	6	32251	03:05	1.88
61	Vellakoil	8	18015	01:36	4.58
62	Villupuram	4	23932	08:12	12.57
63	Virudhachalam	1	2	02:32	7



Annexure 19: Projected Cash Flow (Base Case)

The projected Balance Sheet & Cash Flow till FY19 under base case is presented below –

Cash flow statement	FY 16	FY 17	FY 18	FY 19
Cash from Operations				
Revenue	49,300.19	56,557.05	60,810.46	63,349.91
Operating Costs	(47,155.97)	(50,607.23)	(54,644.54)	(59,403.16)
Miscellaneous expenses				
Increase in Short Term Capital requirements	(1,059.97)	(1,279.21)	(408.00)	(153.96)
Tax	-	-	-	-
Net Cash from Operations	1,084.25	4,670.62	5,757.92	3,792.78
Cash from Investment Activities				
Capex	-	(2,850.00)	(3,064.00)	(7,034.00)
Net Cash from Investment Activities	-	(2,850.00)	(3,064.00)	(7,034.00)
Cash from Financing Activities				
Equity Investments	-	163.73	344.33	2,110.20
Debt Drawn	17,999.50	1,554.21	1,975.61	3,485.28
Loan Repayment	(9,335.25)	(7,741.30)	(7,938.86)	(8,287.39)
Increase in working capital loan	1,059.97	1,279.21	408.00	153.96
Payment of past current liabilities	-	-	-	-
Grants	3,069.44	1,132.06	744.06	1,438.52
Interest on cash deficit loan	-	(662.60)	(2,107.30)	(3,879.81)
Interest on Loans	(9,575.25)	(9,486.08)	(8,669.74)	(7,933.04)
Interest on Working Capital Loan	(418.14)	(1,001.95)	(1,051.93)	(1,070.79)
Net Cash from Financing Activities	2,800.27	(14,762.72)	(16,295.83)	(13,983.07)
Net Cash Balances				
Cash BF	897.57	1,418.69	(11,523.41)	(25,125.33)
Cash Flow during the year	3,884.52	(12,942.10)	(13,601.92)	(17,224.29)
Cash	1,418.69	(11,523.41)	(25,125.33)	(42,349.61)

Annexure 20: Projected Balance sheet (Base Case)

Balance Sheet statement (Rs. Cr.)	FY 16	FY 17	FY 18	FY 19
Assets				
Current Assets				
Cash @ Bank	1,418.69	0.00	0.00	0.00
Short term loan and advances	496.59	496.59	496.59	496.59
Other Current Assets	-615	-615	-615	-615
Stocks – Stores	2,579	3,259	3,276	3,306
Receivables	40,546	50,483	51,667	52,601
Total Current Assets	44,426	53,624	54,826	55,790
Non-current Assets				
Gross Fixed Assets	68,060	69,770	72,748	79,634
Less: Accumulated Depreciation	-8,983	-10,636	-12,352	-14,232
Other current assets	1,856	1,856	1,856	1,856
Loans and Advances	55,820.83	62,237.65	69,146.21	79,458.32
Capital Works in Progress	8,321	9,461	9,546	9,694
Net Fixed Assets	125,074	132,687	140,944	156,410
Total Assets	169,500	186,312	195,770	212,200
Liabilities				
Long Term Debt	75,859	69,672	63,708	58,906
Long Term Liabilities	0	0	0	0
Working Capital Loan/ Short term borrowings	5,395	12,070	12,478	12,632
Cash deficit loan	-	11,523.41	25,125.33	42,349.61
Trade payables	8,719	12,224	12,548	12,852
Short term provisions	0	0	0	0
Current Liabilities	48,908	48,908	48,908	48,908
Total	138,881	154,397	162,767	175,648
Equity				
Share Capital	20,001	20,165	20,509	22,620
Grants	5,118	6,250	6,994	8,433
Consumer Contributions				
Capital Liabilities				
Retained Earnings	2,386	5,499	5,499	5,499
Total	30,619	31,914	33,003	36,551
Total Liabilities	169,500	186,312	195,770	212,200



Annexure 21: Projected Cash Flow (Scenario 1)

