REDESIGNING A VIABLE BUSINESS MODEL FOR THE STATE-OWNED POWER DISTRIBUTION COMPANIES IN INDIA WITH REFERENCE TO THE DISTRIBUTION BUSINESS OF TANGEDCO

A Thesis submitted to the
University of Petroleum & Energy Studies

For the award of
Doctor of Philosophy
in
Management (Power)
By

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December 2021

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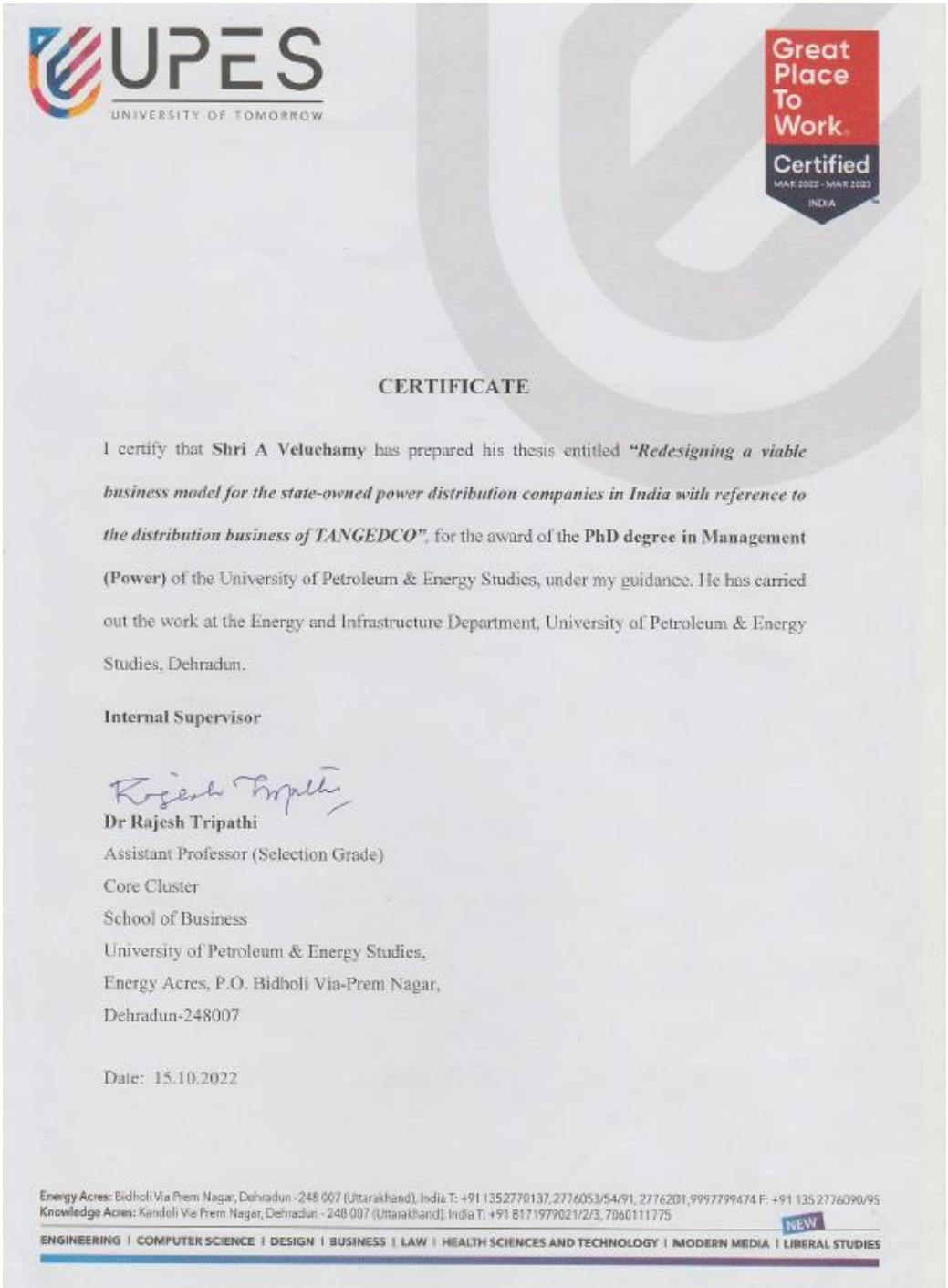

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ABSTRACT

In the post-liberalization era since 1991, several reforms have been implemented in India's power sector to address several challenges, including a huge demand-supply gap, power outages, mounting financial losses of state power utilities, a large number of un-electrified villages, inefficiencies in power distribution, and rampant power theft. However, since the enactment of the most critical legislation, India's power sector has undergone a sea change since the enactment of 'The Electricity Act, 2003,' which introduced competition and private sector investment into the power generation and transmission sectors, with generation capacity quadrupling from 84,000 MW in 1997 to 3,88,000 MW now, power surpluses, and the establishment of a unified synchronous national grid.

Despite multiple rounds of reforms in the power and distribution sectors and the grant of several bailout packages, state-owned DISCOMs continue to incur substantial financial losses. Sustained losses, mounting debt, eroding net worth, and significant payment defaults to power generation companies have made DISCOM's supply business financially unviable and unsustainable. The prolonged deterioration of the state-owned DISCOMs' financial health has impacted the generation and transmission sector and other sectors of the economy, including banking and finance. As a result, it is hindering the nation's economic growth.

Detailed research was conducted to discover the root cause of state-owned DISCOMs' chronic losses and make its business financially viable and sustainable. Additionally, an in-depth study of the distribution business of TANGEDCO, Tamil Nadu's state-owned power utility and the country's top loss-making company, was conducted. The report concludes that the current business model of state-owned DISCOMs is no longer financially viable or

sustainable. Thus, it is crucial to redesign its business models to ensure its financial viability. The study has diagnosed 56 independent variables and 17 latent variables that significantly contributed to the state-run DISCOMs' sustained financial losses. Based on the identified factors contributing to financial unviability, the interrelationship between independent and latent variables, and the weaknesses of the current business model, a Dynamic Business Model for Sustainability (DBMS) is formulated to achieve a vibrant and sustainable power sector.

This innovative research has successfully identified all the nitty-gritty factors contributing to the massive financial losses of the state-owned DISCOMs and the interrelationship among the factors. By developing a theoretical model for diagnosing the factors contributing significantly to the sustained financial loss of TANGEDCO, this research has contributed substantially to the development of the theory. Successful rebuilding of the business model for a state-run DISCOM is a kind in the research parlance, which contributed significantly to the theory of rebuilding business models and business model concepts. Therefore, this research study is of national importance and would pave the way to contain the burgeoning financial losses of the state-run DISCOMs and build a vibrant power sector. Thus, this innovative research contributed substantially to economic growth and nation-building.

ACKNOWLEDGEMENTS

First and foremost, my sincere thanks and gratitude to my supervisors, Dr Raju Ganesh Sunder, Dr Rajesh Tripathi, and Dr R Mohamed Nafi, for their invaluable advice, continuous guidance, and timely support throughout my PhD studies, as well as their immense guidance and support for the publication of three of our theme papers in a SCOPUS, indexed international journal.

I am indebted to all my supervisors in my life for their tremendous support. I am grateful to Dr Anil Kumar, HoD, for his outstanding support and guidance on the research work's technical part and his continuous motivation. I am duty-bound to extend my sincere thanks and gratitude to Dr Tarun Dhingra, Dr Neeraj Anand, Dr Joji Rao, Dr Deepak Bangwal and Dr Pankaj Kumar of UPES for their valuable guidance and great support in employing Research Methodology systematically and as per the requirement of the PhD program. My sincere gratitude to Professors, Assistant Professors and faculty at the School of Business, University of Petroleum and Energy Studies for their unwavering support. They have guided and offered me valuable advice for the research.

My profound thanks and gratitude to Shri C.P. Singh, IAS, Former CMD, TANGEDCO, for his invaluable guidance and support for this research work of national importance and for finding the right solutions to the perennial problem faced by the state-owned DISCOMs. My heartfelt gratitude and thanks to Shri Pratyay Amrit, CMD, Bihar State Power Holding Company Ltd and Chairman, SBPDCL and NBPDCL, and Shri R. Lakshmanan, IAS, ED., REC for their mentorship, steadfast support, encouragement and invaluable learning in the power distribution business.

My heartfelt gratitude to senior officials from TNEB, TANGEDCO, TANTRANSCO, TNERC, and all of my expert friends in the power and finance sectors who took part in the survey and contributed vital information

to the study. My heartfelt gratitude to all senior officials and colleagues at REC and PFC who contributed actively to the survey and expert interview and provided the most needed data for this research.

I extend my sincere thanks and gratitude to all the senior officials of the state-owned DISCOMs, SERCs across the country and Ministry of Power Officials. They participated in the national-level survey and expert interview conducted as part of this research and gave the most valuable input needed for the study.

I'd like to extend my gratitude to Er N.S. Ravikumar, Er Renjit Lal, Shri Soman Nair, Er Braveen Varma and Er Sivamani of the REC Regional Office in Thiruvananthapuram and senior officials of KSEB Ltd, for offering me valuable information, support, and motivation for this novel research study.

Special thanks to my research colleagues Dr R.P.D Arora and Shri Prafulla Varadhe for their valuable input, insightful comments and suggestions for the study. My heartful to Mrs Rakhi Rahall, Asst. Director Shri Mohit, SR&E division, UPES, for their kind and timely support of the study.

Mrs N.R.Latha, my wife, has always been a consistent source of encouragement and unstinted support throughout my PhD programme. My heartful thanks to my son, Er L.V. Chenthil Shiv Guru, and my daughter-in-law, Mrs C. Nivedha, for their constant motivation and unwavering support for the research. My heartfelt gratitude to my loving parents for their persistent encouragement and support during the study.

The report of this innovative research is dedicated to the Indian power sector.

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ABBREVIATIONS

ABT	Availability Based Tariff
APPC	Average Power Purchase Cost
ACS	Average Cost of Supply
APEPDCL	Andhra Pradesh Eastern Power Distribution Company Ltd
APDRP	Accelerated Power Development and Reform Programme
ARR	Average Revenue Realized
AT&C loss	Aggregate Technical and Commercial loss
BMI	Business Model Innovation
BPL	Below Poverty Line
BPLHs	Below Poverty Line Households
BPR	Business Process Reengineering
CCEA	Cabinet Committee on Economic Affairs
CAGR	Compounded Annual Growth rate
CEA	Central Electricity Authority
CERC	Central Electricity Regulatory Commission
DBT	Direct Benefit Transfer Scheme
DERC	Delhi Electricity Regulatory Commission
DDG	Decentralized Distributed Generation
DTR	Distribution Transformer
DISCOM	Power Distribution Company
DDUGJY	Deen Dayal Upadhyay Grameen Jyothi Yojana
DBMS	Dynamic Business Model for Sustainability
EA Act	Electricity Act, 2003
EAB	Electricity Amendment Bill
ECEA	Electricity Contract Enforcement Authority
FI	Financial Institution
FOR	Forum of Regulators
FRBM	Fiscal Responsibility and Budget Management
FRP	Financial Restructuring Package
GDP	Gross Domestic Product
GENCO	Power Generating Companies
GSDP	Gross State Domestic State Product
G,T,D	Generation, Transmission, Distribution
GoI	Government of India
GoTN	Government of Tamil Nadu
GW	Giga Watt
HT	High Tension
HVDS	High Voltage Distribution System
IPP	Independent Power Producer
IPDS	Integrated Power Development and Reform Programme
kV	Kilo Volt
kVA	Kilo Volt Ampere
kW-Hr / kWh	kilowatt-Hour (unit of electric energy)
LT	Low Tension

LVDS	Low Voltage Distribution System
MoP	Ministry of Power
MU	Million Units
MW	Mega Watt
MW-Hr/MWh	Mega Watt Hour (1 MW-Hr = 1,000 kW-Hr)
NDPL	New Delhi Power Ltd
NEF	National Electricity Fund
NPA	Non Performing Asset
NREP	National Renewable Energy Policy
NTP	National Tariff Policy
OBMI	Open Business Model Innovation
O&M	Operating & Maintenance
PLF	Plant Load Factor
PFC	PFC Ltd (Formerly Power Finance Corporation Ltd)
PPA	Power Purchase Agreement
PSPCL	Punjab State Power Corporation Ltd.
R-APDRP	Restructured Accelerated Power Development and Reform Programme
RDSS	Revamped Distribution Sector Scheme
REC	REC Ltd (Formerly Rural Electrification Corporation Ltd.)
RGGVY	Rajiv Gandhi Grameen Vidyutikaran Yojana
RBI	Reserve Bank of India
RM	Research Methodology
RO	Research Objectives
RPO	Renewable Power Purchase Obligation
Rs/INR	Indian Rupees
SAUBHAGYA	Pradhan Mantri Sahaj Bijli Har Ghar Yojana
SEB	State Electricity Board
SERC	State Electricity Regulatory Commission
SFS	Self Finance Scheme under Agriculture Category of Load
SLDC	State Load Dispatch Centre
STL	Short Term Loan
TANGEDCO	Tamil Nadu Generation and Distribution Company Ltd
TANTRANSCO	Tamil Nadu Transmission Company Ltd
TNEB	Tamil Nadu Electricity Board
TNERC	Tamil Nadu Electricity Regulatory Commission
TRANSCO	Power Transmission Company
T&D	Transmission and Distribution
UDAY	Ujwal DISCOM Assurance Yojana

CHAPTER 1

INTRODUCTION

Electricity is included in the concurrent list in the constitution of India. Hence, both the union government and the state governments will exercise jurisdiction over the energy sector. Both central and state governments have implemented a series of reforms to strengthen the energy sector, improve the financial viability of state-owned power utilities, and increase competition through private investment. The Indian power sector has witnessed the implementation of several reforms in the power sector during post-liberalization since 1991 to develop the sector and to address a series of challenges, including a huge demand-supply gap, power outages, mounting financial losses of power utilities, a large number of un-electrified villages, inefficiencies in power distribution, rampant power theft, the deteriorating financial health of state-owned power utilities.

The Indian power sector has undergone a revolutionary change since the enactment of 'The Electricity Act, 2003,' important legislation, which includes the introduction of competition and private sector investment into the power generation and transmission sectors, quadrupling of generation capacity from 84,000 MW in 1997 to 3,88,000 MW now, power surpluses, 100% electrification of rural villages and households and the establishment of a unified synchronous national grid.

Power sector reform schemes

The Government of India and the state government have implemented numerous reform schemes in the power sector to develop the power sector and several reform schemes in the power distribution sector to enhance the financial viability of the state-run DISCOMs after the enactment of the Electricity Act, 2003 with a substantial grant to the state power utilities and

DISCOMs. Several reform schemes undertaken by the Government of India and the State Governments are mentioned hereunder:

1. "Accelerated Power Development Program (APDRP) to reduce AT&C losses
2. Restructured Accelerated Power Development Program (RAPDRP)
3. Ultra Mega Power Projects (UMPP), a novel scheme of the Government of India to dramatically lower the cost of power generation based on the tariff offered by the participants in international bidding.
4. Ultra Mega Power Projects (UMPP), a tariff-based international competitive bidding process for pit-head generation projects to lower power generation and tariff.
5. International competitive bidding for Inter and Intra transmission projects based on the lowest wheeling charge quoted.
6. Rajiv Gandhi Grameen Vidyuthikaran Yojana (RGGVY) for the electrification of rural villages in India
7. Decentralized Distributed Generation (DDG) for power supply to the remote villages not connected to the power grid.
8. Distribution Reforms Upgrade and Management (DRUM)
9. Jawaharlal Nehru National Solar Mission (JNNSM) for implementation of solar power projects
10. National Electricity Fund (NEF)
11. Deen Dayal Upadhyay Gram Jyothi Yojana (DDUGJY)
12. Smart grid initiatives
13. Power for All
14. Ujwal DISCOM Assurance Yojana (UDAY) 2015
15. Restructured Distribution Reform Scheme (RDSS)"

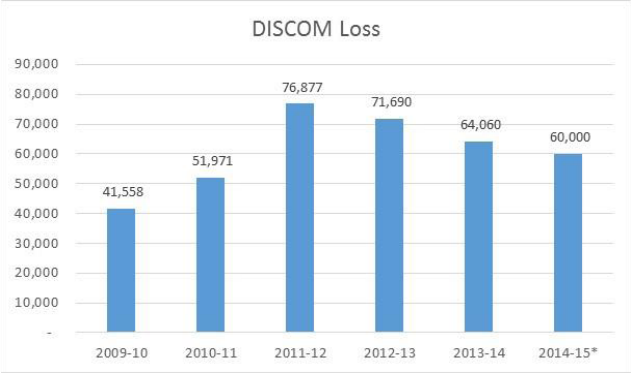
While the past reforms have aided in the significant development of the electricity sector, they have not made the state-owned DISCOMs business financially viable, which is one of the primary objectives of power sector reforms. Despite multiple rounds of reforms in the power and distribution sectors and the grant of several bailout packages, state-owned DISCOMs

continue to incur substantial financial losses. Sustained losses, mounting debt, eroding net worth, and significant payment defaults to power generation companies have made DISCOM's power supply business financially unviable and unsustainable.

1.1 UNSUSTAINABLE BUSINESS OF STATE-OWNED DISCOMS

As per the Ministry of Power statistics, the state-run discoms continue to incur huge financial losses year-on-year basis as shown in Figure1.1.

Figure 1.1



Source: Ministry of Power, GoI ppt dated 9.11.2015 on "Towards Ujwal Bharat UDAY: The story of reforms." (Audited DISCOM Accounts)

The sustained financial loss of Indian DISCOMs

"According to the PFC report on the performance of state power utilities, the cumulative financial losses of state-owned DISCOMs over the six years from 2009-10 to 2014-15 reached an unsustainable level of Rs.3,66,156 crore in March 2015 as shown in Figure 1.1." [35]. The DISCOMs debt keeps mounting year after year. As per the PFC report [35], the total debts of DISCOMs during 2015-16 stood at Rs.88,782 crore. As a result, DISCOMs have registered negative net worth. For 2015-16, state-run DISCOMs had a net worth of Rs.46,299 crore (negative). [35]

Due to the sustained financial losses, and substantial debt levels, state-owned DISCOMs are unable to carry out the needed capital expenditure programmes to reduce the enormous Transmission and Distribution losses. [1] As a result, DISCOMs have defaulted on Banks and Financial institutions in servicing their loans, resulting in huge Non- Performing Assets (NPA) in the Bank's

loan book. In addition, DISCOMs also defaulted in making payments for the power purchased from the power generating companies (GENCOs).[8]

1.1.1 Sustained deteriorated financial performance of state-run discoms

The state-owned power distribution companies (DISCOM) incur substantial financial losses continuously despite the government's numerous reforms in the power sector and continued efforts to improve financial performance. Table 1 shows the deteriorated financial performance of the state-run DISCOMs indicated by the mounting losses, huge accumulated losses, negative net worth, mounting debts and piling up of regulatory assets.

Table 1.1

Financial performance of the state-run Indian DISCOM

(Rs. Crore)

FY	2015-16	2016-17	2017-18	2018-19
After-tax profit/(loss) on a subsidy-received basis	(48,619)	(38,745)	(33,594)	(61,360)
After-tax Profit/(Loss) on subsidy received basis (excluding UDAY Grant and regulatory Income)	(53,287)	(60,911)	(59,588)	(85,803)
Accumulated profit /(losses)	(4,13,933)	(4,11,753)	(4,40,826)	(4,88,686)
Net worth (Negative)	(46,229)	(46,356)	(50,624)	(62,124)
Outstanding loans	4,21,087	4,16,957	4,54,548	4,78,452
Outstanding regulatory assets	79,515	1,12,288	1,26,522	1,34,459

Source: PFC Report [42] [43] [44]

DISCOMs accumulated losses and total debts are mounting year-on-year basis. As per the PFC report [44], as of March 2019, state-run DISCOMs' accumulated losses have reached an unprecedented level of Rs.4,88,686 crore, with a total loss of Rs.61,360 crore on a subsidy-received basis. 'The total debt of DISCOM and aggregate revenue shortage in 2018-19 reached an alarming level of Rs.4,78,452 crore and Rs.49,517 crore, respectively. As a result, the financial health of the state-owned DISCOMs has severely deteriorated.

Even after implementing the Ujwal DISCOM Assurance Yojana (UDAY) scheme, Liquidity infusion packages for state-run DISCOMs the power

distribution business has become financially and commercially unsustainable due to prolonged financial losses of state-run DISCOMs, growing revenue shortages, mounting debts, and vast overdue and acute liquidity crunch.

1.1.2 Financially unviable power distribution business of state-run discoms

The state-owned DISCOMs' financial condition has severely deteriorated. The problems have become acute in recent past years, to the point of being worrisome. As per the World Bank report “India's state-owned power distribution companies incur substantial financial losses despite the government's numerous reforms in the power sector and continued efforts to improve financial performance.[61] While these reforms have aided in the growth of the electricity sector, they have not resulted in achieving the financial viability and business sustainability of state-run DISCOMs, the primary objectives of the energy sector reform in India”[40]. Due to continuous business losses, the state-run DISCOMs' power distribution businesses have become financially unviable and commercially unsustainable. As a result, state-owned DISCOMs are unable to carry out the power supply business without capital and revenue subsidies from the Central and State governments.

1.1.3 Weak distribution sector holding back the nation's economic development

The Government of India has repeatedly emphasized the crucial need for an efficient, robust, and financially sound power sector for economic growth and poverty alleviation. Power is the prime mover for the country's economic development, and the power distribution sector is the backbone of the Indian power sector. The most serious difficulty confronting the Indian power sector is that distribution has historically been the weakest link in the entire value chain of the power sector. The prolonged deterioration of the state-owned DISCOMs' financial health has impacted the generation and transmission sector and other sectors of the economy, including the banking and finance sector. As a result, it is hindering the nation's economic growth.

"The World Bank cautioned in its 2015 study report titled 'Beyond Crisis: India's power sector's financial performance that the Indian power utilities' loss-making tendency continued to deteriorate year after year, reaching a level labelled 'India's subprime crisis."[63]. Sustaining the state-owned DISCOMs' financial losses poses a severe threat to India's energy security and is hampering the country's economic development.[62]

1.1.4 The dire need to financially turnaround DISCOMs for its business sustainability

Several reforms in the power distribution sector have failed to achieve the financial viability of DISCOMs. Therefore, there is an urgent need to find the appropriate solution on a war footing basis for the DISCOMs' severe long-term problems, impeding the nation's economic progress. To ensure the sustainability of power sector reforms, it is critical to strengthen the financial position of state-owned DISCOMs and ensure that their power distribution businesses are financially and commercially viable. [53]

1.2 NEED FOR THE RESEARCH

Since 1991, the Indian electricity sector has undergone various reforms, especially after the enactment of 'The Electricity Act, 2003". However, despite multiple rounds of reforms, these reforms have not been effective in improving the financial health of the state-run DISCOMs. As a result, the cumulative loss of state-owned electricity utilities in 2015-16 reached the critical level of Rs.4,85,923 crores, a whopping 4.3 per cent of India's GDP. According to the PFC report [42], the state-owned DISCOM's aggregate losses increase year after year and have reached an unsustainable level.

Sustained financial losses have heavily deteriorated the financial health of the state-run DISCOMs, which remains a significant threat to India's energy security and economic growth. It has heavily impacted the power sector and the other sectors of the economy, including the banking sector, in a big way witnessed by the mounting Non-Performing Assets (NPA) and massive provisioning in Bank's loan books due to the defaults in serving their loans by

DISCOMs. As a result, the state-run DISCOMs' power supply business becomes financially and commercially unviable and unsustainable.

1.2.1 Motivation behind the research

The economy's primary driver is power, and the power distribution sector has been the backbone of the power sector, which remains the weakest link in India's power sector value chain. As a result, ensuring the electricity sector's financial and operational sustainability and the financial viability of state-owned DISCOMs has become the most critical to achieving the country's economic development.

The Indian government has approved numerous financial restructuring/bailout packages to enable bankrupt DISCOMs to get back on track. The first restructuring package, worth Rs.40,000 crore, was approved in 2002, and the second one, for Rs.1,90,000 crore, was approved in 2012 to turn around the state-run DISCOMs financially. As per the PFC report, the accumulated losses of DISCOMs have ballooned to Rs.3,80,000 crore, and the total DISCOMs debt reached a very high level of Rs. 4,30,000 crore in FY 2014-15 despite the above two bailout packages and several reform programs implemented in the Indian power distribution sector. [42]

1.2.2 Unsustainable business model of the state-run discoms

According to Alexander Osterwalder and Yves Pigneur [3] "A business model explains how a company generates, delivers, and captures value for its customers and for itself. It is a conceptual tool that comprises elements and their interactions and allows a company's logic of earning profit. Alexander Osterwalder and Pigneur have generated a business model canvas with nine interlinking components viz., customer segment, value propositions, channels, customer relationships, revenue stream, key resources, key activities, key partnerships, and cost structure.

Unfortunately, the earlier reforms implemented in the Indian power sector have failed to solve the perennial problem of the financially unviable

distribution business of the state-run DISCOMs. Hence, there is a dire need to enhance the financial solvency of the state-run DISCOMs to put the power sector and the country's economy back on track. Strong reforms in the power distribution sector are urgently required.

Despite several rounds of reforms and bailout packages granted to state-run DISCOMs, their financial health has not improved. Instead, it has heavily deteriorated. As a result, the electricity distribution business of DISCOMs has become unprofitable and unsustainable from a financial and commercial standpoint [56]. The state-owned DISCOMs' current business model has become unsustainable. There is a dire need to radically change its business model to make its distribution business profitable, financially and commercially sustainable.

Therefore, there is a dire need to conduct a research study using scientific methodology to determine the variables causing persistent financial losses to the state-owned DISCOMs, which led to the unsustainable business of the state-run discoms. There is a need to have a detailed study of the present business model and its weaknesses to redesign a financially viable business model for the state-owned discoms.

1.2.3 The dire need to redesign the business model of the state-run DISCOMs

For a business model to be sustainable, it should be commercially viable, future-ready, and part of a sustainable society to succeed in a world of growing, volatile energy and commodity prices.' A profitable business is the best early indicator of a financially viable and sustainable business model. A company's profit formula is the blueprint for how it creates value while also offering value to its customers[56].

Therefore, an appropriate business model is critical for a company's long-term viability and sustainability. Business models are perishable [41]. Hence, there is an urgent need for state-owned DISCOMs to develop or redesign their

business models to make their businesses financially, commercially viable and sustainable.

With this background, a detailed research study has been carried out using scientific methodology to find a long-term solution to the state-run Indian DISCOM's unsustainable business operations and to make its power supply business financially viable and sustainable.

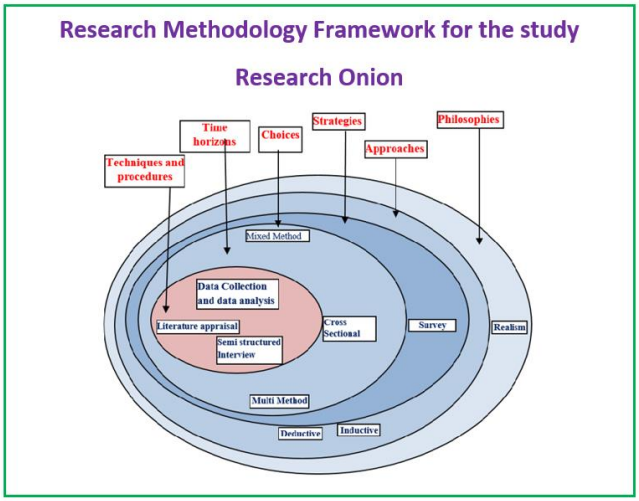
1.3 Research Methodology

A detailed research study was conducted using the scientific methodology in State-run DISCOMs across India to achieve the above objective. In addition, a thorough diagnostic research study was conducted at Tamil Nadu Generation and Distribution Company Ltd. (TANGEDCO), a power utility wholly owned by the Government of Tamil Nadu, incurring the highest losses among DISCOMs across the country.

1.3.1 Research Design

Saunders devised the research Methodology framework in a Research Onion to choose the proper research methodology. As indicated in Figure 1.2, the following research methodology framework was employed to conduct the research work.

Figure 1.2



Research Onion

1.3.2 Research methodology framework

The research methodology framework is detailed in Table 1.2.

Table 1.2

Research Methodology Framework

Research Philosophy	Realism	Realism philosophy is adopted to understand complex problems and issues, as it comprises three components viz., R*eality*, A*ctual* and E*mpirical. It is a* combination of both positivism and interpretivism. The study is both **subjective and objective.**
Research Approach	Deductive & Inductive	The research process follows both deductive (based on logic) and inductive approaches. Thus, the research study is both **Qualitative and Quantitative.**
Research Strategy	Literature survey, Primary data and expert interview	The explorative study method was used to identify the research gap and critical research variables, i.e., the variables that have contributed to the long-term financial losses of the state-owned DISCOMs and TANGEDCO by the in-depth literature survey. Furthermore, primary data was collected for TANGEDCO to validate the identified research variables, i.e., factors contributing to the sustained losses of TANGEDCO. a semi-structured interview was employed to get an expert opinion to develop a conceptual framework for diagnosing the factors contributing to the sustained financial losses of TANGEDCO. Based on the identified factors (independent variables, latent variables and their relationships) conceptual framework (theoretical model) is developed for TANGEDCO to diagnose all the factors contributing to the sustained loss of TANGEDCO. Based on the identified variables and their interrelationship, which are causing financial losses to TANGEDCO, the study of various business models for

		power distribution business and experience gathered from India's past power sector reforms, a financially viable and sustainable business model for TANGEDCO developed.
Research Choice	Multiple methods	Multiple methods were employed in the research viz., secondary data collection from the in-depth literature survey, primary data collected by a survey method using a research questionnaire, interview method to get the expert opinion and Structural Equation Modelling techniques for analysis of the factors contributing to the sustained financial loss of TANGEDCO.
Research time horizon	Cross-sectional method	The primary data collected is for one time period. Hence, it is cross-sectional. However, the secondary data collected for analysis are from past periods.
Research techniques and procedures	The explorative study, survey & semi-structured interview	The secondary data was collected from an in-depth **literature survey** to identify the critical research variables. **Primary data** was collected by the Survey method from TANGEDCO's stakeholders through a well-designed Research Questionnaire and a structured interview to validate the identified research variables. **Statistical tools for analysis & evaluation of models:** SmartPLS3 software was used to analyze and evaluate th e conceptual framework developed for TANGEDCO using Partial Least Square Structural Equation Modelling PLS-SEM) technique. "PLS-SEM is a powerful yet complex, multivariate statistical analysis technique employed to investigate the structural link between measured and latent variables."

1.3.3 Business problem

State-run DISCOMs are incurring significant financial losses, consistently putting a damper on the development of the Indian power sector and other sectors of the economy and hindering the country's economic growth. Despite the implementation of several rounds of reforms in the power distribution sector since 2003, the state-run DISCOMs' financial health has deteriorated significantly, and the DISCOMs' power supply business has become financially unviable and unsustainable. Thus, there is a dire need to make DISCOM's business financially viable and sustainable to bring back the power sector on track and achieve the nation's economic growth.

1.3.4 Research gap

A comprehensive review of the literature is conducted in two streams (1**) Explorative study of the Indian power sector and reforms implemented in the power sector** and (2) **Thematic review** on various themes viz., "*Theory of the firm, Theory of business, business model concept, sustainable business models, business model development, rebuilding business models and the concept of value creation."*

The extensive literature review conducted and the summary of the literature review summary is elaborated on in Chapter 3. From the detailed literature survey, the following research gap was identified:

Research Gap	**"Non-availability of a financially viable and sustainable business model for the state-owned power distribution companies in India"**

1.3.5 Research problem

The research problem was formulated based on the business problem and the identified research gap from the extensive literature survey. Based on the detailed literature review, several research reports and published theme papers have identified several research variables viz., independent variables and dependent variables (and the relationship between them), which contributes

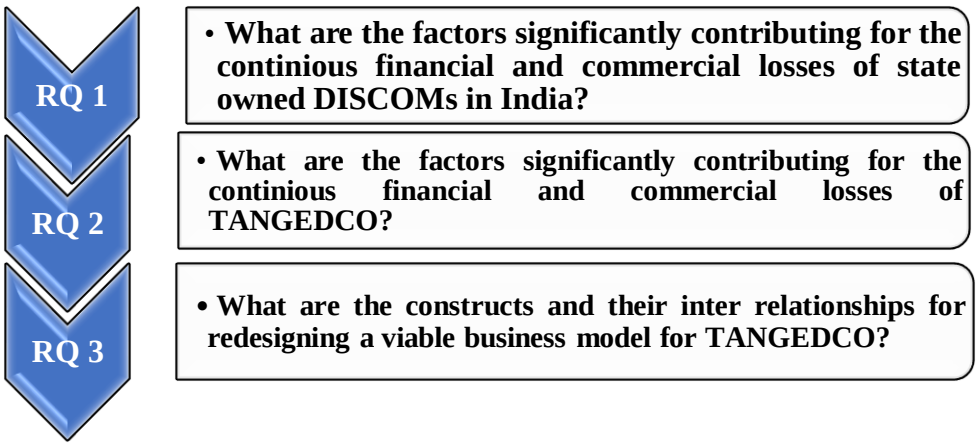
significantly to the sustained financial losses of DISCOMs. However, it was scattered in many research reports and published theme papers. A financially viable business model has not been developed so far using these research variables contributing to the sustained business loss of the state-run DISCOMs in India. The research finds a lack of constructs to build a financially viable and sustainable business model.

The detailed literature survey finds a lack of constructs for building a financially viable and sustainable business model for state-owned DISCOMs in India. Based on the business problem and the identified research gap, the following research problem was formulated:

Research Problem	**"Lack of constructs available for the development of a viable business model for the state-owned power distribution companies in India"**

1.3.6 Research questions

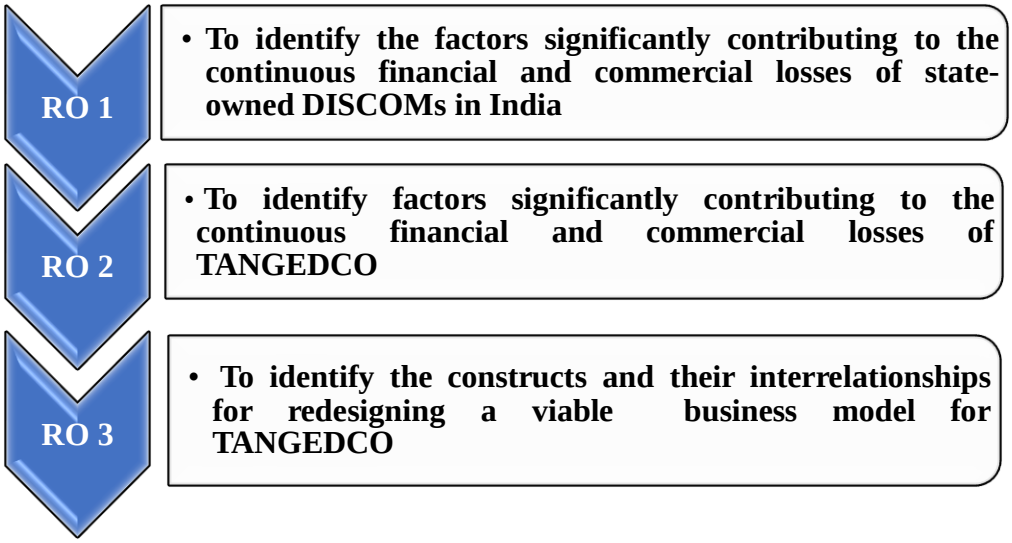
To find the solution to the identified research problem, the following three Research Questions were posed: RQ1, RQ2, and RQ3:



1.3.7 Research objectives

The primary objective of the research is to identify the different variables i.e. both observed variables (Measurable variables) and unobserved variables (Latent variables or construct) that contribute to state-run DISCOMs' long-

term financial losses and find the inter-relationship among the measurable variables and latent variables to redesign a financially viable business model for the state-run DISCOMs. The research was carried out to achieve the following three Research Objectives (RO) viz., Research Objective 1 (RO1), Research Objective 2 (RO2) and Research Objective 3 (RO3) as mentioned below:



1.4 RESEARCH METHODOLOGY TO ACHIEVE RESEARCH OBJECTIVE-1

Research Objective 1 (RO1) is to identify the factors (variables) significantly contributing to the financial and commercial losses of the state-owned DISCOMs.

1.4.1 Secondary data collection to identify the research variables

Secondary data was collected to identify the research variables (both independent and latent variables) contributing to the financial loss of the state-run DISCOMs in India to achieve this Research Objective (RO1). An extensive literature survey was done to collect the needed secondary data for the study. In addition, an explorative study method is employed to identify the research variables.

To identify the factors (research variables) significantly contributing to the sustained financial loss of the state-owned DISCOMs in India, the secondary

data required for the study collected by detailed literature review from the published reports, scholarly research study reports, theme papers on power sector reforms, the performance of DISCOMs from various sources mentioned hereunder:

1.4.2 Sources of secondary data

The study needed secondary data collected from various sources, viz., theme papers on power sector reforms, Performance of SEBs/DISCOMs, Annual financial reports of DISCOMs published by the Ministry of power, PFC Ltd, REC Ltd., published government reports on various power sector reform programs, research reports published by the Multilateral Financial Institutions like the World Bank, study report submitted by the different committee appointed by the Govt. of India (GoI) for reform purposes, Tariff petition filed by DISCOMs, tariff order issued by the SERCs, which is **reliable, accurate and consistent.**

The secondary data for the study was captured from the following sources:

1. "Research reports and periodical reports on state-owned power utilities' performance published by various government agencies, including PFC Limited, REC Limited, Central Electricity Authority (CEA), Planning Commission of India, and NITI AYOG.
2. World Bank and Asian Development Bank research study report on reform in India's Indian power sector, distribution sector, and performance of state power utilities.
3. Reports of various power sector reforms schemes implemented by the Govt of India and the State Governments inter-alia the following:
   - Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY) 2005
   - Accelerated Power Development and Reform Programme (R-APDRP) (2008)
   - Restructured Accelerated Power Development and Reform Programme (R-APDRP) (2008)
   - Decentralized Distributed Generation (DDG) Scheme for electrification of remote villages (2012)

- National Electricity Fund (NEF)
- Financial Restructuring Packages (FRP) granted in 2002 and 2012 By the Ministry of Power to bailout SEBs and DISCOMs
- Deen Dayal Upadhyay Gram Jyothi Yojana (DDUGJY) (2013) for rural electrification of rural India
- Integrated Power Development Scheme (IPDS) for electrification In urban areas
- Ujwal Discom Assurance Yojana (UDAY), a financial restructuring package granted by the Ministry of Power in 2015.

4. Annual Financial report of DISCOMs
5. Annual performance report published by DISCOMs/SEBs.
6. Tariff petitions filed by the state-owned DISCOMs across India.
7. The committee report of the various committee appointed by the Govt of India for a detailed study of the power sector/SEBs/DISCOMs to plan and implement various power sector reform schemes aimed at enhancing the financial health and sustainability of SEBs/DISCOMs viz.,
   - Abraham Committee report for power sector reforms through Accelerated Power Development Programme (APDRP)
   - V.K. Shunglu Committee report (Report of the high-level committee appointed by the Government of India to study the financial health of state-run power utilities headed by former CAG Shri V.K. Shunglu)
8. Performance report published on the respective websites of State Electricity Boards (SEBs)/DISCOMs.
9. Tariff petitions filed by DISCOMs.
10. Tariff order issued by the CERC and SERCs.
11. Theme papers published in national and international journals, research studies on the Indian power sector, and books on the subject matter.
12. The orders issued by the Appellate Tribunal for Electricity.
13. Database of Distribution Reforms, Upgrade and Management (DRUM) program
14. Database and report published by the Central Electricity Authority (CEA)

15. Reports, and guidelines issued by the nodal agencies of the Ministry of Power viz., REC Ltd and PFC Ltd for implementing various Govt of India reform programs.

16. Various Government laws enacted, policies pronounced, rules and regulations issued by the Government of India and the Ministry of Power connected with various power sector reform programmes". The important law and energy policies are mentioned below:

Important laws & energy policies

"Secondary data were collected from various Acts, laws and energy policies including Electricity Act, 1910, Electricity Supply Act, 1948, Amendments to the Electricity Supply Act, 1991, Mega Power Policy, 1995, Electricity Regulatory Commission Act, 1998, Amendment to Electricity Supply Act, 1998, Energy Conservation Act, 2001, Electricity Act, 2003, Electricity Regulatory Commission Act, National Tariff Policy, 2005, National Tariff Policy, 2005, Integrated Energy Policy, 2005, Rural Electrification Policy, 2005, Electricity Amendment Bill, 2014."

Power sector reform schemes

"Secondary data were also collected from various power sector reform programmes implemented in the Indian power distribution sector including Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY), Accelerated Power Development and Reform Programme (APDRP) (2003), Restructured Accelerated Power Development and Reform Programme (R-APDRP) (2008), National Electricity Fund (NEF) Scheme, Decentralized Distributed Generation (DDG) Scheme (2012), Deen Dayal Upadhyay Gram Jyothi Yojana (DDUGJY) (2013), Financial Restructuring Package granted to DISCOMs, Ujwal Discom Assurance Yojana (UDAY) Scheme (2015), Pradhan Mantri Sahaj Bijli Har Ghar Yojana (SAUBHAGYA) Scheme (2018), Atma Nirbhar Bharat Abhiyan (2020)- a reform linked liquidity infusion scheme".

1.4.3 Secondary data on business models of DISCOMs

The secondary data is collected to identify the research variables by a detailed study of various business models adopted by DISCOMs in India viz., Public-Private Partnership (PPP) model, Franchisee model, Wholly-owned ownership of the state-run DISCOMs by the state government, DISCOMs owned by the electricity departments of the Union Territories in India. In addition, various research reports published theme papers on power sector reforms and various business models adopted by DISCOMs in India. Furthermore, business models of power utilities in countries other than India are also studied in detail through various research reports and theme papers.

1.4.4 Analysis of secondary data

The secondary data collected were analysed to diagnose the research variables, significantly contributing to the sustained financial loss of the state-run DISCOMs.

It is worth noting that electricity is on the concurrent list of India's constitution, and energy distribution by state-run DISCOMs is a highly regulated business. The state-owned DISCOMs operate in almost similar regulatory, legal, environmental, social, economic, and political environments. Hence, the research variables contributing to the sustained losses of the state-run DISCOMs are almost common or similar for DISCOMs across the country. For example, the technical loss happens in the distribution network for all DISCOMs; only the quantum of technical losses varies from DISCOM to DISCOM.

From the analysis of secondary data collected, research variables causing the sustained financial losses of the state-run DISCOMs were identified. The research variables identified from the study were taken as input for designing the Questionnaire to collect the needed primary data through the survey method to achieve Research Objective 2. i.e., to identify the factors contributing to the sustained financial and commercial losses of TANGEDCO.