Cash flow statement	FY 16	FY 17	FY 18	FY 19
Cash from Operations				
Revenue	49,300.19	58,986.28	66,176.23	72,238.79
Operating Costs	(47,155.97)	(50,607.23)	(54,644.54)	(59,403.16)
Miscellaneous expenses				
Increase in Short Term Capital Requirements	(1,059.97)	(1,688.09)	(902.27)	(746.96)
Tax	-	-	-	(12.82)
Net Cash from Operations	1,084.25	6,690.97	10,629.42	12,075.85
Cash from Investment Activities				
Capex	-	(2,850.00)	(3,064.00)	(7,034.00)
Net Cash from Investment Activities	-	(2,850.00)	(3,064.00)	(7,034.00)
Cash from Financing Activities				
Equity Investments	-	163.73	344.33	2,110.20
Debt Drawn	17,999.50	1,554.21	1,975.61	3,485.28
Loan Repayment	(9,335.25)	(7,741.30)	(7,938.86)	(8,287.39)
Increase in working capital loan	1,059.97	1,688.09	902.27	746.96
Payment of past current liabilities	-	-	-	-
Grants	3,069.44	1,132.06	744.06	1,438.52
Interest on cash deficit loan	-	(517.45)	(1,478.69)	(2,323.57)
Interest on Loans	(9,575.25)	(9,486.08)	(8,669.74)	(7,933.04)
Interest on Working Capital Loan	(418.14)	(1,052.04)	(1,162.57)	(1,254.07)
Net Cash from Financing Activities	2,800.27	(14,258.78)	(15,283.59)	(12,017.11)
Net Cash Balances				
Cash BF	897.57	1,418.69	(8,999.12)	(16,717.29)
Cash Flow during the year	3,884.52	(10,417.81)	(7,718.17)	(6,975.26)
Cash	1,418.69	(8,999.12)	(16,717.29)	(23,692.55)

Annexure 22: Projected Balance sheet (Scenario 1)

Balance Sheet statement (Rs. Cr.)	FY 16	FY 17	FY 18	FY 19
Assets				
Current Assets				
Cash @ Bank	1,418.69	0.00	0.00	(0.00)
Short term loan and advances	496.59	496.59	496.59	496.59
Other Current Assets	-615	-615	-615	-615
Stocks – Stores	2,579	3,259	3,276	3,306
Receivables	40,546	50,916	52,648	54,263
Total Current Assets	44,426	54,057	55,806	57,451
Non-current Assets				
Gross Fixed Assets	68,060	69,770	72,748	79,634
Less: Accumulated Depreciation	-8,983	-10,636	-12,352	-14,232
Other current assets	1,856	1,856	1,856	1,856
Loans and Advances	55,820.83	59,689.32	60,661.03	60,636.13
Capital Works in Progress	8,321	9,461	9,546	9,694
Net Fixed Assets	125,074	130,139	132,459	137,588
Total Assets	169,500	184,196	188,265	195,039
Liabilities				
Long Term Debt	75,859	69,672	63,708	58,906
Long Term Liabilities	0	0	0	0
Working Capital Loan/ Short term borrowings	5,395	12,479	13,381	14,128
Cash deficit loan	-	8,999.12	16,717.29	23,692.55
Trade payables	8,719	12,224	12,548	12,852
Short term provisions	0	0	0	0
Current Liabilities	48,908	48,908	48,908	48,908
Total	138,881	152,282	155,262	158,487
Equity				
Share Capital	20,001	20,165	20,509	22,620
Grants	5,118	6,250	6,994	8,433
Consumer Contributions				
Capital Liabilities				
Retained Earnings	2,386	5,499	5,499	5,499
Total	30,619	31,914	33,003	36,551
Total Liabilities	169,500	184,196	188,265	195,039



Annexure 23: Projected Cash Flow (Scenario 2)

Cash flow statement	FY 16	FY 17	FY 18	FY 19
Cash from Operations				
Revenue	49,300.19	56,557.05	60,810.46	63,349.91
Operating Costs	(47,155.97)	(50,604.09)	(54,635.47)	(59,390.82)
Miscellaneous expenses				
Increase in Short Term Capital Requirements	(1,059.97)	(1,279.21)	(408.00)	(153.96)
Tax	-	-	-	-
Net Cash from Operations	1,084.25	4,673.76	5,766.99	3,805.13
Cash from Investment Activities				
Capex	-	(2,850.00)	(3,064.00)	(7,034.00)
Net Cash from Investment Activities	-	(2,850.00)	(3,064.00)	(7,034.00)
Cash from Financing Activities				
Equity Investments	-	411.75	592.35	2,110.20
Debt Drawn	17,999.50	2,050.25	2,471.65	3,671.30
Loan Repayment	(9,335.25)	(7,790.91)	(8,038.07)	(8,405.20)
Increase in working capital loan	1,059.97	1,279.21	408.00	153.96
Payment of past current liabilities	-	-	-	-
Grants	3,069.44	388.00	-	1,252.50
Interest on cash deficit loan	-	(667.00)	(2,126.66)	(3,924.15)
Interest on Loans	(9,575.25)	(9,511.75)	(8,743.90)	(8,033.94)
Interest on Working Capital Loan	(418.14)	(1,001.95)	(1,051.93)	(1,070.79)
Net Cash from Financing Activities	2,800.27	(14,842.39)	(16,488.56)	(14,246.11)
Net Cash Balances				
Cash BF	897.57	1,418.69	(11,599.94)	(25,385.52)
Cash Flow during the year	3,884.52	(13,018.63)	(13,785.57)	(17,474.99)
Cash	1,418.69	(11,599.94)	(25,385.52)	(42,860.50)

Annexure 24: Projected Balance Sheet (Scenario 2)

Balance Sheet statement (Rs. Cr.)	FY 16	FY 17	FY 18	FY 19
Assets				
Current Assets				
Cash @ Bank	1,418.69	(0.00)	(0.00)	(0.00)
Short term loan and advances	496.59	496.59	496.59	496.59
Other Current Assets	-615	-615	-615	-615
Stocks – Stores	2,579	3,259	3,276	3,306
Receivables	40,546	50,483	51,667	52,601
Total Current Assets	44,426	53,624	54,826	55,790
Non-current Assets				
Gross Fixed Assets	68,060	69,770	72,748	79,634
Less: Accumulated Depreciation	-8,983	-10,648	-12,430	-14,395
Other current assets	1,856	1,856	1,856	1,856
Loans and Advances	55,820.83	62,276.37	69,335.71	79,865.00
Capital Works in Progress	8,321	9,461	9,546	9,694
Net Fixed Assets	125,074	132,714	141,056	156,654
Total Assets	169,500	186,339	195,882	212,444
Liabilities				
Long Term Debt	75,859	70,118	64,552	59,818
Long Term Liabilities	0	0	0	0
Working Capital Loan/ Short term borrowings	5,395	12,070	12,478	12,632
Cash deficit loan	-	11,599.94	25,385.52	42,860.50
Trade payables	8,719	12,224	12,548	12,852
Short term provisions	0	0	0	0
Current Liabilities	48,908	48,908	48,908	48,908
Total	138,881	154,920	163,871	177,071
Equity				
Share Capital	20,001	20,413	21,006	23,116
Grants	5,118	5,506	5,506	6,758
Consumer Contributions				
Capital Liabilities				
Retained Earnings	2,386	5,499	5,499	5,499
Total	30,619	31,418	32,011	35,373
Total Liabilities	169,500	186,339	195,882	212,444



Annexure 25: Projected Cash Flow (Scenario 3)

Cash flow statement	FY 16	FY 17	FY 18	FY 19
Cash from Operations				
Revenue	49,300.19	56,227.13	60,461.29	62,980.32
Operating Costs	(47,155.97)	(50,607.23)	(54,644.54)	(59,401.98)
Miscellaneous expenses				
Increase in Short Term capital requirements	(1,059.97)	(1,224.22)	(404.79)	(150.56)
Tax	-	-	-	-
Net Cash from Operations	1,084.25	4,395.68	5,411.95	3,427.78
Cash from Investment Activities				
Capex	-	(2,850.00)	(3,064.00)	(7,034.00)
Net Cash from Investment Activities	-	(2,850.00)	(3,064.00)	(7,034.00)
Cash from Financing Activities				
Equity Investments	-	163.73	344.33	2,110.20
Debt Drawn	17,999.50	1,554.21	1,975.61	3,671.30
Loan Repayment	(9,335.25)	(7,741.30)	(7,938.86)	(8,305.99)
Increase in working capital loan	1,059.97	1,224.22	404.79	150.56
Payment of past current liabilities	-	-	-	-
Grants	3,069.44	1,132.06	744.06	1,252.50
Interest on cash deficit loan	-	(682.31)	(2,170.01)	(3,994.77)
Interest on Loans	(9,575.25)	(9,486.08)	(8,669.74)	(7,942.67)
Interest on Working Capital Loan	(418.14)	(995.21)	(1,044.80)	(1,063.25)
Net Cash from Financing Activities	2,800.27	(14,830.68)	(16,354.62)	(14,122.12)
Net Cash Balances				
Cash BF	897.57	1,418.69	(11,866.31)	(25,872.99)
Cash Flow during the year	3,884.52	(13,285.00)	(14,006.67)	(17,728.34)
Cash	1,418.69	(11,866.31)	(25,872.99)	(43,601.33)