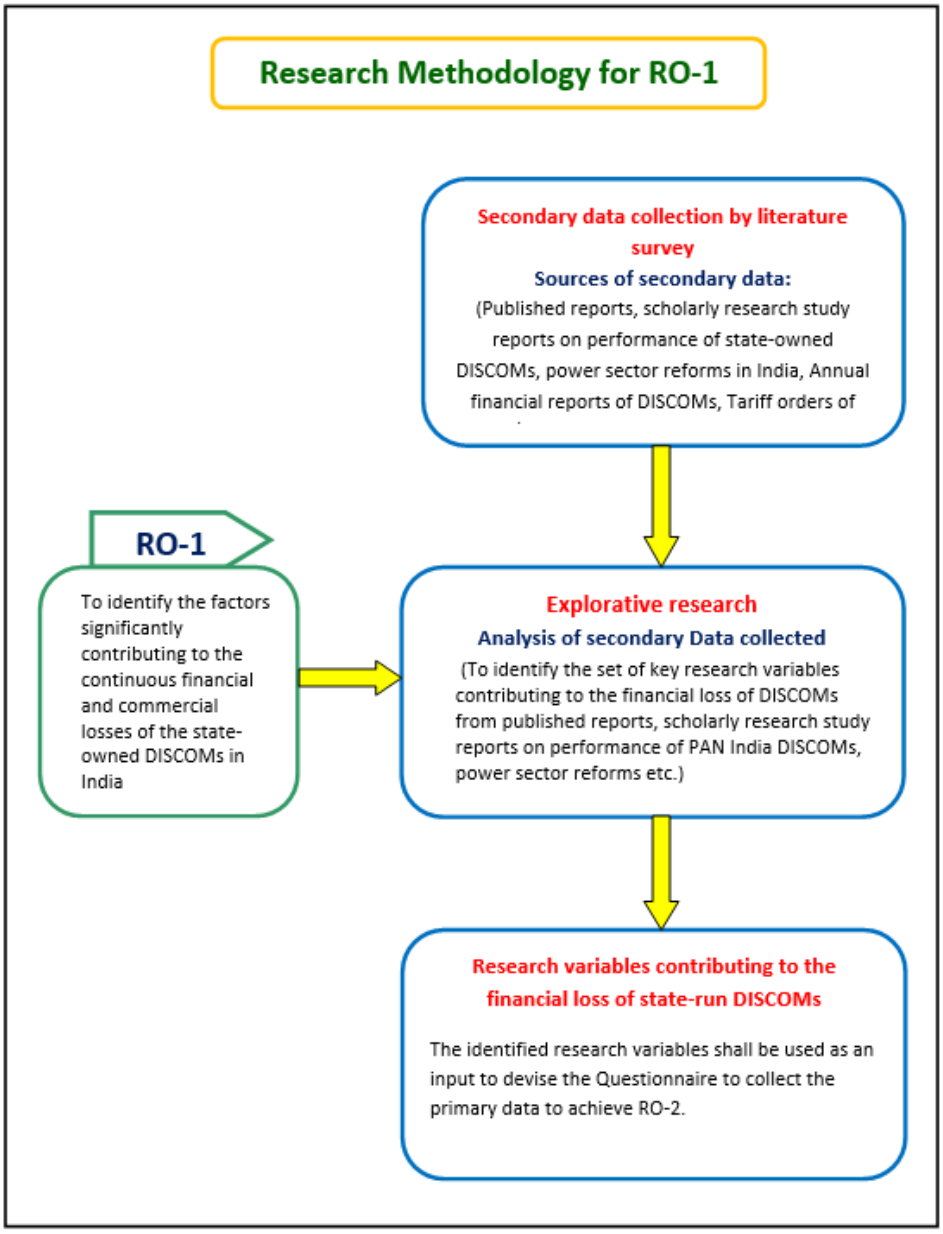
1.4.5 Research Methodology flow chart to achieve Research Objective 1

The Research Methodology flow chart to achieve Research Objective 1 (RO1) is depicted in Figure 1.3

Figure 1.3

Research Objective-1

To identify the factors significantly contributing to the continuous financial and commercial losses of the state-owned DISCOMs in India



Research methodology flow chart for Research Objective 1

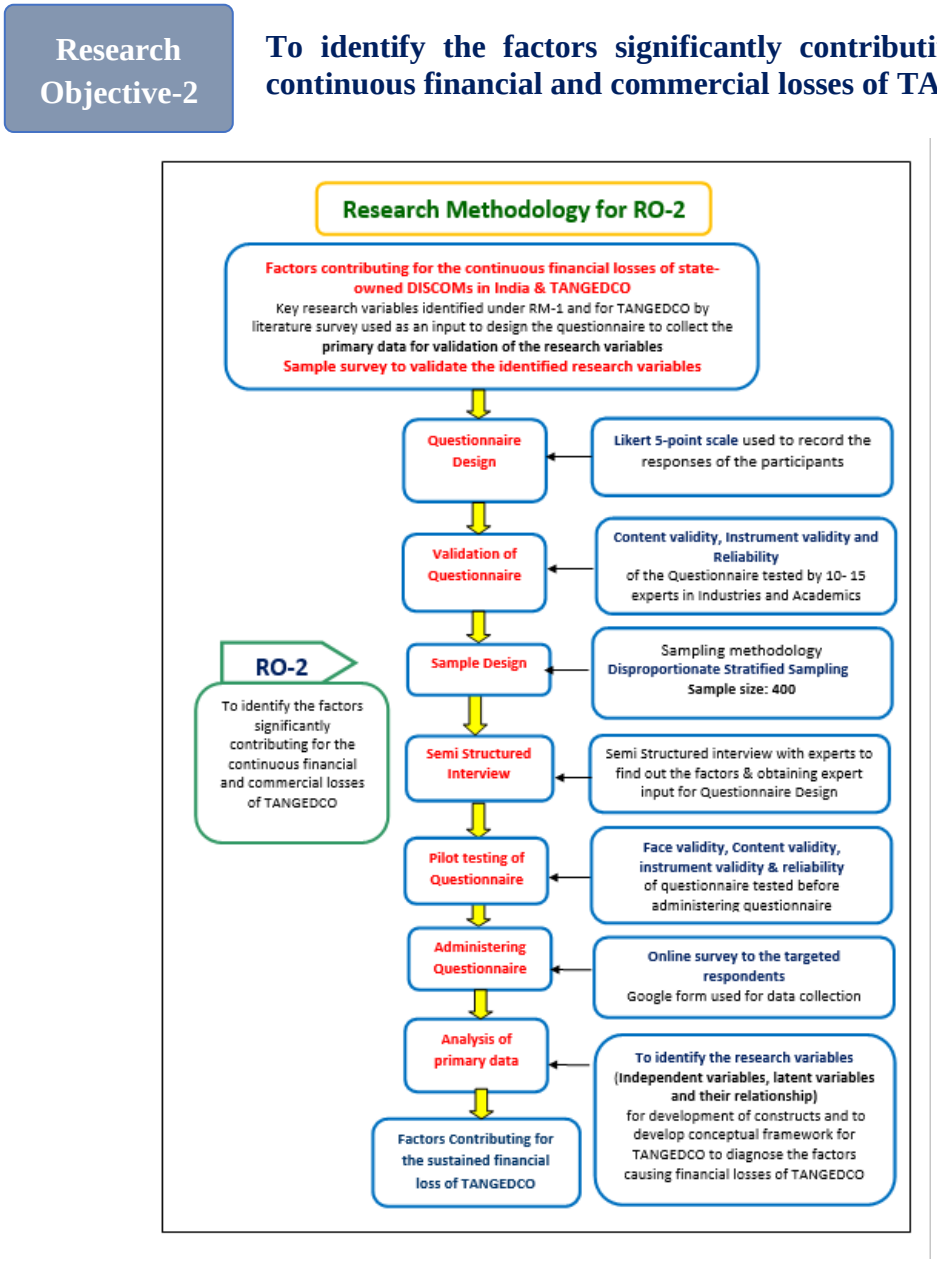
1.5 RESEARCH METHODOLOGY TO ACHIEVE RESEARCH OBJECTIVE- 2

Research Objective 2 (RO2) identifies the factors contributing to the continuous financial and commercial losses of TANGEDCO.

1.5.1 Research Methodology flow chart to achieve Research Objective 2:

The Research Methodology flow chart to achieve Research Objective 2 (RO1) is depicted in Figure 1.4

Figure 1.4

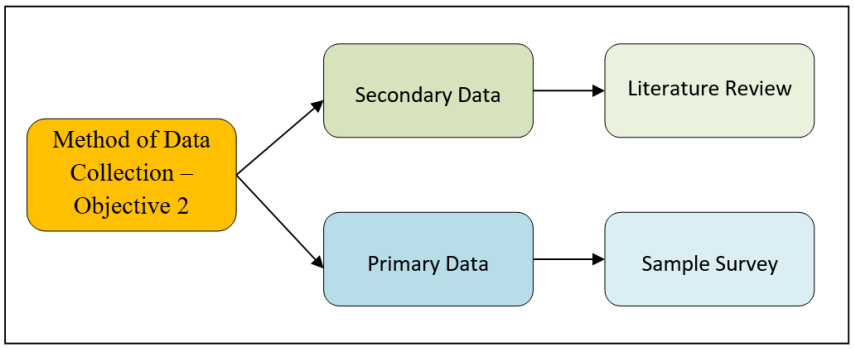


Research methodology flow chart for Research Objective 2

1.5.2 Data collection methods to achieve RO-2

Both secondary and primary data from TANGEDCO were collected to determine the research variables significantly contributing to TANGEDCO's persistent financial losses, as shown in Figure 1.5

Figure 1.5



Data collection to achieve Research Objective 2 (RO2)

1.5.3 Secondary data collection to identify the research variables:

Secondary data was collected to identify the research variables (both independent and latent variables) contributing to the financial loss of TANGEDCO to achieve this Research Objective 2 (RO2). An explorative study and detailed literature review were carried out to collect the needed secondary data.

1.5.4 Sources of secondary data

Secondary data for the study of TANGEDCO was obtained from multiple sources, including "scholarly research study reports, theme papers on power sector reforms in Tamil Nadu, Annual financial reports & performance reports of TANGEDCO, Tariff petitions filed by TANGEDCO, Tariff orders issued by Tamil Nadu Electricity Regulatory Commission (TNERC), World Bank research reports, reports of the Forum of Regulators (FOR), Reports of the Government of Tamil Nadu in respect of Tariff policy, reform policies, various reforms implemented in the power sector in Tamil Nadu to improve the financial performance and financial viability of TANGEDCO and various government of India reports viz., The Ministry of Power report, PFC report, and REC report, which is *reliable, accurate and consistent.*

1.5.5 Analysis of secondary data

TANGEDCO's secondary data were analysed to identify the research variables that significantly contributed to the company's persistent financial losses. For this purpose, the identified variables (by Research Methodology 1) contributing to the state-run DISCOMs' sustained financial losses were considered as input since the state-run DISCOMs are operating their distribution business in a similar business, regulatory and legal environment.

1.5.6 Collection of primary data by survey method

The primary data is collected to validate the identified research variables contributing significantly to TANGEDCO's sustained losses obtained from the analysis of the secondary data. The survey methodology is used to collect primary data.

1.5.7 Survey methodology design

The survey questionnaire was developed using google forms to conduct an online survey among respondents. The research questionnaire is divided into two parts. The demographic information about the respondents is provided in the first section. The second part of the questionnaire was designed to ascertain the variables, which contributed to TANGEDCO's sustained financial losses, using a five-point Likert scale, with 'Strongly disagree' marked as (1) and 'Strongly agree' marked as (5). The questionnaire was distributed through email, WhatsApp, and SMS, and responses were collected in a Google form for analysis.

1.5.8 Sampling design

A proper sampling design was done to collect reliable, relevant data free from bias with negligible error. The sample design involves the selection of the proper sampling method, sample frame, sample element & sampling unit, sample size, research instrument design, and administration of the collection of primary data, which is briefed as under:

1. Population

In the research study, the organization selected for the survey is TANGEDCO. Hence, the management at all levels, i.e., top, senior, middle, and lower levels, shall be a significant part of the population. In addition, policymaking bodies viz., State Government and Central government officials involved in planning, formulating policies, planning, and implementing reform programmes in the power sector also in the population. Further, Banks and Financial Institutions that fund DISCOMs viz., PFC Ltd, REC Ltd., Indian Banks, and the power regulators, State Electricity Regulatory Commission (SERC), and Central Regulatory Commission (CERC) are also part of the population. Government agencies involved in monitoring the reform programmes, and performance of DISCOMs viz., Government of India, Ministry of Power, PFC, REC, Central Electricity Authority (CEA), and Forum of Regulators (FOR) also be part of the population in the present study.

2. Sample frame

The sample frame, also known as the Source list or Respondents from whom the sample is to be drawn, would represent the population. For collecting the primary data by the questionnaire method, the following sample frame is selected:

- Management of TANGEDCO at all levels, including employees (Top-level, middle-level, and lower-level) in Technical, finance, and planning divisions.
- Management of TNEB Ltd and Tamil Nadu Transmission Company Ltd (TANTRANSCO) at the top, middle, and lower levels
- Officials from the Govt. of Tamil Nadu at the policymaking level, Officials from the Union Ministry of Power, State power ministry officials of Govt of Tamandu
- Officials from Tamil Nadu Electricity Regulatory Commission (TNERC) and CERC
- Industrial experts and experts from the power sector and other industries sector,

- Senior management level officials from REC, PFC, CEA and FOR.
- Subject matter experts in the power sector, Banking & finance sector and academics

3. Sampling methodology

The primary data was collected using the ***stratified sampling method*** by research questionnaire. Within different strata, the *Convenient/judgmental sampling method* was used.

4. Sampling units

A single member of a particular sample is called the sampling unit. Samples (respondents) are selected based on ***convenience/judgmental sampling*.**

5. Sample size

"The sample size is computed using the formula devised by *Cochran* (1993) as mentioned below considering the large population size:

Sample size = Z^2 * p (1-p) / c^2 **– Eqn (1.1)**

Where 'Z' equals the value of Z (1.96 for a 95 per cent confidence level)
'p' is the percentage of people who make a choice, given as a decimal
(0.5 used for sample size needed)
'c' = Confidence level in decimal form (0.05)"

The sample size determined by the given formula is 384. However, due to the increased number of variables, a **sample size of 400** was used.

1.5.9 Design of Survey questionnaire

The survey questionnaire was designed to validate each identified independent variable (measurable variables) from the secondary data. A total of fifty-six factors were identified from the secondary data collected. Therefore, at least one question was designed to validate the 56 identified factors. The research survey questionnaire used for collecting the primary data is in **Appendix- 2.**

1.5.10 Testing of the Questionnaire

Five experts from the power, finance sector, industry and academics have reviewed the designed questionnaire and their feedback is considered to improve and finalize the questionnaire before administering the questionnaire.

Pilot testing of the questionnaire

Before administering the questionnaire, pilot testing was done with 40 respondents. The survey questions were redesigned based on the feedback received. The *face validity content validity and instrument reliability* of the questionnaire were checked to validate the questionnaire. Twenty-five experts were interviewed to ascertain the truth of the variables derived from the literature using both secondary and primary data.

Administering the survey

The primary data was gathered from 400 respondents by sending the questionnaires by WhatsApp and email. The response was obtained online using a google form, which helped collate the data for analysis.

1.5.11 Analysis of primary data

The primary data collected by the survey method is analyzed in detail to identify the research variables (Independent variables and latent variables) and their relationship among the independent and latent variables to develop a conceptual framework for TANGEDCO to diagnose the factors significantly contributing to the sustained financial losses of TANGEDCO.

1.6 RESEARCH METHODOLOGY TO ACHIVE RESEARCH OBJECTIVE- 3

Research Objective 3 (RO3) is to identify the constructs and their interrelationships for redesigning a viable business model for TANGEDCO**.**

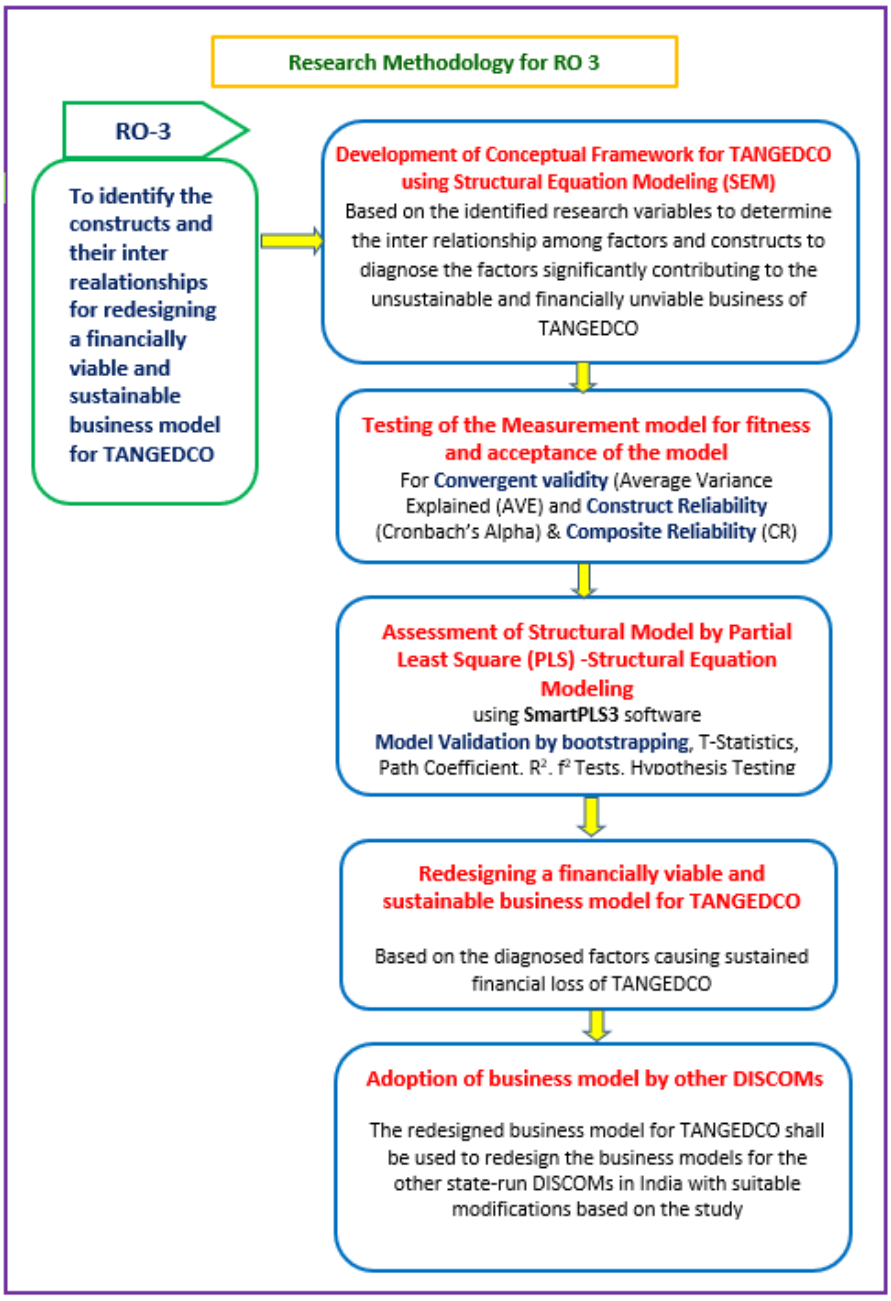
1.6.1 Research Methodology flow chart to achieve Research Objective 2

The Research Methodology flow chart to achieve Research Objective 2 (RO-2) is depicted in Figure 1.6

Figure 1.6

Research Objective-3

To identify the constructs and their inter relationships for redesigning a viable business model



Research methodology flow chart for Research Objective 3

1.6.2 Development of a conceptual framework for TANGEDCO using Structural Equation Modelling

The variables, which are significantly contributing to the sustained financial losses of TANGEDCO, i.e., research variables (independent variables, latent variables) and the relationship between them have been identified from RO2, i.e., through the analysis of secondary and primary data collected for TANGEDCO. Constructs were developed based on the identified research, independent, latent, and relationship.

The identified constructs and their relationships and considering the weaknesses of the current business model of TANGEDCO were used as the basis to redesign a financially viable business model for TANGEDCO. A conceptual framework (theoretical model) was developed using PLS-SEM, based on the developed constructs and their relationships to diagnose the factors significantly contributing to the sustained financial losses of TANGEDCO.

1.6.3 Testing of the Measurement model using PLS-SEM

“TANGEDCO conceptual framework (theoretical model) is evaluated using Partial Least Squares Structural Equation Modeling (PLS-SEM). PLS-SEM is used to determine the relationship between the variables and the lateral constructs. PLS-SEM is a sophisticated yet effective multivariate statistical analysis technique used to determine the structural link between measured and latent variables. PLS-SEM is a technique for estimating composite-based path models based on variance.” [21]

"SmartPLS-3 software was used for the evaluation of the theoretical model developed using PLS-SEM. PLS-SEM is explicitly an approximating technique, promising only "consistency at large." PLS-SEM focuses on prediction. Prediction (data reproduction) is considered more critical than parameter estimation."

1.6.4 Evaluation of the theoretical model developed

Evaluation of the theoretical model carried out to confirm the factors (independent and latent variables) significantly contributing to the sustained financial losses of TANGEDCO and the interrelationship between the independent variables and latent variables.

The conceptual framework developed for TANGEDCO has been tested for ***Convergent validity*** [Average Variance Explained (AVE)], ***Construct Reliability*** and ***Composite Reliability (CR)*** for evaluating the theoretical model developed.

The structural model developed was evaluated by the bootstrapping method in PLS-SEM using SmartPLS3 software. ***"Bootstrapping*** is a powerful tool used for estimating the statistical distribution of any distribution (*Jack et al.*)." [21]. Instead of making parametric assumptions, bootstrapping evaluates the statistic's variability among subsamples. (Chin et al., 1998)".

Model validation for acceptance of the model

To validate the conceptual framework (theoretical model) developed for TANGEDCO, ('t' value), the path coefficient ('p' value), the effect size (f^2) value and the model's predictive accuracy (R^2) were calculated.

't' Statistics

Model validation is accomplished by bootstrapping. "Bootstrapping is a non-parametric test of significance to evaluate the significance of the t-values of the structural model's path coefficients." [21]

Path coefficient ('p' value)

By the bootstrapping method, the Path coefficient 'p' values of all the latent variables were calculated using PLS-SEM. *The larger the sample sizes, the stronger the p-value [21].* A sample size of 400 was taken to get a stronger p-value.

Effect size (f^2)

The model was used to determine each effect's effect size '$f^{2'}$ in the path. "The effect size, '$f^{2'}$ is defined as the increase in '$R^{2'}$ relative to the residual variance of the endogenous latent variable. The effect size can be used to determine whether a latent predictor variable has *small, moderate, or significant impacts*. The effect size values of 0.02, 0.15, and 0.35 indicate minor, medium, and significant effects, respectively (Cohen, 1988)".

Evaluation of inner model (R^2)

The explanatory power of the structural model was tested using the software SamrtPLS3 by examining the dependent variables' amount of variance. By using the PLS-SEM, the predictive accuracy (R^2) was calculated for all endogenous variables in the constructs in the inner path model for the theoretical model developed for TANGEDCO to diagnose the factors significantly contributing to its sustained financial losses.

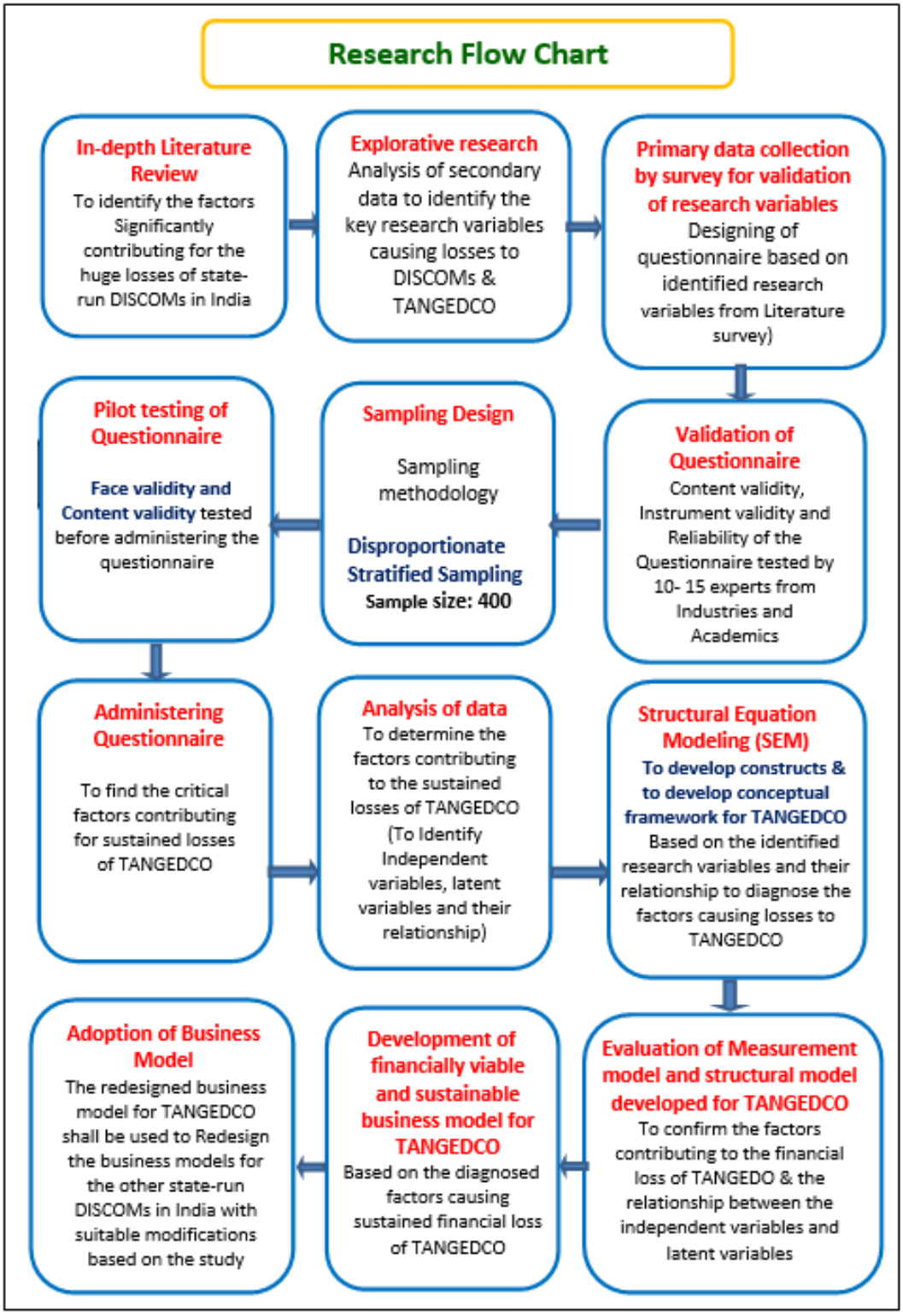
Collinearity Statistics (VIF) for outer and inner model

For the acceptance of the model, there should not be any collinearity. Collinearity Statistics were calculated for the structural model using SmartPLS3 software in Partial Least Square-SEM. The VIF value calculates collinearity Statistics in the SmartPLS3. If the VIF values for the outer and inner model variables are less than 3, there is no multicollinearity. [21].

1.7 RESEARCH FLOW CHART

The Research Methodology for the research is depicted in a flow chart in Figure 1.7

Figure 1.7



Research Flow chart

1.8 RESEARCH CONTRIBUTION

1.8.1 Potential theoretical contributions

Innovative research was conducted to determine the root cause of state-owned DISCOMs' chronic losses and to make its business financially viable and sustainable. Additionally, an in-depth study of the distribution business of TANGEDCO, the top loss-making state power utility was conducted. *This novel research study made in the Indian power distribution sector and an in-depth study made at TANGEDCO have successfully diagnosed 56 independent variables and 17 latent variables that significantly contribute to the sustained financial losses to the state-run DISCOMs in India.* This research also successfully diagnosed the interrelationship between the independent and latent variables. Based on the relationships between 56 identified independent variables (measured variables) and 17 latent variables, 17 formative constructs have been developed (13 first-order constructs and two second-order constructs, one third-order construct and one fourth-order master construct). Using the 56 measured variables and 17 latent variables, and the interrelationship amongst independent and latent variables, a theoretical model (conceptual framework) was successfully developed using Partial Least Squares Structural Equation Modeling (PLS-SEM), a sophisticated yet effective multivariate statistical analysis technique used to determine the structural link between measured and latent variables for diagnosing the factors contributing significantly to the sustained financial loss of TANGEDCO. The theoretical model developed for TANGEDCO is a complex model having 17 formative constructs, 56 independent variables, and 17 latent variables (which include 4 endogenous variables and 13 exogenous variables) contributing to the sustained financial loss of TANGEDCO. The theoretical model developed was evaluated by the bootstrapping method in PLS-SEM using SmartPLS3 software and the model developed is found to be a fit model.

The research conducted so far in the Indian power sector has identified several factors causing the financial losses of the state-run DISCOMs, scattered in several research reports, theme papers and findings from numerous reforms implemented in the Indian power distribution sector. However, by using the

identified factors, no theoretical model has been developed for the state-owned discoms to diagnose the factors that significantly contribute to their sustained financial losses. Further, a successful business model for the state-run Indian discoms was not developed or redesigned to make the power distribution business financially viable and sustainable.

By developing a theoretical model for diagnosing the factors contributing significantly to the sustained financial loss of TANGEDCO, this research has contributed significantly to the development of the theory. The theoretical model is a unique model developed for the first time in the research world.

Further, based on the identified factors significantly contributing to the sustained financial losses and financial unviability, the interrelationship between independent and latent variables, and the weaknesses of the current business model of TANGEDCO, *successfully redesigned a financially viable and sustainable business model for the distribution business of TANGEDCO*, By using the concept of a Dynamic Business Model for Sustainability (DBMS) to achieve a vibrant and sustainable power sector.

B*y successfully redesigning the business model for the state-run Indian discoms, this novel and unique research would significantly contribute to the business model concepts, the theory of rebuilding business models, the theory of developing a sustainable business model and the concept of business sustainability.*

1.9 PRACTICAL CONTRIBUTIONS/IMPLICATIONS

Power is the prime mover of the economy. The state-run DISCOMs are making huge financial losses continuously, as their business becomes financially unviable and sustainable, which has heavily impacted the development of power sectors and the overall economic development of India besides posing a major threat to the nation's energy security. Govt. of India and the state government are infusing lakhs of crores of rupees to reform the power distribution sector and to make the state-run discoms business

financially and commercially viable and sustainable. Thus, making the state-run DISCOMs business financially viable and sustainable is very crucial for the economic development of India.

A financially viable business model redesigned for TANGEDCO through this novel research would help redesign the business model of India's state-owned power distribution companies to achieve its financial viability and business sustainability. This would avert the huge financial losses of the state-run discoms to the tune of 60,000 crores occurring every year and discoms shall run their power distribution business profitably, thus huge savings to the exchequer. Profitable discoms could make investments in projects to develop the power sector.

By making the state-run DISCOMs made financially viable and sustainable, DISCOMs could service the loans obtained from Banks and Financial Institutions promptly, hence the huge Non Performing Asset in the loan book of the Banks and Financial Institutions for the projects funded in the power sector could be averted, thus it could be much beneficial to the Banking and finance sector.

In FY 2020-21 and FY 2021-22, the state-run DISCOMs defaulted in making the payment to their power suppliers (both state-owned and Independent Power Producers) to the tune of Rs.1,10,000 crore and Rs.1,20,000 crore respectively. Ultimately, the Government of India has infused Rs.Rs.1,20,000 crore bailout packages to the ailing state-run DISCOMs. Such huge bailout packages to the state-run DISCOMs shall not be needed once the state-run DISCOMs' businesses are financially viable and sustainable. Thus, there would be huge savings for the exchequer.

Govt of India has planned to add a generation capacity addition of 500 GW in renewable energy by 2030 to achieve the sustainable development goal target, which requires an approximate investment of about Rs.18 lakh crore, out of which about 70 per cent is expected to come from private investors. Since the

state-run discoms are making huge financial losses and discoms are the cash register for the entire power sector value chain, private investors are risk averse and are hesitant to make a huge investment in the massive renewable energy capacity addition program planned by the Government, which would be a major roadblock in achieving the sustainable development goal. Once the state-run DISCOMs power distribution business is made financially viable and sustainable, the Indian power sector could attract the most needed private investment in the renewable energy generation sector, which would help to achieve the sustainable development goal of the country.

Owing to the sustained financial losses of the state-run discoms combined with the higher cost of imported coal and the shortage of coal supply in India, DISCOMs could not able to purchase power at a higher cost and hence are resorting to load shedding, which is heavily impacting all the sectors of the economy and remain as a major hindrance for the overall economic growth of the nation. The redesigned financially viable and sustainable business model of the state-run DISCOMs would make its business sustainable and would help achieve a sustainable power sector in India by supplying reliable and quality power around the clock, would contribute significantly to the nation's overall socio-economic development and help the nation to achieve the sustainable development goal. Therefore, this research study is of national importance and would pave the way to contain the burgeoning financial losses of the state-run DISCOMs and build a vibrant power sector. *Thus, this innovative research would substantially contribute to the economic growth of the nation and nation-building.*

2. OUTLINE OF THESIS CHAPTERS

The chapters of the thesis have been arranged as under:

In chapter 2, an explorative analysis of the Indian power distribution sector and the state-run DISCOMs was made. Various power sector reform schemes were implemented in India with more focus on the implementation of reform programs in the power distribution sector after the enactment of the landmark

legislation, The Electricity Act 2003 was made in detail. The outcome of the reform programs, performance of the state-run DISCOMs, and drivers for its sustained losses were studied in detail in this chapter to diagnose the factors significantly contributing to the sustained financial losses of state-run DISCOMs as well as TANGEDCO.

In chapter 3, an extensive literature review was made on several themes governing financial viability and business sustainability are studied in detail to identify the research gap. Theories and concepts viz., profit maximization theory, business model, business model generation, sustainable business model, business model canvas for development of a business model, business model innovation, and value creation in business were studied in detail. Then, different business models for the power distribution business, and inherent weaknesses in the present business model of the state-owned DISCOMs are studied. The summary of the literature review and the research gap are tabulated at the end. The research gap filled in this thesis is narrated.

In chapter 4, the secondary data collected from PAN India discoms were analysed in detail and the reasons for the sustained financial losses of the state-run DISCOMs, the outcome of several reforms implemented in the power distribution sector and the performance of the state-run DISCOMs are analysed in detail.

In chapter 5, a detailed study of the distribution business of the Tamil Nadu Generation and Distribution Company (TANGEDCO), a state power utility wholly owned by the Govt. of Tamil Nadu, which is one of the tops most loss-making state power utilities were studied in detail. Various reforms implemented in the state of Tamil Nadu in the power distribution sector and TANGEDCO was studied. The financial performance of TANGEDCO and the reasons for its sustained financial losses were studied. Finally, the conclusion from the study of TANGEDCO is summarised at the end of the chapter.

In chapter 6, Primary data collection from TANGEDCO by employing the survey method and the analysis of the primary data is narrated. The factors identified from the analysis of the secondary data collected from PAN India DISCOMs and TANGEDCO are used as input to design the research questionnaire to validate the 56 independent variables identified, which contribute to the huge financial losses of TNAGEDCO. The diagnosed 56 independent variables and 17 latent variables and the relationship between the independent and latent variables were studied. Using the relationship between the research variables, 17 formative constructs developed have been explained. Then, the operationalisation of all 17 constructs was explained in detail.

In chapter 7, using the 56 independent variables, 17 latent constructs and their interrelationship, a conceptual framework (theoretical model) was developed for diagnosing the factors significantly contributing to the sustained financial losses of TANGEDCO (Shown in Figure 7.2). The theoretical model developed is a complex model having 17 interlinked constructs (13 first-order constructs, two second-order constructs, one third-order construct, and one fourth-order construct). Based on the interrelationship between the construct, 16 hypotheses were formulated to ensure the validity of the relationship and to find the model's fitness.

In chapter 8, the theoretical model developed for TANGEDCO was evaluated using Structural Equation Modelling (SEM), a multivariate statistical technique by using SmarPLS3 software. The evaluation of the measurement model for acceptance and validation of the 56 independent variables was done. Convergent validity and composite reliability were analysed to validate the fitness and acceptance of the model. Then the evaluation structural model using Bootstrapping method was explained in detail. Model validation by calculating the 't' values, path coefficient 'p' values and Effect size ($f^{2)}$ for each of the constructs in the theoretical model developed for TANGEDCO were analysed for acceptance and validation of the theoretical model developed for TANGEDCO. Squared multiple correlations (R^2) for

endogenous latent variables were evaluated for endogenous latent variables. Collinearity statistics (VIF) for the outer and inner models were calculated to check the fitness of the theoretical model developed. Finally, 16 hypotheses formulated were tested and the findings of the evaluation are summarised at the end of the chapter.

The summary of the key findings from the research is mentioned in chapter 9.

In Chapter 10, based on the findings from the research study, and considering the inherent weaknesses of the present business model, a financially viable and sustainable business model was redesigned by altering the components of the business model and by using the concept of a Dynamic Business Model for Sustainability (DBMS). The needed reform programs viz., rationalization of subsidies & cross-subsidies, rationalisation of tariffs, Direct transfer of subsidies to the beneficiary, and implementation of cost-reflective tariff, in the power distribution sector and in the state-run DISCOMs to make it business financially and commercially viable and sustainable are prescribed.

In chapter 11, the Contribution of this innovative research work done in the Indian power sector is to make the state-run DISCOM's business financially viable and sustainable. Further, the practical contribution/implication of the research to TNAGEDCO, the power sector, Banking and finance sector and other sectors of the economy other economic sector and overall socio-economic development, impact the central and the central and the state governments and implication to various stakeholders of DISCOMs explained in detail.

In Chapter 12, the conclusion of the research and the future scope for research by linking with the limitation of the research study work. In chapter 13, the details of several relevant references made to carry out the research work made and the scope for future research work are explained. The questionnaire designed to collect the primary data for TNGEDCO is attached in **Appendix A.**

CHAPTER 2

EXPLORATIVE ANALYSIS OF THE POWER DISTRIBUTION SECTOR AND THE STATE-RUN DISCOMS

2.1 CHAPTER OVERVIEW

To determine the root causes for the continuous financial losses of the state-owned DISCOMs in India and to achieve the research objectives, an explorative study of the Indian power sector with a focus on the power distribution sector and the functioning of the state-run DISCOMs was made. A detailed review of the financial performance of the state-owned DISCOMs, several acts, the law enacted, major policies pronounced by the Government of India, various Government of India reform schemes implemented in the Indian power sector to improve the financial performance of the state-run DISCOMs and for the development of the Indian power sector, and the impact of the reforms implemented in the Indian power distribution sector was made, the details of which are narrated in this Chapter.

2.2 DETERIORATING FINANCIAL PERFORMANCE OF DISCOMS

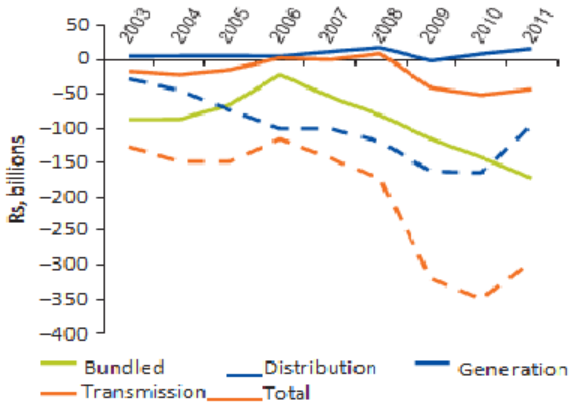
On a long-term basis, state-owned DISCOMs are facing significant financial losses. As per PFC Report, the total financial losses of the DISCOMs during the six years from 2009-10 to 2014-15 have reached a mammoth figure of Rs.3.66 lakh crore as of March 2015 [42]. Massive revenue shortage and the sustained financial losses of the state-run DISCOMs have resulted in the severe deterioration of the financial health of the state-run DISCOMs. The debt level of the DISCOMs has mounted year after year. As a result, state-run DISCOMs have accumulated huge losses, and their net worth becomes negative. The state government-owned power utilities' cumulative loss for FY 2015-16 has reached a worrisome level of Rs.4,85,922 crore, and the total net worth as of March 31, 2016, stood at Rs.46,299 crore (negative). [42]

DISCOMs have defaulted on loan servicing to Banks and defaulted on power generators due to the enormous revenue shortage and severe liquidity crisis. The severe deterioration of financial health has drastically affected the Banking and finance sector and other sectors of the economy.

The continued financial losses of DISCOMs posed a serious challenge to the power sector's long-term viability, as well as India's energy security and economic growth. The state-owned DISCOMs business has become financially unviable and unsustainable due to its mounting revenue shortages and sustained financial losses.

The World Bank undertook a thorough investigation into the business performance of India's state-owned power utilities. "According to the World Bank research report, "except for a few state-owned electric utilities, virtually all state-owned electric utilities sustained significant financial losses even after the unbundling of the State Electricity Boards and executing a series of reforms". [63]. Figure 2.1 illustrates the enormous losses incurred by state-owned Indian power utilities, namely the State Electricity Board, and unbundled state-owned companies, viz., GENCOs, TRANSCOs, and DISCOMs, from 2003 to 2011."

Figure 2.1



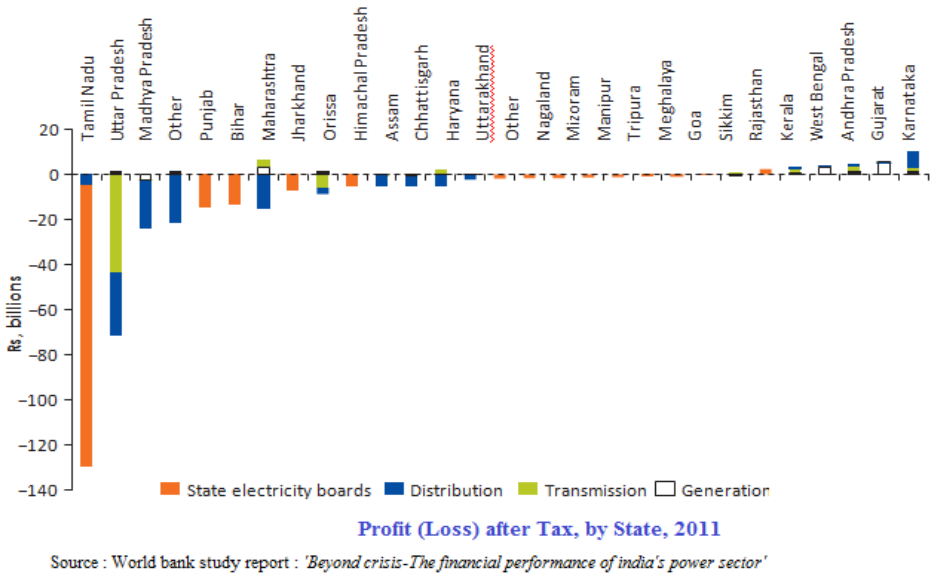
Subsector profit after tax over time

Source : World bank study report : *'Beyond crisis- The financial performance of India's power sector'*

Financial losses of state power utilities in India

"The World Bank (IBRD) research report concluded that the cumulative losses of state-owned power distribution corporations are centred in four of the country's worst-performing states: Tamil Nadu, Uttar Pradesh, Madhya Pradesh, and Jharkhand and Tamil Nadu stood as the top loss-making states as illustrated in Figure 2.2." [63]

Figure 2.2



Profit (Loss) After Tax of state power utilities in India

2.3 DISCOM'S POOR FINANCIAL PERFORMANCE - A THREAT TO THE BANKING SECTOR

Due to the sustained financial losses, the state-owned DISCOMs could not service their loans to the Banks and Financial Institutions, resulting in growing Non-Performing Assets (NPA) in the loan books of the Banks and Financial Institutions and the Banks have made substantial provisioning as per prudential guidelines of the Reserve Bank of India. The poor financial performance of DISCOMs has heavily impacted the Indian Banking system in a big way.

Sumedh Deorukhkar/ Le Xia, in his study on 'Indian banking sector – Dragging down or driving up India's growth story?' reported that "over the past five years since 2008-2009, the performance of the state-owned public

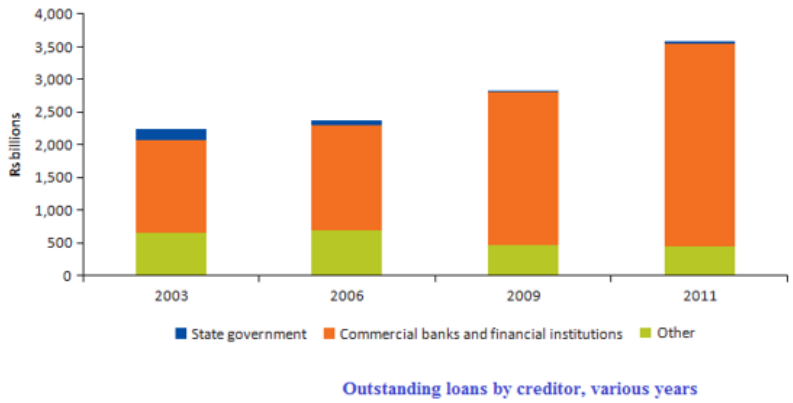
sector banks in India has been facing declining earnings growth, narrowing profit margins, significant deterioration in asset quality and elevated credit costs. Weakness in India's banking sector is highly skewed, with the bulk of the restructured loans (nearly 80%) sitting with small state-owned banks, which have just 50% of the Indian banking system's Tier -1 capital. India's public sector banks' high level of impaired loans and weak capital positions undermines India's banking system's overall credit profile."

"According to the RBI's report dated 15.09.2017, gross impaired loans reached an all-time high of Rs.12,29,105 crore, and the NPAs of the power sector have a substantial share." Therefore, the growing NPAs of Banks pose a significant threat to the Banking sector, besides it has affected the capital adequacy ratio and the net worth of Indian Banks and Financial Institutions.

2.4 DISCOM'S DEBT TRAP

Due to the sustained losses, the state-run DISCOMs are in a debt trap. "According to a *World Bank study report (2015)*, the total unpaid loans of the electricity sector were Rs.3,50,000 crore in 2011, with approximately 50% of loans coming from commercial banks, 23% from PFC and 20% from REC, as illustrated in Figure 2.3". [63]

Figure 2.3



Outstanding loans by creditor, various years

Source : World bank study report : 'More Power to india'- *The challenge of electricity distribution*

Outstanding loans of DISCOMs in India

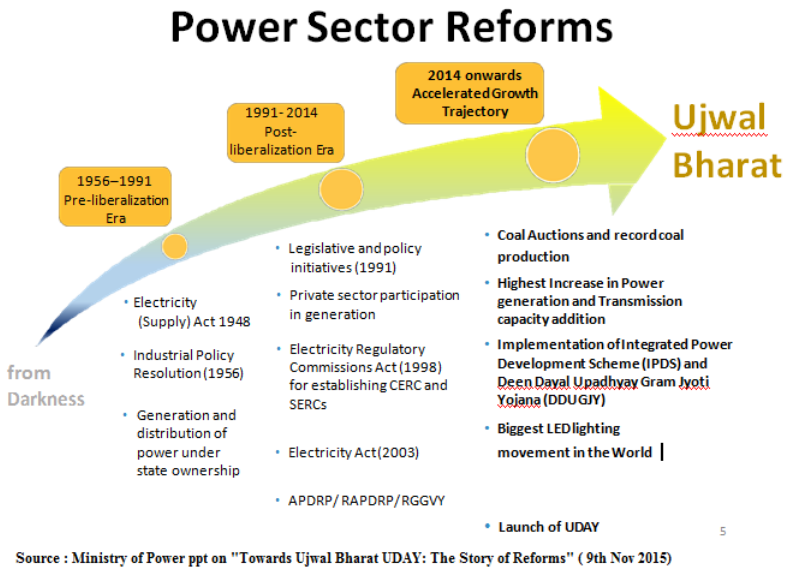
Due to their poor financial performance, and defaults in loan servicing by the state-owned DISCOMs, DISCOMs are unable to obtain loans from Banks and Financial Institutions at a competitive interest rate due to their lower credit rating. The high-interest costs ultimately result in higher tariffs. In addition, DISCOM's mounting debt and growing NPAs of the power sector pose a significant cause of concern for the power and banking and finance sectors.