Annexure 26: Projected Balance Sheet (Scenario 3)

Balance Sheet statement (Rs. Cr.)	FY 16	FY 17	FY 18	FY 19
Assets				
Current Assets				
Cash @ Bank	1,418.69	(0.00)	(0.00)	(0.00)
Short term loan and advances	496.59	496.59	496.59	496.59
Other Current Assets	-615	-615	-615	-615
Stocks – Stores	2,579	3,259	3,276	3,306
Receivables	40,546	50,428	51,609	52,540
Total Current Assets	44,426	53,569	54,768	55,728
Non-current Assets				
Gross Fixed Assets	68,060	69,770	72,748	79,634
Less: Accumulated Depreciation	-8,983	-10,636	-12,352	-14,244
Other current assets	1,856	1,856	1,856	1,856
Loans and Advances	55,820.83	62,580.56	69,893.87	80,702.78
Capital Works in Progress	8,321	9,461	9,546	9,694
Net Fixed Assets	125,074	133,030	141,692	157,643
Total Assets	169,500	186,600	196,460	213,371
Liabilities				
Long Term Debt	75,859	69,672	63,708	59,074
Long Term Liabilities	0	0	0	0
Working Capital Loan/ Short term borrowings	5,395	12,015	12,420	12,570
Cash deficit loan	-	11,866.31	25,872.99	43,601.33
Trade payables	8,719	12,224	12,548	12,852
Short term provisions	0	0	0	0
Current Liabilities	48,908	48,908	48,908	48,908
Total	138,881	154,685	163,457	177,006
Equity				
Share Capital	20,001	20,165	20,509	22,620
Grants	5,118	6,250	6,994	8,247
Consumer Contributions				
Capital Liabilities				
Retained Earnings	2,386	5,499	5,499	5,499
Total	30,619	31,914	33,003	36,365
Total Liabilities	169,500	186,600	196,460	213,371

Annexure 27: Annual Training Program of Thermal Training Institute, North Chennai

Sl.	Name of the Training Programme	Level of Participants	Mandays
1	Protection and Advances in Control and Instrumentation in Thermal Power Plant	EE/AEE/AE/JE/JE.II (Eelec)	40
2	O&M of HT/LT Switch Gears, Transformers and Motors	EE/AEE/AE/JE/JE.II (Eelec)	40
3	Generator & Auxiliaries Including Excitation System & AVR and Recent Trends	EE/AEE/AE/JE/JE.II (Eelec)	40
4	Power System Studies, Grid Management, Black Start Procedures	EE/AEE/AE/JE/JE.II (Eelec)	40
5	VFD and Energy Efficient Motors	EE/AEE/AE/JE/JE.II (Eelec)	20
6	SCADA, DCS, DAS and PLC in Power Plant	EE/AEE/AE/JE/JE.II (Eelec/Mech)	40
7	Vibration Monitoring and Analysis, Balancing and Alignment techniques	EE/AEE/AE/JE/JE.II (Eelec/Mech)	40
8	Contact Programme with Manufacturers of ESP, Fans & Air Preheaters for 210/600 MW Power Plant	EE/AEE/AE/JE/JE.II (Eelec/Mech)	40
9	Welding & NDT	EE/AEE/AE/JE/JE.II (Eelec/Mech)	40
10	O&M of Boilers 210/600MW Auxiliaries and Optimization	EE/AEE/AE/JE/JE.II (Eelec/Mech)	40
11	Case Studies on Boiler tube failures Analysis Recent Trends in Boiler Tube Techonogy FSSS	EE/AEE/AE/JE/JE.II (Eelec/Mech)	40
12	O&M of Fuel Handling and Ash disposal /Retrieval, Milling, Balance of Plant, Equipment, schemes	EE/AEE/AE/JE/JE.II (Eelec/Mech)	40
13	Workshop on Operational Emergencies in Thermal Power Plants/ Causes and Remedies	EE/AEE/AE/JE/JE.II (Eelec/Mech)	80
14	Workshop on Operational Emergencies in Gas Turbine/ Causes and Remedies	EE/AEE/AE/JE/JE.II (Eelec/Mech)	40
15	Power Plant Chemistry and Recent Trends	EE/AEE/AE/JE/JE.II (Eelec / Mech), Chemist	40
16	Environment Management in Thermal Power Plant and intro to ISO 14001-2015	EE/AEE/AE/JE/JE.II (Eelec/ Mech/ Civil)	40
17	Workshop on Startup, Synchronisation and Shutdown procedures in 210 /600MW Power Plant	EE/AEE/AE/JE/JE.II (Eelec/Mech)	80
18	Energy Management, Energy Audit and Safety Audit in Power Plant	EE/AEE/AE/JE/JE.II (Eelec/ Mech/ Civil)	40
19	Testing, O&M and Condition Monitoring of TPS Equipments and Station batteries	EE/AEE/AE/JE/JE.II (Eelec/ Mech)	40
20	Protective Relaying and Applications in TPS and Recent Trends	EE/AEE/AE/JE/JE.II (Eelec)	40
21	Workshop on Steam Turbine and its Auxiliaries, Governing System with Case Studies	EE/AEE/AE/JE/JE.II (Eelec/Mech)	40
22	Workshop in O&M of GTPP Equipments	EE/AEE/AE/JE/JE.II	40

Sl.	Name of the Training Programme	Level of Participants	Mandays
		(Elec/Mech)	
23	Performance Optimization of GTPS	EE/AEE/AE/JE/JE.II (Elec/ Mech/ Civil)	40
24	Industrial Safety, Health, Hygiene and Disaster Management in GTPS	EE/AEE/AE/JE/JE.II (Elec/ Mech/ Civil)	40
25	Contact Programme with Manufacturers of GTPS	EE/AEE/AE/JE/JE.II (Elec/Mech)	40
26	Administrative Regulations, Legal aspects & Court Craft	Thermal Engrs/Officers/ Staff	120
27	Tender Regulations, Procurement Procedures & Contract Management	Thermal Engrs/ Officers/ Staff	40
28	Industrial Relation, Labour Laws, RTI & Factories Act.	Thermal Engrs/ Officers/ Staff	40
29	Certified Course on First Aid	Thermal Engrs/ Officers/ Staff	40
30	Onsite training programme on Disaster Management & Mitigation	Thermal Engrs/ Officers/ Staff	120
31	Fire Prevention, Safety, Health and Hygiene & Disaster Management	Thermal Engrs/ Officers/ Staff	120
32	Testing, O&M of Electrical Equipments	TA/RWE	40
33	O&M of Boiler, Turbine and Generator & Auxiliaries	TA/RWE	40
34	O&M of Pumps & Valves	TA/RWE	40
35	On site Scheme tracing in TPS	TA/RWE	80
36	Fire Prevention, Safety and First Aid	TA/RWE	40
37	Seminar for Thermal Power Station (Topics on Field Requirements)	TPS & GTPS Engineers/Staff	180

Note: 57 Batches / 1,260 trainees / 1,960 Man-days

Annexure 28: Annual Training program of Cable Jointing Training & Development Centre

Sl.	Name of the Training Programme	Level of Participants	No. of Days
1	Low Voltage (LV) Heat Shrinkable (PVC/ XLPE) Power Cable Jointing - Hands on Practical Training	RWE Staff	04
2	11 KV High Voltage (HV) Heat Shrinkable XLPE Power Cable Jointing & Termination - Hands on Practical Training	RWE Staff	05
3	33 KV High Voltage (HV) Heat Shrinkable XLPE Power Cable Jointing & Termination - Hands on Practical Training	RWE Staff	05
4	11 KV High Voltage (HV) Tapex XLPE Power Cable Jointing & Push on End termination - Hands on Practical Training	RWE Staff	05
5	Workshop about Power Cables & Jointing Techniques with Practical Demonstration	AEE/AE/JE	03
6	On-site Awareness Training Programme about Power Cables & Jointing Techniques at Generating Stations	AEE/AE/JE	01
7	Effective Power Distribution in Chennai Metros	RWE Staff	02

Note: Total: 36 Batches / 504 trainees / 1776 Man-days

Annexure 29: Annual Training program of Technical Training and Development Centers