"According to the World Bank report [63], by 2017, the DISCOMs of two of the worst-performing states, Rajasthan and Tamil Nadu, may incur losses of Rs.24,800 crore and Rs.24,200 crore, respectively, in the fiscal year 2016-17". The state-run DISCOMs faced acute financial problems as they cannot generate adequate revenues even to meet their operational expenditure and debt repayment obligations to the Banks and FIs.

2.5 POWER SECTOR REFORMS IN INDIA

'Electricity' is included in India's constitution's concurrent list. "As a result, from the pre-liberalization era (1956-1991) to the post-liberalization era (1991-2014), the Government of India and state governments undertook several reforms in the electricity sector, which are continuing till date as depicted in Figure 2.4."

Figure 2.4



Source : Ministry of Power ppt on "Towards Ujwal Bharat UDAY: The Story of Reforms" (9th Nov 2015)

Power sector reforms in India in the pre and post-liberation era

2.6 MAJOR POWER SECTOR REFORM POLICIES

The major legislation brought out by the Government of India for the development of the Indian power sector, to promote competition in the power sector by attracting private sector investments in the power sector, which is mentioned hereunder:

Amendments to Electricity Supply Act (1991), Mega Power Policy (1995), Electricity Regulatory Commission Act (1998), Energy Conservation Act (2001), Electricity Act (2003), National Tariff Policy (2005), Integrated Energy Policy (2005), Rural Electrification Policy (2005), National Electricity Policy, 2006, Ultra Mega Power policy, Renewable Energy Policy.

The electricity sector was regulated earlier under the following Acts:

- The Indian Electricity Act, 1910
- The Electricity (Supply) Act, 1948
- The Electricity Regulatory Commissions Act, 1998

"The **Indian Electricity Act, 1910** provides the basic framework for the electric supply industry in India, the growth of the sector through private licensees. Issue of License by the State Govt., Provision for a license for electricity supply in a specified area, the legal framework for laying down wires and other works, and provisions for laying down the relationship between licensee and consumer."

"**The Electricity Supply Act, 1948** mandated the creation of the State Electricity Boards (SEB) and the need for the state to step in (through SEBs) to extend electrification (so far limited to cities) across the country."

"**The Electricity Regulatory Commissions Act, 1998** internal, provides for setting up of Central Electricity Regulatory Commission (CERC) and State Electricity Regulatory Commission (SERC) with powers to determine tariffs. The constitution of SERC is optional for states. The act has also had a provision for the distancing of Govt. from tariff determination."

2.7 THE ELECTRICITY ACT 2003

Govt of India, in 2003 enacted a landmark new legislation viz., "The Electricity Act 2003" [37], which has made sea changes in the power sector.

2.7.1 Objectives of the Electricity Act

"The Electricity Act of 2003 was created to accomplish the following goals:

- To integrate the legislation governing the generation, transmission, distribution, trade, and use of the power.
- To promote competition
- To ensure the financial viability of the SEBs /DISCOMs
- Rationalization of tariff
- To have transparent policies regarding subsidies
- To protect consumers' interest
- To promote the supply of electricity to all areas
- Establishment of Electricity Regulatory Commission viz., CERC and SERCs, Special Courts and Electricity Appellate Tribunal."

2.7.2 Highlights of the Electricity Act of 2003

"The Electricity Act, 2003 [37] emphasizes the unbundling of the State Electricity Board into Generation, Transmission and Distribution Companies, formulation of national electricity policies and plans, and the de-licensing of Generation and Transmission companies. As per the Electricity Act 2003, distribution and power trading will be licensed activities."

"The E.A. 2003 has provisions for the establishment of a Central Transmission Utility (CTU) and State Transmission Utility (STU), the vesting of necessary powers and the operation of Regional Load Dispatch Centres (RLDC) and State Load Dispatch Centres (SLDC), the provision of Open Access (O.A.) in transmission and distribution, to issue Notification on performance standards, the establishment of a market mechanism, the establishment of a Central Electricity Authority (CEA), the establishment of one Electricity Regulatory Commissions at the centre and establishing State Electricity Regulatory Commission (SERC) in each States and establishing an Appellate Tribunal for Electricity (ATE)."

The Electricity Act 2003 has an enabling provision for the distancing of the state government in the tariff setting process and legislation for dealing with power theft and the establishment of special courts to deal with energy theft; consumer grievance redressal process & Electricity Ombudsman

2.8 POWER SECTOR REFORM SCHEMES

"Both Government of India and the state governments have implemented several reform schemes in the Indian power sector for the development of the power sector. The major power sector reform schemes implemented are as under:

1. Accelerated Power Development Program (APDRP) to reduce AT&C losses
2. Restructured Accelerated Power Development Program (RAPDRP)
3. Ultra Mega Power Projects (UMPP), a tariff-based international competitive bidding process for pit-head generation projects to lower power generation and tariff.
4. International competitive bidding for Inter and Intra transmission projects based on the lowest wheeling charge quoted.
5. Rajiv Gandhi Grameen Vidyuthikaran Yojana (RGGVY) for the electrification of rural villages in India
6. Decentralized Distributed Generation (DDG) for power supply to the remote villages not connected to the power grid.
7. Distribution Reforms Upgrade and Management (DRUM)
8. Jawaharlal Nehru National Solar Mission (JNNSM) for implementation of solar power projects
9. National Electricity Fund (NEF)
10. Deen Dayal Upadhyay Gram Jyothi Yojana (DDUGJY)
11. Smart grid initiatives
12. Ujwal DISCOM Assurance Yojana (UDAY) 2015
13. Power for All
14. Pradhan Mantri Sahaj Bijli Har Ghar Yojana (SAUBHAGYA) Scheme for 100%electrification of households in the country.
15. Rs.1,20,000 crore liquidity infusion package to ailing discoms”

2.8.1 Prime objectives of the power sector reforms

A detailed review of the literature that several reform programs in the Indian power sector were implemented to accomplish the long-term growth of the Indian power sector and to improve the financial viability of the state Electricity Board and State-owned DISCOMs. Furthermore, these reforms aimed to improve efficiency in the transmission and distribution of power to achieve the nation's overall socio-economic development.

2.9 NATIONAL TARIFF POLICY (NTP), 2006

2.9.1 The objective of the National Tariff Policy:

"The main Objectives of the National Tariff Policy are as under:

- To ensure that customers access electricity at reasonable and competitive prices.
- To ensure the financial viability of the state power utility and to attract private sector investments in the power sector.
- To enhance transparency, consistency, and predictability in regulatory procedures across jurisdictions and reduce perceptions of regulatory risks.
- To promote competitiveness, operational efficiency, and supply quality improvement."

2.9.2 Impact Analysis of National Tariff Policy

"In 2006, CRIS-INFAC conducted an Impact analysis study on the National Tariff Policy. From the impact analysis study, it is learnt that:

- ❖ The National Tariff policy provides a blueprint for the reliable calculation method of tariff cross-subsidies. Higher cross-subsidy charges offset the main objective of open access.
- ❖ Charging a cross-subsidy surcharge by DISCOMs results in a consumer who desires to switch to a licensee, who charges a lower tariff may pay a higher tariff.
- ❖ To achieve the objective the open access and to bring competition in the power distribution sector, the cross-subsidies should be limited."

2.10 Aggregate technical & commercial loss

To efficiently monitor and accurately measure the transmission and distribution losses, state power regulators developed a parameter called Aggregate Technical and Commercial Losses, or AT&C losses. AT&C losses can accurately assess energy and revenue losses. The AT&C loss has two components: (1) Technical loss and (2) Commercial loss, as stated below:

Technical Losses

Technical losses are the energy losses that occur in transmission and distribution lines.

Commercial losses

The commercial losses result from the inaccurate measurement of energy consumed, faulty energy meters, energy theft, and low efficiency in energy billing and revenue collection. The AT&C losses will be calculated using the following formula:

AT&C Losses = Total units sold (in Million Units) / Total input (MU) – Eqn (2.1)

Collection Efficiency = Revenue collected (in Rs.) / Amount billed (in Rs.) - Eqn (2.2)

2.11 ACCELERATED POWER DEVELOPMENT & REFORM PROGRAMME (APDRP)

"The Government of India has launched the APDRP scheme to strengthen the transmission and distribution network and to bring AT&C losses in urban areas below 15 per cent". The scheme was implemented to improve the financial sustainability of the state power distribution utilities, reduce AT&C losses, and improve power supply quality. The APDRP scheme consists of a 25% grant from the Government of India, a 25% soft loan to the states, and a 50% contribution from the state/state power utility.

As per the Ministry of Power, on implementing the APDRP scheme, the overall AT&C loss had lowered from 39 per cent in 2001-02 to 35 per cent in 2005-06. However, it has failed to bring AT&C's losses below 15%, as planned in the program. The scheme was unable to achieve the set goal of reducing AT&C losses below 15% within the set time frame primarily due to the underutilization of grants fully and the failure of the state-run power utilities to upgrade the system.

According to a PFC report titled "The Performance of State Power Utilities for the Years 2011-12 to 2013-14,"[42] large numbers of consumers remain unmetered in all states, and essential information for calculating AT&C Losses is missing from the annual financial reporting of DISCOMs.

2.12 SPECIAL COMMITTEE OF THE GOVT OF INDIA FOR REFORMS IN THE POWER SECTOR

The Union Government has constituted special committees to study and recommend for successful implementation of the reform programmes in the Indian power sector. The primary committee formed are (1) The Abraham Committee, (2) B K Chaturvedi Committee (3) The V.K. Shunglu Committee. The study made by these committees and its recommendation briefed below:

2.12.1 The Abraham Committee

"The Government of India has appointed an expert panel led by Abraham [1] to oversee the execution of the APDRP scheme and its impact, as well as to make suggestions for improvement and successful implementation of reform programs."

Significant findings of the Abraham committee report

"The important findings Abraham Committee report [1] are as follows:

- Despite the best efforts of the Government of India to successfully implement reforms in the power distribution sector, several states had yet to implement the sanctioned APDRP projects and follow the reform paths.

- States that implemented reforms outperformed states that did not.
- The financial health of DISCOMs has been further worsened. There is a dire need to monitor the performance of all the state power utility
- States have failed to prevent power theft, resulting in increased AT&C losses.
- Although most feeders are metered, the benefits of loss reduction are not realized, and there is a dire need to carry out energy audits at feeders.
- The electricity supply to agricultural consumers without metering has resulted in considerable losses to DISCOMs.
- The state government's subsidy is not adequate to cover the cost of providing a power supply free of charge or at a significantly lower price.
- Good planning and the use of technology in project management will help DISCOMs avert delays in implementing APDRP schemes."

Recommendation of the Abraham committee:

"The Abraham Committee report's essential recommendations to the Government of India are as follows:

- To receive the grant under the Restructured Accelerated Power Development and Reform Program (R-APDRP), strict guidelines must be put in place, ensuring that all states implement the reform.
- The state power regulator needs to perform its role efficiently.
- Need to combat power theft by setting up a special court to deal with power theft, an anti-theft squad
- States should implement reform with utmost commitment in various areas of the power distribution sector, including Multi-Year Tariff (MYT), Energy Audit, 100% metering in R-APDRP zones, up to 100 kV feeders, and power supply to agricultural power consumers.
- DISCOMs should be given yearly targets to reduce AT&C losses, and DISCOMs should be rewarded for achieving the AT&C loss reduction target.

- DISCOMs must implement an incentive system to improve performance. A total of 5% of the R-APDRP budget will be allocated to impart training and project impact assessment studies.
- For the effective and timely implementation of R-APDRP schemes, all stakeholders, including DISCOMs, monitoring agencies, and the Ministry of Power, should be made accountable.
- The grant shall be enhanced to 50% of the scheme cost for general category states.
- The scheme's Detailed Project Repor (DPR) should be realistically prepared in consultation with DISCOMs, and include a plan to achieve quality and provisions for price escalation."

"The Government of India has launched the Restructured APDRP (R-APDRP) scheme in the XI plan based on the recommendation of the Abraham committee."

2.12.2 V.K. Shunglu Committee

In 2010, the Government of India appointed a high-level committee led by the former Comptroller and Auditor General of India (C&AG) Shri V.K. Shunglu to investigate the reasons for the state power utilities' financial performance deterioration, recommend measures to contain financial losses, and examine their accounting practises.

Recommendation of V.K. Shunglu committee

"The observations and recommendation of the V.K. Shunglu committee [53] are as follows:

- Inadequate tariffs and the gap between the Average Cost of Supply of power (ACS) and the Average Revenue Realized (ARR) to the tune of 60 paise per kW-Hr are the two primary reasons for the substantial financial losses of DISCOMs. The aggregate losses of the DISCOMs during the period from 2006 to 2010 stood at Rs.1,80,000 crore. Severe measures need to be taken to contain the massive financial losses of the state-run DISCOMs.

- Because of the state government's political sensitivity to raising the power tariff, DISCOMs are not filing their tariff petitions in a timely and acceptable manner with SERC.
- Instead of waiting for the audit report, SERC needs to set tariffs on ad-hoc basis based on the best available data pertaining to DISCOMs if DISCOMs fail to file the tariff petitions on time.
- The retail tariff must be set with a suitable built-in model to automatic correction in tariff to increase fuel price. Furthermore, power customers in high-default-rate areas should pay a higher tariff than those in lower-default-rate areas.
- The Shunglu committee has recommended for *Distribution Franchisee Model* to bring down the distribution losses and creation of *Special Purpose Vehicle (SPV) to buy bad loans* from Banks and Financial Institutions"

2.12.3 BK Chaturvedi panel

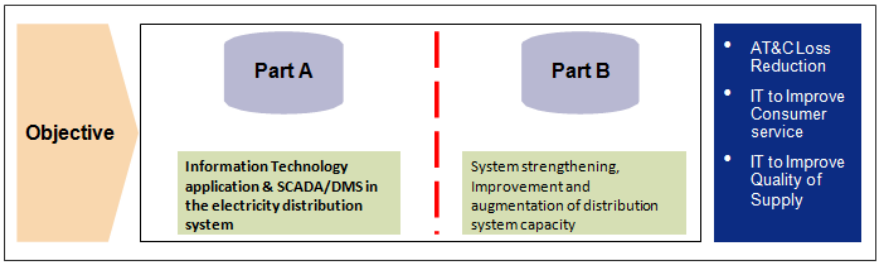
"The Government of India has also appointed a sub-committee, led by B K Chaturvedi, to enhance the financial sustainability of the state-owned power utilities." The committee has recommended a Public-Private Partnership (PPP) model for improving the financial viability of DISCOMs, as the VK Shunglu committee's franchisee model with private participation will not be able to bring in sufficient capital funds.

2.13 RESTRUCTURED ACCELERATED POWER DEVELOPMENT REFORM PROGRAM (R-APDRP)

"The R-APDRP programme was launched by the Indian government in July 2008 to establish baseline data, establish accountability, and reduce AT&C losses by 15% by strengthening and upgrading the sub-transmission and distribution system."

"R-APDRP Scheme comprising of two parts viz., Part A and Part B as mentioned in the schematic diagram in Figure 2.5

Figure 2.5



Source: Ministry of Power's R-APDRP Scheme: PFC Report on *"Methodology for Establishing Baseline AT&C losses"*- 4th September 2009

Restructured R-APDRP Scheme

Component-A: This component is designed to assist state power utilities in preparing baseline data for project areas using cutting-edge technology. The scheme will be implemented in cities with more than four lakhs and around 350 million units of annual energy input.

Component-B: This component will help state distribution utilities renovate, modernize, and strengthen 11 kV level Substations, Transformers and reconductoring of 11 kV distribution lines. States must establish the State Electricity Regulatory Commission (SERC) and meet an AT&C loss reduction target of 3% per year for utilities with an AT&C loss of 30% or more; and 1.5 per cent for utilities with an AT&C loss of less than 30% to qualify for assistance under the scheme.

The R-APDRP scheme was announced with great enthusiasm and zeal, but it has fallen short of expectations and exuberance. The main reasons are (i) Inordinate delay in implementation (ii) Automating and integrating I.T. to reduce AT&C losses from 30% to less than 15% in 5 years is unrealistic. This Monumental task has yet to be completed."

2.14 DRIVERS OF DISCOM'S LOSSES

The factors contributing considerably to the state-run DISCOMs' long-term financial losses have been thoroughly investigated in the explorative study, which forms the basis for the identification of research variables (both measurable variables and latent variables) to carry out the research.

2.14.1 High AT&C losses

"As per the PFC report 2009, the major reasons for the AT&C losses are huge revenue shortage arising out of the non-Cost reflective tariff, irrational power tariff, theft of energy, non-metering, incorrect billing, low billing and collection efficiency, higher T&D losses, lack of investment in distribution sector for system upgradation to reduce the distribution losses".

"According to a World Bank study report (2014) titled *'More power to India: The challenge of electricity distribution'* [62], "the major reasons for the massive financial losses of the distribution power utilities in India are due to the higher T&D loss, which is much higher than the 10% international norms, losses due to under-collection of bills, and losses due to below-cost-recovery pricing."

High technical losses

Many research studies in the Indian power sector, including the World Bank research report [56], concluded that inadequate distribution infrastructure, lengthy L.T. lines, inefficiencies in power distribution, failure of critical electrical equipment viz., Distribution Transformers, lines, inadequate Operation & Maintenance of distribution infrastructure and due to the non-implementation of segregation of feeders for each consumer categories.

Huge commercial losses

As per the World Bank report (2014) [62], the state-run DISCOMs incur huge financial losses primarily due to the tariff under-pricing, inefficiency in billing and collection, unmetered power supply, power theft, high level of subsidies, poor subsidy policies of the state government, untargeted subsidies, high power purchase cost and high cost of power generation.

According to a PFC study report on DISCOM performance, "In 2012, the average T&D losses in India was 24 per cent, and the average AT&C loss for was 27 per cent in 2009-10.

2.14.2 Raising gap between ACS and ARR

Several pioneering research studies conducted on the Indian power sector including the World Bank research report [61][62][63] concluded that "the sustained massive financial losses of DISCOMs are primarily due to the growing gap between the Average Cost of Supply (ACS) of power and the Average Revenue Realized (ARR). The gap between the ACS and ARR is on the rise primarily due to the following:

(i) Tariff underpricing

(ii) Tariff fixed do not align with the rising cost of supply. While the input cost increases year-on-year basis, the tariff is not hiked in consonance with the average cost of supply

(iii) Huge tariff subsidies are offered to several customer categories, especially agricultural and domestic supply

(iv) Irrational tariff subsidies

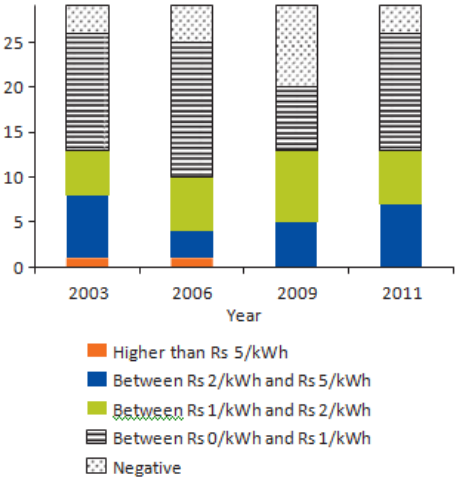
(v) Dealy in tariff setting

(vi) Not revising the tariff periodically by the state-run DISCOMs for political reasons

(vii) Building up of regulatory assets. State Electricity Regulatory Commission (SERC) instead of regularly revising the upward revision of the tariff by aligning it with the cost of supply, resorting to the build-up of regulatory assets, which postpone the upward revision of the tariff by keeping it as an asset in the category of receivables from the power consumers by way of future power hike.

"The World Bank study report (2015) [63] on the study of the performance of Indian state-owned power utilities from 2003 to 2011 found that "the gap between ACS and ARR (without subsidies) is the significantly largest factor contributing to the huge financial losses of the state-run DISCOMs in India. (about 28 per cent). As shown in Figure 2.6, approximately 12% of the gap in 2011 is in the range of Rs. zero per kW-Hr and Rs.1 per unit."

Figure 2.6



Size of gap without subsidies (Real)

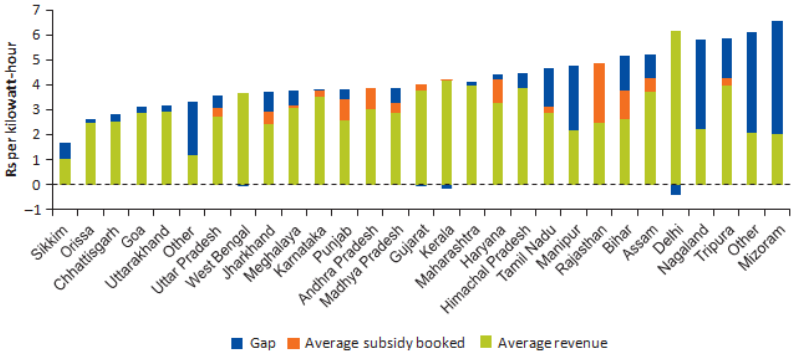
Source : World bank study report : *'Beyond crisis-The financial performance of india's power sector'*

The gap between ACS and ARR (without subsidies)

The gap between ACS & ARR (state-wise)

"As per the World Bank study report (2015) [63], the state-by-state gap between the ARR and the ACS for the FY 2011 is depicted in Figure 2.7."

Figure 2.7



Gap between Average cost and Average revenue, 2011

Source : World bank study report : *'The challenge of eletricity distribution'*

The state-wise gap between ACS and ARR in 2011

2.14.3 Intervention of the state government with SERC

As per the Electricity Act, 2003, the power regulators, i.e. SERCs and CERC, are quasi-judicial bodies mandated to determine tariffs and fix a cost-reflective tariff based on the Average Revenue Requirement (ARR) filed by DISCOMs

in its tariff petition. Several research reports including the World Bank study reports [8][9][62] confirmed that in reality, despite these legal provisions, the state government intervenes with the SERCs in tariff determination and the tariff fixing process of the SERCs, State Government does not allow the SERCs to set the cost-reflective tariff for political reasons, and SERCs are toothless and are unable to exercise their judicial power and are subservient to the state government and SERCs.

The state government's withdrawal from its intervention with SERCs in the tariff-setting process: A hard reality

"It is clear from the reports of the special committees appointed by the Government of India, viz., The Abraham Committee, V.K. Shunglu committee [53], and World Bank study report [63], that the political intervention by the State Government in the tariff-setting process with the state power regulator is one of the key factors attributable to the significant financial losses of the DISCOMs."

Political intervention in tariff setting derails the power sector reforms

According to a comprehensive literature review, "the state-owned power utilities are subject to political interference and are unable to revise tariffs on a year-to-year basis, and politicians have subverted power reforms."

"According to a World Bank study on the performance of Indian DISCOMs, "interference of the state government in the tariff setting process of SERC is one of the primary reasons for the significant financial losses of state-owned DISCOMs, even though there is an explicit provision in important legislations such as the National Tariff Policy, Electricity Act, 2003, and Electricity Regulatory Commission Act for distancing of the state government from the SERC in tariff setting process." [61]

"Lalit Jalan et al. (2012) concluded their research that the logic behind the rationalization of power tariffs should be used at least once a year. Power purchase costs typically account for 80% of the total cost of supply, so

permanent methods need to be put in place to pass through any variations in the cost of supply to consumers ".

2.14.4 Creation of regulatory assets

Many SERCs, instead of fixing cost-reflective tariffs, are resorting to the creation of regulatory assets, which are receivables to be recovered by way of future tariff hikes. As per the PFC Report 2019 [44], due to the non-revision of periodical tariff and the fixation of Non-cost reflective tariff, five states viz., Uttar Pradesh, Rajasthan, Tamil Nadu, West Bengal and Maharashtra, and Delhi has created huge regulatory assets. The accumulated regulatory assets of these five states for the FY 2017-18 reached an alarming level of Rs.1,35,833 crore. Realizing revenue from these huge regulatory assets created through future tariffs is remote. The building up of huge regulatory assets leads to the rising gap between the ACS and ARR, resulting in huge financial losses to the state-run DISCOMs.

Because the SERC's tariff-truing process takes years, it's critical to put in place a system that allows for the pass-through of any changes in power supply input costs, such as automatic adjustment of fuel costs to avoid the accumulation of regulatory assets. Non-revision of tariff in consonance with the rising cost of supply and Non-revision of tariff at a periodical interval by the SERC, state government intervention with SERCs to not hike the tariff are primary reasons for the building up of huge regulatory assets.

2.14.5 Huge tariff subsidy and cross-subsidy

The state-owned DISCOMs are heavily reliant on subsidies. According to the PFC Report [44], the tariff subsidy booked received by the state-owned DISCOMs increased year after year, reaching Rs.1,10,390 crore in FY 2018-19.

According to the PFC report [44], "the agricultural sector consumes 24 per cent of total electricity but generates less than 6 per cent of total revenue". The explorative research with an extensive literature survey finds that to

compensate for the considerable subsidy given to the agriculture and domestic power consumers, the state government is hiking the tariff to the industrial and commercial consumers by highly cross-subsidising the tariff beyond the permissible level of +/- 20 per cent of the average cost of supply as per the National Tariff Policy and the Electricity Act 2003. A huge cross-subsidy is provided by state-owned DISCOMs across the country [47]. Therefore, urgent action needs to be taken to reduce the cross-subsides between different power consumer categories.

"To improve the financial position of the state-owned Indian DISCOMs, it is necessary to recover prudent costs, reduce the gap between tariff and cost, distribute subsidy effectively, simplify their tariff structure, reduce cross-subsidy, and rationalize the tariff," according to Anand Kumar et al. (2010).

FFEEDBACK(2013) report concluded that "Cross-subsidies have kept the implied objective of balancing the effect of price rises on specific categories of consumers, who have historically paid lower tariffs when setting tariffs. Cross-subsidies must be reduced and eventually phased out as part of efforts to make power sector reforms successful."

Massive Agricultural subsidy- significant contributors to the DISCOM's loss

"Electricity subsidy in Indian agriculture is part of the state budget in India," wrote Mamta Bhargava (2015) in her research theme paper on "Cost and Revenue Paradox of Electricity Sector in Indian Agriculture." Agriculture receives power subsidies from two sources: (i) cross-subsidization by charging higher prices from industrial and commercial consumers than agriculture, and (ii) State support to the state-owned DISCOMs in the form of a loan or interest write-off. Political parties give promises in the election agenda for a free supply of power and waive off the electricity dues payable by the segment of consumers.

"The World Bank has established that the tariff applied is lower than the cost of supply, leading to substantial financial losses to Indian DISCOMs,"

according to the study report "More Power to India: The Challenge of Electricity Distribution" (2014) [62]. It is evident that "The state government's policy of supplying power at a heavily subsidized tariff or no cost will be an important factor in the state-owned DISCOMs' deteriorated financial performance".

From the detailed study of several research reports including the World Bank study report, and Annual PFC reports on state power utility's performance, it is evident that the subsidy issue remains crucial to achieving the financial viability of state-run DISCOMs and India's power sector. There is a dire need to rationalize the subsidies. Blanket subsidies to all the power consumers in agriculture and free power supply to domestic consumers for the specified quantum of power consumed resulted in huge revenue leakage to the state-run DISCOMs, resulting in huge financial losses.

Direct subsidy over cross-subsidy

The state government may have to provide subsidies to such vulnerable consumers. "The direct subsidy has been preferred over cross-subsidy under Section 65 of the EA 2003. The amendment to section 61, which replaces the word elimination with the word reduction, maintains cross-subsidy."

2.14.6 Irrational tariff

"Slower revenue growth than costs for the period from 2003–2011 was largely driven by increased tariffs that did not keep pace with cost increases," according to a World Bank study report (2015) [63]. Non-cost reflective tariffs and the non-revision of tariffs annually are two significant drivers of massive revenue shortfall resulting in substantial financial losses for the state-owned DISCOMs.

The Electricity Act, 2003 and the Tariff policy 2016 mandated the appropriate commission viz., SERC/CERC for fixing adequate tariffs in consonance with the cost of supply regularly. From the study of India's tariff orders issued by SERCs, many SERCs are not fixing the cost-reflective tariff, and tariffs are

not being revised annually. The deferred tariff hike resulted in a colossal revenue shortage leading to substantial financial losses to state-run DISCOMs.

2.14.7 Irrational tariff structure

The irrational tariff structure is one of the leading causes of the power sector's poor financial situation. "The SERC is expected to rationalize tariffs by taking into account, among other things, the government's subsidy, DISCOMs operational efficiency, and their ability to reduce the AT&C losses."

"It was desired that by establishing an independent power regulator, the Government's age-old choice of designing and setting electricity tariffs, keeping in mind its political constituencies, would come down," *Shahid Hasan et al.* (2012)

"To avoid a significant tariff increase, regulators have traditionally deferred a portion of revenue required by placing them as regulatory assets, which shall be collected from the consumers through future tariff revision. The chances of recovering from the regulatory asset are remote. Rather than providing free or heavily subsidised energy, the government should develop a rational tariff pricing approach complemented by improved service delivery."

2.14.8 Non-cost reflective tariff

A comprehensive review of literature on the performance of the state-owned power utilities in India by the World Bank, PFC, and the special committee appointed by the Ministry of Power has concluded that the tariff being charged to certain segments of power consumers viz., agricultural consumers and segments of domestic consumers are much lower than their cost price, resulting in huge financial losses for DISCOMs. Furthermore, to compensate for the losses, DISCOMs are heavily cross-subsidizing the tariff by charging it at a much higher price than its average cost of supply even though there is a clear-cut provision in the Electricity Regulatory Commission Act, 1998 Electricity Act, 2003, National Tariff policy, 2006 to set the cost-reflective tariff and reduce and eliminate tariff cross-subsidies by the regulatory

commission, which are explained as under:

"**Section (29) (2) of the Electricity Regulatory Commission Act, 1998** (ERC Act) states that the state power regulator shall provide the terms and conditions for tariff fixation by regulations. For doing so, it shall be guided by the following:

- Sub-clause (c): The tariff gradually reflects the cost of electricity supply at an adequate and improving efficiency level.
- Sub-clause (e) of the ERC Act provides that to protect the interest of the power consumers. On the other hand, consumers pay a fair price for the electricity consumed based on the average cost of supply of energy."

"The state power regulator (SERC) is mandated by Section 62 of the EA 2003 [37] to set the retail tariff to be charged by distribution licensees to their customers." "As per **Section 61 (g) of the Electricity Act, 2003** [37], the tariff set must gradually reflect the cost of power supply. And cross-subsidies should also be minimized and eventually removed within a period specified by the regulatory commission. It makes perfect sense in theory, but its application in law and spirit, as well as the ability to identify and provide subsidies to any consumer or group of consumers, renders it weak."

Tariff subsidies must, of course, be provided to the weakest and financially deprived power consumers. Notwithstanding this, regulators have yet to implement a strategy for eliminating cross-subsidies over time.

Roadmap for cost-reflective tariff and reduction of cross-subsidies

"**Section 8.3 (2) of The National Tariff Policy, 2006 (NTP 2006)** set a goal for tariffs to be within ± 20% of the average cost of supply by the end of the 2010-2011 fiscal year, to achieve the goal of tariffs gradually reflecting the cost of electricity supply."

"**Section 62 (3) of the EA, 2003** [37] specifies the criteria that can be used to differentiate the tariffs of different consumers. Some of these factors are load factor, power factor, voltage, total electricity consumption over a given period, and geographic location, impacting the consumer's supply cost. Therefore, these factors can be given an appropriate weighting in tariffs to differentiate tariffs."

2.14.9 Non-revision of tariff periodically

Further, on perusal of the tariff orders issued by the Tamil Nadu Electricity Regulatory Commission (TNERC) to TANGEDCO and the erstwhile TNEB, it is learnt that the t*ariff has not been revised upward for the period from 2003 to 2010 despite the increase in input cost viz., cost of fuel, operational expenditure, and interest cost, which led to the burgeoning financial losses and significant of these losses are the commercial losses.*

"As per the Ministry of Power [28], the tariff increase is not the only solution to DISCOM distress, as states had charged the tariff higher than the national average. *However, the hard reality is that after implementing the recommendations of so many committees constituted intending to improve the financial viability of the state-owned DISCOMs and implement several reforms, the financial health of the DISCOMs has not improved. Instead, financial health has worsened and has been severely deteriorated and has led to a severe financial crisis."*

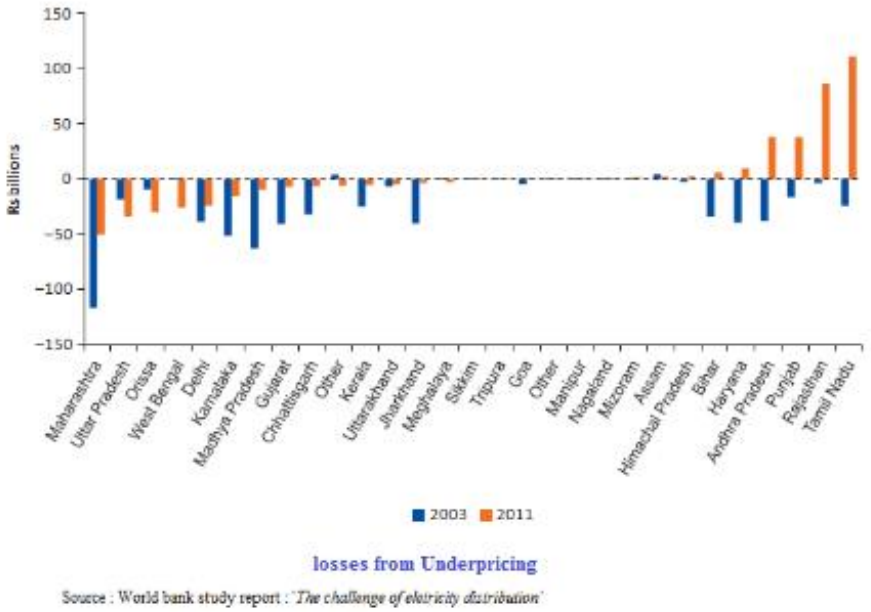
2.14.10 Non-compliance with critical legal provisions by SERCs

Even though the Electricity Act, 2003 [37] and the National Tariff Policy 2016 Tariff Policy, 2016 give state power regulators broad mandates for fixing cost-reflective tariffs, setting tariffs yearly and for determination of tariffs on the sue-moto basis by the regulator in case of delay in filing the tariff petition by the distribution licensees, many SERCs do not comply with these necessary legal provisions results in mounting losses to DISCOMs and creation of regulatory assets.

2.14.11 Tariff under-pricing

"The underpricing of the tariff had been one of the major reasons contributing to the huge financial losses of DISCOMs in India," according to a World Bank report [63], as shown in Figure 2.8.

Figure 2.8



DISCOMs losses due to tariff under-pricing

2.15 FINANCIAL RESTRUCTURING PACKAGE TO BAILOUT DISCOMS

The Government of India has intervened multiple times to bail out the bankrupt DISCOMs due to its sustained financial losses resulting from a huge revenue shortage. Barring a few DISCOMs, the financial position of almost all the state-owned DISCOMs is drastically affected and has led to a severe financial crisis.

2.15.1 Financial Restructuring to DISCOMs Package 2012

To bail out the state-owned DISCOMs, the Government of India has granted several Financial Restructuring Packages in the year 2002, 2012 and 2015 and 2021. The Government of India gave Rs.1,90,000 crore under Financial Restructuring Plan (FRP) in 2012 [27] to restructure their debts. “As per the

FRP, 2012, fifty per cent of the outstanding short-term loans of state-owned DISCOMs would be taken over by the respective state governments. DISCOMs shall issue bonds backed by the state government guarantee. The Balance 50% of debts, a 3-year moratorium for repayment of principal was granted as a part of FRP."

2.15.2 Financial Restructuring to DISCOMs Package 2015

The state-run DISCOMs were unable to repay the principal after the three-year principal moratorium expired in 2015 due to their worsening financial position, resulting in granting of another major restructuring package by the union government to financially turn around the ailing state-owned DISCOMs through the Ujwal DISCOM Assurance Yojana (UDAY) Scheme. In 2015 under UDAY Scheme, 75% of the debts of the state-run DISCOMs were taken over by the state government. UDAY Scheme and its impact has been elaborated in detail in Chapter 4.

2.15.3 Financial Restructuring to DISCOMs Package 2021

UDAY Scheme has helped DISCOMs to improve some operational performance. However, the financial health of the state-run DISCOMs, even after implementing the UDAY Scheme has deteriorated. In January 2021, a substantial financial package of Rs.1,20,000 crore was granted to the ailing state-run DISCOMs to clear the huge overdue electricity purchase made. TANGEDCO in Tamil Nadu received Rs.30,000 crore, accounting for one-fourth of the package. Rs.1,20,000 crore liquidity infusion package granted to the state-run DISCOMs in 2021 is elaborated in detail in Chapter 4.

Despite the above massive bailout package, the state-run DISCOMs were unable to financially turn around, and their financial performance has worsened.

2.16 DISCOM'S LOSSES DUE TO ADDITIONAL DEMAND CREATED IN RURAL ELECTRIFICATION SCHEMES

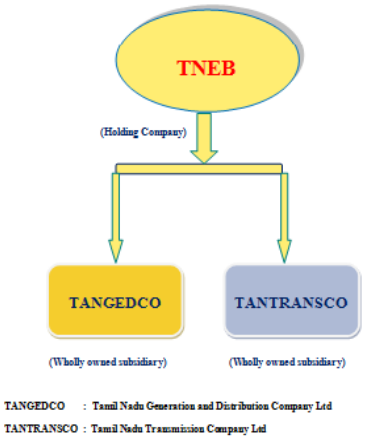
On perusal of the reports of REC in respect of the implementation of the rural electrification schemes viz., RGGVY and DDUGJY, there were 18,500 Un Electrified Villages (UEVs) across India by December 2017. Under the rural electrification schemes, the Below Poverty Line Households (BPLHh), electrical connections were given with a 100 % capital subsidy from the Government of India to the state governments. Several DISCOMs are supplying power free of cost or at a highly subsidized tariff with revenue subsidy from the state government. The additional power demand created due to the rural electrification and free supply to BPLHh has further deteriorated the financial health of DISCOMs.

2.17 POWER SECTOR REFORMS IN TAMIL NADU

Unbundling of TNEB

"Tamil Nadu Electricity Board (TNEB), a single integrated state power utility owned by the Government of Tamil Nadu was unbundled in 2010 into Tamil Nadu Generation and Distribution Company Limited (TANGEDCO), and Tamil Nadu Transmission Company Limited (TANTRANSCO), both are made as a subsidiary of TNEB Ltd (a holding company) as shown in Figure 2.9. TANGEDCO has the responsibility of generating and distributing power in Tamil Nadu."

Figure 2.9



The unbundled structure of TNEB

Unbundling of Tamil Nadu Electricity Board

2.18 DETERIORATING FINANCIAL PERFORMANCE OF TANGEDCO

TNEB has been operational till November 2010. After unbundling in 2010, TANGEDCO has been a consistent loss-maker since its inception. As per PFC Report, for the FY 2014-15, TANGEDCO has the second-largest accumulated losses accounting for about one-fifth of the aggregate of all DISCOM's accumulated losses of Rs 4.34 lakh crore. [42]. Rajasthan's DISCOMs are the largest loss-making utilities in India, accounting for an accumulated loss of about Rs 1 lakh crores. (Source: Ministry of Power). Eleven state DISCOMs account for about 80% of the accumulated losses; three states account for 50% of the total accumulated losses of the Indian DISCOMs.

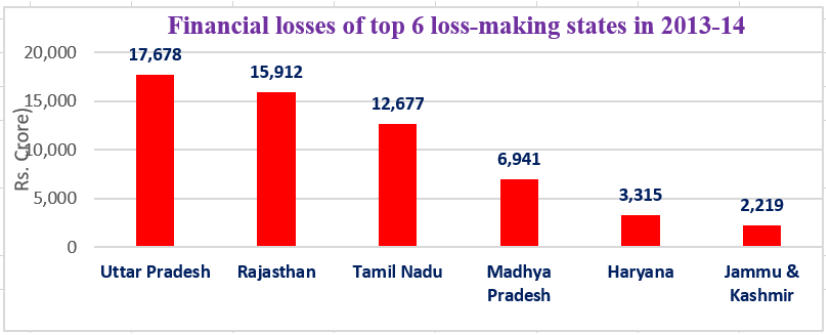
Non-revision of tariffs periodically results in huge financial loss

As per the PFC report [42], TANGEDCO operates as a loss-making company with a net loss of about Rs.14,336 crores for the FY 2014-15 with its huge accumulated losses make TANGEDCOs business operation financially and commercially unviable and unsustainable. TANGEDCO's AT&C losses for the fiscal year 2013-14 were 22 per cent, during the national average AT&C loss of India was 36 per cent. In addition, TANGEDCO has not revised its retail tariff from 2003 to 2011, even though the power supply cost has increased year on year, which is one of the primary reasons for its substantial financial losses.

“As per the tariff order issued by TNERC, it is learnt that the power demand has also increased manifold during the period from 2003 to 2011, the non-revision of tariffs for the prolonged years has led to huge revenue shortage and mounting of debts. The cost of procurement of power was at Rs. 6.15 per unit till 2012 and has been sold at Rs. 3.74 per unit, and TANGEDCO is incurring a loss of Rs. 2.41 for every unit sold till 2012.” The low tariff charged by TANGEDCO and highly subsidized power to agriculture customers and a particular segment of domestic customers is critical factors influencing the substantial financial losses.

According to the PFC report, the top six state DISCOMs (accrual basis) incurred losses in 2013-14 [42], as shown in Figure 2.10

Figure 2.10



Source: PFC report on the performance of state power utilities [35]

With a financial loss of Rs.12,677 crore in FY 2013-14, Tamil Nadu ranked third among the top loss-making DISCOMs. TANGEDCO's financial losses in the fiscal year 2014-15 added up to Rs.14,336 crore, making it the nation's highest loss-making power utility. [42]

2.19 SUSTAINED HUGE FINANCIAL LOSSES OF TANGEDCO

TANGEDCO is incurring sustained financial losses year on year. TANGEDCO in FY 2018-19 incurred a loss of Rs.17,962 crore. The detailed study carried out at TANGEDCO in this research finds that the huge gap between the ACS and ARR is Rs.1.82. That is TANGEDCO is losing Rs.1.82 on every unit of energy sold [42]. TANGEDCO's distribution business has become financially and commercially unviable and unsustainable. The Rs.1.82 difference between the Average Cost of Supply (ACS) and the Average Revenue Realized (ARR) has been the single most significant cause of its sustained financial losses and financial insolvency of TANGEDCO. The continuous huge financial losses of TANGEDCO due to the huge revenue shortage that arose from the huge gap between the ACS and ARR have resulted in TANGEDCO’s power distribution business becoming financially and commercially unviable and unsustainable.

2.20 CONCLUSION FROM THE EXPLORATIVE ANALYSIS OF THE POWER DISTRIBUTION SECTOR AND STATE-RUN DISCOMS CHAPTER SUMMARY

From the explorative research conducted in the Indian power sector with more focus on power distribution sectors and in search for the factors significantly contributing to the sustained huge financial losses of the state-run DISCOM including TANGEDCO, the following conclusion emerges:

Both Government of India and the state government have implemented several reforms in the Indian power sector and a series of reforms implemented after the enactment of the Electricity Act of 2003 has significantly contributed to the development of the power sector. However, these reforms have not been able to make the state-owned DISCOMs financially viable, which is one of the prime objectives of the reforms and also the Electricity Act, 2003. The sustained financial losses of the state-owned DISCOMs have severely impacted the power and other sectors of the economy and are hindering the country's economic development.

The higher AT&C losses resulted in huge financial losses to the state-run DISCOMs. Several reforms implemented in the power distribution sector viz., APDRP, R-APDRP, RGGVY, and DDUGJY have not reduced AT&C losses substantially, resulting in higher operational losses to the state-run DISCOMs. The state-owned DISCOMs have failed to meet the target of reducing the AT&C losses to 15% and the zero gaps between ACS and ARR under the UDAY Scheme implemented from FY 2016 to FY 2019 to strengthen the financial and operational performance of the state-owned DISCOMs, despite the state governments taking over a portion of the DISCOMs debts and losses.

The primary factors significantly contributing to the huge financial losses of the state-owned DISCOMs are primarily due to the huge revenue shortage, arising out of the huge gap between the ACS and ARR, Non-cost reflective tariff, non-revision of the tariff periodically, high AT&C losses, huge tariff

subsidy, non-receipt of the subsidy and delayed receipt of the subsidies from the state governments resulting in financial insolvency.

SERCs are subservient to the state government and are unable to do their tariff determination independently despite their quasi-judicial authority. There is a strong intervention of the state government with the SERCs in tariff setting results in the setting of a non-cost reflective tariff. SERCs take into account the subsidy receivable while determining the tariff. Non-receipt, delayed receipt and partial receipt of subsidies from the state governments results in massive losses to the DISCOMs.

The regulatory delay in determining the tariff and the issue of tariff orders occurs due to the non-submission, and delayed submission of tariff petitions by DISCOMs, resulting in burgeoning financial losses to the state-run DISCOMs.

Non-compliance with the legal provisions of the Electricity Act, 2003 and the Tariff Policy 2016 relating to the setting of cost-reflective tariffs and limiting to cross-subsidies within 20 % of the cost of supply results in huge losses to the state-run DISCOMs. SERCs of several states have created huge regulatory assets. Recovery from huge regulatory assets by way of future tariffs is very remote, which would result in tariff shock.