Sl.	Name of the Training Programme	Level of Participants	Training Man-days
1	Hands on Training programme on "Standard erection Practices in Distribution Network" (including 1 day on site practical)	RWE Staff	150
2	Hands of Training programme on "Onsite Repairing Techniques on Distribution Transformer (with one-day hands-on training at Spl.Mtce)	RWE Staff	100
3	Training Programme on" Maintenance of Distribution Network for Revenue Maximisation" (Including One day onsite)	RWE Staff	150
4	Training programme on "Condition Monitoring of Sub- Station"	JE II Gr and SS Staff	100
5	Training programme on " Disaster, Emergency planning and Safety Aspects"	RWE staff	200
6	Training Programme on "Loss reduction Through R- APDRP, IPDS and DDGVY Funding Schemes"	RWE Staff	150
7	Training programme on "Effective Estimation Skills in Section office"	CA/CI	100
8	Training programme on "Revenue Maximization in LT Billing and Collection"	Assessment Staff	150
9	Training programme on " Distribution Earthing Practices & achieving Zero outages"	RWE staff	150
10	Training programme on "Effective Monitoring of LT Billing and Auditing"	RB staff	100
11	Training Programme on planning for "post retirement life"	RWE/ Provincial	150
12	Training programme on"Communication & Customer Relations"	RWE/ Provincial	150

Sl.	Name of the Training Programme	Level of Participants	Training Man-days
13	Training programme on "Balancing Role"	Class III&IV Women employees	100
14	Training Programme on "Enhancing IT Skills" (with Hands On training)	RWE/ Provincial	150
15	Workshop on Energy Conservation without funding	Public / Students	250
16	Training programme on " Distribution Earthing Practices & achieving Zero outages"	RWE staff	150

Note: 37 Batches / 925 Trainees / 1900 Man-days

Annexure 30: Annual Training program of Hydro Training Institute, Kuthiraikalmedu

Programme Type	Name of the Training Programme	Level of Participants
REGULAR TRAINING PROGRAMME (RTP)	Right to information Act and Electricity Act	Engineers
	Operating Principle of various types of Governor & Pressure Oil system in Hydro Stations.	Engineers
	Operation and maintenance of Batteries and switch yard equipments.	Engineers / RWE
	Working principle and Operation & Maintenance of Generator.	Engineers / RWE
	Prevention of accident and electrical hazards in hydro power houses & safety	
	Fire Fighting Equipments & Fire Quenching Technique, Rescue Operation and First Aid.	Engrs & RWE Staff
	Capacity building in Disaster Management.	Engrs & RWE Staff
	Principle of Operation of Turbine, its maintenance, Trouble shooting & case studies.	Engrs & RWE Staff
	Prestressed concrete Technologies, Maintenance in Substations	Engrs/RWE Staff
	Maintenance of Power Houses, Roads and approaches, Asset management	Engrs/RWE Staff
	Upkeeping of Dams, Trashrack cleaning works, Do's and Don'ts in operation of Gates	Engrs/RWE Staff
	Recent trends in Energy conservation Techniques and safety in Electrical equipments.	RWE
	SS Equipments ,Earthing practices and measurement.	RWE
	Enhancing Financial skills,Uniform Commercial Accounting System(UCA),Survey reporting	Engineers/ accts/store staffs
ON-SITE TRAINING PROGRAMME (OTP)	Seminar with manufacturers of Batteries and relays	Engineers
	Seminar with Manufacturers on Alignment, Balancing and Vibration Analysis in Preventive/ Predictive Maintenance,	Engineers
	Emerging trends in Non- Destructive Testing Techniques at Testing Laboratories.	Engineers

Programme Type	Name of the Training Programme	Level of Participants
	RLA, R&M and Up-rating of Hydro Stations.	Engineers
	Issues and Challenges faced by Hydro areas.	Engineers
	Training on Computer Aided Design	Engineers
	Seminar on Latest construction techniques with Promoters/ Applicators	Engineers
	Recent trends in application of Chemicals, Coatings, Workshop with applicators	Engineers
	Maintenance of power transformers through seminar with manufacturers.	Engineers / RWE
	Seminar with Manufacturers on Pumps & Compressor used in Hydro stations, its maintenance, performance assessment and trouble shooting.	Engrs & RWE Staff
	Seminar with Manufacturers on Operation & Maintenance of Lifting Machineries like Hoists, Cranes, Steel ropes and the statutory requirement.	Engrs & RWE Staff
	Types of Gates & Valves, Manufacturers view on its maintenance & operation and problems encountered.'	Engrs & RWE Staff
	Computer applications in office.	Adm/Accts/ Stores/RWE
	Manufacturers outlook on Use & Handling of Bearing, Mechanical Seals & Lubrication and its Operation & Maintenance.	Engrs & RWE Staff
	Seminar with manufacturers on Mechanical Auxiliaries of Hydro Stations.	Engrs & RWE Staff
	Dam safety, upkeeping of Dams, Workshop on DRIP works @ site	Engineers/ RWE
	Switchgears & breakers - SF6 gas leakage detection, arresting and Techniques	Engineers / RWE
MANAGEMENT TRAINING PROGRAMME(MTP)	Positive attitude and motivation	Engineers / AO / SO / A.Ad.O & RWE
	Disciplinary proceedings and court crafts.	Engineers / Adm / Store staff
	Stress management for women employees.	Engrs/Adm/ Accts/ Store