Several reforms implemented in the power distribution sector so far have focused primarily to reduce technical losses. However, reform programmes have not been implemented successfully to contain the huge financial losses arising out of the rising gap between the average cost of supply and the average revenue realized, non-cost reflective tariff, huge subsidies, and non-realization of subsidy dues from the state government fully and timely.

Untargeted and unfunded massive subsidies are causing huge financial losses to the state-run DISCOMs. The state-run DISCOMs are highly subsidy-dependent. The subsidy issue remains crucial to achieving the financial

viability of state-run DISCOMs and India's power sector. Poor subsidy policies of the several state governments resulted in massive losses to the state-run DISCOMs. Free supply of power to agriculture and supply of power to domestic consumers with huge subsidies and only partial realization of subsidies from the state government results in financial insolvencies of the DISCOMs.

“The Electricity Act, 2003 provides that the state government needs to give subsidies upfront at the beginning of the financial year to the DISCOMs for the power supplied at lower than its cost price”. However, most state governments are not releasing the subsidies upfront, which results in massive revenue shortages and financial losses to DISCOMs.

The study has found numerous independent variables and latent variables that significantly contribute to the sustained financial losses of the state-run DISCOMs. It is found that there exists a relation between several independent and latent variables, which need a detailed analysis to diagnose the factors significantly contributing to the continuous financial losses of the state-run DISCOMS.

The power distribution business of TANGEDCO become financially and commercially unviable and unsustainable. It has been the top loss-making power utility in India. Several factors were identified for its huge financial losses on a sustainable basis. The prime factors causing the huge financial losses to TANGEDCO are huge revenue shortage arising from the rising gap between the ACS and ARR, Non-revision of tariff periodically, Cost reflective tariff not implemented, accumulation of huge regulatory assets, and unsustainable huge power subsidies which include a free power supplied to agricultural consumers and free power supply to the tune of 100 units to all domestic consumers irrespective of their social status. The huge blanket subsidy has resulted in huge financial losses for TANGEDCO.

To achieve the financial viability and sustainability of the state-owned DISCOMs business, it is crucial to implement reforms focusing on tariff rationalization, implementation of cost-reflective tariff, direct subsidy transfer to consumers, rationalization of subsidy and cross-subsidy, and improvement in operational performance of DISCOMs.

From the detailed explorative analysis of the power distribution sector and the performance of the state-run Indian DISCOMs, it is found that there is an inherent weakness in the current business model of the state-run DISCOMs in India, and it needs to be studied in detail to redesign a financially viable and sustainable business model for the state-run DISCOMs

CHAPTER 3

LITERATURE REVIEW

3.1 CHAPTER OVERVIEW

From the explorative analysis of the Indian power distribution sector, analysis of the performance of the state-run DISCOMs over a period from 2003 and the learning from the several reform programs implemented in the power distribution sector to improve the financial health of the state-run discoms, it is found that a series of reforms implemented in the power distribution sector after the enactment of the Electricity Act, 2003 has failed to financially turnaround and to make the state-run DISCOM's power supply business financially viable, which is one of the prime objectives of the Electricity Act 2003. The state-run DISCOMs continued to incur huge financial losses and the state-run DISCOMs' performance has heavily deteriorated even after the sanction of several financial restructuring packages including the UDAY Scheme implemented from 2015 to 2019 and a huge fund infusion to the tune of Rs.1,20,000 crore under the liquidity infusion package under the Atmanirbar Bharat program by the Government of India to bail out the ailing state-run DISCOMs in 2020. As per the Ministry of Power, the sustained financial losses due to a huge revenue shortage and the acute liquidity crunch, the state-run DISCOMs have made defaults in making payments to its power suppliers to the tune of Rs.1,10,000 crore in the year 2021 and the state-run DISCOMs power supply business become unviable and unsustainable.

Further, the explorative research revealed that there are a plethora of factors contributing to the sustained financial losses of the state-run discoms. The prime objective of this research is to find the right solutions to the long-term problem of the unsustainable and financially unviable distribution business of the state-run DISCOMs by correctly identifying the root cause of the problem by diagnosing the factors viz., research variables both independent variables

and latent variables significantly contributing to its sustained financial losses and the relationship between the independent and latent variables.

From the explorative analysis, it is concluded that there are very serious issues in the way in which the state-run DISCOMs operate their power distribution business and the current business model of the state-run DISOCMs has become unviable and unsustainable. There is a dire need to redesign its business model to make its power supply business financially and commercially viable and sustainable.

The business model of the state-run DISCOMs needs to be studied in detail to redesign its business model to make the state-run DISCOMs business financially viable and sustainable. To achieve these objectives, besides an explorative analysis of the performance of the state-run DISCOMs and the reform programs implemented in the power distribution sector to make the state-run DISCOM's business financially viable and sustainable, a detailed literature survey was carried out following themes viz., *Theory of the firm, Theory of business, the concept of business model, sustainable business model, Concept of business sustainability, Business model generation, Rebuilding business models, and the concept of value creation.*

In this chapter, various business models of the state-run DISCOMs were analysed in detail. Further, the inherent weaknesses in the current business model of the state-run DISCOMs including TANGEDCO were studied in detail. To achieve the research objectives, the research gap has been identified from the detailed literature survey.

3.2 THEMATIC REVIEW OF LITERATURE

3.2.1 Theory of firm/profit maximisation theory

"The theory of the firm is the microeconomic concept in neoclassical economics. According to the theory of the firm, the business entities are driven with the prime motto to maximize their profits." Firms make decisions to

maximise profit by setting their price based on the demand in the market. To earn maximum profits, the firms must satisfy the following two conditions:

(i) Marginal Cost (MC) = Marginal Revenue (MR) --- **Equation 3.1**
(ii) MC curve cuts the MR curve

Maximum profit is the residual income remaining with the firm after making payments to all factors of production. The above two conditions apply to monopoly and perfectly competitive firms.

Average Cost principle

"According to *Hall and Hitch*, to maximize profit, firms fix the prices based on the average cost principle as **under**:

Price = Average Variable Cost +Average Fixed Cost + Profit Margin
--- **Equation 3.2**"

Criticism of profit maximisation theory

Economists have severely criticized the profit maximization theory due to (i) the uncertainty of earning a profit, (ii) Firms not following the average cost principle to maximise profits (iii) it is a static theory and does not apply to Oligopoly firms.

3.2.2 Theory of business

"According to *Peter F. Drucker*, the underlying assumptions upon which the organisation was founded and is run no longer hold. These assumptions shape an organization's behaviour, dictate its decisions about what to do and what not to do, and define what constitutes meaningful results for the organisation. These assumptions pertain to the company's markets, customers, competitors, values, and behaviour and are collectively referred to as the *theory of the company's business*." Certain business theories developed by firms are extremely powerful and will endure longer. However, every business theory

eventually becomes obsolete, and the firm must constantly test its business theory to remain successful

3.2.3 Business model

There are various definitions for the term 'business model' in the literature. “According to *Alexander Osterwalder* (2014)[3], a business model provides the reasoning of how a company generates, delivers, and acquires value"

“According to *Alexander Osterwalder and Yves Pigneur* (2014) [3], “a business model explains how a company generates, delivers, and captures value for its customers and for itself. It is a conceptual tool that comprises elements and their interactions and allows a company's logic of earning profit. It is a description of the value a company provides to one or more categories of consumers, as well as the firm's and its network of partners' architecture for producing, promoting, and delivering this value and relationship capital to produce lucrative and sustainable revenue streams."

As per *Beltramello et al.* (2013), "The quality of management is important since they influence the success of the company's business model through their skills, capacity to acquire, integrate, and utilize valuable.” “According to *Michael Porter and Daniel Kramer*, Harvard Business Review (HBR) "Creating Shared Value," Jan-Feb 2011, the purpose of a business must be redefined around creating shared value (CSV).”

3.2.4 Strategy, business model, and business plan

The terms "business model”, "strategy," and "business plan" are frequently interchanged. However, all of them are distinct from one another but work well together. “A business plan is a document that outlines the business opportunity that a firm wants to pursue.” The strategy aids a company's competitiveness and business success. However, having a solid business model is not enough to ensure long-term success; the company also needs a well-devised strategy.

“A business model takes a visual representation of the business, describing how it creates, delivers, and captures values while delivering values to its customer. A business model is a visual description of a company that shows how it creates, offers, and captures values serving its customers.” [3]. The business model defines the firm's consumers and how it makes money while delivering value to them. In contrast, the strategy shows how the company differentiates itself from the competition. *An appropriate business model is critical for a company's long-term viability and sustainability.* Hence, Companies should devote more time to building their business models. A good business model for a company helps in executing its strategy.

A business model explains how an organisation generates, distributes, and captures value. "A business model is essentially a blueprint for a plan that will be carried out through organisational structures, procedures, and systems" [3].

“According to *Chesbrough and Rosenbloom* (2002) and *Teece* (2010), a business model explains what benefit an organisation will provide to its customers, how it will do so, and how it will recoup some of the value it generates.” “The key to building business models is determining how to deliver benefits and capture value [*Teece*, (2010); *Boons and Luedke-Freund*, (2013).”

Strategy vs business model

“According to *Cherbourg and Rosenbloom*, the concept of a business model differs from the strategy's focus in the following ways:

(1) The business model focuses more on value creation, whereas the strategy focuses more on value capture and long-term sustainability.
(2) The business model does not assume that information about the firm's knowledge, its customers, or other parties are available to the firm. On the other hand, business model designs assume that the firm's ability is cognitively limited and impacted by the firm's previous success.”

3.2.5 Business Model Innovation (BMI)

“Business model innovation is critical for an enterprise's success since it adds value to the firm, its consumers, and society at large.” According to *Amit and Zott (2012)*, "Business model innovation is revamping the obsolete business model by changing from 'what we do to 'the way we do business.’ Business model development is a dynamic process. For business sustainability, firms need to change their business model. *Johnson and Sulkowicz (2009*) described BMI as "moving the focus from developing individual technologies to constructing new systems."

3.2.6 Business model framework

“According to *Bocken, S.W. Short, P. Rana and S. Evans* [10], the business model has three essential components viz., (i) Value proposition (ii) Creating and delivering value (iii) Capture of value”, which are explained briefly as below:

(i) Value proposition

"Value proposition focuses on the product and service offering to generate profit. It would give a proven ecological and social benefit In addition to economic value." *(Boons and Luedke-Freund, 2013).*

(ii) Value creation

"New business opportunity, new markets, and new sources of revenue are typical ways for organisations to capture value to their company." *(Beltramello et al., 2013; Teace, 2010).*

(iii) Value capture

"Capturing value to the business is regarding how to earn profits by supplying goods, services, or information to consumers and customers" *(Teece et al., 2010).*

3.2.7 Conceptual business model framework

Figure 3.1 depicts *Alexander Osterwalder and Pigneur's* conceptual business model framework.

Figure 3.1

Conceptual business model framework

Osterwalder and Pigneur 2005

3.2.8 Sustainable business model

"According to Alexander Osterwalder, for a business model to be sustainable, it should be commercially viable, future-ready, and part of a sustainable society to succeed in a world of growing, volatile energy and commodity prices. Therefore, it is impossible to run a sustainable business in an unsustainable economy."

Sustainability - The critical driver of innovation

"Companies who make Sustainability a priority will gain a competitive advantage in the future, which necessitates redesigning of business models" (*Harvard Business Review -Sep - Oct 2009*)." According to *S.W. Short, P. Rana, S. Evans, S. Bocken, and S. Evans* (2014), "To create and implement corporate sustainability innovation, the sustainable business model is of paramount importance, which would help integrate Sustainability into the company's goals and procedures and achieve competitive advantage."

3.2.9 Financially viable business model

The best early indicator of a financially viable and sustainable business model is a profitable business. A company's profit formula is the blueprint that descri bes how it creates value while also offering value to its customers. To make the business model of a company financially viable, radical changes in its

business model are to be done by reform. According to *Bhattacharyya S.C. (2007),* "A *r*eform can be considered sustainable if it is politically acceptable, financially viable, economically efficient, socially desirable, environmentally benign, and implementable as a project [9].

3.2.10 Business Model Innovation (BMI) - A key to sustainability

According to *Kay Plantes,* Business model innovation provides the solution for companies to deliver value to their customers and create value by generating profit. However, to make the business model sustainable, companies must redesign their business model range from modest to transformational changes to be more open to outside ideas and routes to market to prosper.

Open Model Business Innovation (OMBI)

To create value and enhance the business's competitive advantage, organizations today are changing their business models by practising Open Model Business Innovation (OMBI) techniques.

"Lingyun Wang, Paivi Jaring, and Arto Wallin, in their research paper on 'Developing a Conceptual Framework for Business Model Innovation in the Context of Open Innovation' (1999) has concluded that "the business model is regarded as a cognitive tool, not as a strategy of the company, to transform technology innovation into economic value."

3.2.11 Business model generation

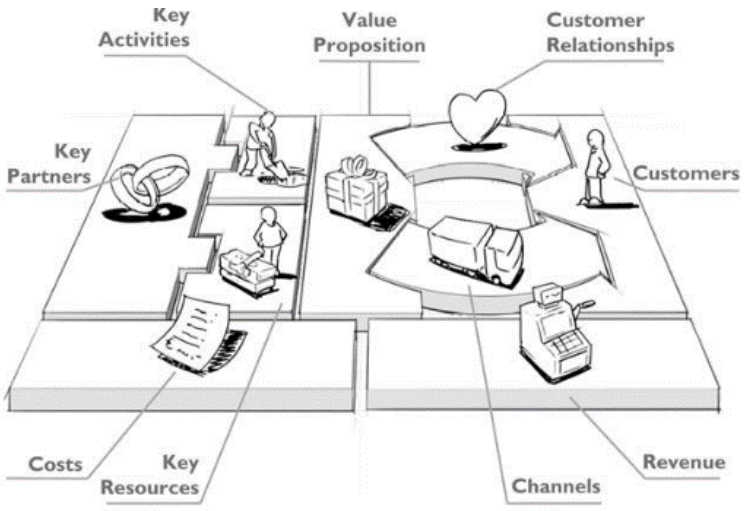
Alexander Osterwalder and Yves Pigneur (2014) [3] developed two tools viz., (i) a **'Business Model Canvass'** tool for generating a business model and (ii) a **'Value Proposition Canvass'** tool for value creation, primarily used to build company models. "There are five steps to the business model design process viz., (i) Identification of interdisciplinary stakeholders, (ii) Knowing the business environment (iii) Ideation, (iv) prototyping, and (v) business model implementation."

3.2.12 Business model canvass

"According to *Alexander Osterwalder* [3], the business model is a blueprint for implementing a strategy through organizational structures, procedures, and systems. A business model canvas is used to express, visualize, evaluate and redesign business models. A business model is best described as a set of nine basic building blocks that demonstrate how organizations seek to create profit. The nine blocks are divided into four major business domains: customers, products & services, infrastructure, and financial viability".

Alexander Osterwalder and Pigneur's Business Model Canvas has become a widely accepted standard for business model design among practitioners and academics. (Biloslavo et al., 2018). The business model canvass conceived by Alexander Osterwalder [3], as shown in Figure 3.2, is extensively used to develop new business models and redesign existing ones.

Figure 3.2



Business Model Canvass developed by Alexander Osterwalder

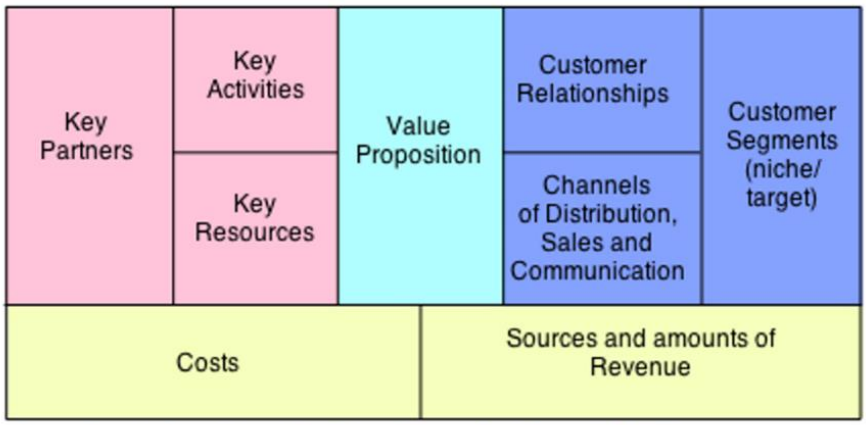
Components of the business model

Alexander Osterwalder and Pigneur [2] have generated a "business model canvass with nine interlinking components viz., customer segment, value propositions, channels, customer relationships, revenue stream, key resources, key activities, key partnerships, and cost structure shown in Figure 3.3."

Figure 3.3

Business Model Canvas

Nine segments of Business Model



Source: Alexander Osterwalder and Yves Pigneur "Business Model Generation" (2014)

Business model canvass

The customer segments building block describes the company's customer segments to target and serve. No business can survive without profitable consumers. "**The value proposition** component shows how the combination of products and services bring value to a particular consumer group." Organizations create value for their clients by customizing their products and services as per their specific requirements. Value proposition aims to solve client problems and meet client needs. Organizations create quantitative values like price, and volume and qualitative values like customers' perception of their products and services.

The channels building block explains how a firm provides value to its clients using communication, distribution, and sales channels. **The customer relationships** building block shows how the company needs to build a strong relationship with every customer segment it serves and manage the relationship well.

The revenue stream building block describes how an organization generate a revenue stream from the value proposition presented to its customers. The pricing structure for each revenue stream may differ. **The key resources** building block describes the assets needed to provide and deliver the value

proposition to its customers viz., products, facilities, equipment, and technology. **The cost structure building block** summarises all of the costs associated with the operation of the business model. By carefully defining all business model components, organisations can better understand how the business model successfully delivers on its value proposition while utilising specific critical resources and critical processes.

The key activities building block specifies the most important tasks the firm must do for its business model to function effectively. **Key partnership** block shows the company's network of suppliers and partner s. Companies make partnerships to optimize their business model to decrease risks or acquire resources. Companies are resorted to outsourcing some of the activities and getting sources outside the company.

3.2.13 Rebuilding the business model

To sustain its business in the long run, the organisation must enquire about the best possible ways to develop the new, explore the untapped, or accomplish the functional to create, capture, deliver value to customers and redesign their business models.

Business models are perishable

Paul Nunes and Tim Breene (2018) in the theme paper in the book titled "*Rebuilding your business model: Expert advice on business model innovation"* by the Harvard Business Review [41] confirms that "many organisations are entirely focused on executing its current business model and forget that business models are perishable. Today's success is no guarantee of tomorrow's success. Consequently, they are unable to make the needed changes in the organisation for its sustained growth. Visionary CEOs should unleash the power of the past, the present, and the future in three most important areas: strategy formulation, accountability, and organisational design."

3.2.14 Developing a sustainable business model

Developing or redesigning a business model is a dynamic process. According to *Alexander Osterwalder* [3], "Companies must redesign their business model and continues to find new ways to create and capture value for its stakeholders. To keep its business model viable and sustainable, companies should concentrate on new ways to earn profits and building value propositions for their valued clients, partners and stakeholders."

Almost all businesses reach a phase of stagnation at some point in their business cycle. "When a business hits a serious stall in its growth, companies have only less than a ten per cent chance of attaining its growth path." *(Matthew S., Olson, and Derek van Bever, 2009). "*Companies must redesign their business model periodically to be successful by leaping from the flattened end of one business performance curve to the ascending curve of another" [41].

In the past decade, the business model for sustainability has increased attraction. A sustainable business model is a template for a sustainable business that considers the triple bottom line of the environment, society, and economy. The sustainable business model can be adapted and changed over time to create sustainable value." *(Boons F.et al., 2013; Bocken N.M.P et al., 2014).* "Economic, social, and environmental concerns are all part of the global challenges connected with sustainable development. These issues affect practically every area of a company's strategic plan and its business model*."* *(Stuart L. Hart and Mark B. Milstein, 2003).*

The dynamics and business model development processes have been the subject of formal research. Few firms have a thorough understanding of their current business model, including the basis for its formation, inherent interdependencies, and strengths and limits [22].

Steps for rebuilding the business model

Redesigning the business model is of paramount importance before the present business model becomes obsolete. One of the cornerstones to sustaining a company's business is timely recognising when a significant change is required. *(Mark W. Johnson, 2008).* According to Mark W Johnson, "Redesigning the business model involves three simple steps namely (1) identify the need of the customer, (2) develop a business model specifying how the company can fulfil the need of the customers while making a profit, and (3) compare the current business model with that of the newly developed models and look for how and what changes need to be done in the current business model to grab the business opportunity." [22]

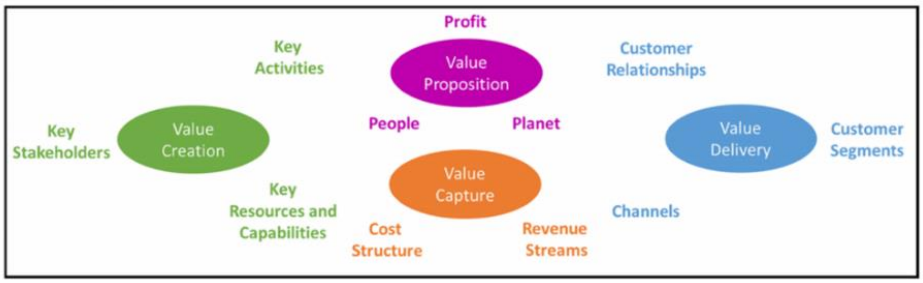
While redesigning organisations, business models and processes, the organisation must consider a complex web of factors such as the business environment in which it operates (e.g., technical, financial, competitive, legal, political, and environmental), the reasons for the stall in the growth or decline in profit and the root cause for it by probing the factors significantly contributing to its stalled growth.

3.2.15 Dynamic business model for sustainability (DBMS)

The "Dynamic Business Model for Sustainability (DBMS) developed by Bocken in 2015 is the redesigned version of an adopted sustainability business model by *Alexander & Osterwalder & Pigneur* in 2010". Figure 3.14 depicts the components of the adapted sustainability business model canvass developed by Boken et al. In the "DBMS methodology, social value, environmental value, and economic value are integrated into the business model structure, and it overcomes the gaps in the business model development. Thus, DBMS is used to design and find the sustainable value creation process" [16]. The adapted sustainable business model is shown in Figure 3.4. The Dynamic Business Model for Sustainability (DBMS) is shown in Figure 3.5.

Figure 3.4

Adapted sustainable business model canvass



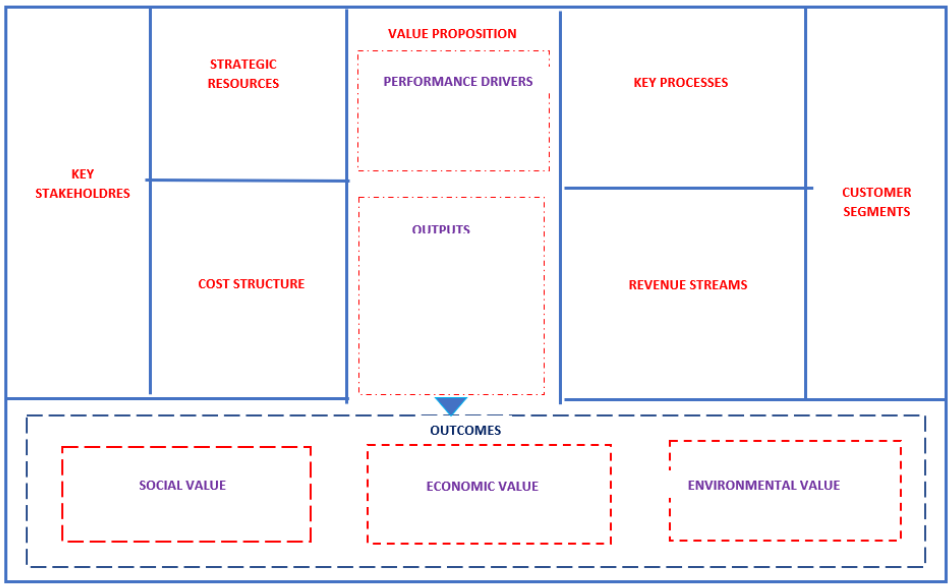
Source: Adapted sustainable business model canvass (Bocken et al., 2018, Bocken, 2015) www.wileyonlinelibrary.com

Sustainable business model canvass

Figure 3.5

Business model Canvass

Dynamic Business Model for Sustainability (DBMS)



Source: Dynamic Business Modelling for Sustainability www.wileyonline.com

Dynamic Business Model for Sustainability

3.2.16 Value proposition design

Value propositions are embedded in a viable business model, allowing compa nies to capture the value of their business. The value proposition design of a business model encompasses a collection of products and services of the company, which create value for their customers. Thus, the value proposition canvass aids in creating value for their customers, whereas the business model canvas aids in creating value for their business. Businesses must keep developing value propositions to attract new customers and retain existing customers, and this is a continuous process.[2]

3.2.17 Business models and energy systems

According to *Foxon*, "policy and system regulation must evolve in tandem with technological and innovation in the business model." Business model innovation research has concentrated on implementing specific technologies such as smart metering, smart grid, solar power generation, and SCADA (*Verbong, 2013)*. "The value proposition being used in the conventional business model for power distribution is that to stay profitable, state power utilities increase the number of kWh units sold as compared to cost." *(Blyth et al., 2014).* The unit-volume-based business model promotes the entire power distribution value chain to maximize output, driving power consumers into unsustainable activities.

3.2.18 Value proposition and value capture through technological innovation

The research on business model innovation reveals that "value proposition and value capture are critical components of business models, as they can provide many benefits to stakeholders other than power consumers." [55].

Technological developments in power distribution, namely smart meters, prepaid meters, SCADA, HVDS, and Customer Relationship Management (CRM) online, assist in overcoming the challenges inherent in capturing diverse values. The intelligent system provides a door for innovation in business models having intricate value chains. Complex value entails creating various stakeholders' financial, developmental, and environmental values through multiple systems over several locations and time frames. "For business models with complex value propositions to be sustainable, they must appropriately capture numerous values across multiple systems." *(Foxon et al., 2015)*. The other value proposition is the opportunity to harness renewable energy to help achieve low carbon transition.

Value capture through Demand Side Response and Participation

Tariffs based on demand-side response and participation (DSR/P) and time of use of energy is another value proposition, which derives the following benefits:

(i) It helps to avert the charges associated with the balancing process to the power suppliers.

(ii) It helps to identify the faults in the power distribution network

(iii) It helps to use the operational services.

Time of use of tariff

Smart metering helps to use time-off-use of tariff, incentivizes the power consumers to consume power during the off-peak load period, and helps the power distribution utilities shift the power demand and flatten the load curve. Therefore, the time-of-use of tariff and DSR/P are critical techniques that help to achieve flexibility in the power distribution network.

Revenue generation through potential value propositions

Each of the benefits indicates possible revenue-generating value propositions. By a suitable business model, every opportunity can generate a revenue stream in a complex value proposition.

3.3 ANALYSIS OF DIFFERENT BUSINESS MODELS OF DISCOMS

To redesign the business model of the state-run DISCOMs in India, the following three business models are analysed in detail.

1. The present business model of state-run DISCOMs with 100% ownership of the state government
2. Public-Private Participation (PPP) business model for electricity distribution
3. Business models by segregation of carrier and content in the power distribution business

Further, a detailed analysis of the TANGEDCO business model and the inherent weaknesses in the business model was made.

3.4 ANALYSIS OF THE PRESENT BUSINESS MODEL OF STATE-RUN DISCOMS WITH 100% OWNERSHIP OF THE STATE GOVERNMENT

In India, barring a few DISCOMs, the state-run DISCOMs are 100 per cent owned by the respective state government. Detailed analysis of the state-run DISCOMs from the explorative analysis has found that it is incurring huge financial losses despite several reform measures implemented in the power distribution sector to make the state-run DISCOMs business financially viable and sustainable. Several research studies made in the Indian power sector including the World Bank reports [8] [9] [60] [61] [62] [63], PFC annual study reports of the state power utilities in India, [42] [43] [44], research report of the International Institute for Sustainable Development [20], study reports of several committees appointed by the Government of India to make the state-run DISCOMs financial viability and business sustainability including reports of *V.K.Shunglu committee [53]*, *Abraham committee* [1], *report of Central Electricity Authority* [12], reports of the Ministry of Power [26] [27] [28] [29] [30 [31] [32] [33] [34] [35] [36] and the joint report of NITI Aayog, Government of India and the Institute of Energy Economics, Japan [39] has found several factors viz., both measurable variables and latent variables are contributing to its sustained financial losses of the state-run DISCOMs in India.

These study reports have found that there are complex factors and the interrelationship between the measurable variable and latent constructs have significantly contributed to the sustained financial losses of the state-run DISCOMs. The identified variables are scattered in several research reports as mentioned. However, by using these identified variables, a successful business model has not been developed. The World Bank reports and several research reports have concluded that there is strong political intervention by the state governments with SERCs and the state government does not permit the SERCs to fix a cost-reflective tariff for political reasons and SERCs are

subservient to the state governments, even though it is having quasi-judicial power.

3.4.1 Repeated bailout package to state-run discoms

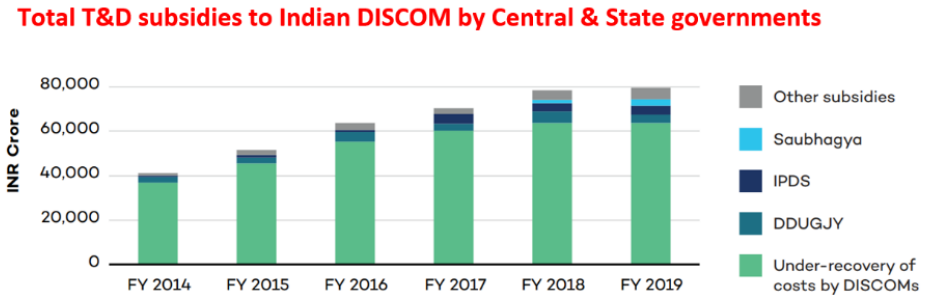
"As per the PFC report in F.Y. 2018-19 [44], the direct subsidy and cross-subsidy of DISCOMs at the national level amounts to Rs.1,10,391 crore and Rs.75,000 crore, respectively. Additionally, the Government of India provided an Rs.1,90,000 crore Financial Restructuring Package (FRP) to state-run DISCOMs in 2012 to come out of the severe financial crisis." Further, under Ujjwal DISCOM Assurance Yojana (UDAY), DISCOMs availed funding support of Rs.92,113 and Rs.74,228 crore in F.Y. 2016 and F.Y. 2017, respectively (Garg et al., 2020). In addition, the Government of India granted a major liquidity infusion package of Rs.1,20,000 crore in 2020 to clear the substantial overdue payable by DISCOMs to its power generators.

Huge unfunded subsidies, formation of regulatory assets, and mismanagement of the DISCOMs have resulted in huge financial losses to the state-run DISCOMs and the Government of India continued to implement several reforms, restructuring and bailout packages. With all these reforms and bailout packages. There is a dire need for robust reforms to make the state-run DISCOMs business financially variable and sustainable.

3.4.2 Unsustainable & untargeted subsidies - a major cause for financial unsustainability

"As per India's energy transition report 2020 [20], the state-run DISCOMs have received an aggregate T&D subsidy amount of Rs. 38,44,879 crores from the various Government of India Schemes and Rs.1,98,572 crore as bailout package from the Central and State Government under FRP and UDAY during six years from FY 2014 to FY 2019", as shown in Figure 3.6. The total T&D subsidy to DISCOMs during the F.Y. 2018-19 stood at Rs.80,000 crore. About 62,000 crores (77%) are the state subsidies arising out of the under-recoveries of cost by DISCOMs, primarily causing the financial unsustainability of DISCOMs.

Figure 3.6



Source: India's energy transition report on 'Mapping India's energy subsidies 2020' International Institute for Sustainable Development www.iisd.org

3.4.3 Tariff reform - a pressing need

One of the most important goals of India's power sector reform was to ensure the long-term viability of state-owned DISCOMs by instituting financial rigour and allowing utilities to fully collect the actual cost of the electricity supply. Irrational tariffs, a massive level of subsidies and untargeted subsidies, on the other hand, are significant concerns to achieving sustainability [61]. The state governments have resorted to granting blanket subsidies, which are not given to only the neediest consumers for political and non-economic reasons. Unless a cost-reflective tariff is fixed to agricultural consumers, the subsidy burden and the loss will continue to increase, which results in the further financial unsustainability of the state-run DISCOMs. *"Thus, rationalisation of tariffs, subsidies, and cross-subsidies would be critical for improving the financial viability of state-owned DISCOMs and sustainable power sector".*

3.5 PUBLIC-PRIVATE PARTICIPATION (PPP) BUSINESS MODEL FOR ELECTRICITY DISTRIBUTION

Delhi government adopted the Public-Private Participation (PPP) Model for electricity distribution by unbundling Delhi-Vidyut Board in 2002 by selling a majority of equity shares of 51% to a private player viz., Tata Power and Reliance Energy.

“Following the dissolution of the Delhi-Vidyut Board in 2002, the Delhi government entrusted the task of power distribution in Delhi to three DISCOMs viz., (i) BSES Rajdhani Power Ltd (BRPL), (ii) BSES Yamuna Power Ltd (BYPL), and (iii) New Delhi Power Ltd. (NDPL).” Reliance Energy owns a 51% majority stake in BRPL and BYPL, while Tata Power owns a 51% stake in NDPL and all three distribution companies; Delhi Government retains a 49 per cent stake in each of the three DISCOMs. Together, BRPL and BYPL serve nearly 24 lakhs customers in North and North-West Delhi, while NDPL serves almost 12 lakh customers [30].

The Delhi government has drastically reduced AT&C losses from 53% in 2002 to below 8% today through private participation. NDPL, BRPL and BYPL have replaced the dilapidated distribution network through substantial investment in the electricity distribution sector to revamp the distribution network. These companies have brought technological, product, and service innovations to create and capture value. “They provide value-added services to their customers through smart metering, Automated Meter Reading (AMR) metering technologies, Supervisory Control And Data Acquisition (SCADA) systems with a Global System of Mobile (GSM) communication Power Line Communication (PLCC) technology and reduced the commercial losses drastically.”

These companies have successfully implemented the High Voltage Distribution System (HVDS) and other system improvement measures and successfully reduced AT&C losses below 8%. With the improved efficiency in distribution, the Delhi government has been making savings of about Rs.30,000 crore since 2002 by improving distribution efficiency *(Sanjay Banga, 2019).* Thus, the privatisation of Delhi discoms is a success story. As of 2021, only three states/U.T. viz., Delhi, Maharashtra and Odisha, have successfully attracted private investments from major players such as Tata Power and Reliance Power.

It is observed that these private players viz., Tata power and Reliance Power have taken over the power distribution business by cherry-picking only in Mumbai and New Delhi, where the purchase parity or ability to pay by the consumers is high. These players are profit motive and hence, not keen to take over the power distribution businesses in rural India.

3.6 BUSINESS MODELS BY SEGREGATION OF CARRIER AND CONTENT IN THE POWER DISTRIBUTION BUSINESS

To bring in competition in the power distribution business, the Government of India has introduced the Electricity Amendment Bill, 2014 [54], in the Lok Sabha, which segregates the carrier and content business of the power distribution business. As per the Electricity Amendment Bill, 2014, there will be two types of licensees, viz., (i) Distribution licensees and (ii) Supply licensees. The Distribution licensees provide non-discriminatory access to their distribution network in exchange for the payment of regulated network access charges, and The Supply licensees compete to supply power to customers in a specific area using the distribution network."

Increased competition may result from additional supply licensees, as customers may switch to other supply licensees if they are dissatisfied with the service quality provided by the current supply agency. As a result, the supply licensee will provide its customer with the best service possible at a competitive tariff. While the distribution licensee is responsible for network maintenance and distribution losses, the supplier is accountable for commercial losses. The state power regulator shall issue Separate distribution and supply licences after the amendment bill's effective date of notification. SERC may grant a distribution licence for a period of up to 25 years. In comparison, a supply licence can be issued for 3-5 years and includes universal service obligations and standards of performance.

Existing licences held by the incumbent distribution licensee shall remain valid until they expire or are renewed, whichever occurs first. Upon expiration of the incumbent distribution licence, the existing distribution licensee must be

divided into separate distribution and supply licences for the area. Until now supply licensees enter the market, the incumbent distribution licensee may retain the supply licence as a last resort provider. The competition level may increase through more supply licensees since the customer may switch to another supply licensee if the customer is not satisfied with the present supply agency's service quality. So, the supply licensee will provide the best service to its customer at a competitive price.

3.6.1 States and DISCOMs' refusal to accept the Electricity Amendment Bill

Although the Electricity Amendment Bill, 2014 is expected to significantly improve financial efficiency and reduce losses, most state governments, politicians, DISCOMs, and their employees are vehemently opposed to privatising DISCOM's business by segregating C&C from the distribution sector. The main reason for not supporting the bills is as under:

1. As the profit-making revenue collection part (Content part of the distribution) will be given to private firms, DISCOMs will retain only the wire business (Carrier business) in the Amendment Bill, which would further deteriorate the financial health of state-run DISCOMs.
2. It is a handing over of the distribution business to the hand of a few private firms.
3. The expected loss of employment by way of Voluntary Retirement Schemes, as the private supply agency, shall employ their team after the Segregation of C&C business.
4. The PPP model has been implemented in Delhi, Maharashtra and Odisha only in cities like Delhi, Mumbai, and Ahmedabad in the urban areas, as the private players with the prime motive of earning profit picked and chose only the urban areas. While the affordability of the metropolitan regions to pay higher tariffs is more than rural areas, which disrupts the profit-earning capacity of private supply agencies due to affordability issues.
5. The State governments fear only having the loss-making rural segments subsidise customers in agriculture. Domestic consumers will only be

there with state-DISCOMs, which will impact its revenue-earning capacity from urban, industrial and commercial customers.

6. Supply licensees will immediately cut the power supply to customers when the customer does not promptly pay the bill or delay receiving a subsidy from the state government.
7. Presently, most State Governments are not paying subsidies in advance to DISCOMs as provided in the Electricity Act. Therefore, the states continued to make the book adjustments at the end of the year regarding the subsidy payments.
8. As per the RBI report, many states' financial positions become very weak due to the states' massive spending through several subsidy schemes, freebies, and social welfare schemes. Therefore, the state does not expect the advance payment and prompt payment of subsidies to DISCOMs through budget provision.
9. The fear of the state government is losing its autonomy and public agitation for privatisation. The state government carried out a substantial reform in the distribution sector by rationalising the tariff in the past. However, they lost their chance to form the Government next time, as the public continues to enjoy subsidies [62].

Because of these reasons, most of the states have not agreed to the Electricity amendment bill to get it passed in the parliament.

Opportunistic behaviour of political parties

Numerous World Bank research studies [8][63][56] on the Indian power sector's reforms confirm that unless tariffs, subsidies, and cross-subsidies are rationalised through a robust reform of the power distribution sector, the DISCOMs' financial viability and the power sector's sustainability are highly remote. However, India's political parties' opportunistic behaviour and instability have contributed to the declining acceptance of reform [56].

3.6.2 The Electricity Amendment Bill, 2020 and 2021

The Government of India also introduced the Electricity Amendment Bill 2020. As per the Electricity Amendment, Bill 2020 [35][36], the Ministry of Power has proposed amendments to the Electricity Act 2003. The prime objective of this bill is to achieve a sustainable power sector, with more focus on consumer service, to promote green energy and ease of doing business. The Electricity Amendment Bill 2020 provides for the fixation of the cost-reflective tariff by the SERCs and Direct transfer of subsidies to the identified beneficiaries through the DBT scheme and private participation in the distribution business to bring in competition and attract capital and empower the State Load Dispatch Centre (SLDC) to monitor payment security mechanism to avert the inordinate delay in payment by the state-run DISCOMs of power purchase dues, which went up to Rs.1,20,000 crore, which has made the state-run DISCOMs business financially unviable and unsustainable.

Not surprisingly, many states have vehemently opposed the proposed distribution reform and the Electricity Amendment Bill, 2020, as states are not aggregable for directly transferring subsidies to consumers through DBT Scheme, increasing private participation. As a result, privatisation has not gained much ground despite potential benefits due to political unacceptability *(Sanjay Kumar Banga).* However, some states are already started moving in the right direction and started implementing the DBT schemes and cost-reflective tariffs without the Amendment Bill. Therefore, a strong political will to accept and implement the above reform is needed to implement the most needed reform in the power distribution sector.

In the Budget 2021-22, the Central Government proposed a paradigm shift in the distribution reforms to dispense the distribution business to invite private participation in the distribution business. The Government of India proposed in Budget 2021-22 to introduce the Electricity Amendment Bill, 2021 with conditional segregation of carriage and content businesses in the distribution sector to allow consumers to choose their suppliers by opening the power

distribution sector to real competition. The bill has not been passed due to the strong opposition by the political parties in several states.

3.7 BUSINESS MODELS OF DISCOMS IN DEVELOPED COUNTRIES

Most developed nations have adapted privatisation to compete, improve financial and operational performance, and provide better service delivery. However, state-run DISCOMs dominate the power distribution business in India. While India succeeded in attracting private investment in the generation and transmission sectors, it has not been successful in bringing in private investment in the distribution sector.

The Government of India makes periodic attempts to privatise state-run discoms to improve their financial viability. Still, these efforts are unsuccessful, as many states oppose the Central Government's move to privatisation of the state-run DISCOMs.

Several power utilities worldwide adopt many business models, viz., the Public-Private Participation (PPP) model, Franchisee model, and segregation of carrier and content for private participation in the power distribution business.

3.8 ANALYSIS OF THE PRESENT BUSINESS MODEL OF THE DISTRIBUTION BUSINESS OF TANGEDCO

3.8.1 Financial viability

"For DISCOMs to be financially viable, they must operate on commercial principles and be able to meet their financial needs without government assistance [45]." This translates to:

1. Cost minimization through enhanced operating performance, judicious investment decisions, and efficient commercial/contractual performance in a regulated environment.
2. Adequate income generation via correctly set tariffs and a thriving commercial operation.
3. State government support in the form of revenue and capital subsidies is reduced."

The present business model of the state-run DISCOMs was analysed in detail. It is found that its business model become financially viable and unsustainable.

3.9 Inherent weaknesses of TANGEDCO's current business model

The business model of the distribution business of TANGDECO was analysed in detail. It was found that there are weaknesses in the current business model of TANGEDCO, resulting in huge financial losses to TANGEDCO, the details of which are narrated below:

3.9.1 Financially unviable & unsustainable business model of TANGEDCO

Detailed research has been done on TANGEDCO's current business model.

"The research finds that TANGEDCO's current business model is financially and economically unsustainable". Therefore, to financially turn around TANGEDCO and make its power distribution business financially and commercially viable and sustainable, TANGEDCO must redesign its business model.

TANGEDCO's business model failed to achieve financial viability

The financial viability of the business, creation of values, capturing values and delivering values to its customers are inherent in any successful business model. However, if there are inherent weaknesses in the business model, the organization may not achieve financial viability by operating its business efficiently. Organizations need to redesign their business models to achieve financial viability, as the evolving business model is a continuous process. Various internal and external factors impact the performance of an organization and achieve financial viability. The Business model of today does not guarantee business success for tomorrow. This research finds that the present business model of TANGEDCO is financially and commercially unviable and unsustainable. Furthermore, "the present business model neither creates value for its companies nor to its various stakeholders."

3.9.2 Inability to generate adequate revenue

The research finds that TANGEDCO is not generating adequate revenue from selling power through correctly set tariffs. As per the PFC report [37], TANGEDCO in 2018-19 has generated a total income (on a subsidy received basis) of Rs.56,328 crore against the total expenditure of Rs.74,290, and there is a 24.18% revenue shortage of Rs.17,964 crore.

The study finds that TANGEDCO loses Rs.1.82 on each unit of power sold due to the vast gap between the power supply cost and the revenue realized. The massive gap between the ACS and ARR is arising primarily due to the non-cost reflective tariff, non-revision of the periodical tariff, high AT&C losses (17.29%) and lower billing efficiency (83.42%) of TANGEDCO for the FY 2018-19.

3.9.3 High subsidy dependence

TANGEDCO's power distribution business is heavily reliant on subsidies. TANGEDCO is unable to sustain its power distribution basis financially on a stand-alone basis without receipt of the capital subsidy from the central government and revenue subsidies from the Government of Tamil Nadu. TANGEDCO is incurring substantial financial losses despite the receipt of significant revenue subsidies from the state government with a high level of cross-subsidies on the sale of power to industrial and domestic consumers and a substantial receipt of capital subsidies from the Government of India for the implementation of various power sector reform schemes in the state viz., RGGVY, APDRP, R-APDRP, NEF, DDUGJY, UDAY and Adma Nirbar Bharat Abhiyan.

In 2020, TANGEDCO received the most extensive bailout package of Rs.30,000 crore under the Government of India's liquidity package, Atma Nirbhar Bharat Abhiyan, to help it recover from a severe liquidity crisis. TANGEDCO obtained a loan of Rs.30,000 crore from PFC and REC to pay off its massive overdue payments to power generators.

As per the PFC report [44], the financial health of TANGEDCO has heavily deteriorated due to sustained financial losses. TANGEDCO in 2018-19 has an alarming level of accumulated loss of Rs.87,895 crore and high debt of Rs.1,13,438 crore with a negative net worth of Rs.62,124 crore. With the above trend and unsustainable tariff subsidy, the power distribution business operation of TANGEDCO is financially and commercially unviable and unsustainable.

3.9.4 TANGEDCO's business model does not create and capture values for itself and its various stakeholder

The present business model of TANGEDCO failed to capture and create values for itself and its various stakeholders, viz., State Government (the owner), the Central Government, customers, power suppliers, vendors and its employees.

"A business model describes the rationale of how an organization creates, delivers and captures values *(Alexander Osterwalder & Yves Pigneur, 2009)* [2]." "The business model has been firmly rooted in the rationale of how a company does business and how its structure creates, delivers and captures values *(Evans et al., 2017; Lozana, 2018; Osterwalder & Pigneur, 2010, Teece, 2010)."* A business model is a vital source of value creation for the firm and its various stakeholders. Value creation for shareholders valued customers, and other stakeholders are key to business success. From a financial point of view, value is created when a company generates enough revenue to cover its expenses.

Non-creation of values to its owner

TANGEDCO has not created, delivered, and captured value for its owner, the state government, as it does not generate sufficient revenue to make a profit. As a result, TANGEDCO is making sustained financial losses sustainable. TANGEDCO recorded the highest financial loss of Rs.17,962 crore (on a subsidy-received basis) in 2018-19. It stands at the top amongst state-run DISCOMs in India in incurring a financial loss. TANGEDCO cannot sustain

its business financially on its own without the revenue and capital subsidy from the state.

Non-creation of value to its customers

TANGEDCO has not created, delivered, and captured value to its valued customers, viz., power consumers, by supplying uninterrupted, quality power at affordable prices.

Migration of industrial and commercial consumers due to higher tariff

TANGEDCO sells electricity to its industrial and commercial power consumers at an exorbitantly higher price than the supply cost, leading to dissatisfaction with its customers in delivering the service. In addition, many industrial and commercial establishments have either shifted to other states or migrated to open access to purchase power with lower tariffs due to an irrational tariff structure, resulting in the loss of valued customers.

TANGEDCO in 2018-19 supplied power to industries by charging an exorbitantly higher tariff level of Rs.13.91 per unit (kW-Hr), with the highest cross-subsidy percentage of 128.4%. The tariff charged to the industries is 128% higher than its Average Cost of Supply (ACS). The higher tariff charged to industrial consumers resulted in industrial deceleration. It drastically affected the energy-intensive industries, textile, steel and cement, substantial revenue loss to TANGEDCO, tax revenues to the state government, and employment opportunities.

Exorbitantly higher tariff cross-subsidies beyond the limit prescribed under Tariff policy

To establish the cost-reflective tariff gradually, the National Tariff Policy set the maximum cross-subsidy at 20% of the average supply cost and the cross-subsidy phased out over time. However, the cross-subsidy charged to industries by TANGEDCO is 128% higher than its Average Cost of Supply (ACS). As a result, the state could not attract new industries due to the higher tariffs. Thus, TANGEDCO and the Govt. of Tamil Nadu have failed to create

value for its industrial power consumers, commercial customers and stakeholders. Further, the higher tariff to industries shall go against the Government of India's plan for Make in India.

Non-creation of values to its stakeholders

Huge payment defaults to its power suppliers

TANGEDCO has not made its payments due to its power supplier being on time due to the liquidity crisis arising from revenue shortage and substantial financial loss. As a result, TANGEDCO has a massive overdue Rs.20,000 crore payable to GENCOs as of September 2020 (www.praapti.in). Thus, it has failed to create value for one of its critical stakeholders, i.e., power-generating companies.

3.9.5 Inability to service the debt obligation

As per the PFC report [44], TANGEDCO's total borrowings as of 31.03.2019 stood at Rs.1,13,438 crore. As per the agreement entered with the Ministry of Power, TANGEDCO shall not borrow working capital loans of more than 25% of its total revenue earned during the previous financial year. Due to the liquidity crisis and massive revenue shortage, TANGEDCO could not service its loans to Banks and Financial Institutions and pay their dues to the power generators. TANGEDCO has availed Rs.30,000 crore loans from PFC and REC, a significant bailout package under the Government of India's Liquidity infusion package in 2020 under the Atma Nirbhar Bharat Abhiyan Scheme after crossing the 25% threshold limit of the Ministry of Power and RBI.

Thus, TANGEDCO has not created values for its one significant stakeholder, viz., its Borrowers, i.e., Banks and Financial Institutions. Moreover, its creditworthiness has come down due to sustained financial losses, huge debts, and inability to service its loans to Banks and Financial Institutions.

3.9.6 Need for the frequent bailout

The sustained financial losses of TANGEDCO and inefficient business operations have resulted in the need for repeated bailouts and massive capital

subsidy infusion to TANGEDCO by the Government of India. Thus, TANGEDCO has not created values for the central government. Govt. of India has in the past infused huge funds by way of the Financial Restructuring Package (FRP) three times to bail out TANGEDCO in 2002, 2015 and 2020. Govt. of India has also sanctioned capital subsidy schemes to TANGEDCO to implement reform schemes viz., RGGVY, DDUGJY, APDRP R-APDRP, NEF, Power for All and UDAY.

3.9.7 Dire need for redesigning the business model of TANGEDCO and state-run discoms

Today, most of the state-run DISCOMs are beset with operational inefficiencies and acute financial crunch, with an average AT&C loss of 22%. An unsustainably designed tariff structure with non-cost reflective tariffs with lower billing and collection efficiencies results in massive revenue shortage, and financially and commercially unsustainable business operations of DISCOMs. The aggregate DISCOMs overdue shoot up to Rs.1,25,369 crore, which has drastically reduced the investments in the Indian power sector.

Any capital funding from the central government for the distribution package without rationalizing the tariff would be a waste of taxpayers' money. The perennial problem of the inefficient DISCOMs needs to be fixed before any plan for bringing in competition in the sector, viz., private sector participation in the power supply business, and delicensing of distribution.

A robust reform in the power distribution sector focusing on tariff regulation is the need of the hour to achieve the financial sustainability of state-run DISCOMs, revive the Indian power sector, bring it back on track, and achieve overall economic development. There is a dire need for DISCOMs to change the way it does business radically, and it makes no sense to expect DISCOMs to financially turn around when the tariff charged by it is much below its cost price.

3.10 Findings from the literature survey of thematic review and explorative analysis chapter summary

A Series of reforms implemented in the power distribution sector since the enactment of the Electricity Act, 2003 has failed to make the state-run DISCOMs power supply business financially viable and sustainable, which is one of the prime objectives of the reforms and the Electricity Act, 2003. Sustained financial losses of the state-run DISCOMs with huge revenue shortages have made the state-run DISCOMs' business model financially viable and unsustainable.

A business model explains how a company generates, delivers, and captures value for its customers and for itself. An appropriate business model is critical for a company's long-term viability and sustainability. The best early indicator of a financially viable and sustainable business model is a profitable business. To make the business model of a company financially viable, radical changes in its business model are to be done by reform.

Alexander Osterwalder and Pigneur have generated a "business model canvass with nine interlinking components viz., customer segment, value propositions, channels, customer relationships, revenue stream, key resources, key activities, key partnerships, and cost structure. To sustain its business in the long run, the organisation must enquire about the best possible ways to develop the new, explore the untapped, or accomplish the functional to create, capture, deliver value to customers and redesign their business models. Companies must redesign their business model and continues to find new ways to create and capture value for their stakeholders. To keep their business model viable and sustainable, companies should concentrate on new ways to earn profits and build value propositions for their valued clients, partners and stakeholders.

Several research studies made in the Indian power sector including the World Bank reports, and PFC annual study reports of the state power utilities in India. has found several factors viz., both measurable variables and latent

variables are contributing to the sustained financial losses of the state-run DISCOMs in India. These study reports have found that there are complex factors and the interrelationship between the measurable variable and latent constructs have significantly contributed to the sustained financial losses of the state-run DISCOMs. The identified variables are scattered in several research reports as mentioned. However, by using these identified variables, a successful business model has not been developed.

The Public-Private Partnership (PPP) business model has been successfully implemented only in Delhi and Mumbai with 51 per cent share capital held by the private players viz., Tata Power and Reliance Power. These private players viz., Tata Power and Reliance Power have taken over the power distribution business by cherry-picking only in Mumbai and New Delhi, where the purchase parity or ability to pay by the consumers is high and these private players are not keen to implement PPP model in the distribution in rural areas.

The detailed literature survey finds that TANGEDCO's current business model is financially and economically unsustainable. Therefore, to financially turn around TANGEDCO and make its power distribution business financially and commercially viable and sustainable, TANGEDCO must redesign its business model. The present business model of TANGEDCO failed to capture and create values for itself and its various stakeholders, viz., State Government (the owner), the Central Government, customers, power suppliers, vendors and its employees. To financially turn around TANGEDCO and make its business model financially commercially viable and sustainable, a dire need to redesign its current business model.

This study finds that a financially viable and sustainable business model for India's state-owned power distribution companies has not been developed despite several rounds of reforms in the power distribution sector in India or is not available

3.11 Summary of research done and researcher(s) and contribution- Outcome of the literature survey and the research gap

The summary of the research done, researchers and their research contribution and the gap in the research gap from the detailed literature survey in the thematic review of the literature on the themes viz., *Theory of business, the concept of business model, sustainable business model, Concept of business sustainability, Business model generation, Rebuilding business models, the concept of value creation, building a sustainable business model* and explorative analysis of the state-run DISCOMs the reforms implemented in the power distribution sector have been tabulated in Table 3.1.

Table 3.1
Summary of literature review and research gap

The summary of the research done, researchers and their research contribution and the gap in the research gap from the detailed literature survey on (**1) Explorative analysis of the state-run DISCOMs, the reforms implemented in the Indian power distribution sector, and (2) Thematic review of the literature on the themes** viz., *Theory of business, the concept of business model, sustainable business model, Concept of business sustainability, Business model generation, Rebuilding business models, the concept of value creation, building a sustainable business model* and is tabulated below:

(1) Explorative analysis of the state-run DISCOMs, the reforms implemented in the Indian power distribution sector

Themes	Authors/Reports	Contribution / Inference	Research Gaps
	PFC Ltd. (2017). *Report on the Performance of State Power Utilities for 2013-14 to 2018-19.* [42] [43][44]	The **state-run DISCOMs' accumulated losses have reached an unprecedented level of Rs.4,88,686 crore,** with a total loss of Rs.61,360 crore on a subsidy-received basis. **'The total debt of DISCOM and aggregate revenue shortage in 2018-19 reached an alarming level of Rs.4,78,452 crore and Rs.49,517 crore,** respectively. As a result, **the financial health of the state-owned DISCOMs has severely deteriorated.** Even after	**A financially viable and sustainable business model is yet to be built. Several reform programmes implemented in the Indian power sector have failed to make DISCOM's business financially viable and sustainable.**

		implementing several reforms and financial restructuring packages granted to the state-run DISCOMs including the Ujwal DISCOM Assurance Yojana (UDAY) scheme, **the power distribution business of the state-run DISCOMs remains financially and commercially unsustainable.**	
Factors contributing to the sustained financial losses of the state-run DISCOMs	The World Bank Study Report. (2015). *Beyond Crisis: The Financial Performance of India's power sector.* Washington DC: World Bank. [63]	The gap between ACS and ARR (without subsidies) is the significantly largest factor contributing to the huge financial losses of the state-run DISCOMs in India. (about 28 per cent).	Despite several reforms implemented in the power distribution sector, there exists a big gap between the Average Cost of Supply (ACS) and the Average Revenue Realised (ARR). **A financially viable business model not developed by improving the financial and operational efficiency of the state-run DISCOMs That is by reducing the gap between the ACS and ARR,**

			reducing the AT&C losses below 15%.
Factors contributing to the sustained financial losses of the state-run DISCOMs	The World Bank Report. (2013). *Review of reforms implemented in the Indian Power Sector*. Washington DC: World Bank [61]	Rationalisation of tariffs, subsidies, and cross-subsidies would be critical for improving the financial viability of state-owned DISCOMs and the sustainable power sector. "interference of the state government in the tariff setting process of SERC is one of the primary reasons for the significant financial losses of state-owned DISCOMs, even though there is an explicit provision in important legislations such as the National Tariff Policy, Electricity Act, 2003, and Electricity Regulatory Commission Act for distancing of the state government from the SERC in tariff setting process."	**Despite knowing the significant factors contributing to the sustained financial losses of the state-run DISCOM,s a financially viable business model nor developed.**
Factors contributing to the sustained	The World Bank Study Report. (2014). *More*	The major reasons for the massive financial losses of the distribution power utilities in India are due to the	**Even though the significant factors contributing to the**

financial losses of the state-run DISCOMs	*Power to India: The Challenge of Electricity Distribution.* Washington DC [62]	higher T&D loss, which is much higher than the 10% international norms, losses due to under-collection of bills, and losses due to below-cost-recovery pricing. The state-run DISCOMs incur huge financial losses primarily due to the tariff under-pricing, inefficiency in billing and collection, unmetered power supply, power theft, high level of subsidies, poor subsidy policies of the state government, untargeted subsidies, high power purchase cost and high cost of power generation. As per the Electricity Act, 2003, the power regulators, i.e. SERCs and CERC, are quasi-judicial bodies mandated to determine tariffs and fix a cost-reflective tariff based on the Average Revenue Requirement (ARR) filed by DISCOMs in its tariff	**sustained financial losses of the state-run Indian DISCOMs, a financially viable business model is yet to be developed.**

		petition. "The state government's policy of supplying power at a heavily subsidized tariff or no cost will be an important factor in the state-owned DISCOMs' deteriorated financial performance". DISCOMs face a financial crisis because they cannot recover their entire supply cost, as the tariff does not reflect the power supply cost, as the tariff is underpriced.	
	Subhas C. Bhattacharya. (2006) [56}	India's political parties' opportunistic behaviour and instability have contributed to the declining acceptance of reform	**A financially viable business model was not developed for the state-run DISCOM, as the political intervention, played a key role in not accepting the sustainable reforms for the political reasons**

Sustainable in the power sector	The World Bank Study Report. (2014). *More Power to India: The Challenge of Electricity Distribution.* Washington DC [62]	Despite implementing several rounds of reforms in the power sector post-enactment of the Electricity Act 2003, the reform has failed to achieve the state power utilities' financial viability. "Reform can be considered sustainable if it is financially viable, commercially efficient, socially desirable, politically acceptable, environmentally benign, and acceptable as a project".	**Sustainable reform not implemented in India, the deteriorated financial performance and the financially unviable business of the state-run DISCOMs in India is impacting the economic development of the nation and the nation's energy security.**
Power sector reforms	Ministry of power reports, Electricity Act 2003, B.K. Chaturvedi Committee, V.K. Sunghlu committee report, Tariff orders of SERCs, scholarly research articles authored by *Arthur D. Little,* Anoop Singh	**India witnessed several reforms in the power sector since 1956 and a series of reforms after the enactment of the Electricity Act 2003.** The reform programs were implemented primarily to develop the power sector, improve the SEBs/DISCOMs and enhance the financial viability of the state power utilities. Although these reforms have contributed to the development of the power sector and socioeconomic development, **it has not achieved the primary objective of the reforms of improving the financial viability of the**	Earlier reforms implemented in the power distribution sector have failed to achieve the financial viability of the DISCOMs. **There is no successful business model available to make the state-run DISCOM's business model financially viable and sustainable.**

	Rosenzweig and Carlos Pabon Agudelo, Ranganathan, V, O. P Rahi, Harish Kumar Thakur, and A.K. Chandel, Thakur, Tripta, Soham Ghosh, Siddharth N. Khobragade, Dhananjay and B. Mishra, Sarh Patts Voll, Michael B. Ninad P. Totara, Shubha Pandit, Bajaj H. L., and D. Sharma	**SEBs/DSICOMs. State-owned DISCOM's business has become financially unviable and unsustainable. There is a dire need to make the distribution business financially viable and sustainable.**	
Performance of the state-owned DISCOMs	Ministry of Power, PFC report, World Bank report	The state-run DISCOMs are making huge financial losses on a sustainable basis (About Rs.60,000 crore every year). The accumulated losses for the FY 2015 reached an alarming level of Rs.3.8 lakh crore, which is 3.425 % of India's GDP for the FY 2014-	Despite several reforms in the power distribution sector implemented to improve the financial health of the state-run DISCOMs, There is a dire need to address the

		15. The primary reasons for the sustained losses are due to high AT&C losses, and the huge gap between the Average Cost of Supply (ACS) and Average Revenue Realised (ARR). **State-run DISCOM's power distribution business become financially unviable and unsustainable, which has impacted the power and other sectors of the economy.**	business sustainability of DISCOMs on a war footing basis.
Implementation of Govt of India Strategies for development of power sector & AT&C loss reduction	Guidelines of various GoI Schemes viz., APDRP, R-APDRP, RGGVY, DDUGJY, IPDS, DDG, Tariff Based International competitive bidding for the Ultra Mega Power Projects (UMPP), UDAY, scholarly research articles done	Govt of India has formulated various strategies, which are implemented through various reform programs viz., Un-bundling of SEBs, Formation of SERC/CERC (for setting the power tariff and to keep away state govt away from the tariff setting process), Energy conservation measures, AT&C loss reductions through APDRP, R-APDRP, RGGVY, DDUGJY, IPDS, DDG, Tariff Based International competitive bidding for the Ultra Mega Power Projects (UMPP), Financial Restructuring Plan and UDAY.	**The power distribution business, the weakest link in the power sector value chain, has been heavily affected. The power distribution business of state-run DISCOMs has become unviable and unsustainable.** There is a dire need to make the distribution business financially viable and sustainable.

	by authors A.K. Chandel, Thakur, Tripta, Soham Ghosh, Siddharth N. Khobragade, Dhananjay and B. Meshra, Sarh Patts Voll, Michael B. Ninad P. Totare, *Arthur D. Little*, Anoop Singh. Rosenzweig and Carlos Pabon Agudelo, Ranganathan, V, O.P Rahi, Harish Kumar Thakur	**However, the sustained efforts of the Govt have not achieved the reform's objective, and the reform program has failed to improve the financial viability and sustainability of the power distribution business of DISCOMs.**	
Impact of the sustained losses of DISCOMs	Research articles are done by authors A.K. Chandel, Thakur, Tripta, Soham Ghosh, Siddharth N.	The sustained losses combined with the mounting losses of the DISCOMs resulted in the severe deterioration of the financial health of almost all the state-run DISCOMs across the country, and its net worth eroded and led to a severe financial crisis.	The unsustainable business of DISCOMs has heavily impacted the power sector & the overall economic development. Therefore, there is a dire need to plug the leakage and

	Khobragade, Dhananjay and B. Meshra, Sarh Patts Voll, Michael B. Ninad P. Totare, *Arthur D. Little,* Anoop Singh Rosenzweig and Carlos Pabon Agudelo, Ranganathan, V, O.P Rahi, Harish Kumar Thakur	This has heavily impacted the development of the power sector and other sectors of the economy and is holding back the nation's economic growth. *DISCOMs are unable to generate sufficient revenues to make a profit, Service loans to Banks/FIs, Defaulted to Banks/FIs and built the NPAs in Bank loan assets, take up the Capacity addition and CAPEX program, meet their operational expenditure, Purchase power due to debt trap leading to power supply cut.* DISCOMs are unable to service their debt repayment obligation, resulting in mounting NPAs in the books of Banks and FIs, and it has heavily impacted the Banking industry. It is unable to raise loans at a competitive rate as its rating has come down. Govt. is pumping in huge money to the ailing power sector through various reform programs, which involve the highest subsidy (about 50 – 90% of the	make the business model of DISCOMs sustainable and to create, deliver and value for its business, customers and society at large. **The present business model being adopted by the state-owned DISCOMs in India including TANGEDCO has failed to create value for itself, its customers, and society at large. Its present business model is unsustainable.** There is a gap in the non-availability of sustainable business models for state-owned DISCOMs. Therefore, there is a dire need to redesign the business model of the state-run DISCOMs to plug the huge leakage and for its business sustainability. Developing a sustainable business

		project cost), resulting in leakage in the Govt coffer. They affected the private power generators, as the DISCOMs are the single largest buyers of electricity. Private players are not coming forward to add generation capacity to meet the demand-supply gap. DISCOMs are unable to supply quality power 24X7 to customers impacting the industry, agriculture and social development. <u>DISCOM has failed to create value for its business, its customers and society at large.</u> The sustained losses have posed a significant threat to India's energy security. The state-run DISCOMs cannot survive, as the power distribution business of the state-run DISCOMs becomes *financially and commercially unviable and unsustainable.*	model for the state-run DISCOMs is the need of the hour.
Variables/factors contributing to substantial financial	PFC Report on DISCOM's performance, world	The reasons attributed to the sustained financial losses are the High AT&C losses, comprising of technical and commercial losses. While more	**The major variables and factors responsible for the sustained losses were identified. However, using**

losses of DISCOMs	bank report, Reports of the Govt. of India appointed committee viz., Abraham committee, B.K. Chaturvedi Committee, V.K. Sunghlu committee report, Tariff orders of SERCs, scholarly research articles done by authors Thakur, Tripta, Soham Ghosh, Siddharth N. Khobragade, Dhananjay and B. Meshra, Sarh Patts Voll, Michael B. Rosenzweig and Carlos Pabon Agudelo, Ranganathan, V, O. P Rahi, Harish Kumar Thakur, and A.K.Chandel, Ninad	importance was given by the Govt. to reducing the technical losses, the reforms measures to drastically decrease the commercial losses are not adequate. The significant factors attributable to high Technical losses are losses in the distribution system, lengthy LT lines, and inefficiency in the distribution system. *The significant factors attributable to high Commercial Losses are Irrational tariffs, tariffs not revised periodically, power tariffs not in consonance with the cost of supply (Section 61 (g) of EA, 2003),* **Building-up of regulatory assets** due to inordinate delay in filing of tariff petition, **delay in 'truing-up' and tariff determination** by SERC, increase in fuel cost not passed through then and there, the **wide gap between ACS & ARR, Huge power subsidy to Agriculture sector** (Out of 24% of the power supplied to the agricultural sector only yields less than 6% of the total revenues) & domestic sector, **Free power supply, state Govt./Politicians distancing from tariff setting -A hard reality**	**these key factors, a sustainable business has not evolved, as the present business model being adopted by DISCOMs is unsustainable.** **Non-availability of the sustainable business model for the state-owned DISCOMs** **A lack of research has been done to develop a sustainable business model for the state-run DISCOMs in India.**

	P.Totare, Shubha Pandit, Bajaj H. L., and D. Sharma, *Arthur D. Little*, Anoop Singh	(State Govt using Section 108 of the Electricity Act for not adhering to adopt the tariff fixed by the regulator) Non-receipt/Lower receipt of subsidy from the state, **Non-billing/incorrect billing**, consumers un-metered, inefficiency in billing, bill collection, **power theft,** The connivance of DISCOMs employees with customers involved in power theft, **the higher interest rate of loans** due to poor rating, the **unwillingness of the customers to pay an affordable price for electricity** **Political intervention** (Political party both ruling and opposition parties demanding not to raise tariffs and to continue with the free /highly subsidize power for agriculture and domestic consumers.	

Summary of literature review and research gap

(2) Thematic review of the literature on the themes viz., *Theory of business, the concept of business model, sustainable business model, Concept of business sustainability, Business model generation, Rebuilding business models, the concept of value creation, building a sustainable business model*

Based on the thematic literature review, the following significant findings have emerged

Themes	Authors/Reports	Key findings	Research Gaps
Theory of business	*Peter F. Drucker*	The underlying assumptions upon which the organisation was founded and is run no longer hold Certain business theories developed by firms are extremely powerful and will endure longer. However, **every business theory eventually becomes obsolete, and the firm must constantly test its business theory to remain successful**	**The state-run DISCOMs become obsolete. The business theory on which the state-run DISCOMs make a profit has not been tested to build a financially viable business model**
Theory of firms	The Peter F. Drucker, Osterwalder & Pigneur, The Harvard business Review	The theory of the firm states that **firms** (including businesses and corporations) **exist and make decisions to maximize profits.** It elaborates on the **logic of doing business profitably.** The behaviour of a particular business entity is said to be driven by profit maximization. **This theory governs decision-making in various areas,**	**It has not explained how value could be created for the business and customers to make the business profitable.**

		including resource allocation, production technique, pricing adjustments, quantity produced, etc. **The theory of the firm goes along with the theory of the consumer**, which states that consumers seek to maximize their overall utility.	
Business model generation	*Alexander Osterwalder and Yves Pigneur (2014) Business model generation.* [3]	A business model explains how a company generates, delivers, and captures value for its customers and for itself. **An appropriate business model is critical for a company's long-term viability and sustainability.**	**For long-term viability and sustainability, an appropriate business has not been developed for the state-run DISCOMs yet.**
Business model generation	Alexander Osterwalder and Pigneur [2]	**A business model canvass developed by the authors comprising nine interlinking components** viz., customer segment, value propositions, channels, customer relationships, revenue stream, key resources, key activities, key partnerships, and cost structure	**A sustainable business model has not been built for the state-run DISCOMs by redesigning its components of the business model. The cost and revenue stream components of the present business model need a major change to make its business model financially viable and sustainable. Lack of research done to make the DISCOMs**

			business model financially viable.
Business model generation	*(Matthew S., Olson, and Derek van Bever, 2009)* [41]	When a business hits a serious stall in its growth, companies have only less than a ten per cent chance of attaining its growth path." "Companies must redesign their business model periodically to be successful by leaping from the flattened end of one business performance curve to the ascending curve of another.	**Even though the nosiness growth of the state-owned DISCOMs has affected them drastically, a financially viable business model has not been redesigned.**
Business model generation	Mark W. Johnson, Clayton M. Christensen, and Henning Kagermann. (2018). *Reinventing your business model.* Harvard Business Review.	The dynamics and business model development processes have been the subject of formal research. Few firms have a thorough understanding of their current business model, including the basis for its formation, inherent interdependencies, and strengths and limits.	**The business model of the state-run DISCOMs has not been understood. Further, there are a lot of bottlenecks in implementing a financially viable business model. Various stakeholders including the state governments and politicians.**
Sustainable business model	*Alexander Osterwalder and Yves Pigneur* (2014) [3]	For a business model to be sustainable, it should be commercially viable, future-ready, and part of a sustainable society to succeed in a world of growing, volatile energy and commodity prices. Therefore, it	**A financially viable business model is yet to be developed for the state-run Indian DISCOMs**

		is impossible to run a sustainable business in an unsustainable economy. **The best early indicator of a financially viable an d sustainable business model is a profitable busin ess.**	**including TANGEDCO**
Sustainable business model	*Bhattacharyya S.C. (2007) [9]*	Reform can be considered sustainable if it is politically acceptable, financially viable, economically efficient, socially desirable, environmentally benign, and implementable as a project.	**The power sector reforms made so far in India have not been successful distribution reforms to make the state-run DISCOMs business financially viable and sustainable.**
Sustainable business model	Federico Cosenz, Vinicious Picanco Rodrigues and Francesco Rosati. (2019). Dynamic business modelling for sustainability: Exploring a system dynamics	The "Dynamic Business Model for Sustainability (DBMS) developed by Bocken in 2015 is the redesigned version of an adopted sustainability business model by *Alexander & Osterwalder & Pigneur* in 2010". In the "DBMS methodology, social value, environmental value, and economic value are integrated into the business model structure, and it overcomes the gaps in the business model development. Thus, DBMS is used to design and find the sustainable value creation process"	**By using the DBMS methodology, a financially viable and sustainable business model is yet to be developed.**

	perspective to develop sustainable business models. *Business Strategy and the Environment* [16]		
Reinventing the business model	Mark W. Johnson, Clayton M. Christensen, and Henning Kagermann. (2018). *Reinventing your business model.* Harvard Business Review [12]	**One of the cornerstones to sustaining a company's business is timely recognising when a significant change is required.** According to Mark W Johnson, "Redesigning the business model involves three simple steps namely (1) identify the need of the customer, (2) develop a business model specifying how the company can fulfil the need of the customers while making a profit, and (3) compare the current business model with that of the newly developed models and look for how and what changes need to be done in the current business model to grab the business opportunity.	**Even though, the need for changing the obsolete business model of the state-run DISCOMs in India, a financially viable business was not yet developed.**
Value creation in business model	*(Evans et al., 2017; Lozana, 2018; Osterwalder & Pigneur, 2010, Teece,*	The business model has been firmly rooted in the rationale of how a company does business and how its structure creates, delivers and captures values. A business model is a vital source of value creation for	**The state-run DISCOM's distribution business does not create value for itself and its various stakeholders. The**

	2010)	the firm and its various stakeholders. Value creation for shareholders valued customers, and other stakeholders are key to business success. From a financial point of view, value is created when a company generates enough revenue to cover its expenses.	**business model of the state-run DISCOMs become obsolete. No successful and financially viable business model was developed for the state-owned Indian DISCOMs. business mod**
Value proposition/ value creation	Johnson, M., Suskewicz, Johnson, M., Suskewicz, J., Bocken, S.W. Short, P. Rana, S. Evans, Mark W. Johnson, Clayton M.Cheristensen and Hagermann, Hedman, J. and T. Kalling, Florian Lüdeke-Freund, Morris et al., Purdy, Robinson, & Wei, Storbacka, Frow, Nenonen, & Payne, Al-Debei& Avison, Chesbrough& Rosenbloom, Amit &Zott, Johnson et al.,	**Business needs to create value for themselves, their customers, and society to survive, compete, and sustain.** **No generic business model templates for issues of corporate sustainability exist.**	**The concept of value creation has not been grounded in theory.** **Non-availability of a sustainable business model for state-owned DISCOMs in India to capture, create and deliver value to its customers, its business and other stakeholders**

	Baden-Fuller & Haefliger, Chesbrough& Rosenbloom, Enkel & Mezger, Holm et al.,		
Business sustainability	Bocken, S.W. Short, P. Rana, S. Evans, Mercados, Ram Nidumolu, C.K. Prahalad, and M.R. Rangaswami, Yosef Jabareen, Florian Lüdeke-Freund, Florian Lüdeke-Freund, Morris et al., Purdy, Robinson, & Wei, Susan Lambert	**An appropriate business model is of paramount importance for the business sustainability of any organisation and its commercial success.** **Organisations have to innovate to create a sustainable business model for their corporate sustainability**	**A sustainable business model for the state-owned DISCOMs is not available and not developed yet, as its existing business model become unviable and unsustainable**
Business models/ Business model generation	Osterwalder & Pigneur, The Harward Business Review, P.Rana, S. Evans, Mark W. Johnson, Clayton M.Cheristensen and Hagermann, David	A huge number of business models should be designed to create value for its business, customers, **and society.** **Vast nos. of definitions available for the business model and a common definition or common**	**Various concepts have been developed to develop business models, while theories are still undeveloped.** **The business models conceived**

	Johann Hermann Klang, Maria Wallnöfer and Fredrik Hackli, Hedman, J. and T. Kalling, Mercados, Ram Nidumolu, C.K. Prahalad, and M.R. Rangaswami, Yosef Jabareen, Lingyun Wang, Päivi Jaring, Arto Wallin, Morris et al., Storbacka, Frow, Nenonen, & Payne, Lingyun Wang, PäiviJaring, and ArtoWallin, Peter Yanopoulos, Susan Lambert, Govt of Gujarat paper, Al-Debei& Avison, Chesbrough& Rosenbloom, Amit &Zott, Baden-Fuller	**language does not exist** **Various concepts have been developed to develop business models, while theories are still undeveloped.** **A universally acceptable business model concept does not exist yet**, as in most cases, practitioners and *academics create business model approaches according to their individual needs.* The burgeoning literature on the business model is young and quite dispersed. It is starting to make inroads into the top management journal. **A common conceptual base of the business model is still lacking**. Few important themes are available, primarily around notions of the business model as a new unit of analysis, offering a systematic perspective on how to do business, encompassing organizational activities and as a source of value	**are rarely grounded in existing theory.** **A common conceptual base for the business model is still lacking.** **Non-availability of a sustainable business model for the state-owned power distribution companies in India**

	&Haefliger, Johnson et al., Baden-Fuller &Haefliger, Chesbrough& Rosenbloom, Enkel & Mezger, Holm et al.,	creation. *These themes are interconnecting and mutually reinforcing, and the field is moving towards conceptual consolidation,* which paves the way for more cumulative research on business models. An array of conceptualizations of business models have been conceived from different views of the problem domain Moreover, **the business models conceived are rarely grounded in existing theory.** Very little literature is available, that defines a framework for developing a sustainable business model for India's state-owned power distribution companies. **Minimal scientific research has been done for developing a sustainable business model for the state-owned DISCOMs.** The **'business model canvass'** and **'value creation canvass'** as developed by **Alexander Osterwalder & Yves Pigneur** are widely used tools and	

		techniques for generating a successful business model. Through the business model canvass, one would realise the business model.	

3.12 RESEARCH GAP FILLED IN IN THIS THESIS

The following research gap identified is identified from the detailed literature survey has been filled in by this thesis is as under:

"Non-availability of a financially viable and sustainable business model for India's state-owned power distribution companies".

CHAPTER 4

ANALYSIS OF SECONDARY DATA OF ALL INDIA DISCOMS

CHAPTER OVERVIEW

An in-depth study has been made to find out various factors significantly contributing to the sustained financial issues of the state-run DISCOMs across the country and the outcome of several reforms implemented in the power distribution sector and the performance of the state-run DISCOMs are analysed in detail. The detailed analysis of the secondary data collected for all India DISCOMs is mentioned hereunder:

4.1 REFORM PROGRAMS IMPLEMENTED IN THE POWER DISTRIBUTION SECTOR

The Indian power sector has witnessed several reforms since 1991. The Government of India and state governments have implemented a series of reforms after enacting landmark legislation 'The Electricity Act, 2003'[37].

Several reform programs have been implemented in the power distribution sector with a prime objective to improve the financial performance of the state-run DISCOMs, as its financial health has heavily deteriorated and to contain the sustained financial losses of DISCOMs. "Major reforms schemes implemented include Rajiv Gandhi Garmin Vidyutikaran Yojana (now subsumed in Deendayal Upadhyaya Gram Jyoti Yojana (DDUGJY), Accelerated Power Development and Reform Programme (APDRP), and Integrated Power Development Programme (IPDS), Ujwal DISCOM Assurance Yojana (UDAY) to strengthen the sub-transmission and distribution networks and reduce AT&C losses to 15% and to make the state-run DISCOMs business financially viable and sustainable." Although the technical losses have declined after the implementation of the reform programs, the pace

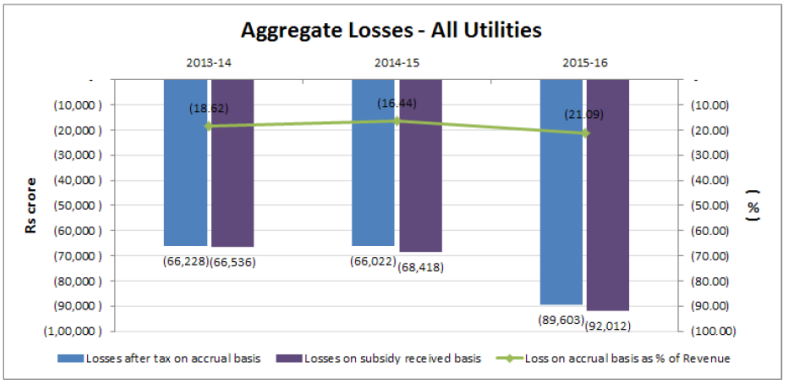
of reduction has been meagre. However, these reforms have failed to achieve the financial viability of the state-run DISCOMs.

4.2 ANALYSIS OF FINANCIAL HEALTH OF THE STATE-RUN DISCOMS

4.2.1 Mounting financial losses of DISCOMs

Despite implementing several rounds of reforms in the power sector post-enactment of the Electricity Act 2003, the reform has failed to achieve the state power utilities' financial viability [61] [62]. The aggregate losses of all the state power utilities are mounting year-on-year, reaching an alarming level. The aggregate losses of state power utilities for the FY 2015-16 on a subsidy received basis increased to Rs.92,012 crore from Rs.68,418 crore in FY 2014-15 [42] shown in Figure 4.1. The financial losses on an accrual basis increased to 21.09% of the total revenue for FY 2015-16 from 16.44% in FY 2014-15 [42].

Figure 4.1



Source: PFC report on performance of state power utilities 2015-16

Aggregate loss of DISCOMs in India

Mounting accumulated losses

The accumulated loss of all the state-owned power utilities for the FY 2015-16 has reached an alarming level of Rs.4,85,922 Crores, 4.28% of India's GDP for 2015-16.

4.2.2 Negative net worth

The sustained substantial financial losses have eroded the net worth of the state-run DISCOMs. As a result, it became bankrupt, which derailed the power sector reforms and heavily impacted its economic growth in a big way. “As per the PFC Report 2015-16, the total net worth of state power utilities selling power directly to the consumers for the FY 2015-16 stood at Rs.2,16,125 Crore (Negative)”. [42].

4.2.3 Unsustainable power distribution business of state-run DISCOMs

For the sustainable development of the power sector, the financial viability of the discoms is of paramount importance. Therefore, achieving financial viability is one of the primary objectives of the power sector reforms. To achieve the financial viability of the power distribution business of the state-run discoms, it needs to operate its business on commercial principles and make a profit. However, despite several rounds of reforms, discoms are unable to generate sufficient revenue to meet the cost incurred to supply electricity resulting in substantial revenue shortages and mounting accumulated losses [56].

4.3 FINANCIAL RESTRUCTURING PACKAGES TO DISCOMS

The Government of India has granted several Financial Restructuring Packages (FRP) to bail out the bankrupt DISCOMs for their financial turnaround. The first financial restructuring package of Rs.40,000 crore in 2002, with FRP of Rs.1,90,000 in 2012 crore was granted to DISCOMs by the Govt. of India. Despite the above two major significant financial restructuring packages, DISCOM had accumulated losses of Rs.3,80,000 crore and massive debt of Rs.4,30,000 crore as of March 2015. The aggregate loss of the DISCOMs has grown exponentially. The total losses of state-run DISCOMs were mounting year-on-year, and they reached an alarming level in FY 2015-16. The aggregate losses of DISCOMs for the FY 2015-16 on a subsidy received basis increased to Rs.92,012 crore from Rs.68,418 crore in FY 2014-15 [42] shown in Figure 4.1. The State-run DISCOMs are unable to invest in

capital schemes due to their high debt level and sustained high financial losses.

4.4 UJWAL DISCOM ASSURANCE YOJANA (UDAY)

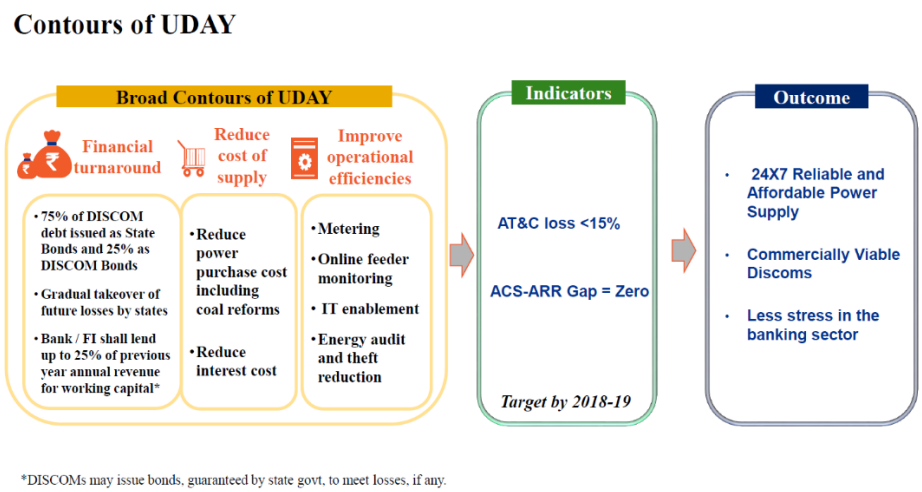
The accumulated losses of DISCOMs have reached an alarming level of Rs.3,80,000 crore, and its outstanding debt has ballooned to Rs.4,10,000 crore in FY 2014-15 [42]. The mounting financial losses, huge borrowings by DISCOMs and massive revenue shortage have put DISCOMs under deep financial stress, which has heavily impacted the Indian power sector.

"For the financial turnaround of the state power utilities, the Government of India granted major financial restructuring packages three times to bailout discoms in 2003, 2012 [27], and in 2015 through Ujjwal Discom Assurance Yojana (UDAY), a reform linked financial restructuring package for financial and operational turnaround of DISCOMs." [29]

4.4.1 Contours of UDAY

"As per UDAY Scheme [29], the State Government shall take over 75% of DISCOM's debt as of September 2015 in two instalments, i.e., 50% in 2015-16, 25% in 2016-17, as shown in Figure 4.2." Twenty-seven States/Union Territories have participated in UDAY Scheme after signing an MoU with the Ministry of Power.

Figure 4.2



Contours of the UDAY Scheme

As per the UDAY Scheme, the State Government shall issue Non-SLR (Statutory Liquidity Ratio) bonds, including SDL (State Development Loan), and transfer the funds raised at a lower interest rate to DISCOMs in the form of grant loan equity.

As per the scheme, the State Govt. shall issue a bond with a 10-15 years maturity period and a moratorium of up to 5 years. The interest rate for the bond is G-Sec, plus a 0.5% spread plus a 0.25% spread for non-SLR shall reduce the interest cost of DISCOMs drastically, which will also significantly bring down its cost of supply. The debts so taken over by the State Government will not be included in calculating the state's fiscal deficit in the first two years. However, the interest needs to be serviced within the states' Fiscal Responsibility and Budget Management limits.

For the balance 25% debts of DISCOMs as of September 2015, DISCOMs shall issue bonds guaranteed by the respective State Govt. or Banks/FI shall reduce interest rate at not more than bank base rate + 0.10%. Further, the State Government shall need to take over the future losses of DISCOMs as per the UDAY trajectory in a phased manner. That is in FY 2016-17: 5%; FY 2017-18: 10%; FY 2018-19: 25% and in FY 2019-20: 50%. Balance losses are to be financed through State Govt. bonds or DISCOM bonds backed by the state govt. Guarantee to the extent of loss as per trajectory agreed with the Ministry of Power in the UDAY agreement. Jammu & Kashmir has been granted a special dispensation to take over the outstanding dues owed to CPSUs.”

UDAY's implementation aimed to achieve DISCOMs supply power to consumers at a reasonable price. In addition, Banks and Financial Institutions funded DISCOMs are expected to get assured loan service obligation as respective states are taking over the DSICOMs debt.

4.4.2 Operational parameters target for DISCOMs under UDAY

Under UDAY, DISCOMs need to bring down the AT&C losses to 15% (from the national average AT&C loss of 23.95% in 2015-16) by 2018-19 and to bring down the gap between the Average Cost of Supply (ACS) and Aggregate Revenue Realized (ARR) to zero by 2018-19 [48].

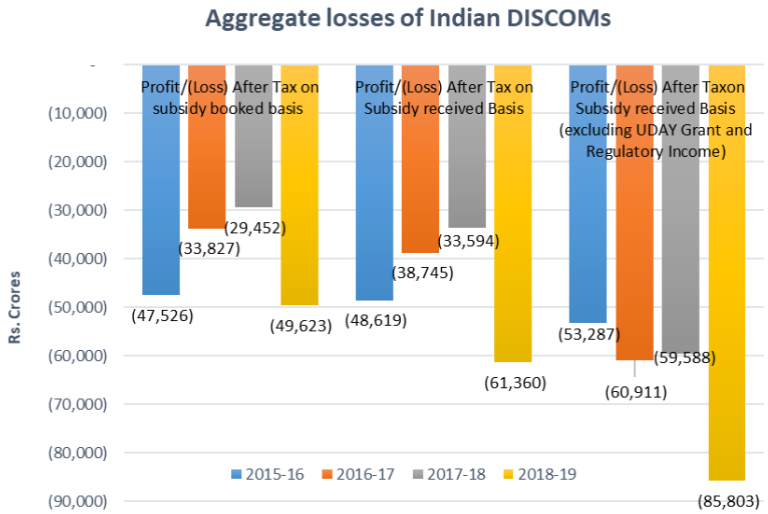
4.5 ANALYSIS OF DISCOM'S FINANCIAL PERFORMANCE DURING THE UDAY SCHEME PERIOD

The financial and operational performance of state-run DISCOMs over the four-year implementation period of the UDAY scheme from 2015-16 to 2018-19 has been studied in detail to diagnose the significant factors contributing to the unsustainable business operations of DISCOMs. In addition, a study was made at the end of the UDAY period, on whether DISCOMs were able to achieve the set financial and operational target parameters by the Ministry of Power to the participating state-run DISCOMs or not.

4.5.1 Mounting financial losses of DISCOMs

The Aggregate losses of DISCOMs have declined in 2017-18 and 2018-19 compared to FY 2015-16. However, it has increased exponentially in FY 2018-19. As a result, the aggregate losses of the DISCOMs have reached higher than in the Pre-UDAY period, which shows the poor financial performance of the DISCOMs even after the implementation of UDAY. As per the PFC Report [44], the aggregate losses of DISCOMs have declined from Rs.47,526 crore in FY 2016 to Rs.33,820 crore in FY 2017 and Rs.29,452 crore in FY 2018. However, in FY 2019, the aggregate losses after tax increased to Rs.49,623 Crore, a deterioration of 68%. As a result, DISCOMs losses have reached Rs.2,097 crore more than the pre-UDAY period aggregate losses of Rs.47,526 crore, as shown in Figure 4.3.