Note: 38 Batches / 760 tainees /480 Man-days

Annexure 31: Annual Training program of Transmission and Distribution Training and Development Institute / Madurai

Type of Programme	Name of the Training Programme	Level of Participants
Need Based Training Programmes	Workshop on "Operation and Maintenance of GRID Sub-Station and Lines" (one day on site demo)	AEE/AE/JE I gr.of TANTRANSCO
	Workshop on " Hot line Techniques" (one day on site Demo)	AEE/AE/JE I gr.of TANTRANSCO
	Workshop on "Failure Analysis of Power/ Auto Transformer"	AEE/AE/JE I gr.of TANTRANSCO/ TANGEDCO

	(including Repair bay Visit for Demo)	
	Workshop on "Failure Analysis of Battery, Relay and Control Circuit " (tie up with manufacturer)	AEE/AE/JE I gr. of TANTRANSCO/ TANGEDCO
	Workshop on "Operation and Maintenance of Breakers, PT, CT and Isolators" (tie up with manufacturer)	AEE/AE/JE I gr. of TANTRANSCO/ TANGEDCO
	Workshop on "MRT Activites" (tie up with Realy/ meter manufacturer)	AEE/AE/JE I gr. of MRT TANGEDCO
	Workshop on "Special Maintenance Activities" (tie up with Breaker/ Transformer manufacturer)	AEE/AE/JE I gr. of Spl mtce TANGEDCO
	Reorientation Training for Assistant Engineers	Recurited / Internally selected AEs of 2014.
	Workshop on "Techno commercial Aspects in HT Metering and Billing "	AEE/JE I gr. of TANGEDCO
	Workshop on "Techno commercial Aspects in HT Metering and Billing "	AO/AAO/Accts staffs
	Workshop on " Latest Meters and Metering arrangement in Distribution" (Interaction with Meter manufacturer)	AEE/JE I gr. of TANGEDCO
	Workshop on "Theft of Energy and Assesment and procedures"	AEE/AE/JE I gr. of TANGEDCO
	Workshop on "Distribution Planning"	AEE/AE/JE I gr. of TANGEDCO
	Workshop on "Distribution Section Management"	AEE/AE/JE I gr. Of TANGEDCO
	Workshop on "Building Maintenance & Asset Management"	AEE/AE/Civil
	Workshop on "Enhancing Driving Skills"	Drivers of TANGEDCO/
	Training of Trainers "Distribution Planning"	HRD Wing
On site Programmes	Workshop on "Techno commercial Aspects in LT Metering and Billing " (Regional level)	AEE/AE/JE I gr. of TANGEDCO
	Workshop on "Implementation of IPDS and DDUGJY Schemes" (Regional level)	AEE/AE/JE I gr. of TANGEDCO
	Workshop on " Latest Amendment in Electricity Act 2003, CEA	AEE/AE/JE I gr. of TANGEDCO

	Regulations and TNERC Regulations" (Regional level)	
	Workshop on "Disaster Management and Safety Aspect" (Regional level)	AEE/AE/JE I gr. of TANGEDCO
	Workshop on "Operation and Maintenance of Sub-Station" (Regional level)	AEE/AE/JE I gr. of TANGEDCO
	Seminar on "Energy Conservation & Electrical Safety" without fund	Public / School / College Students