Figure 4.3



Source: PFC Report 2018-19 [44]

DISCOMs losses during four years from FY 2015-16 to 2018-19

The aggregate losses of DISCOMs on a subsidy received basis increased to Rs.61,360 crore in 2018-19 from Rs.33,595 crore in 2017-18, i.e., 82.6% increase in losses of Rs.27,765 crore [44]. The aggregate losses on a subsidy received basis excluding UDAY grant and regulatory income increased to Rs.85,803 crore in 2018-19 from Rs.59,588 crore, an increase in loss of Rs.26,215 crore (43.5% increase). The sustained loss-making trend shows the financially unsustainable business operations of the state-run DISCOMs even after UDAY implementation.

4.5.2 States with an improvement in financial performance in 2018-19 vis-à-vis 2017-18

"As per PFC Report [44], DISCOMs of Maharashtra and Punjab have come out of red and achieved Profit After Tax (on subsidy received basis excluding UDAY Grant and Regulatory Income) of Rs.1,916 crore and Rs.272 crore respectively as compared to the loss of Rs.3,927 crore and Rs.2,760 crore in the previous year. As per the Ministry of Power, States viz., Delhi, Kerala, Assam, Jammu & Kashmir, Meghalaya, Sikkim, and Arunachal Pradesh have shown improvements in profitability trends in these States/UTs reduced their losses in 2018-19 as compared to 2017-18". [24]

4.5.3 States with deterioration in financial performance in 2018-19 vis-à-vis 2017-18

The trend of Profit After Tax figures (on subsidy received basis excluding UDAY Grant and Regulatory Income) for the FY 2018-19 vis-à-vis 2017-18 is shown in Table 4.1. The financial performance of Andhra Pradesh, Madhya Pradesh, Telangana, Karnataka, Uttar Pradesh, and Rajasthan has deteriorated, as it has incurred huge losses in FY 2018-19 as compared to FY 2017-18.

Table 4.1
States with deterioration in financial performance in 2018-19 vis-à-vis 2017-18

States	Profit/(Loss) After Tax (on subsidy received basis excluding UDAY Grant and Regulatory Income)		
	2017-18	2018-19	% Change in losses
Andhra Pradesh	(546)	(16,831)	2982% (29.8 times)
Tamil Nadu	(12,541)	(17,962)	43.2%
Madhya Pradesh	(5,802)	(10,143)	74.8%
Telangana	(6,697)	(9,525)	42.2%
Karnataka	(2,439)	(4,889)	100.6%
Uttar Pradesh	(5,269)	(6,497)	23.3%
Rajasthan	(11,314)	(12,524)	10.7%

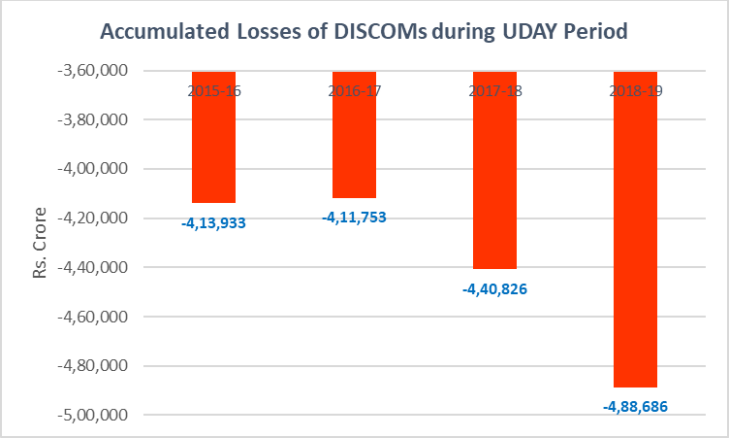
Source: PFC Report [37]

Tamil Nadu stood as the highest loss-making in the distribution business with a loss of Rs.17,962 crore in 2018-19 [44].

4.5.4 Burgeoning accumulated losses

"As per the PFC report, the sustained losses of DISCOMs during the UDAY period increased its accumulated losses from Rs.4,13,933 crore in 2015-16 to Rs.4,88,686 crore in 2018-19", as shown in Figure 4.4.

Figure 4.4



Source: PFC Report 2018-19 [20]

Accumulated loss of DISCOMs during the UDAY period

4.5.5 State-wise Profit & Loss of DISCOMs during the UDAY period

State-wise Profit & Loss of DISCOMs during the UDAY period at Table 4.2 [39]

Table 4.2

Profit & Loss of State DISCOMs during UDAY Period

State	FY16	Change	FY17	Change	FY18	Change	FY19
Tamil Nadu	(5,787)	→	(4,349)	→	(2,975)	↘	(9,257)
Telangana	(1,948)	↘	(6,206)	→	(2,827)	↘	(7,609)
Madhya Pradesh	(5,751)	→	(1,468)	↘	(2,194)	↘	(6,331)
Jammu & Kashmir	(4,532)	→	(3,368)	→	(3,174)	↘	(3,654)
Bihar	(1,074)	↘	(1,419)	→	(1,053)	↘	(1,440)
Uttar Pradesh	(7,689)	→	(6,619)	→	(3,430)	→	(2,576)
Andhra Pradesh	(3,899)	→	(2,331)	→	7	↘	(1,563)
Kerala	(517)	↘	(1,098)	→	(832)	↘	(941)
Jharkhand	(1,162)	↘	(1,741)	→	(731)	→	(695)
Assam	(363)	→	(157)	↘	(401)	→	(2)
Uttarakhand	(125)	↘	(289)	→	(229)	↘	(308)
Punjab	(1,989)	↘	(2,836)	→	(907)	→	(288)
Chhattisgarh	(541)	→	451	↘	103	↘	(145)
Manipur	(124)	→	(10)	→	(5)	↘	(28)
Daman and Diu	28	→	26	→	5	↘	(16)
Meghalaya	(193)	↘	(409)	→	(317)	→	(115)*
Puducherry	(8)		(8)	↘	(206)	→	(11)
Tripura	(57)	→	(5)	↘	(25)	→	4
Goa	0	→	15	→	31	→	19
Dadra and Nagar Haveli	NA		(68)	→	(56)	→	16
Himachal Pradesh	(3)	↘	(44)	→	14	→	20
Haryana	(808)	→	(193)	→	412	→	278
Gujarat	178	→	275	→	339	→	464
Maharashtra	(3,499)	→	(3,348)	→	847	→	472
Karnataka	(377)	↘	(698)	→	(20)	→	1,949
Rajasthan	(11,241)	→	(1,981)	→	2,573	→	4,773
UDAY states' total	**(51,480)**	→	**(37,877)**	→	**(15,049)**	↘	**(27,741)**

* Data for Meghalaya is for 9MFY19

Source: Ministry of Power

4.5.6 Raising revenue gap

The total revenue of DISCOM (including subsidy booked, regulatory income, revenue grants, and other income) increased by 12.80% from Rs 5,97,147 crore in 2017-18 to Rs 6,73,584 crore in 2018-19 [44]. In contrast, total expenditure increased by 15.35% from Rs 6,26,848 crore in 2017-18 to Rs 7,23,101 crore in 2018-19. The cost recovery has increased to 94.08% and 95.26% in 2016-17 and 2018-19 respectively, from 91.15% in 2015-16. The recovery % decreased from 95.26% in 2017-18 to 93.15% in 2018-19. The Revenue Shortage in FY 2018-19 stood at Rs.49,517 crore, as shown in Table-4.3 and Figure 4.5.

Table 4.3

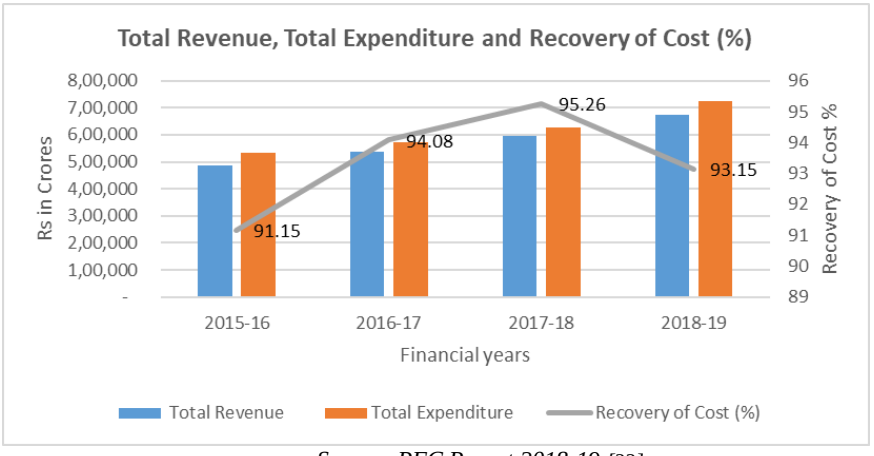
Mounting DISCOMs revenue shortage

(Rs. Crore)

FY	Total Revenue	Total Expenditure	Revenue shortage	Recovery of Cost (%)
2015-16	4,87,497	5,34,810	47,313	91.15
2016-17	5,37,605	5,71,433	33,828	94.08
2017-18	5,97,147	6,26,848	29,701	95.26
2018-19	6,73,584	7,23,101	49,517	93.15

Source: PFC Report 2018-19 [44]

Figure 4.5



Source: PFC Report 2018-19 [33]

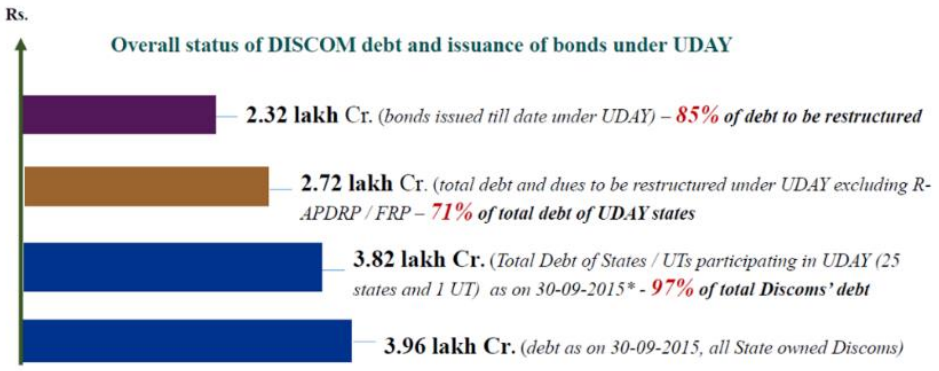
DISCOM's Revenue, expenditure and recovery during the UDAY period

4.5.7 Status of DISCOM's debt and issuance of bond under UDAY

"As per the UDAY portal, as of March 2017, State Government Bonds for Rs.2,09,000 Crore and DISCOM Bonds for Rs.24,000 Crore have been issued." The overall status of DISCOMs debt and issuance of Bond as of March 2017 is in

Figure 4.6

Status of DISCOMs debt and issuance of Bond under UDAY



Source: UDAY portal, Ministry of Power [30]

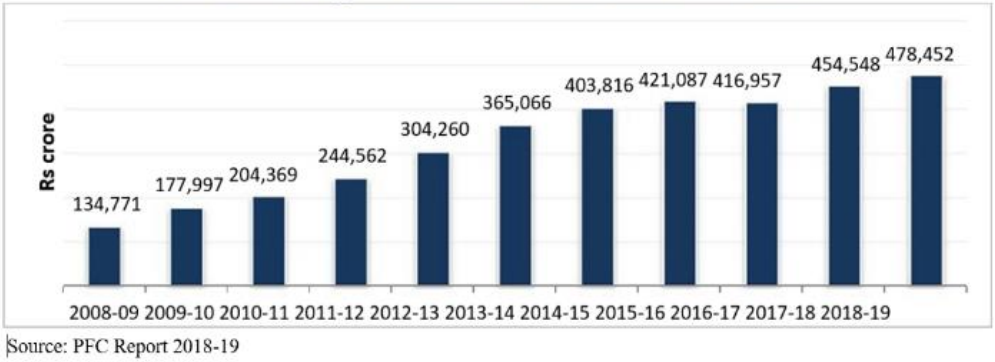
DISCOMs debt and bond issued under UDAY

4.5.8 High DISCOMs debts even after debts takeover by states Governments:

Despite 75% of the debts of DISCOMs being taken over by their State Government under UDAY, DISCOMs continue to be mounting their debts. "As per the PFC report [44], the total borrowings of DISCOMs have reached an alarming level of Rs.4,78,452 crore, establishing the growing indebtedness of DISCOMs", as shown in Figure 4.7. The high debt level is due to the enormous revenue shortage arising from the non-cost reflective tariff, high AT&C losses, subsidy, delayed release of subsidy by the state governments to DISCOMs and operational inefficiencies.

Figure 4.7

Total Borrwings of DISCOMs since 2008-09 to 2018-19



Source: PFC Report 2018-19

DISCOMs debt from FY 2008-09 to 2018-19

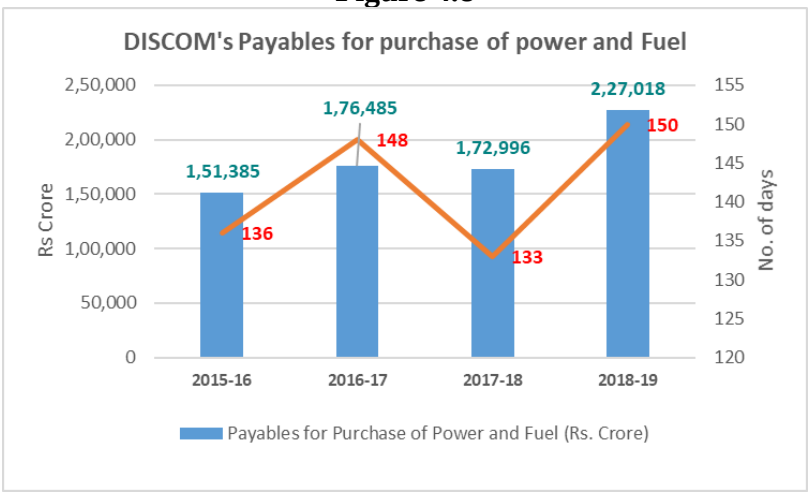
4.5.9 DISCOMs severe liquidity crunch

The financial performance of the state-run DISCOMs has not shown improvements despite the reform package under UDAY. Due to the poor cash flow, state-run DISCOMs have faced a severe liquidity crunch. As a result, DISCOMs have defaulted in making payments to the power generators for the power purchased.

4.5.10 Increase in payables

DISCOMs payable for purchasing power and fuel have increased exponentially during the UDAY period. It has reached an alarming level of Rs.2,27,018 crore as per the Ministry of power portal (https://praapti.in/) [31] in Figure 4.8. This is because DISCOMs could not pay dues for the power and fuel purchase due to the shortage in revenue realization. The number of days payable also increased from 136 days in 2015-16 to 150 days in 2018-19.

Figure 4.8



Source: Ministry of Power https://praapti.in/ [31]

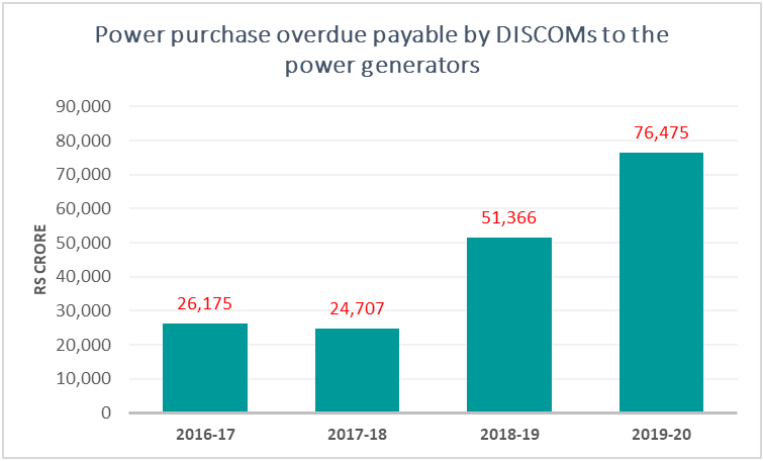
DISCOM's power purchase payable during the UDAY period

4.5.11 DISCOM's mounting overdue to power generators

DISCOM's overdue payable to the power generators during UDAY in FY 2017-18 and 2018-19 has ballooned and reached an alarming level of Rs.76,475 crore as of March 2019 [31]. As a result, DISCOMs face an acute liquidity crunch, as shown in Figure 4.9. It establishes the deteriorating

condition of DISCOMs to make timely payments due to the low cash flow arising out of revenue shortage.

Figure 4.9

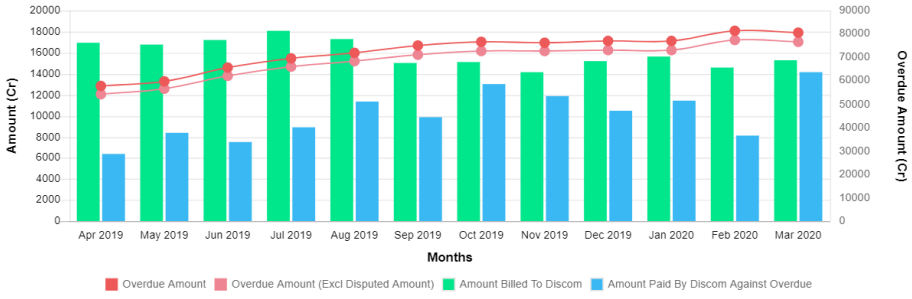


Source: Ministry of Power https://praapti.in/ [31]

DISCOM's overdue payable for power purchased during the UDAY period

In FY 2018-19, DISCOMs payable to power generators increased, as shown in Figure 4.10.

Figure 4.10



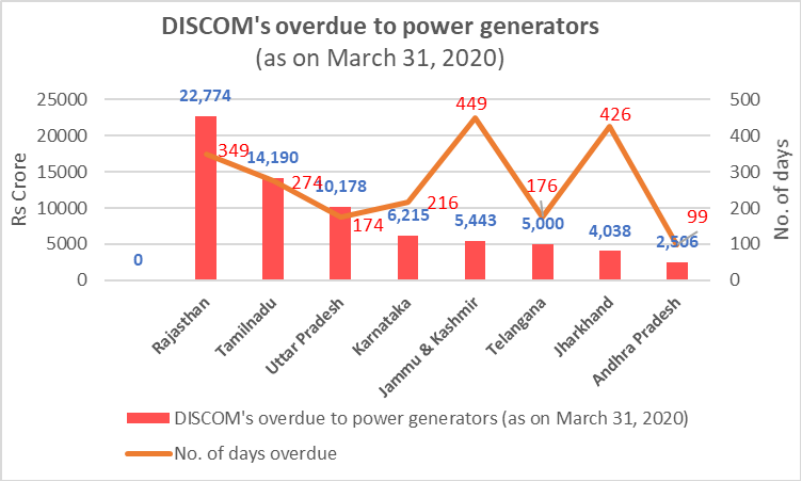
Source: Ministry of Power https://praapti.in/ [31]

DISCOM's overdue payable for power purchased during 2019-20

States with high overdue to power generators

States viz., Rajasthan, Tamil Nadu, Uttar Pradesh, Karnataka, Jammu & Kashmir, Telangana, Jharkhand, and Andhra Pradesh have a high level of overdue amount payables to the power generators as shown in Figure 4.11. The number of days of due ranges from 100 to 449 days.

Figure 4.11



Source: Ministry of Power https://praapti.in/ [31]

State-run DISCOM's overdue to power generators in FY 2019-20

4.5.12 Increase in receivables

DISCOMs Receivables for the sale of power increased from Rs.1,46,222 crore on March 31, 2017, to Rs 1,69,745 crore as on March 31, 2018 [44]. The receivables for the sale of power (No. of days) increased from 132 days of the sale on March 31, 2017, to 138 days of the sale on March 31, 2018.

4.5.13 Loss takeover by the state governments

As per the Ministry of Power report, the State Governments have taken over 81% of the losses of DISCOMs in FY 2017-18. The state government took over 48% of the losses in 2018-19, as detailed in Table 4.4

Table 4.4
Compliance of loss takeover by states

	2017-18	2018-19
Provision for loss takeover (Rs. Cr)	1,602	2,726
Actual loss has taken over (Rs. Cr)	1,299	1,311
Loss takeover %	81%	48%

Source: PFC Report 2019 [44]

States viz., Haryana, Bihar, Punjab, Himachal Pradesh, Madhya Pradesh, Jammu and Kashmir, and Uttar Pradesh have taken over the FY 2017 losses in FY 2018 and FY 2019 *[44].*

States which have not taken over losses in FY 2019

Six states, namely Tamil Nadu, Jharkhand, Assam, Meghalaya, Chhattisgarh, and Telangana, have not taken over the DISCOM's losses as per the target agreed by the States under UDAY, the details mentioned in Table 4.5.

Table 4.5
Non-compliance of loss takeover by States

State	Booked losses as per UDAY portal (FY 17)	Provision for 5% loss takeover (FY 18)	Booked losses as per the UDAY portal (FY 18)	Provision for 10% loss takeover (FY 18)
Tamil Nadu	(4,349)	217	(7,761)*	776
Jharkhand	(1,741)	87	(212)*	21
Assam	(157)	Nil	(401)	20*
Meghalaya	(409)	Nil	(317)	16*
Chhattisgarh	718	49	(328)	33
Telangana	(6,209)	310	(5,485)	549

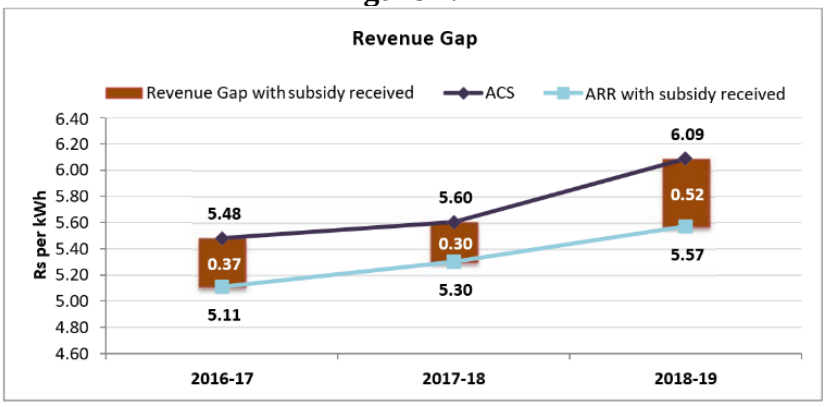
Source: Ministry of Power

4.6 ANALYSIS OF OPERATIONAL PERFORMANCE OF DISCOMs DURING THE UDAY SCHEME PERIOD

4.6.1 Average cost of supply (ACS), Average Revenue Received (ARR), and the gap between ACS and ARR

DISCOMs Average Cost of Supply (ACS) increased from Rs 5.48 per kWh in 2016- 17 to Rs 5.60 per kWh in 2017-18, as depicted in Chart 24. The Average Revenue Realized (ARR) with subsidy received increased from Rs.5.11 per kWh in 2016-17 to Rs 5.30 per kWh in 2017-18. The revenue Gap with subsidy received decreased from Rs 0.37 per kWh in 2016-17 to Rs 0.30 per kWh in 2017-18 as shown in Figure 4.12. The revenue Gap with subsidy booked reduced from Rs 0.32 per kWh in 2016-17 to Rs.0.27 per kWh in 2017-18. [44]

Figure 4.12



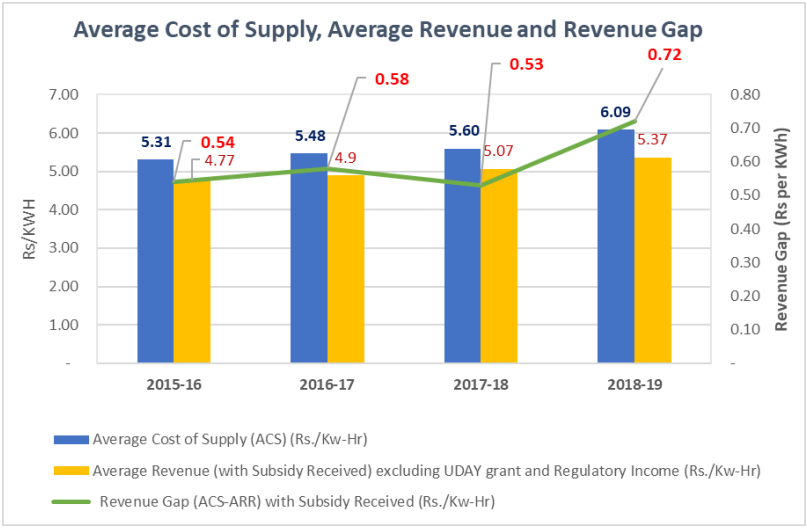
Source: PFC Report 2018-19 [44]

The gap between the ACS and ARR during the UDAY period

4.6.2 Revenue gap without UDAY grant and regulatory income

"As per PFC Report 2018-19 [44], the Average Cost of Supply increased year on year during the UDAY period. However, the Average Revenue Realized during UDAY is much lower than its cost. Hence, there is a gap between ACS and ARR, which has led to a vast revenue shortage for DISCOMs. As a result, the gap between the ACS and ARR (with subsidy received excluding UDAY Grant and Regulatory Income) has increased from Rs.0.54 per kW-Hr in 2015-16 to Rs.0.72 per kW-Hr in 2018-19, as shown in Figure 4.13."

Figure 4.13



Source: PFC Report 2018-19 [37]

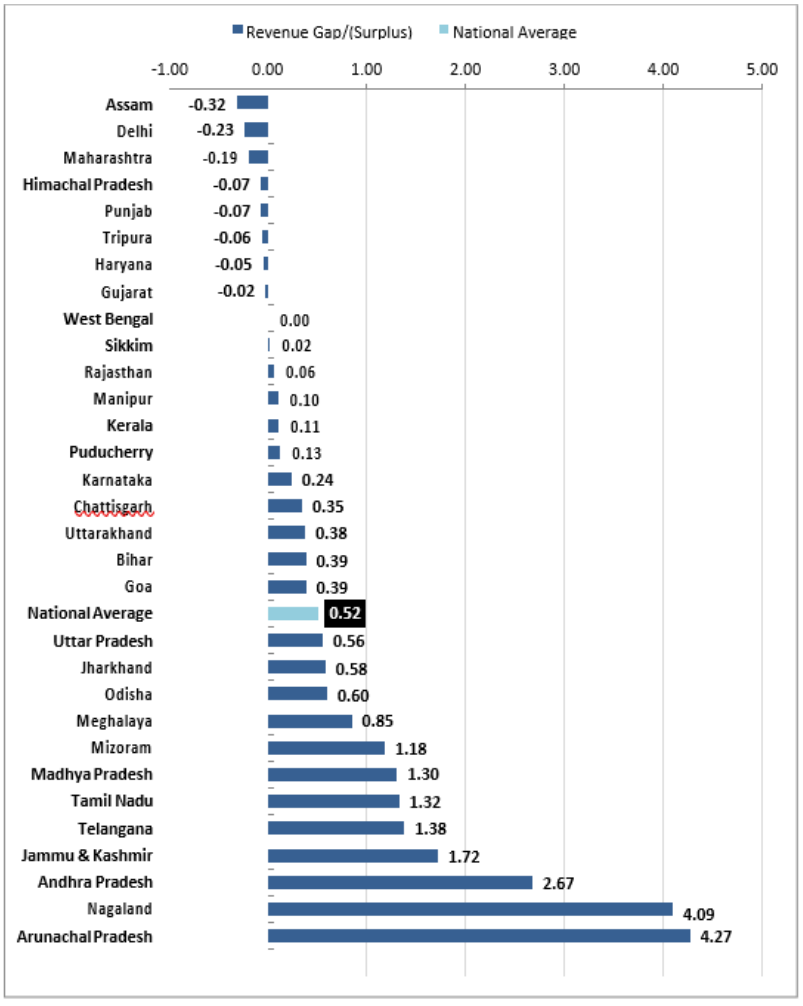
Average Cost of Supply, Average Revenue Realised and ACS-ARR Gap

As per UDAY Scheme, DISCOMs are supposed to achieve a zero gap between ACS and ARR. Despite the implementation of UDAY, DISCOMs are unable to reduce the gap to zero level. Instead, it is increasing year-on-year basis. In FY 2018-19, it reached Rs.0.72 per kW-Hr, higher than its Pre-UDAY period in 2015-16. The state-wise trend of DISCOMs ACS-ARR gap during the UDAY period is in Table 4.6.

4.6.3 State-wise ACS-ARR gap

The state-wise ACS-ARR Gap in FY 2018-19 [37] is in Figure 5.14. DISCOMs in 8 States viz., Gujarat, Tripura, Punjab, Himachal Pradesh, Maharashtra, Delhi, and Assam have achieved Revenue Surplus (Negative gap between ACS and ARR).

Figure 4.14



Source: PFC Report [44]

State-wise ACS-ARR Gap of state-run DISCOMs

Table 4.6

ACS-ARR Gap during UDAY Period

State	FY16	Change	FY17	Change	FY18	Change	FY19	Target
Jammu & Kashmir	2.55		2.15		1.96		2.13	0.49
Telangana	0.69		1.24		0.55		1.13	0.00
Madhya Pradesh	0.92		0.24		0.33		0.88	0.03
Jharkhand	1.22		1.39		0.57		0.54	0.00
Bihar	0.65		0.59		0.39		0.41	0.48/0.34
Tamil Nadu	0.60		0.39		0.27		0.85	(0.07)
Andhra Pradesh	0.82		0.44		0.02		0.39	(0.02) / (0.03)
Kerala	0.23		0.53		0.27		0.37	(0.06)
Meghalaya	0.88		1.99		1.30		NA	0.35
Goa	1.50		0.95		0.41		0.28	(0.15)
Manipur	1.31		0.10		0.08		0.24	(0.36)
Uttar Pradesh	0.88		0.62		0.28		0.22	0.22
Uttarakhand	0.10		0.22		0.17		0.22	(0.03)
Chhattisgarh	0.18		(0.15)		(0.03)		0.04	(0.52)
Puducherry	0.03		(0.11)		0.00		0.04	0.00
Daman and Diu	(0.11)		(0.11)		(0.02)		0.06	(0.05)
Punjab	0.53		0.65		0.48		0.05	(0.09)
Tripura	0.24		0.02		0.08		0.05	0.03
Himachal Pradesh	(0.32)		0.21		(0.09)		(0.02)	(0.05)
Dadra and Nagar Haveli	NA		0.27		0.06		(0.03)	0.00
Karnataka	0.06		0.06		0.07		(0.03)	0.00
Maharashtra	0.30		0.28		(0.07)		(0.04)	(0.39)
Gujarat	(0.02)		(0.03)		(0.04)		(0.05)	(0.06)
Haryana	0.18		0.04		(0.02)		(0.05)	0.12
Assam	0.58		0.30		0.43		(0.29)	(0.05)
Rajasthan	1.65		0.36		(0.33)		(0.58)	(0.15) / (0.11)
UDAY states' average	**0.59**		**0.41**		**0.17**		**0.27**	**0.0**

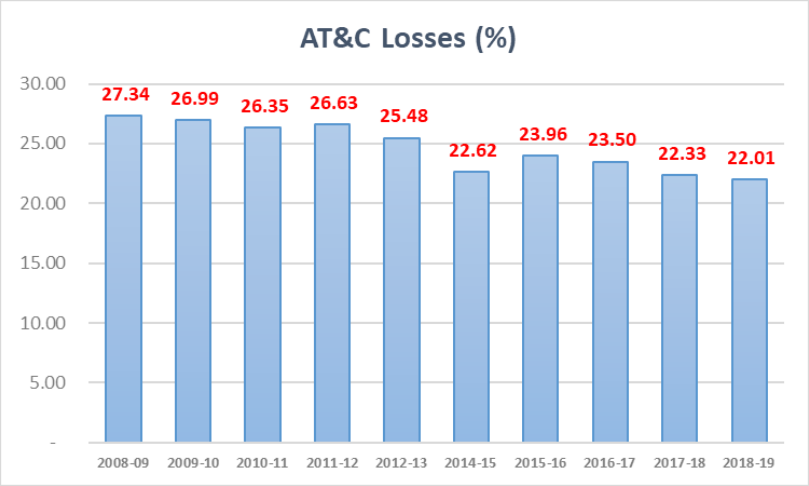
Source: UDAY Portal

State-run DISCOMs of 10 States have lower than the national average ACS-ARR gap of Rs.0.52 per kW-Hr. In 2018-19, the substantial positive gap between ACS-ARR (in Rs. /kW-Hr) in respect of bigger states like Andhra Pradesh (Rs.2.77), Telangana (Rs.1.31), Tamil Nadu (Rs.1.32), Madhya Pradesh (Rs.1.30), Uttar Pradesh (Rs.0.56) was worrisome. This wide gap has contributed to the substantial financial losses of DISCOMs. Arunachal Pradesh has recorded the highest revenue gap of Rs.4.27 Rs. /kW-Hr in India *[44]*.

4.6.4 AT&C losses

The aggregate AT&C Losses of DISCOMs have improved year-after after during the UDAY periods shown in Figure 4.15. However, AT&C's Losses had decreased from 23.96% in 2015-16 to 22.01% in 2018-19 and could not achieve a UDAY target of 15%. State-wise AT&C loss during the UDAY period is shown in Table 4.7.

Figure 4.15



Source: PFC Report 2019[37]

Aggregate AT&C losses of DISCOMs

State-wise, DISCOM's AT&C losses during the UDAY period is in Table-4.7

Table 4.7

AT&C Losses (%) during UDAY period

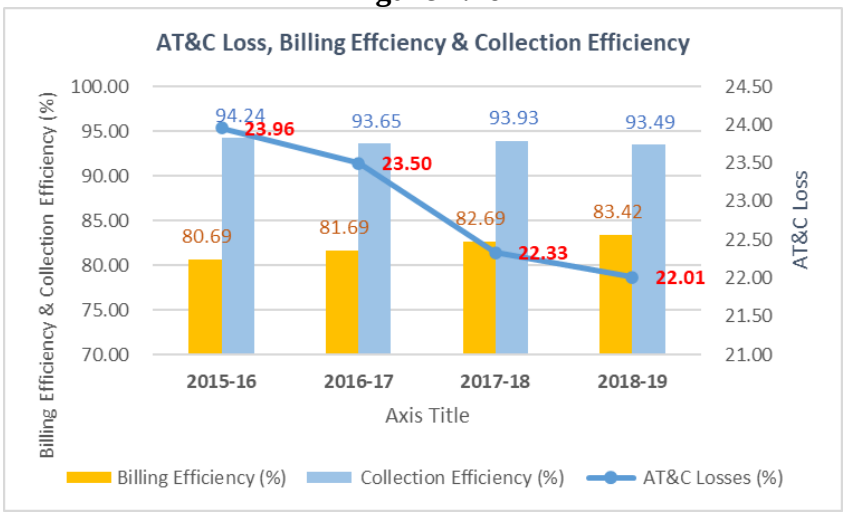
State	FY16	Change	FY17	Change	FY18	Change	FY19	Target FY19	Achievement Q1 FY20
Jammu & Kashmir	61.6%	↑	61.4%	↑	53.8%	↑	49.8%	25.0%	NA
Jharkhand	34.7%	↑	31.8%	→	31.8%	↓	31.9%	15.0%	39.53
Madhya Pradesh	24.0%	↓	26.5%	↓	29.7%	↓	31.9%	17.0%	NA
Meghalaya	36.5%	↑	34.9%	↑	34.6%	↑	32.6%	21.5%	NA
Bihar	43.7%	↑	39.0%	↑	33.2%	↑	27.4%	20.0% / 22.0%	NA
Uttar Pradesh	26.47%	↓	30.2%	↑	27.7%	↑	24.6%	19.4%	37.95
Chhattisgarh	21.8%	↑	19.4%	↑	18.8%	↓	23.3%	15.0%	NA
Manipur	44.2%	↑	36.9%	↑	24.6%	↑	22.5%	15.0%	NA
Rajasthan	30.4%	↑	26.0%	↑	20.0%	↓	21.3%	15.0%	29.34
Assam	25.5%	↑	23.8%	↑	15.7%	↓	18.2%	16.1%	22.13
Haryana	29.8%	↑	25.4%	↑	20.3%	→	17.4%	15.0%	22.67
Maharashtra	19.1%	↑	18.9%	↑	17.4%	→	16.9%	15.0%	16.95
Puducherry	19.9%	→	19.0%	↓	19.6%	→	16.4%	12.0%	NA
Tripura	20.9%	→	16.6%	↑	15.5%	→	15.2%	20.0%	23.13
Karnataka	14.9%	↓	15.4%	↑	14.5%	→	14.1%	14.0%	16.10
Tamil Nadu	14.4%	↓	14.5%	↑	14.2%	→	14.0%	13.5%	14.08
Andhra Pradesh	9.4%	→	11.0%	↑	8.7%	→	13.4%	5.4% / 10.9%	9.41
Uttarakhand	17.2%	→	14.0%	↓	15.7%	→	12.6%	14.5%	40.51
Gujarat	15.0%	↑	12.3%	↑	11.7%	→	12.6%	13.0%	13.09
Punjab	15.9%	↑	14.5%	↓	17.3%	↑	12.0%	14.0%	34.30
Telangana	14.0%	↓	15.9%	↑	13.5%	→	11.8%	9.9% / 10.0%	9.99
Kerala	16.0%	↓	17.3%	↑	12.0%	→	10.8%	11.0%	10.29
Goa	17.1%	↑	16.8%	↑	16.1%	→	10.5%	15.0%	13.00
Daman and Diu	13.3%	↑	10.6%	↑	10.3%	→	9.4%	8.3%	5.97
Himachal Pradesh	12.9%	↑	8.5%	→	12.1%	→	8.0%	12.8%	NA
Dadra and Nagar Haveli	NA	↑	9.2%	↑	6.1%	→	8.0%	7.0%	NA
UDAY states' average	**20.74%**		**20.23%**	↑	**18.72%**	↑	**18.15%**	**15.0%**	**21.99**

Source: Ministry of Power UDAY portal [49]

4.6.5 Billing efficiency & collection efficiency

"As per PFC Report 2018-19 [44], the billing efficiency of DISCOMs has improved in all four years during the UDAY period. It had increased from 80.69% in 2015-16 to 83.42% in 2018-19. The Collection Efficiency of DISCOMs deteriorated from 94.24% in 2015-16 to 93.49% in 2018-19 during the UDAY period", as shown in Figure 4.16. State-wise, DISCOM's AT&C losses during the UDAY period is in Table 4.8

Figure 4.16



Source: PFC Report 2019 [44]

AT&C Loss, Billing Efficiency & Collection Efficiency

The state-wise DISCOM's Billing Efficiency and Collection Efficiency during the UDAY period is in Table 4.8

Table 4.8

Billing Efficiency (%) and Collection Efficiency (%) during UDAY period

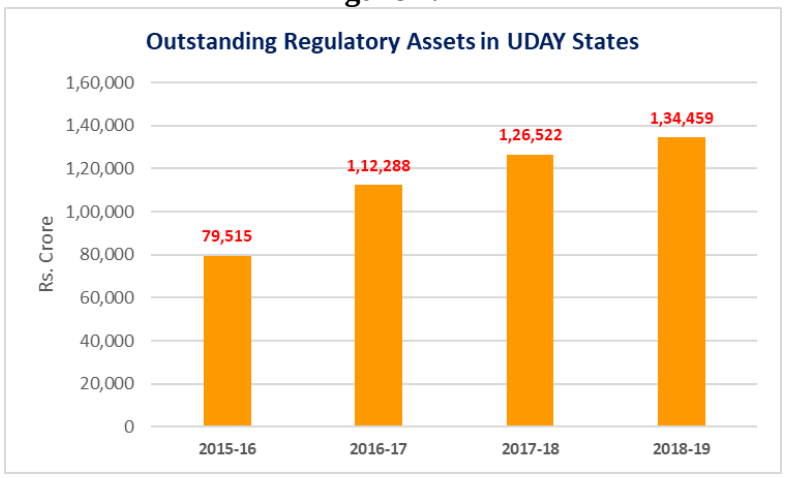
State	Billing Efficiency (%)				Collection Efficiency (%)			
	FY16	FY17	FY18	FY19	FY16	FY17	FY18	FY19
Andhra Pradesh	92.6%	92.7%	92.9%	92.3%	97.9%	96.0%	98.3%	93.8%
Assam	81.9%	82.1%	82.4%	82.0%	91.0%	92.8%	102.3%	99.7%
Bihar	60.7%	66.9%	70.0%	75.7%	92.8%	91.3%	95.5%	96.0%
Chhattisgarh	78.5%	81.4%	81.9%	83.5%	99.7%	99.0%	99.1%	91.9%
Dadra and Nagar Haveli	NA	94.4%	95.6%	96.2%	NA	96.1%	98.3%	95.7%
Daman and Diu	90.7%	90.8%	93.1%	93.8%	95.7%	98.4%	96.3%	96.6%
Goa	95.1%	87.9%	90.8%	89.3%	87.1%	94.6%	92.4%	100.3%
Gujarat	85.2%	87.6%	88.3%	87.4%	99.8%	100.1%	100.0%	100.0%
Haryana	72.3%	74.1%	79.1%	81.6%	97.1%	100.6%	100.8%	101.2%
Himachal Pradesh	88.0%	88.8%	89.3%	87.6%	97.0%	103.0%	98.4%	105.0%
Jammu & Kashmir	46.2%	53.1%	52.5%	61.2%	83.1%	72.9%	88.0%	82.1%
Jharkhand	71.6%	75.2%	78.8%	76.0%	91.2%	90.7%	86.5%	89.5%
Karnataka	86.1%	85.9%	86.3%	87.4%	98.9%	98.5%	99.1%	98.3%
Kerala	85.6%	86.6%	89.5%	89.9%	98.1%	95.5%	98.3%	99.2%
Madhya Pradesh	76.6%	78.4%	76.2%	72.3%	99.3%	93.8%	92.1%	94.2%
Maharashtra	85.5%	85.3%	86.1%	86.4%	94.7%	95.1%	95.9%	96.2%
Manipur	61.9%	71.7%	76.6%	85.3%	90.2%	88.0%	98.4%	90.8%
Meghalaya	67.4%	67.2%	70.1%	67.8%	94.3%	96.9%	93.2%	99.5%
Puducherry	86.4%	84.4%	86.0%	89.1%	92.7%	96.0%	93.5%	93.9%
Punjab	88.4%	88.0%	88.9%	88.9%	95.1%	97.2%	93.0%	99.0%
Rajasthan	72.3%	76.7%	80.0%	79.9%	96.2%	96.4%	100.0%	98.6%
Tamil Nadu	85.6%	85.6%	86.6%	86.3%	99.8%	99.9%	99.1%	99.6%
Telangana	88.1%	88.4%	88.7%	89.8%	97.7%	95.2%	97.5%	98.3%
Tripura	81.7%	84.4%	85.8%	83.9%	96.8%	98.8%	98.5%	101.0%
Uttar Pradesh	78.8%	78.9%	79.1%	81.6%	93.3%	88.4%	91.4%	92.4%
Uttarakhand	82.0%	83.3%	85.0%	84.5%	101.0%	103.2%	99.1%	103.4%
UDAY states' average	**81.6%**	**82.9%**	**83.9%**	**84.3%**	**97.1%**	**96.2%**	**96.9%**	**97.1%**

Source: UDAY Portal

4.7 CREATION OF REGULATORY ASSETS

The accumulated regulatory assets at the national level reached an alarming level of Rs.1,50,000 crore. For the UDAY States, the Regulatory Assets increased by Rs.54,944 crore during the UDAY implementation period, i.e., from Rs.79,515 crore in 2015-16 to Rs.1,34,449 crore in 2018-19, as shown in Figure 4.17.

Figure 4.17



Source: Ministry of Power [44]

Outstanding regulatory assets in UDAY states

States and one Union Territory have outstanding Regulatory Assets during UDAY Period, as depicted in Table 4.9. The increase in Regulatory assets during the UDAY period is in Table 4.10

Table 4.9

Outstanding Regulatory Assets in UDAY States

(Rs. Crore)

No	State	2015-16	2016-17	2017-18	2018-19
1	Uttar Pradesh	20,261	26,342	33,000	40,541
2	Rajasthan	51,867	38,646	40,116	40,116
3	Tamil Nadu	0	32,532	32,532	32,532
4	Maharashtra	(316)	4,924	9,479	10,734
5	Kerala	5,655	6,734	6,734	5,693
6	Karnataka	2,033	3,016	3,701	3,929
7	Chhattisgarh	0	0	761	761
8	Puducherry	15	94	199	153
	Total	**79.515**	**1,12,288**	**1,26,522**	**1,34,459**

Source: Ministry of Power

Table 4.10

Increase in Regulatory Assets during UDAY period

(Rs. Crore)

No	State	2016-17	2017-18	2018-19
1	Uttar Pradesh	6,081	6,658	7,541
2	Rajasthan	(13,221)	1,470	0
3	Tamil Nadu	32,532	0	0
4	Maharashtra	5,240	4,555	1,255
5	Kerala	1,079	0	(1,059)
6	Karnataka	983	685	228
7	Chhattisgarh	0	761	0
8	Puducherry	79	105	(46)
	Total	**32,773**	**14,234**	**7,937**

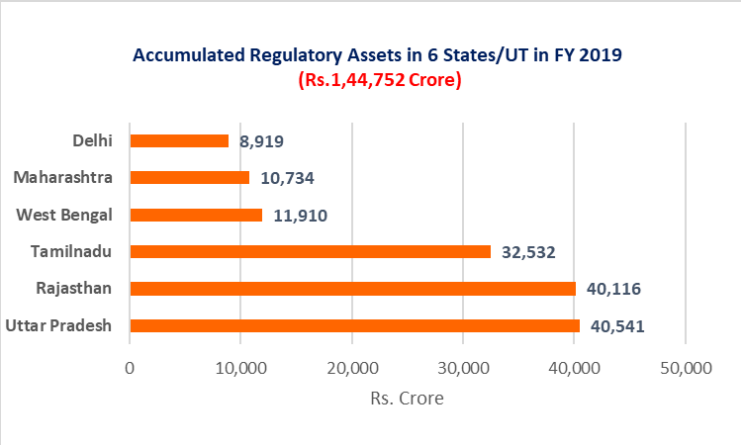
Source: Ministry of Power

As per PFC Report [44], DISCOMs have booked Rs 3,872 crore as income recoverable through future tariffs compared to Rs 6,331 crore booked during 2017-18. DISCOMs have booked a Revenue grant under UDAY as income of Rs 20,570 crore in 2018-19 and Rs.19,633 crore in 2017-18.

4.7.1 States with huge accumulated regulatory assets

Six States/Union Territories viz., Uttar Pradesh, Rajasthan, Tamil Nadu, West Bengal, Maharashtra, and Delhi have huge accumulated regulatory assets in their books with aggregate regulatory assets of Rs.1,44,752 crore in the FY 2018-19, as shown in Figure 4.18

Figure 4.18



Source: Ministry of Power

Six states having high accumulated regulatory assets

The state power regulators have chosen to create regulatory assets instead of penalizing DISCOMs for the high AT&C loss. Therefore, this menace should discontinue containing the mounting losses of the state-run DISCOMs.

4.8 TARIFF SUBSIDY

4.8.1 Subsidy booked & subsidy realised

As per the PFC Report [44], Tariff Subsidy booked by State-run DISCOMs increased exponentially year-on-year basis during the UDAY period from Rs.75,608 Crore in 2015-16 to Rs.1,10,391 crore in 2018-19 with the year-on-year growth rate of 11.5 % per annum as shown in Table 4.11 and Figure 5.19. However, the Realization of Subsidy by DISCOMs from the State Governments as a percentage of subsidy booked declined drastically year-on-year (10.3% p.a.) during the UDAY period from 98.55% in 2015-16 to 89.37% in 2018-19, which is worrisome.

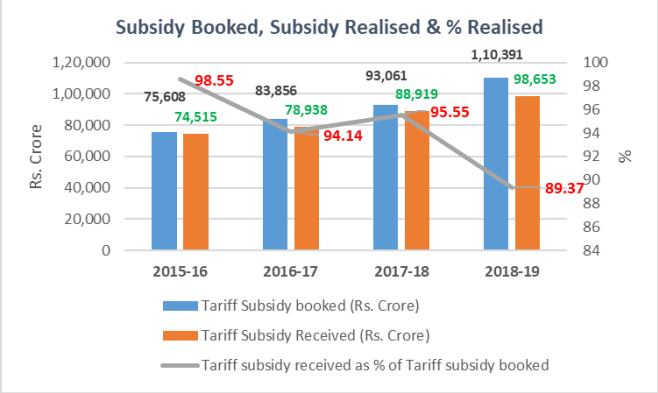
Table 4.11

Subsidy booked and realised by DISCOMs

FY	Subsidy booked (Rs. Crore)	Subsidy Received (Rs. Crore)	Subsidy realization (%)
2015-16	75,608	74,515	98.55
2016-17	83,856	78,938	94.14
2017-18	93,061	88,919	95.55
2018-19	1,10,391	98,653	89.37

Source: PFC Report 2018-19 [43][44]

Figure 4.19



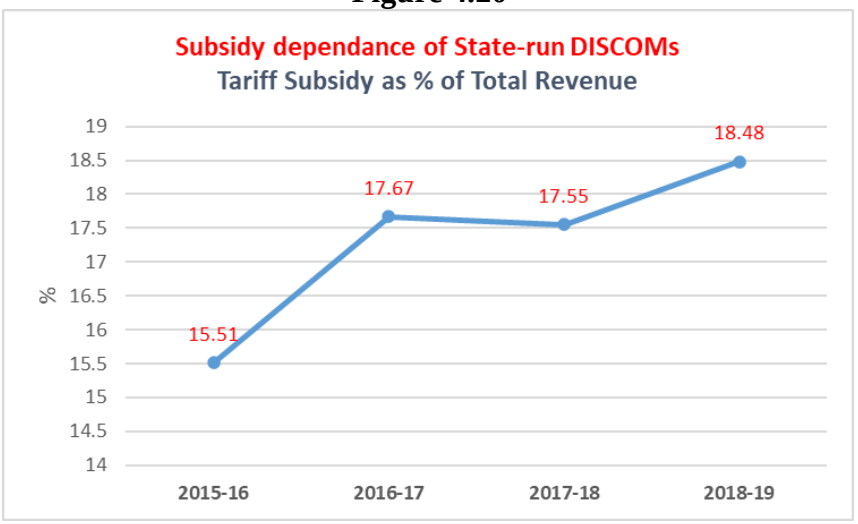
Source: PFC Report 2018-19 [43][44]

Subsidy booked and realised by DISCOMs

4.8.2 Exponential growth of subsidy dependence of DISCOMs from states

Tariff subsidy dependence of DISCOMs from the States has increased exponentially during the UDAY period. Tariff subsidies as % of the total revenue of the State-owned DISCOMs have increased from 15.51% in FY 2015-16 to 18.48% in FY 2018-19 [44]. The year-on-year growth rate of 19.1% per annum, shows the increased dependence of DISCOMs for the tariff subsidy from the states, as shown in Figure 4.20.

Figure 4.20



Source: PFC Report 2018-19 [44]

The exponential growth of subsidy dependence on state-run DISCOMs

4.8.3 Higher tariff subsidy-dependent states

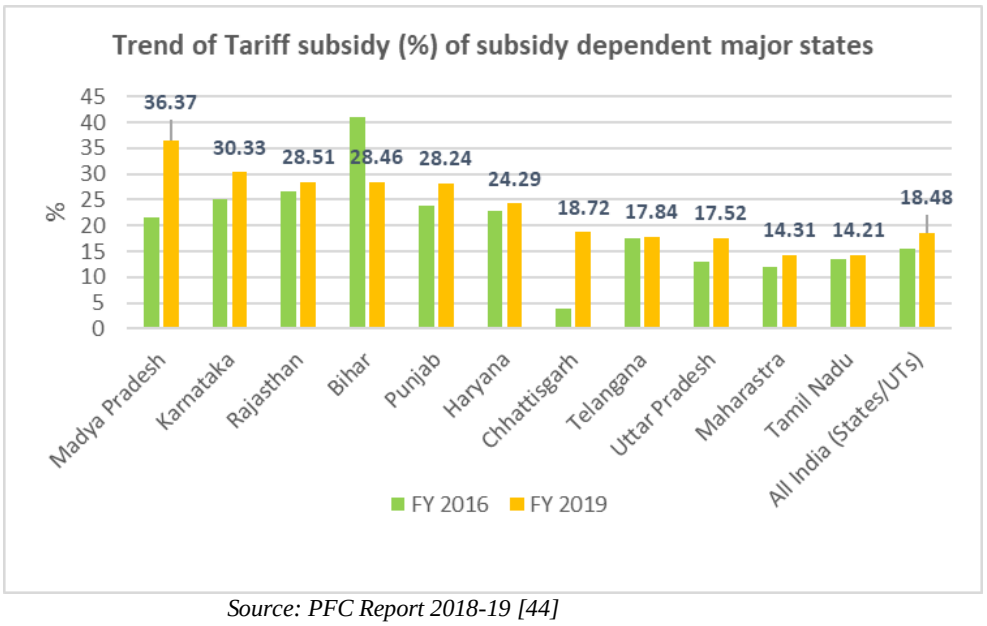
As per the PFC Report [44], in FY 2018-19, DISCOMs of 11 bigger states viz., Madhya Pradesh, Karnataka, Rajasthan, Bihar, Punjab, Haryana, Chhattisgarh, Uttar Pradesh, Maharashtra, and Tamil Nadu have a higher dependence on tariff subsidy from the State Governments as shown in Table 4.12. Moreover, the higher subsidy dependence states' tariff subsidy dependence trend has exponentially increased from 2015-16 to 2018-19, as shown in Figure 4.21.

Table 4.12
Higher tariff subsidy-dependent states

No	State	Tariff Subsidy as % of Total Revenue				Revenue from operations including subsidies booked (Rs. Crore)
		FY 2016	FY 2017	FY 2018	FY 2019	
1	Madya Pradesh	21.45	26.57	31.59	36.37	31,935
2	Karnataka	25.13	30.01	29.41	30.33	39,181
3	Rajasthan	26.55	31.49	29.36	28.51	37,930
4	Bihar	40.92	35.90	21.79	28.46	13,504
5	Punjab	23.93	25.80	29.09	28.24	30,578
6	Haryana	22.91	26.96	27.02	24.29	30,271
7	Chhattisgarh	3.97	21.87	21.41	18.72	15,227
8	Telangana	17.48	18.59	17.72	17.84	31,672
9	Uttar Pradesh	13.02	13.52	11.89	17.52	57,465
10	Maharashtra	11.98	14.90	12.65	14.31	72,282
11	Tamil Nadu	13.47	16.37	15.24	14.21	54,140
All India (States/UTs)		**15.51**	**17.67**	**17.55**	**18.48**	**5,97,383**

Source: PFC Report [43],[44]

Figure 4.21



Source: PFC Report 2018-19 [44]

The trend of tariff subsidy dependence by major subsidy dependant states

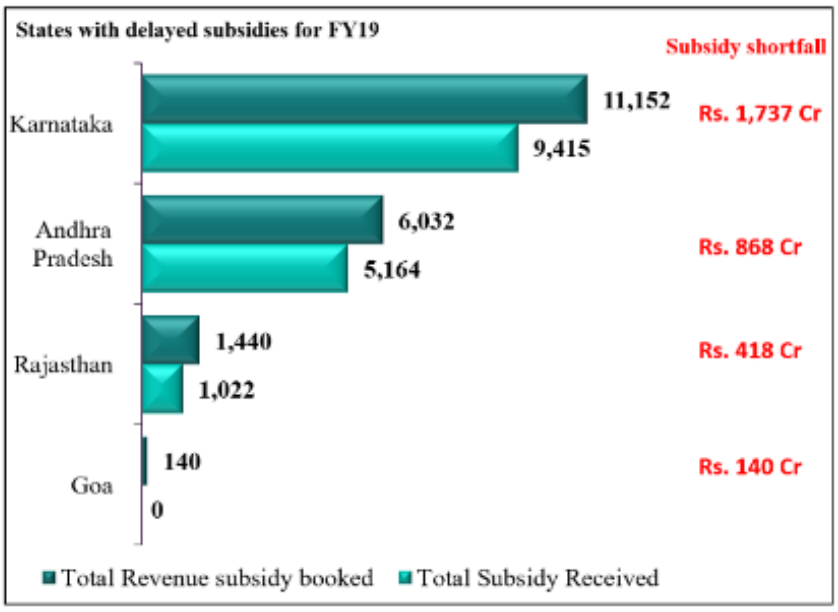
Few small Union Territories/States have a significantly higher dependence on subsidy (as a percentage of the total revenue) from the State Governments viz., Nagaland (67.36%), Mizoram (52.72%), Jharkhand (48.35%), Manipur (41.37%), Jammu & Kashmir (33.69%) [44].

4.8.4 Delayed release of subsidies by the state governments

As most DISCOMs are dependent on state governments' subsidies, the delay in receiving subsidies from the State Government leads to a cash crunch and acute liquidity crunch for DISCOMs. Hence, DISCOMs are unable to pay their dues payable to the power generators for the power procured by the DISCOMs.

In the FY 2018-19, out of Rs. 87,758 Crore subsidies booked, there was a shortfall in the release of subsidies by the State Government to DISCOMs to the extent of Rs.3,200 crore (3.6%). Karnataka, Andhra Pradesh, Rajasthan, and Goa have released their subsidies with delay, as shown in Figure 4.22.

Figure 4.22

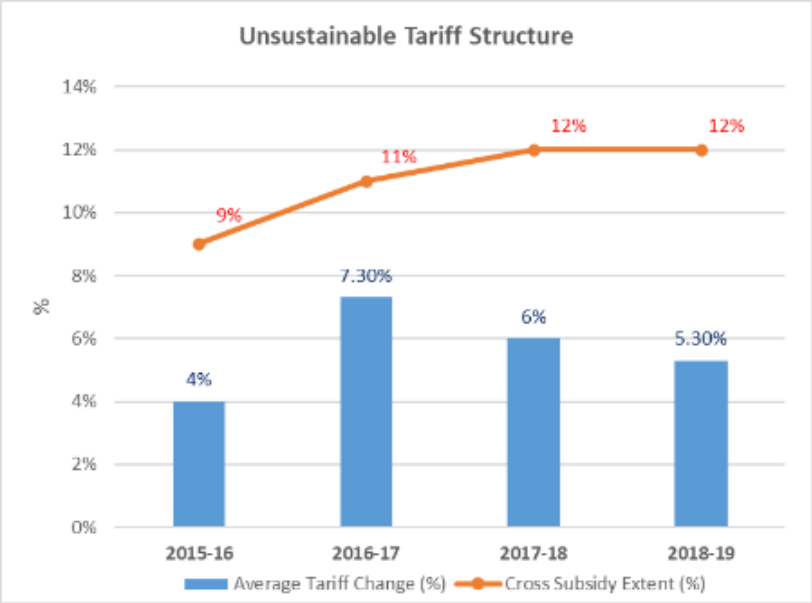


Delayed release of subsidy by states to DISCOMs

4.9 TARIFF UNDERPRICING

DISCOMs face a financial crisis because they cannot recover their entire supply cost, as the tariff does not reflect the power supply cost, as is the tariff underpriced [62]. It is evident from Figure 4.23 that the tariff determined by the SERCs is not reflecting the cost of supply of electricity due to high AT&C losses and the creation of regulatory assets due to the partial approval of the price. As a result, the input cost has increased year-on-year basis. However, the tariff has not been fixed by aligning with the supply cost. Due to the Non-Cost reflective tax and under-recovery of the fixed price through fixed charges in tariff, DISCOMs are incurring massive revenue shortages and mounting financial losses.

Figure 4.23



Source: Ministry of Power

Unsustainable under-priced tariff of the state-run DISCOMs

4.10 NON-COST REFLECTIVE TARIFF, A SIGNIFICANT CAUSE FOR DISCOM'S LOSSES

As per the Ministry of Power's Seventh Integrated Rating report for State Power Distribution Utilities 2019 [24], the cost coverage ratio for 19 DISCOMs was below 0.90 (90%) due to higher expenses and non-cost reflective tariffs.

As per the Ministry of Power portal (https://praapti.in/) [31], the total overdue payable by the DISCOMs to the power generating companies at the end of May 2020 ballooned to Rs.1,16,584 crore. The state power regulators have chosen to create regulatory assets instead of penalizing DISCOMs for the high AT&C loss target. This menace should discontinue containing the mounting losses of DISCOMs.

It is found that the present non-cost reflective tariff is unsustainable, which is causing huge financial losses to DISCOMs. Therefore, the tariff needs to be increased incommensurate with the cost of supply to contain the burgeoning financial losses of DISCOMs. Otherwise, the state government needs to increase its subsidies to DISCOMs.

These unfunded and unsustainable subsidies designed to compensate for low tariffs and power supply to agricultural and domestic consumers at below-cost recovery have led to a vast revenue shortage, affecting the cash flow and leading to severe liquidity. Due to the enormous revenue shortage arising out of the non-cost reflective tariff, DISCOMs resorted to defaulting payments to the power-generating companies for the power procured by DISCOMs. “As a result, as per the Ministry of Power portal (https://praapti.in/) [31], the total overdue payable by the DISCOMs to the power generating companies at the end of May 2020 ballooned to Rs.1,16,584 crore.”

4.11 HIGH LEVEL OF TARIFF CROSS-SUBSIDIES

Cross subsidies show an increasing trend up to FY 2017, and they stabilized in FY 2018. During the UDAY period, the tariff has increased. However, the accumulation of regulatory assets of Rs.52,530 crore in the UDAY period clearly shows that the tariff increases have not been commensurate with the Cost of Supply.

Higher power tariffs fixed to industrial and commercial consumers by heavily cross-subsidizing the tariff to compensate for the low tariff set to agricultural and domestic consumers have deteriorated the industry competitiveness. It

shall go against the Govt. of India's 'Make in India' plan. These unfunded and unsustainable subsidies designed to compensate for low tariffs and power supply to agricultural and domestic consumers at below cost-recovery levels led to substantial revenue shortages and financial losses to DISCOMs and resulted in severe liquidity.

Higher power tariffs fixed to industrial and commercial consumers by heavily cross-subsidizing the tariff to compensate for the low tariff set to agricultural and domestic consumers shall deteriorate the industry competitiveness and go against the Govt. of India's 'Make in India' plan.

4.12 INCREASED BORROWINGS TO MEET THE REVENUE GAP

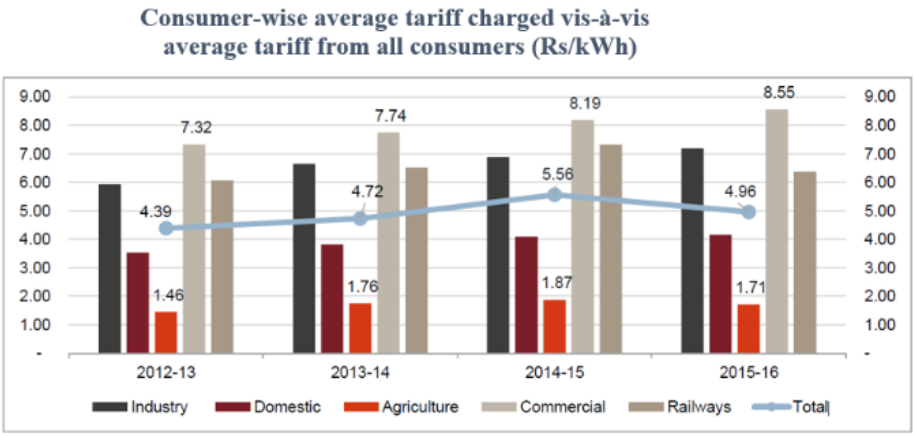
To meet this gap, DISCOMs are raising huge short-term loans from Banks and Financial Institutions, which has created huge debts to DISCOMs, despite the takeover of 75% of loans of DISCOMs by the state Government under the UDAY Scheme. Due to the deteriorated financial health of DISCOMs, their ability to raise loans from Banks and Financial Institutions has been drastically affected. Banks and FIs are also risk-averse due to the higher risk of defaults in repaying the loans by DISCOMs and the consequent substantial provisioning requirements when DISCOMs loan account becomes Non-Performing Asset (NPA). As a result, DISCOMs resorted to defaulting payments to the power-generating companies for the power procured by DISCOMs.

4.13 CONSUMER MIX AND DISCOM'S FINANCIAL HEALTH

The revenue realization and the profitability of DISCOMs depend on the level of tariff approved by the SERC and consumer mix type. The revenue realized by DISCOMs and profitability also depend on the consumer mix. DISCOMs with higher industrial consumers are getting better revenue realization. This is because DISCOMs have a higher number of subsidized consumers. Agriculture consumers face massive revenue shortages and cash crunch due to the delay in realising subsidies from their State Governments, as shown in Figure 4.24 and Figure 4.25.

The industrial and commercial power consumers contribute to DISCOMs for their liquidity by cross-subsidising tariffs on domestic and agriculture. Therefore, consumer mix plays an essential role in receivables days. The delay in receiving money from consumers will have a cascading effect on debtor days.

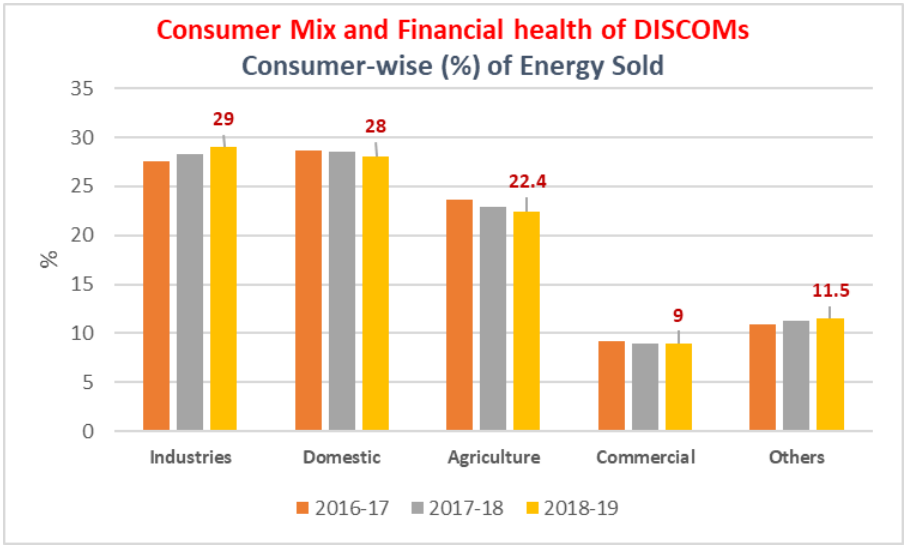
Figure 4.24



Source: PFC report on performance of discoms

Consumer-wise average tariff vis-à-vis Average tariff of all consumers

Figure 4.25



Consumer-wise percentage of energy sold by DISCOMs

4.14 MORATORIUM TO DISCOMS AS PER RBI POLICY

As per the direction of RBI, Banks and FIs also granted a moratorium for payment of principal and interest for six months from March to August 2020

to the DISCOMs, as they cannot meet their loan service obligations to the Banks and FIs.

4.15 Rs.1,20,000 CRORE LIQUIDITY INFUSION PACKAGE TO DISCOMS

Despite the implementation of UDAY, the financial performance of DISCOMs has worsened. The sustained financial losses of DISCOMs have created much stress in the DISCOMs balance sheet, which is facing an acute liquidity crunch. In addition, the Covid-19 pandemic has created further stress in the cash flows of DISCOMs, which has resulted in a severe liquidity crisis.

The aggregate overdue of DISCOMs to the power generators will shoot up to Rs.76,475 crore by March 2020. The risk of liquidity crunch by DISCOMs has worsened further since March 25, 2020, due to the country-wide lockdown announced by the Govt. of India to avert the spread of COVID-19. The covid-19 outbreak and lockdown have profoundly impacted the Indian power sector and the economy. The power supply has decreased by 25% (year-on-year), drastically affecting the cash inflow to DISCOMs. However, DISCOMs need to continue to pay the fixed charges to the power generators despite the less drawl of power as per the Power Purchase Agreement (PPA). Further, many DISCOMs also have given a moratorium on payment of electricity bills or to pay in instalments to various power consumers affected during the lockdown period, which is continuing in many states till July 2020, which further affected the DISCOM's liquidity position.

4.15.1 Atma Nirbhar Bharat Abhiyan

In May 2020, the Government of India approved Atma Nirbhar Bharat Abhiyan. This reform-linked liquidity infusion scheme envisages an Rs.90,000 crore fund infusion to DISCOMs through REC and PFC to settle their massive overdue payable by DISCOMs to their power suppliers. The package was enhanced to Rs.1,20,000 crore, considering the total due of DISCOMs to its power generators.

As per the Scheme, PFC and REC shall sanction a Special Long-Term Transition Loan of Rs.45,000 crore each by raising funds from the market, and it shall on-lend to DISCOMs at a concessional interest rate with minimum spreads of 150 Basis Points (1.5% p.a.) in two instalments. The loan shall be released directly to the power generators with the concurrence of the DISCOMs to clear its overdue. The state government need to give a government guarantee as security for the loan. Further, the State Government needs to agree to install smart prepaid or prepaid meters in Govt departments, and attached offices to ensure DISCOMs get their timely payment for the electricity supplied to Govt departments. The State Govt. agreed to release upfront subsidies to DISCOMs every quarter/month. While the above Scheme would benefit the DISCOMs to come out of their present liquidity crunch. The funding of losses incurred by DISCOMs to the tune of Rs.1,20,000 crore only by PFC and REC will impact PFC and REC if DISCOMs default to service the loans.

4.16 PAYMENT SECURITY MECHANISM

Due to the high under-recovery of cost, DISCOMs face severe liquidity crises and default payments to their power generators. As a result, the overdue payable to its power generators is mounting sustainably. As a result, it has reached an alarming level.

The Ministry of Power introduced a payment security mechanism in June 2019 to maintain financial discipline and ensure that power generators are paid on time for power supplied to DISCOMs. The payment security mechanism requires DISCOMs to open a Letter of Credit (L.C) facility favouring power generators with a bank. The L.C amount shall equal the amount of their monthly power purchase bills to ensure secure payments for power supplied to DISCOMs.

Despite the above mandates by the Ministry of Power, DISCOMs continued to make defaults, and it has a burgeoning overdue payable to DISCOMs. “As per the CRISIL report 2020, maintaining an L.C facility will be arduous for many

DISCOMs, given their poor financial positions". "As per the Ministry of Power praapti portal [31], the aggregate discoms overdue to power GENCOs shoot up to Rs.1,25,478 crore in January 2021 despite the sanction of Rs.1.2 lakh crore liquidity package granted to DISCOMs only to clear their overdue." The sustained default has highly impacted the upstream value chain of power generation primarily due to the under-recoveries of its cost by DISCOMs.

4.17 REVAMPED DISTRIBUTION SECTOR SCHEME (RDSS)

To address the more severe issue of unviable state-run DISCOMs business, "the Government of India announced in its budget for FY 2021-22 [38] to implement a vital reform viz., 'Revamped reform-based and resulted linked distribution reform scheme' with an outlay of about 3.04 lakh crore."

The new reform scheme will address the most critical issues plaguing the distribution sector, viz., high AT&C losses, ACS-ARR gap and low billing and collection efficiency of the state-run DISCOMs. The new reform scheme is planned with a primary focus towards 100% pre-paid/smart metering and to support the up-gradation of the distribution infrastructure required by DISCOMs to reduce AT&C losses and improve their operational efficiency.

"According to the new reform linked scheme comprises a 15% capital subsidy from India's Government for achieving the 100% metering of feeders, DTRs and consumers, including agriculture consumers, to improve the billing and collection efficiency by installing Smart/pre-paid meters by discoms.

In addition, a capital subsidy of 60% of the project cost will be given for feeder segregation for agriculture, aerial bunched cabling in high-loss areas, SCADA in urban areas, Distribution Management System in urban areas, High Voltage Distribution System (HVDS), reconductoring of old conductors, and substation augmentation.

Further, 90% of subsidies have been provided for special category states viz., all northeastern states, Himachal Pradesh, Andaman & Nicobar and

Lakshadweep. The Government shall release the grant through nodal agencies, PFC and REC based on achievement of the agreed trajectory of performance parameters with the Ministry of Power viz., reduction of AT&C loss, ACS-ARR gap, and improvement the financial viability."

If DISCOMs implement the above reform scheme effectively, it will increase billing and collection efficiency while decreasing AT&C losses.

4.18 CONCLUSION FROM ANALYSIS OF SECONDARY DATA OF PAN INDIA DISCOMS CHAPTER SUMMARY

The following conclusion from the analysis of the secondary data collected for the state-owned DISCOMs in India:

Although several reforms implemented in the Indian power distribution sector after the enactment of the Electricity Act of 2003 have significantly contributed to the development of the power sector, it hasn't been able to make the state-owned DISCOMs financially viable. The sustained financial losses of the state-owned DISCOMs have severely impacted the power and other sectors of the economy and are hindering the country's economic development.

The present business model of the state-owned DISCOMs failed to make its business financially and commercially viable, as it is unable to create and deliver value to its customers, owners and stakeholders and DISCOMs are making huge losses continuously. There is a lack of reforms at the state level to improve the financial performance of DISCOMs. Unsustainable tariff subsidy, non-receipt of 100% subsidy from the state by DISCOMs, and non-cost reflective tariff have led to a huge gap between the ACS and ARR resulting in the financial insolvency of state-run DISCOMs.

The state-owned DISCOMs have failed to meet the target of reducing the AT&C losses to 15% and the zero gaps between ACS and ARR under the UDAY Scheme implemented from FY 2016 to FY 2019 to strengthen the

financial and operational performance of the state-owned DISCOMs, despite the state governments taking over a portion of the DISCOMs debts and losses.

SERCs are subservient to the state government and are unable to do their tariff determination independently despite their quasi-judicial authority. There is a strong intervention of the state government with the SERCs in tariff setting results in the setting of a non-cost reflective tariff. SERCs take into account the subsidy receivable while determining the tariff. Non-receipt, delayed receipt and partial receipt of subsidies from the state governments results in massive losses to the DISCOMs.

The regulatory delay in determining the tariff and the issue of tariff orders occurs due to the non-submission, and delayed submission of tariff petitions by DISCOMs, resulting in burgeoning financial losses to DISCOMs. Non-compliance with the legal provisions of the Electricity Act, 2003 and the Tariff Policy 2016 relating to cost-reflective tariffs and limiting to cross-subsidies within 20 % of the cost of supply results in huge losses to DISCOMs. SERCs have created huge regulatory assets. Recovery from huge regulatory assets by way of future tariffs is very remote, which would result in tariff shock. Several reforms implemented in the power distribution sector so far have focused primarily to reduce technical losses. However, reform programmes have not been successfully implemented to contain the huge commercial losses primarily arising out of the non-cost reflective tariff, huge subsidies, and non-realization of subsidy dues from the state government fully and timely.

Untargeted and unfunded massive subsidies are causing huge losses to the state-run DISCOMs. The state-run DISCOMs are highly subsidy-dependent. The subsidy issue remains crucial to achieving the financial viability of state-run DISCOMs and India's power sector. Poor subsidy policies of the several state governments resulted in massive losses to the state-run DISCOMs. Free supply of power to agriculture and supply of power to domestic consumers

with huge subsidies and only partial realization of subsidies from the state government results in financial insolvencies of the DISCOMs.

The Public-Private Participation (PPP) model in the DISCOMs business operation has yielded promising results in the distribution business of DISCOMs in Delhi and Mumbai by two private players, who have successfully made its DISCOMs business financially viable and sustainable. The Government of India 2014 has made numerous attempts to bring private investors into the power distribution business through various measures to achieve financial viability of the state-run DISCOMs viz., (1) Separation of Carriage & Content part of the power distribution business and to open up the distribution sector for private participation for the power supply business (2) Privatization of DISCOMs and (3) Delicensing distribution business by amending the Electricity Act, 2003 through the Electricity Amendment Bill, 2014 (EAB, 2014), EAB, 2020 and EAB, 2021. However, the reform proposed by the Government of India through the privatization of DISCOMs is not acceptable to most states.

The Govt. of India's plan for privatizing the state-run DISCOMs is not acceptable to the state governments, politicians, DISCOMs and their employees and is a politically sensitive issue. Further, private investors are keen to take the distribution business only in urban areas, where the consumer's paying capacity is more than the rural areas.

To achieve the financial viability and sustainability of the state-owned DISCOMs business, it is crucial to implement reforms focusing on tariff rationalization, implementation of cost-reflective tariff, direct subsidy transfer to consumers, rationalization of subsidy and cross-subsidy, and improvement in operational performance of DISCOMs.

There is a dire need to reform the distribution sector to make the state-owned DISCOM’s power supply business financially and commercially viable and sustainable to make the sustainable power sector in India.

CHAPTER 5

ANALYSIS OF SECONDARY DATA OF TANGEDCO

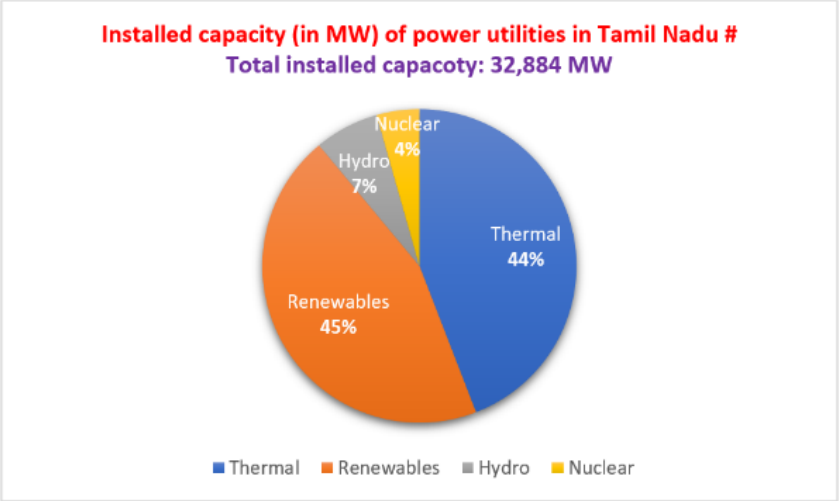
CHAPTER OVERVIEW

In chapter 5, a thorough investigation was conducted to identify all of the reasons that contributed to TANGEDCO's massive financial losses. Several power sector reforms implemented in the state of Tamil Nadu in the power distribution sector and TANGEDCO was analysed The financial performance of TANGEDCO and the reasons for its sustained financial losses were analysed. studied.

5.1. POWER SUPPLY SCENARIO IN TAMIL NADU

Tamil Nadu has successfully bridged the demand-supply gap by continuous capacity addition, and today it stood as a power surplus state. As a result, the state's power supply position has drastically improved. The total installed capacity, including common and central share, is 32,884 MW, as shown in Figure 5.1.

Figure 5.1



including allocated shares in Joint and central sector utilities

Source: CEA Report: Executive Summary on Power Sector September 2020

Power mix of Tamil Nadu

5.1.1 Demand and Supply of Power

Energy demand for the state as of September 2020 stood at 8,313 MU, as shown in Table 5.1 and the peak demand stood at 14,700 MW. Tamil Nadu has added a renewable power capacity of 14,745 MW, 45% of the total installed capacity, the highest in India.

Table 5.1
Energy Demand & Supply (MU) in Tamil Nadu

Energy Demand & Supply	September 2020	April-Sep 2020
Energy Demand (MU)	8,313	49,976
Energy Supplied (MU)	8,313	49,972

Source: CEA Report September 2020

5.2. Unbundling of TNEB

"Tamil Nadu Generation and Distribution Company (TANGEDCO), a Tamil Nadu state-owned power utility, was unbundled from Tamil Nadu Electricity Board (TNEB) on 1st November 2010. TNEB is one of the last Electricity boards to have opted for unbundling. TNEB was reluctant to unbundle since the enactment of the Electricity Act (EA- 2003). After seven years of implementation of the Electricity Act, 2003, TNEB unbundled into Tamil Nadu Generation and Distribution Company Ltd (TANGEDCO) and Tamil Nadu Transmission Company Ltd (TANTRANSCO) as a wholly-owned subsidiary of TNEB. In TANGEDCO, both Generation and distribution are bundled into one company."

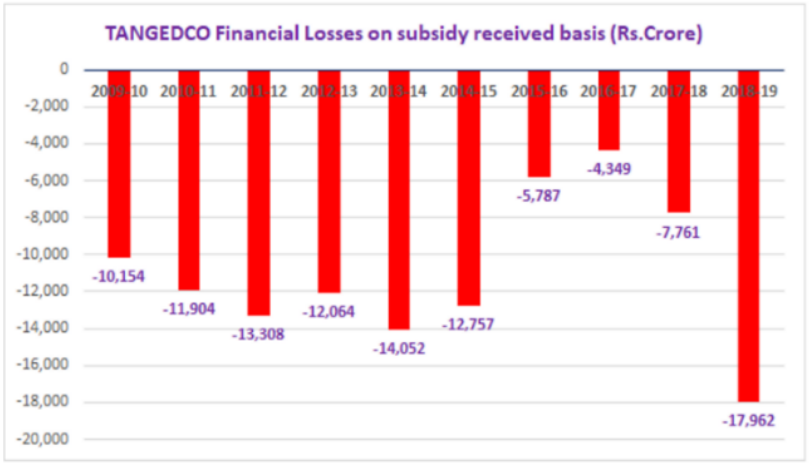
5.3 ANALYSIS OF THE FINANCIAL PERFORMANCE OF TANGEDCO

5.3.1 Burgeoning financial losses

TANGEDCO has continued to operate as a loss-making company since its company formation. It has incurred a net loss of about Rs. 14,336 Crores for the FY 2014-15 [28] in addition to its vast accumulated losses. The losses have decreasing trend during the UDAY implementation period, and again it has recorded a huge financial loss of Rs.17,962 crore (on a subsidy received

basis). Tamil Nadu finds at the top of the loss-making state in the power distribution business, as depicted in Figure 5.2.

Figure 5.2



The Figures of 2018-19 is financial loss on subsidy received basis excluding Regulatory income and UDAY Grant

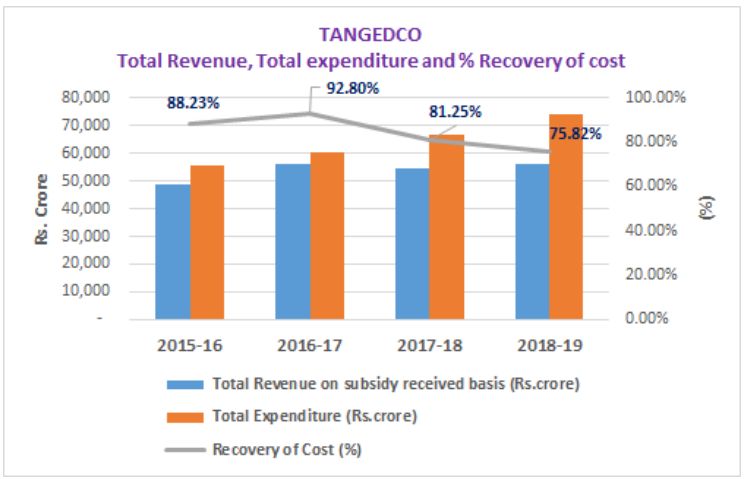
Source: PFC Report [44]

Sustained financial losses of TANGEDCO

5.3.2 Mounting Revenue Shortage

Analysis of the trend of the percentage of recovery of its cost by TANGEDCO, as shown in Figure 6.3, indicates that the deficit in the recovery of its cost is one of the significant reasons for its sustained financial losses. For example, in 2018-19, TANGEDCO recovered only 75.82% of its cost, with about 25% under-recovery of its cost, indicating the unsustainable business operation of TANGEDCO *[44].*

Figure 5.3



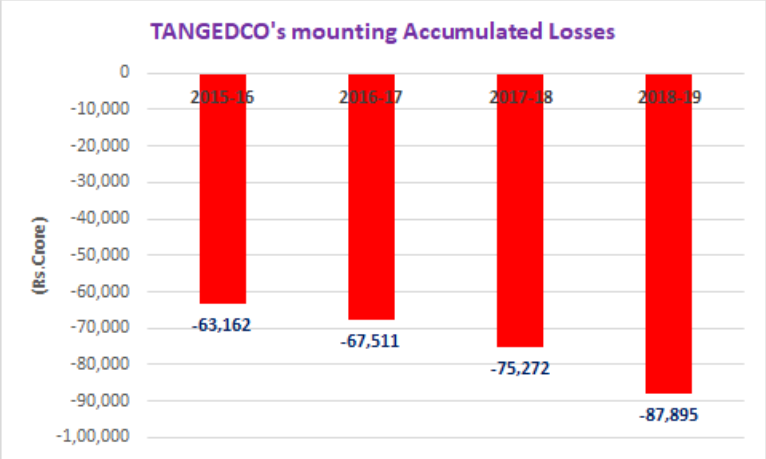
Source: PFC Report [37]

Total Revenue, total expenditure and % of the recovered cost

5.3.3 Burgeoning accumulated losses

The accumulated losses of TANGEDCO are growing at a rate of 39.1% over a period from 2015-16 to 2018-19 [44]. As a result, it reached an alarming level of Rs.87,895 crore in 2018-19, as shown in Figure 5.4.

Figure 5.4



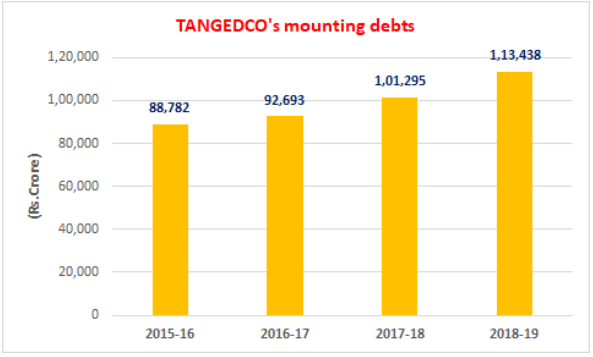
Source: PFC Report 2018-19 [44]

Accumulated loss of TANGEDCO

5.3.4 Mounting debts

TANGEDCO, to meet the vast revenue shortage arising primarily due to the big gap between ACS and ARR and periodical non-revision of the tariff, TANGEDCO resorted to massive borrowings from Banks and Financial Institutions. "As per the PFC report 2018-19 [44], TANGEDCO's debt has risen sharply year-on-year basis from 2015-16 to 2018-19. As a result, the total borrowings had reached an alarming level of Rs.1,13,438 crore in FY 2018-19 from Rs.88,782 crore in 2015-16, and the debt is growing at an annual compounded growth rate of 6.94% every year" as depicted in Figure 5.5.

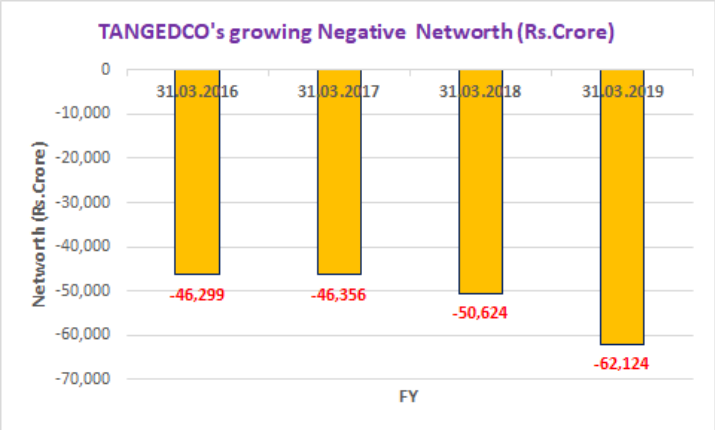
Figure 5.5



Source: PFC Report 2018-19 [44]

TANGEDCO's mounting debts

Figure 5.6



Source: PFC Report 2018-19 [44]

The negative Net worth of TANGEDCO

5.3.5 Severe liquidity crisis

The study finds that the considerable revenue shortage arising primarily from the gap between the ACS and ARR and the non-revision of tariffs periodically resulted in the deterioration of the financial health of TANGEDCO in a big way causing a severe liquidity crisis.

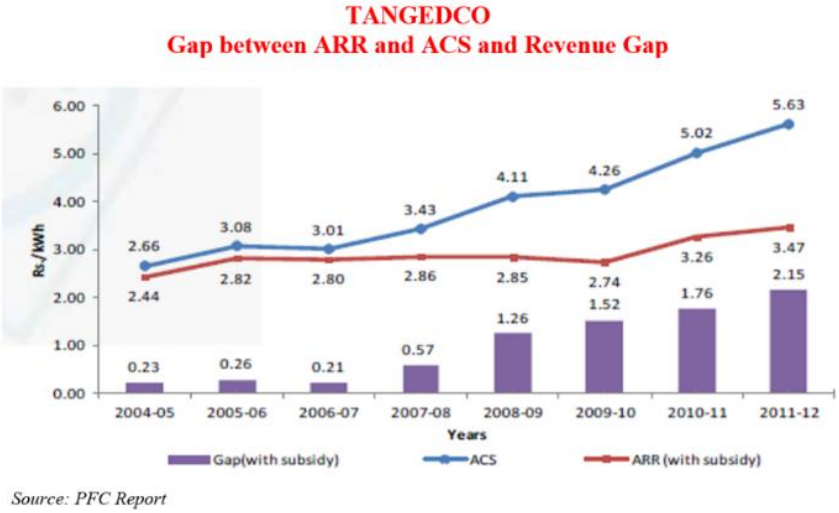
5.4. DRIVERS OF TANGEDCO's SUSTAINED FINANCIAL LOSSES

A detailed study has been made in TANGEDCO to diagnose the factors significantly contributing to the sustained financial loss of TANGEDCO as detailed below:

5.4.1 Raising gap between ACS and ARR

"As per the PFC report, it is evident from Figure 6.7 that the growing gap between the Average Cost of Supply (ACS) and the Average Revenue Realized (ARR) has been significantly contributing to the sustained financial losses of TANGEDCO."

Figure 5.7



Source: PFC Report

TANGEDCO's raising gap between ACS and ARR

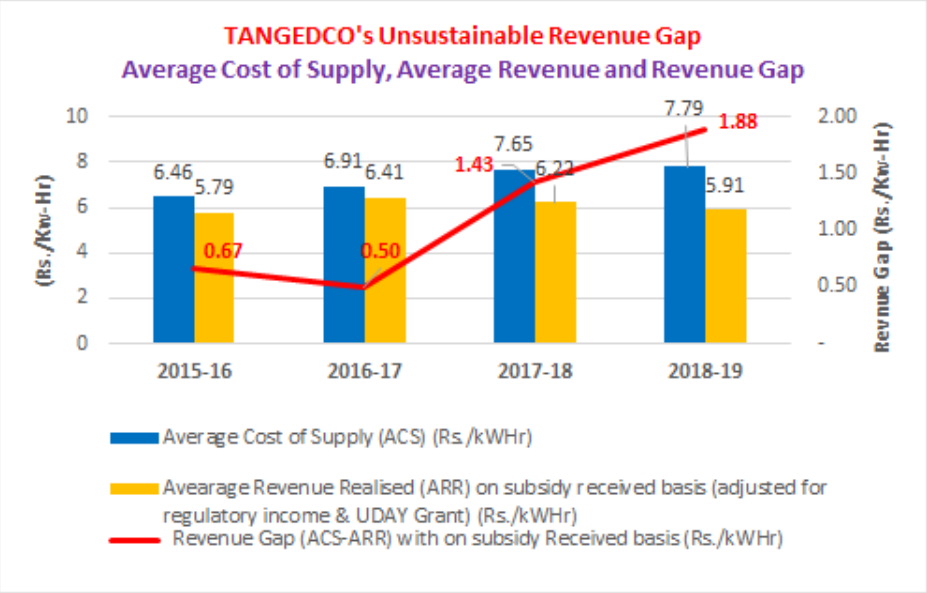
In its 2015 report [62], "World Bank cautioned that if TANGEDCO continued to operate its distribution business in the same fashion with a big gap between the ACS and ARR, it would be making a substantial financial loss of Rs.27,000 crore (on subsidy received basis). But, unfortunately, Tamil Nadu has not woken up even after the alarming bell raised by the World Bank and the Government of India."