Note: 93 Batches / 1905 trainees / 4310 Man-days

Annexure 32: Annual training program of Staff Training College / Chennai

Type of Programme	Name of the Training Programme	Level of Participants
Regular Programmes	Executive Development Programme	Engineers/Adm./Accounts/Audit/Stores
	Preparing for a Happy and Healthy Retired Life	Class I & II Officers
Need Based Programmes	Management of Power Business in Regulatory Frame Work	EEs/AEEs/AEs/JEs I Gr. (TANGEDCO/ TANTRANSCO)
	Towards Financial Excellence - A Techno-Commercial Approach (TANGEDCO/TANTRANSCO)"	"AEEs/AEs/JEs I Gr./AOs/AOs/ATOs
	Legal Procedures	AEE/AE/JE I Gr. (TANGEDCO/ TANTRANSCO)
	Handling of Court Cases	Adm.O/A.Adm.O (TANGEDCO/ TANTRANSCO)
	Office Administration & Implementation of Taxes	Adm.O/A.Adm.O /AS (TANGEDCO/ TANTRANSCO)
	Enhancing Administrative skills & Implementation of Taxes	Sect. Br./Admn Br. /Tech Br./ Accts. Br (HQ)
	Towards Effective accounting – A Techno-Commercial Approach	AO/AAO/AS (TANGEDCO/ TANTRANSCO)
	Towards Effective Auditing	IAO/AAO
	Payroll Software	Adm. Personnel (TANGEDCO/ TANTRANSCO)
	Enterprise resource planning	Engineers/Officers/Staff
	Revenue & Expenditure Monitoring System Officers/Staff of GCC and P&C Circles	Officers/Staff of GCC and P&C Circles
	Renewable Energy Sources – Status & Development	Engineers
	Stores Management – An Overview	SO/SS/Stores Custodian
	Effective Revenue Management through HT Billing	Officers/Staff of TANGEDCO
Management Programmes	Training of Trainers (TOT)	HRD wing
	Enhancing Managerial Competence	SE / EE

Type of Programme	Name of the Training Programme	Level of Participants
	Enhancing Managerial Competence	EE / AEE /AE / JE I Gr.(Distn.-MRT/ Gen.-MRT/C&I/EM)
	Enhancing Managerial Competence	AEE/AE /JE I Gr
	Enhancing Managerial Competence	AAO/ AS/ Asst. (Accts)
	Enhancing Managerial Competence	A.Adm.O/ Adm. Sup./ Asst. (Adm)
	Enhancing Managerial Competence	FC/DFC/Acct.O/Sr.DCIAO/DCIAO US/DS/SPO/PO/APO/Sr.Adm.O/Adm.O
	Towards Customer Ecstasy	AEE/AE /JE I Gr (Distribution)
	Group Dynamics and Team Building	Class III, Adm of HQ
	Training programme on "Balancing Role"	Class I & II Women Employees
On site Programmes	CGRF Programme	CGRF Members
	RTI & DP – Case studies	Engineers/Adm.Personnel.
	Seminar on Health/General Awareness	Officers/Staff of Headquarters

Note :90 batches/2870 Trainees/5050 Mandays

Annexure 33: Step down transformers in TANTRANSKO

Sl.	Voltage Class (KV)	Number of Sub stations	Total number of units	Different Ratios in use	Different Capacities in use	Number in Each Capacities	Aggergate Capacity (MVA)
1	400	6	22	400/230	315	14	4410
				400/110	200	8	1600
2	230	89	219	230/110	100	179	17900
					80	3	240
					50	12	600
					33.33	3	99.99
				230/33	100	4	400
					50	18	900
3	110	807	2057	110/66	25	1	25
					12	2	24
				110/33	50	71	3550
					25	168	4200
					16	242	3872
					10	61	610
					7.5	1	7.5
					110/22	25	120
					16	239	3824
					10	142	1420
					5	7	35
					4	2	8
					3	1	3
				110/11	25	10	250

Sl.	Voltage Class (KV)	Number of Sub stations	Total number of units	Different Ratios in use	Different Capacities in use	Number in Each Capacities	Aggergate Capacity (MVA)
					16	514	8224
					10	465	4650
					7.5	1	7.5
					5	3	15
					4	6	24
					1	1	1
4	66	6	12	66/11	10	1	10
					7.5	1	7.5
					5	5	25
					3	1	3
					2.5	1	2.5
					2	2	4
					1.75	1	1.75
5	33	593	998	33/11	16	200	3200
					8	591	4728
					5	144	720
					3.15	0	0
					3	39	117
					2	12	24
					1.6	3	4.8
					1.5	7	10.5
					1.25	1	1.25
					1	1	1
Total	--	1501	3308	--	--	3308	68760.29