5.4.2 Huge gap between ACS and ARR

"As per PFC Report 2018-19 [44], while the national average figure for the gap between the ACS and ARR for the DISOMs in 2018-19 stood at Rs.0.72 per Kw-Hr, for TANGEDCO, the gap is Rs.1.82 per kW-Hr, 2.52 times (252%) higher than the national average gap."

The gap between ACS and ARR of TANGEDCO increases year on year with an annual rate of 24.2% during 2015-16 to 2018-19*[37].* As a result, it has reached an alarming level of Rs. Rs.1.82 per kW-Hr. That is, TANGEDCO loses Rs.1.82 on every unit of energy sold by it and, by doing so, incurred the highest loss of Rs.17,962 crore during FY 2018-19, as depicted in Figure 5.8.

Figure 5.8



Source: PFC Report [37]

Unsustainable revenue gap of TANGEDCO

5.4.3 Non-revision of tariff at periodical interval

The detailed study carried out on TANGEDCO and its financial performance from 2005-06 to 2013-14, as shown in Table 5.2, reveals that TANGEDCO has not raised its retail tariff since 2003. TANGEDCO has revised its domestic tariff upward for the first time during the FY 2010-11 after 2003 only by 9%. TANGEDCO has not hiked the tariff for an extended period from 2003 to 2010, despite the manifold increase in its input cost and Average Cost of Supply (ACS).

Periodical non-revision of its tariff upward was another important reason for its sustained financial losses. The tariff being adopted by TANGEDCO does not reflect its actual cost, and the tariff is under-priced heavily. Huge under-pricing in retail tariff with free electricity to agriculture and supply of power to some domestic power consumer segments at a highly subsidized tariff has rendered TANGEDCOs business operation financially and commercially unviable and unsustainable.

Table 5.2

Financial performance of TANGEDCO

Key Parameters	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
AT&C losses	17%	16%	16%	14%	19%	19%	20%	n.a	n.a
Tariff Hikes	0%	0%	0%	0%	0%	9%	9%	37%	4%
Subsidy Received/Booked	100%	100%	100%	86%	100%	100%	100%	n.a	n.a
Interest Cost/Total Cost	6%	6%	7%	8%	10%	11%	10%	n.a	n.a
ACS-ARR Gap w/o subsidy – Rs./kWh	0.49	0.44	0.81	1.55	1.77	2.00	2.47	n.a	n.a

Comparison of Key Parameters indicating the performance of TANGEDCO over the years

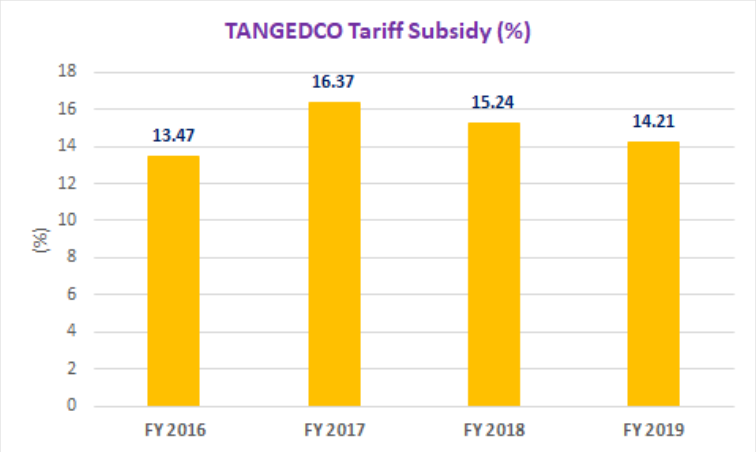
Source: PFC report

As per the PFC report, the non-revision of the tariff was upward over a period from FY 2002-03 to FY 2010-11, when the input cost and the power purchase cost have been raised during this period, and the power demand increased manifold. As a result, the power procurement cost in 2011-12 was at Rs. 6.15 per unit and was at Rs.3.74 per unit, and TANGEDCO is incurring a loss of Rs. 2.41 for every unit sold *[44]."* Therefore, periodical non-revision of tariffs by TANGEDCO was one of the unhealthy practices that resulted in the financially unviable business of TANGEDCO's distribution business.

5.4.4 Unsustainable tariff subsidy

The detailed study of tariff subsidies given by TANGEDCO to various power consumers over four years from 2015-16 to 2018-19 is shown in Table 16. The study finds that massive subsidy given to the Agricultural and some domestic consumer segments has led to substantial financial losses for TANGEDCO. For example, TANGEDCO offers about 14% of the tariff subsidy to agriculture power consumers, as shown in Figure 5.9.

Figure 5.9



Source: PFC Report 2018-19 [44]

Power tariff subsidy % of TANGEDCO

5.4.5 Free supply of electricity to agriculture and some consumer segments

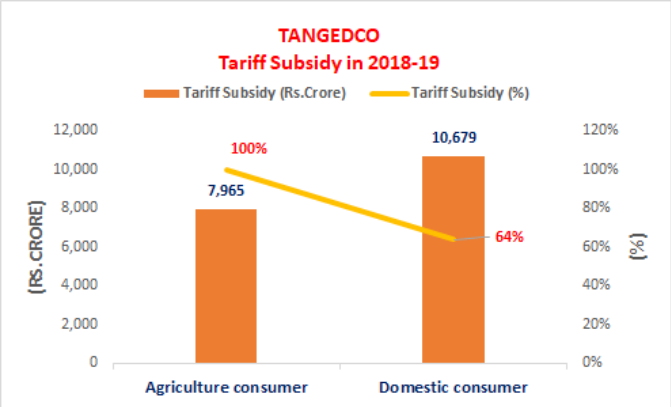
The study finds that TANGEDCO has given substantial subsidies to Agricultural and domestic consumers. Free electricity supply becomes the election manifesto for political parties in Tamil Nadu. As per PFC Report 2018-19 *[44],* TANGEDCO is continued to give a 100% power subsidy. The electricity supply to agriculture power consumers is free irrespective of the consumers' quantum of power consumed. In 2018-19, the total subsidy to agriculture stood at Rs.7,965 crore (100% subsidy).

All energy consumed is not metered, and TANGEDCO does not receive the full subsidy from the Tamil Nadu government. Free power supply to agricultural and supply of power at a highly subsidized tariff to domestic consumers has been a campaign promise for political parties in Tamil Nadu, resulting in massive losses for TANGEDCO.

Similarly, TANGEDCO gives a massive power subsidy to domestic power consumers. *It is pertinent to note that TANGEDCO gives 100 units free of cost in each billing period to all domestic consumers irrespective of their economic status.* As per PFC Report 2018-19 *[44], the total subsidy granted by TANGEDCO to its domestic power consumers in 2018-19 is Rs.10,679 crore*

(64% subsidy), and TANGEDCO has supply power with 100% subsidy in tariff to its agricultural power consumers, which amounts to Rs.7,965 crore in FY 2018-19. The revenue loss to TANGEDCO on account of the subsidy given by TANGEDCO to agricultural and domestic consumers in 2018-19 alone is Rs.18,644 crore, as shown in Figure 5.10.

Figure 5.10



TANGEDCO's tariff subsidy to agriculture and domestic consumers

5.4.6 Tariff cross-subsidies beyond 20% prescribed limit

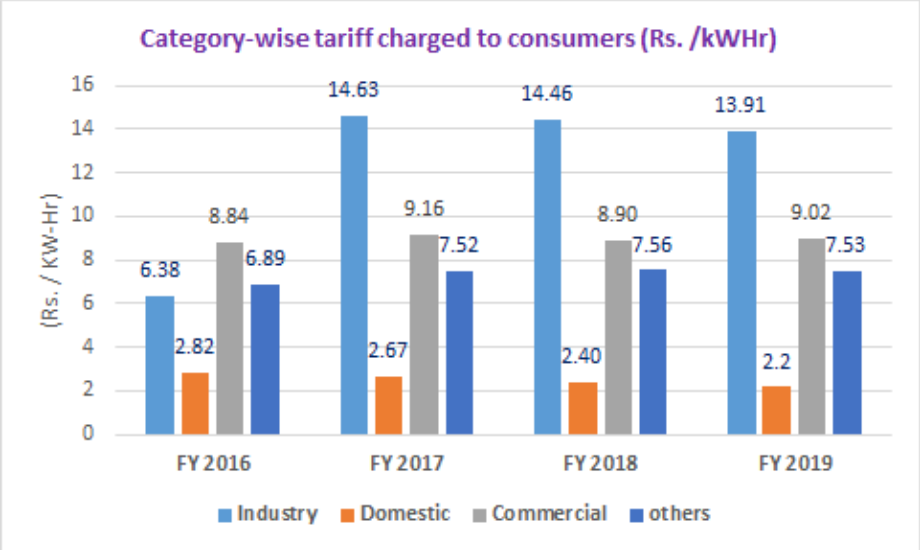
"The Electricity Act, 2003 provides that the maximum cross-subsidy allowed is 20%, and DISCOMs need to remove the cross-subsidy over a time frame specified by SERC." The consumer-wise tariff charged to various power consumer segments by TANGEDCO is shown in Table 5.3 and Figure 5.11.

Table 5.3

The tariff charged to consumers by TANGEDCO (Rs. /Kw-Hr)				
	FY 2016	FY 2017	FY 2018	FY 2019
Industry	6.38	14.63	14.46	13.91
Domestic	2.82	2.67	2.40	2.2
Commercial	8.84	9.16	8.90	9.02
Agriculture	0	0	0	0
Others	6.89	7.52	7.56	7.53
Average Revenue	5.94	6.37	6.21	6.10

Source: PFC Report 2018-19 [44]

Figure 5.11



Source: PFC Report 2018-19 [44]

Tariffs charged by TANGECO to various consumer categories

To compensate for the vast subsidy given by TANGEDCO to its agriculture and domestic power consumers, TANGEDCO is charging higher tariffs to Industry, Commercial and other consumers by heavily cross-subsidizing the tariff levied to these segments of power consumers.

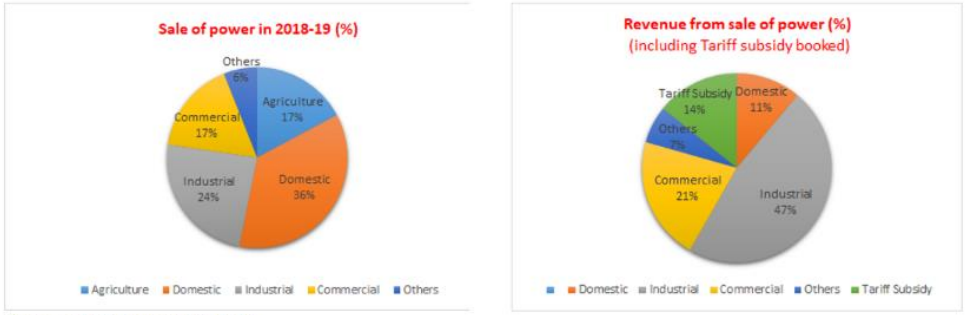
5.4.7 Comparison of category-wise sales and revenue realized

As per PFC Report 2018-19*[44],* TANGEDCO sells 24% of the total power to industries and generates 47% of the total revenue from industrial consumers. Similarly, it sells 17% of the total energy to commercial consumers and generates 21% of revenue from the sale to commercial consumer segments, as shown in Figure 5.12. Out of 17% of the total power supplied to the agriculture sector, TANGEDCO does not generate any income. It is provided free of cost to all agricultural consumers irrespective of their economic status.

Figure 5.12

TANGEDCO

Comparison of category-wise Sales and Revenue realized by TANGEDCO in FY 2018-19



Source: PFC Report 2018-19

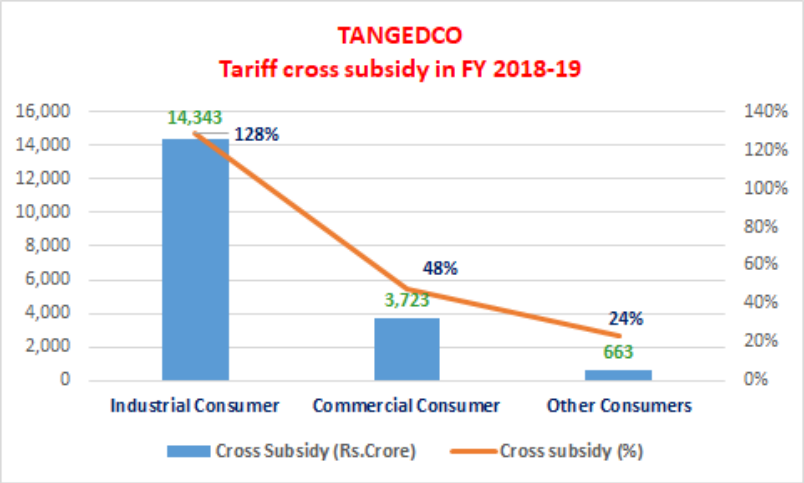
Consumer category-wise sales and revenue realised by TANGEDCO

5.4.8 Higher tariffs on industries affected the industry competitiveness

"As per PFC Report 2018-19 [44], the cross-subsidy percentage for the cross-subsidization of tariff given to Industry, Commercial and other consumers stood at 128% (Rs.14,343 crore), 48% (Rs.3,723crore) and 19% (Rs.663 crore) respectively. The tariff charged by TANGEDCO to industrial consumers is Rs.13.91 per kW-Hr, which is very high compared to its Average Cost of Supply of Rs.5.91 per kW-Hr." TANGEDCO sells electricity at 123% higher than its average supply cost, as shown in Figure 6.13, despite the 20% upper limit prescribed for cross-subsidization. It would drastically affect the competitiveness of the industries in the state besides decelerating industrial growth.

The exorbitant cross-subsidy charged by TANGEDCO to industrial consumers goes against the Make in India plan of the Govt. of India. The higher tariff rate charged to industries has heavily affected the power-intensive sectors like textile, cement steel, and sugar, as the share of power cost in the total cost ranges from 40 to 60 per cent. Many studies reported that most textile industries from Tirupur and Coimbatore (South Indian Manchester) found many textile units in Andhra Pradesh because of the higher tariff charged to industries.

Figure 5.13



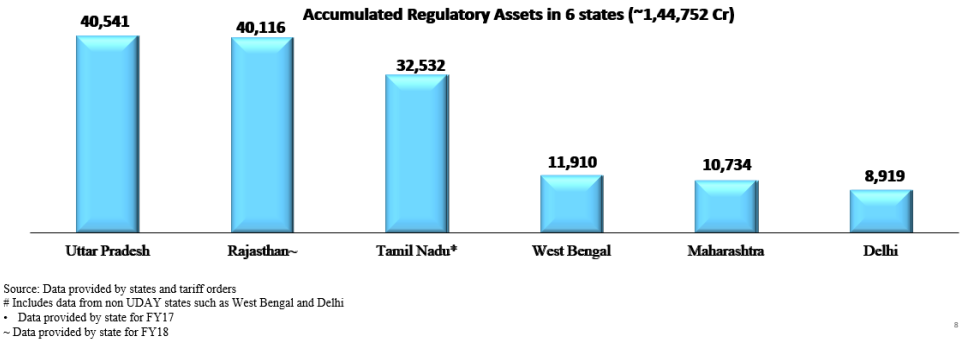
Source: PFC report [44]

TANGEDCO's cross-subsidies to industrial and commercial consumers

5.4.9 Non-cost reflective tariff drives massive build-up of regulatory assets

Due to the non-revision of periodical tariff and the non-cost reflective tariff, TANGEDCO has created regulatory assets of Rs.32,532 crore as of 31.3.2018, as shown in Figure 5.14, which is shown as regulatory income in its book of accounts. However, it is future receivables from the consumers due to the lower tariff charged to them by TANGEDCO during the previous year and will be collected by increasing the tariff hike. Therefore, realising huge regulatory income booked out of regulatory assets is remote.

Figure 5.14



Source: PFC Report 2019 Ministry of Power [44]

Six states with high regulatory assets

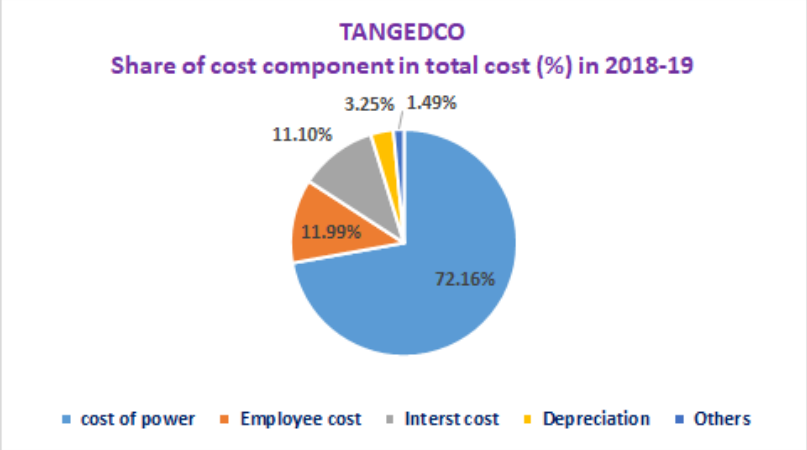
5.4.10 Strong intervention by the state government in tariff setting process of SERC

The state power regulators join hands with the State government to not increase the tariff. The state government has a strong intervention with the State Electricity Regulatory Commission (SERC), even though SERCs have vested the power as a quasi-judicial body. However, SERCs are not exercising their judicial authority. Most retired officials and bureaucrats from DISCOMs and state power utilities of the concerned states are appointed as Chairman and Members of the SERCs. SERC, instead of hiking the tariff, resorted to converting the shortfall in revenue of DISCOMs into regulatory assets.

5.4.11 High power purchase cost

"According to the PFC report, the cost of power as a percentage of overall cost was 72.16 per cent in 2018-19 [44], as illustrated in Figure 5.15." The purchase and average cost of Supply (ACS) increase yearly. While the input cost, cost of power generation and ACS increases year-on-year, the tariff has not been fixed at regular interval every year by TANGEDCO. Further, the tariff set and adopted is lower than its cost and stood as a Non-Cost Reflective tariff, contributing significantly to the sustained financial losses of TANGEDCO.

Figure 5.15



CEA Report 2020 [44]

Cost break-up of cost of supply of TANGEDCO in 2018-19

5.4.12 Unsustainable distribution business of TANGEDCO

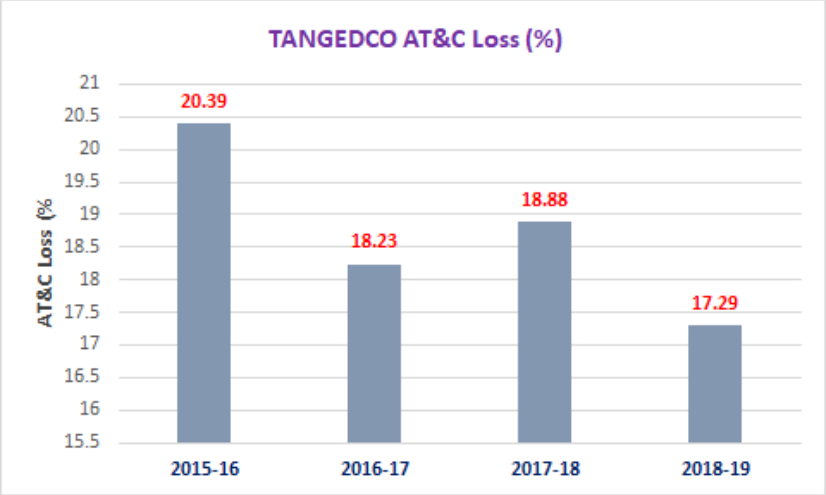
Despite several rounds of reforms since 2003, TANGEDCO is continuously making financial losses year-on-year due to the drivers discussed in detail above TANGEDCO. In FY 2018-19, TANGEDCO incurred a financial loss of Rs.17,962 crore. Tamil Nadu stood as the highest loss-making state in the power distribution business of its state power utility, TANGEDCO [44]. The fact is that TANGEDCO losses Rs.1.82 on every unit of energy sold. TANGEDCO's distribution business has become financially and commercially unviable and unsustainable.

5.5 LOSS DRIVERS DUE TO OPERATIONAL INEFFICIENCIES OF TANGEDCO

5.5.1 High AT&C losses

Despite implementing several reform programs and the UDAY Scheme from 2015-16 to 2018-19, the AT&C loss of TANGEDCO has not come down. It stood at 17.29%, as shown in Figure 5.16. TANGEDCO has failed to achieve the AT&C target of 15% under UDAY.

Figure 5.16



Source: PFC Report [44]

AT&C losses of TANGEDCO

The AT&C losses declared by TANGEDCO are approximately 17%. According to International Standards, the benchmark is 8.5% and the maximum allowable limit of 15%. It is to mention that unless all the energy sold is measured, the AT&C Losses calculation will not yield correct results. TANGEDCO is giving blanket subsidies to all agriculture consumers without metering the actual power consumed by them. TANGEDCO theoretically calculates the approximate expected power consumed by the agriculture consumers based on the agriculture consumers' horse-power rating, which is not the proper practice. Unless all the energy sold, even free of cost is measured, the substantial financial losses of TANGEDCO could not be contained.

Due to the above flaws, there are chances that TANGEDCO may book a significant part of the commercial losses arising out of free supply power supplied to the agriculture sector into the Transmission and Distribution Losses to avoid the state Government paying a lower amount of subsidy to TANGEDCO.

Factors contributing to technical losses

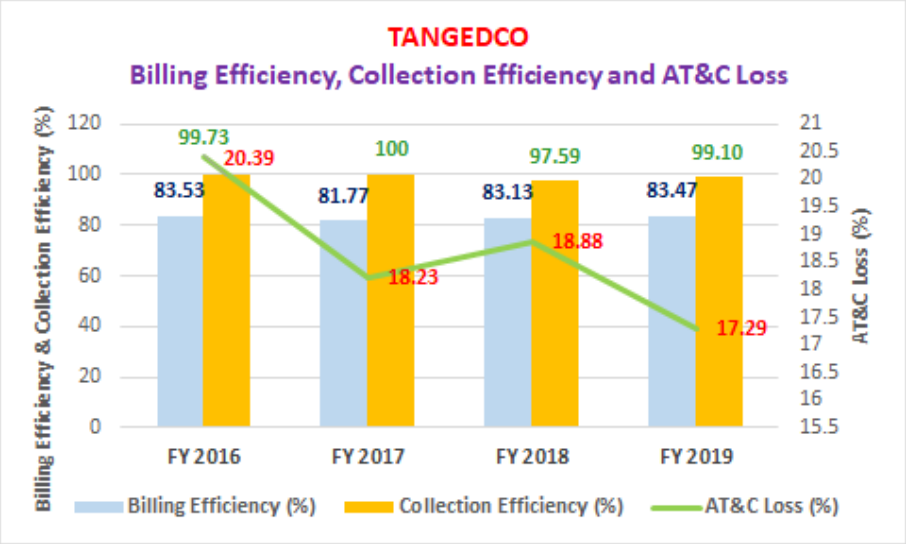
Due to the poor financial health of TANGEDCO, it is unable to take up the most needed capital expenditure projects in distribution and unable to carry out the Operation & Maintenance (O&M) works to improve the distribution system efficiency and decrease the technical losses. This has resulted in a periodical equipment outage; lower system availability resulted in a considerable revenue shortage and inefficiencies in the business operation of TANGEDCO.

5.5.2 Low billing efficiency

As per PFC Report 2018-19 [44], TANGEDCO has achieved 99.10% collection efficiency. However, TANGEDCO achieved lower billing efficiency of 83.47% in 2018-19, contributing to the enormous revenue shortage, as shown in Figure 5.17.

Unless all the energy consumed is metered, 100% billing will not happen in line with the good old proverb viz. Therefore, even if we pour the food grains into the river, we need to measure them before pouring them into the river to contain the substantial financial losses of TANGEDCO.

Figure 5.17



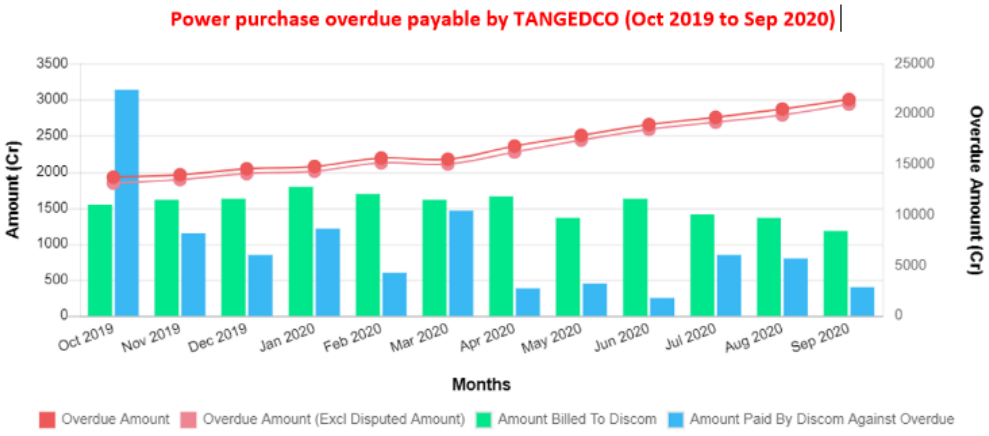
Source: PFC Report [44]

TANGEDCO's Billing and collection efficiency and AT&C loss

5.6 HUGE OVERDUE PAYABLE TO POWER-GENERATING COMPANIES

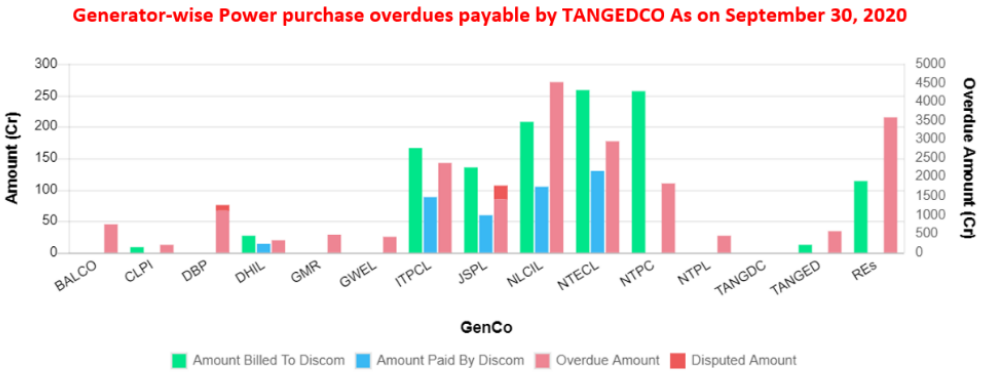
Due to the enormous revenue shortage and low cash flow arising out of the massive gap between the ACS and ARR, TANGEDCO was unable to meet its obligation to make timely payments for the power procured by it from power-generating companies in Central, Joint and private sectors including Independent Power Producers (IPP). As a result, TANGEDCO has defaulted in making its payment due to the power generators. "As per the Ministry of Power (www.praapti.in) [31], TANGEDCO has a massive overdue Rs.20,000 crore payable to GENCOs as of September 2020, shown in Figure 5.18. GENCO-wise due payable by TANGEDCO as of September 30, 2020", as shown in Figure 5.19.

Figure 5.18



Source: Ministry of Power (http://praapti.in)

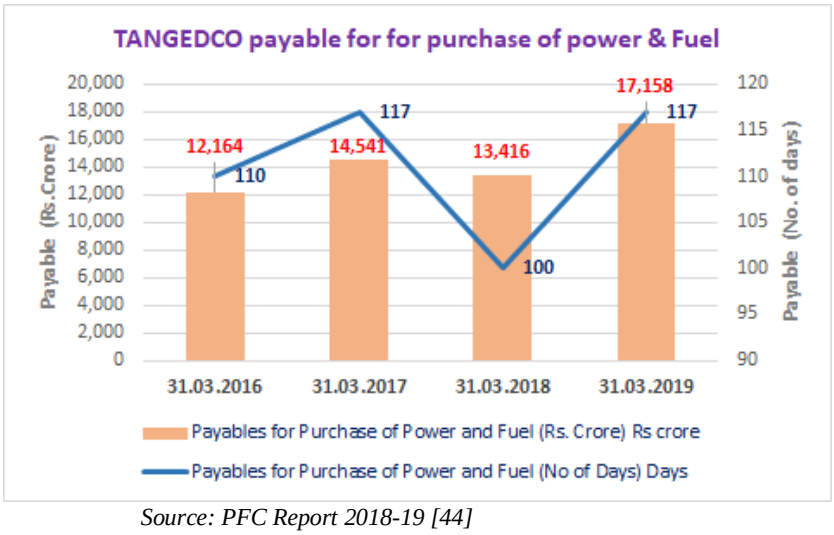
Figure 5.19



Source: Ministry of Power (http://praapti.in)

The increasing payables for the power purchased by TANGEDCO are depicted in Figure 5.20.

Figure 5.20



Source: PFC Report 2018-19 [44]

The trend of huge payables for the power purchased by TANGEDCO

5.7 SIGNIFICANT FINDINGS FROM THE ANALYSIS OF SECONDARY DATA OF TANGEDCO- CHAPTER SUMMARY

The detailed analysis of secondary data collected for TANGEDCO, as well as the investigation of several government-sponsored power sector programs aimed at enhancing the financial sustainability of the state-owned DISCOMs, have revealed the following significant findings:

The Government of India and state governments have implemented several reforms in the Indian power sector and a series of reforms in the electricity and distribution sectors post-enactment of the Electricity Act, 2003. However, while these reforms significantly improved the electricity infrastructure and accomplished many objectives of the reforms, these reforms have failed to achieve financial viability and turn around the bankrupt state-owned DISCOMs including TANGEDO. As a result, the unsustainable distribution operations of the state-owned DISCOMs remain a significant hindrance to developing a sustainable power sector and overall economic growth and a severe threat to the nation's energy security.

The Government of India and State Governments implemented the Ujwal DISCOM Assurance Yojana (UDAY), a distribution reform scheme, over four years from FY 2015-16 to FY 2018-19 to revive the DISCOMs' financial condition by enhancing their financial and operational performance to improve their financial viability. However, while the UDAY Scheme partially aided in achieving the target of operating parameters and taking over substantial debts of the state-owned DISCOMs by the respective state government, the Scheme has not achieved the target set by the Ministry of Power under UDAY schemes. DISCOMs have not eliminated the gap between the ACS and ARR, not bringing down the AT&C losses below 15% by 2018-19. Ultimately, UDAY Scheme did not achieve the intended outcome of financially and commercially sustainable operations for DISCOM. On the contrary, sustained financial losses, growing revenue shortfalls, mounting debts, and a severe liquidity crunch have rendered DISCOMs financially and commercially

unsustainable. TANGEDCO’s financial position deteriorated heavily post-implementation of the UDAY scheme.

Despite several rounds of reforms and the Government of India's grant to DISCOMs through numerous financial restructuring packages undertaken to achieve the financial viability of the state-run DISCOMs, even after implementing UDAY and absorption of 75% of DISCOMs' debts by the respective state governments, DISCOMs' power supply businesses remain financially and commercially unsustainable. The state-run DISCOMs' current business models, including TANGEDCO, continued to be financially and commercially unviable and unsustainable.

Implementing a cost-reflective tariff is still a long way off. Massive revenue shortfall caused by the positive difference between the ACS and ARR and the irrational tariff structure contributes significantly to the state-run DISCOMs' substantial financial losses. As a result, implementing cost-reflective tariffs and rationalising the tariff structure and subsidies are crucial to achieving DISCOMs' financial viability. Un-targeted and unfunded subsidies given to the agricultural consumers, 100% free supply to agriculture consumers without metering and free supply of power up to 100 units in each billing cycle to all domestic consumers given by the Government of Tamil Nadu/TANGEDCO are causing massive losses to TANGEDCO and its unsustainable power supply business.

State government intervention with the state power regulator, including with TNERC by the Government of Tamil Nadu, has resulted in the fixation of suboptimal tariffs with massive subsidies to agricultural and domestic LT power consumers. SERCs are unable to carry out their tariff determination by matching the tariff with the cost of supply as mandated by the Electricity Act, 2003, National Tariff Policy and the Electricity Regulatory Commission Act, 1998 despite their quasi-judicial and SERCs subservient to the respective state government. SERC's structural reform is critical to ensuring that the state government is separated from the SERC's tariff-setting process and determines

and fix cost-reflective tariffs. TANGEDCO has not revised the tariff for several years despite the huge increase in the cost of power supply, resulting in huge financial losses for TANGEDCO. TANGEDCO and state-run DISCOMs must revise their tariffs regularly to remain financially viable and sustainable.

DISCOMs including TANGEDCO are highly subsidy dependent on the state and the Central Government. Consequently, the state-owned DISCOMs are unable to sustain their business without government support.

TANGEDCO is incurring sustained financial losses. TANGEDCO loses Rs.1.82 on every unit of energy sold. The big gap between the ACS and ARR, massive subsidy to agriculture and domestic consumers, non-revision of tariff at the periodical interval, and free electricity supply policy of the state government are significant contributors to the sustained financial losses and financial un-viability of TANGEDCO.

The growing trend of politicians acting opportunistically by insisting on selling electricity below its cost price through substantial, untargeted subsidies has been the most significant barrier to achieving financial viability for state-run DISCOMs and the sustainability of the Indian power sector. Politicians' patronage relationships with specific segments of consumers have been a significant driver of the subsidy. As a result, electricity became a tool for political patronage.

The higher tariff charged to the industrial and power consumers by TANGEDCO by heavily cross-subsidizing the agricultural and domestic consumers has hampered industrial development and significantly impacted the state and national economy. Higher tariffs charged to industries have drastically affected the industries' competitiveness, which will go against India's Make in India plan. The industrial and commercial consumers of TANGEDCO are charged with exorbitantly higher tariffs to cross-subsidise agriculture and domestic consumers. This has resulted in the migration of industries and commercial businesses to other states and the shifting of

industrial consumers to OPEN access, resulting in huge revenue loss to TANGEDCO, Tax revenue to the state government, and loss of employment opportunities in Tamil Nadu.

The Government of India succeeded in opening up the Generation and transmission sector to private participation. However, the Government of India's efforts to unbundle the DISCOMs business into carrier and content by inviting private investment in the distribution sector has not happened. There is a strong objection by the state governments, DISCOMs and politicians to handing over the DISCOMs to the hand of a few private monopolies. They are neither accepting the privatisation of DISCOMs nor the participation of private firms in the power distribution business. Fewer reforms have been carried out to reduce commercial losses and to rationalise subsidies.

The analysis finds that there is vast scope to achieve the financial viability of the state-run DISCOMs. TANGEDCO could achieve financial viability by adopting cost-reflective tariffs, timely revision of tariffs annually, rationalisation of tariffs, reduction of subsidies by targeting the subsidies, reducing cross-subsidies, and improving its operational performance in its billing and collection and reducing AT&C losses below 15% level. These measures would pave the way to substantially reducing the gap between the ACS and ARR and achieving financial viability even without the privatisation of the power distribution business. The distribution sector requires significant reforms, including tariff and regulatory reforms, to ensure the financial viability of state-owned DISCOMs and the sustainability of the Indian power sector.

CHAPTER 6

PRIMARY DATA COLLECTION FROM TANGEDCO AND ANALYSIS OF PRIMARY DATA

6.1 CHAPTER OVERVIEW

This chapter describes 56 numbers of independent variables and 17 numbers of latent variables identified from the detailed review of the literature and analysis of the secondary data, which are causing the sustained financial losses to TANGEDCO. To validate the 56 nos of independent variables, primary data was collected by the survey method by designing a questionnaire. The Research methodology followed for the collection of the primary data is narrated. The study finds the relationship between the independent variables and latent variables, the study formulated 17 constructs, 13 first-order constructs, 2 second-order constructs, 1 third-order construct and 1 fourth-order construct. The operational definition of the 17 constructs developed is given.

6.2 THE METHODOLOGY ADOPTED FOR THE COLLECTION OF PRIMARY DATA

From the detailed literature review and analysis of the secondary data, the study has identified 56 independent variables and 17 latent variables, which are significantly contributing to the sustained financial losses of TANGEDCO. To identify the factors significantly contributing to the continuous financial and commercial losses of TANGEDCO, the top loss-making state

power utility, primary data were collected for TANGEDCO by employing a survey method.

The detailed literature survey has found that the state-run DISCOMs operate their power distribution business in a similar business environment, financial, commercial, social, economic, regulatory, political, and environmental. Moreover, the identified factors for the sustained financial losses of almost all the state-run DISCOMs are similar, as all DISCOMs operate in a similar business environment. However, the intensity of the factors varies from discom to discom.

To validate the identified 56 independent variables obtained from PAN India DISCOMs and TANGEDCO and analysis of the secondary data, primary data was collected from Tamil Nadu Generation and Distribution Company Ltd (TANGEDCO), the top loss-making state power utility. The identified research variables from RO 1 have been used as input to devise the research questionnaire for collecting primary data.

Research Questionnaire

The primary data was collected by a survey method from various stakeholders of TANGEDCO through a well-designed research questionnaire with a 5-point Likert scale. The questionnaire designed for the collection of primary data by the survey method is attached in **Appendix 1**. A disproportionate stratified random sampling technique was employed to collect the response from

the targeted respondents with a sample size of 400 by administering the online questionnaire.

The developed questionnaire was validated for content validity, instrument validity, and reliability by 25 experts in the power sector, finance sector, and academia. Pilot testing of the questionnaire was done before conducting the survey using the questionnaire method and ensured the face validity, content validity, instrument validity and reliability of the questionnaire. The detailed analysis of the primary data and secondary data collected from TANGEDCO results in diagnosing the factors contributing significantly to the sustained financial losses of the state-run DISCOMs.

6.3 PRIMARY DATA COLLECTION FOR TANGEDCO

As per the methodology narrated in Para 6.2 and the research methodology adopted to achieve research objective 2 (RO-2) as explained in detail in Para 1.5 in Chapter 1, the primary data were collected by the survey method.

6.4 KEY RESEARCH VARIABLES DETERMINED FROM THE ANALYSIS OF SECONDARY DATA OF PAN INDIA DISCOMS AND TANGEDCO, CONTRIBUTING TO THE SUSTAINED FINANCIAL LOSSES

From the extensive literature survey and the analysis of secondary data, this research study has identified several independent variables and dependent variables, which are causing sustained financial losses to TANGEDCO.

6.4.1 Identified independent variables and latent variables significantly contributing to the financial losses of TANGEDCO and the relationship between them

The analysis of secondary data collected for this research from various sources including published theme papers, World Bank research reports, PFC research reports, Government of India appointed committee reports, and findings from the several power sector reform schemes implemented in the power distribution sector to improve the financial viability of the state-run DISCOMs including TANGEDCO, the research study has identified 56 Independent Variables (IV) ranging from F1 to F57 and 17 Latent Variables (LV), which are causing huge financial losses to TANGEDCO. The 56 independent factors and 17 latent variables discovered are summarized in Tables 6.1 and Table 6.2. Independent variable 32 has not been considered.

Table 6.1

Identified research variables contributing to the sustained financial losses of TANGEDCO and the relationship between the independent and latent variables

Latent Variable (LV) (Dependent Variables)		Independent Variables (IV)	
Technical loss (LV1)	⇦	F1	Overloading of Distribution Transformers and its failure
	⇦	F2	Inferior quality of electrical equipment
	⇦	F3	Faults in critical electrical equipment and energy meters
	⇦	F4	Failure of critical electrical equipment and delay in rectification
	⇦	F5	Inadequate Operation & Maintenance of critical equipment
	⇦	F6	Lengthy LT lines with a high LT/HT ratio
	⇦	F7	Non-implementation of High Voltage Distribution (HVDS) Scheme
	⇦	F8	Non-implementation of the Feeder Segregation Program

Power theft (LV2)	⇦	F9	Power theft by consumers by bypassing energy meters.
	⇦	F10	Involvement of TANGEDCO Officials in power theft
	⇦	F11	Inadequate theft control measures
	⇦	F12	Non-implementation of Smart metering & Aerial Bunched cabling
Low billing efficiency (LV3)	⇦	F13	Absence of 100% metering in Agriculture
	⇦	F14	Inadequate staff to take the energy meter reading at regular intervals
	⇦	F15	Non-usage of Technological interventions and other measures
Low Collection Efficiency (LV4)	⇦	F16	Inadequate measures to improve collection efficiency
	⇦	F17	Absence of incentive schemes to employees & Absence of Distribution Franchisee
Increase in cost of supply (LV5)	⇦	F18	High power purchase cost due to increase in input cost
	⇦	F19	Increase in cost of power generation of Non-Renewable Energy
	⇦	F20	Power-generating plants operating with lower Plant Load Factor (PLF)
	⇦	F21	The inability of TANGEDCO to procure cheaper Renewable power due to Long-term PPA with GENCOs/IPPs
	⇦	F22	High-interest costs for the loans
Non-Cost reflective tariff (LV6)	⇦	F23	Non-revision of tariff upward periodically at regular intervals in line with the cost of supply
	⇦	F24	Huge nos. of subsidised power consumers in the consumer mix of TANGEDCO
	⇦	F25	Irrational tariff structure
	⇦	F26	Billing is not based on actual power consumed by subsidised consumers
	⇦	F27	Poor tariff subsidy policies
	⇦	F28	Un-targeted tariff subsidy
	⇦	F29	Under-pricing of tariff to some

Tariff subsidy (LV7)			segments of power consumers
	⇦	F30	Free power supply to Agriculture and some segments of domestic consumers
	⇦	F31	Non-release of tariff subsidy directly to targeted consumers
Delay in tariff setting (LV8)	⇦	F33	Delay in finalisation and auditing of Annual accounts by TANGEDCO
	⇦	F34	Delay in filing tariff proposal & filing it in incomplete form by TANGEDCO
	⇦	F35	Delay in tariff determination and issue of tariff order by State Electricity Regulatory Commission (SERC)
	⇦	F36	SERC not issuing tariff order based on Suo-motto basis in case of inordinate delay in filing tariff petition by TANGEDCO
Building-up of regulatory assets (LV9)	⇦	F37	Tariffs determined by considering the subsidy receivables from the State Govt.
	⇦	F38	Partial approval of cost in tariff by SERC (TNERC)
	⇦	F39	SERC converting uncovered costs into Regulatory assets
	⇦	F40	Non-release/delayed release of subsidy by States
Political intervention (LV10)	⇦	F41	The strong intervention of the State Govt. with SERC in tariff fixation
	⇦	F42	Lack of political will and political support for fixing rationale tariff
	⇦	F43	Political parties demand free power for Agriculture & subsidised power for some consumer segments
	⇦	F44	State Govt. not agreeing to transfer subsidy directly to the targeted beneficiaries
	⇦	F45	Political sensitivity to increase power tariff
	⇦	F46	Lack of coordination between Central & State Govt. in the implementation of power distribution reforms

	⇦	F47	Strong political support to consumers for their demand for free/subsidised power
	⇦	F48	State Govt. unable to withdraw free power policy
Inefficient management (LV11)	⇦	F49	Inefficiency in business operation
	⇦	F50	Mismanagement & Corruption
	⇦	F51	Inefficiencies in billing and revenue collection
Huge debts (LV12)	⇦	F52	Huge payables to power GENCOs
	⇦	F53	Delay in receipt of subsidy from the State Govt.
	⇦	F54	High working capital dependence and huge long-term debt for Capital expenditure projects
Liquidity problem (LV13)	⇦	F55	Huge receivables with a more extended collection period
	⇦	F56	Huge payables with longer payable days
	⇦	F57	Massive Overdue in payment of electricity bills by Govt. Dept./Municipalities

6.5 THE INTERRELATIONSHIP BETWEEN INDEPENDENT VARIABLES AND LATENT VARIABLES BASIS FOR THE DEVELOPMENT OF 13 FIRST-ORDER CONSTRUCTS

From the primary and secondary data analysis, this research discovered that 56 Independent variables (F1 to F57) have positive relationships with 13 latent Variables or Dependent Variables (LV1 to LV13). The details of the relationships between independent and dependent variables are shown in Table 6.1. Furthermore, it is found that a set of Independent Variables (IVs) have positive relationships with Latent variables (LV). This is because each set of independent variables causes the dependent variables, forming 13 formative constructs as shown in Table 6.1. The details of the relationships amongst the set of IVs and LVs and the constructs formed are as under:

6.6 OPERATION DEFINITION OF 13 FIRST-ORDER CONSTRUCTS DEVELOPED

6.6.1 Construct 1- Technical losses (LV-1)

Technical losses (LV-1) are caused due to the eight independent variables (IVs) viz., (i) Overloading of Distribution Transformers and its failure (F1), (ii) Inferior quality of electrical equipment used in the power distribution system (F2), (iii) Faults in critical electrical equipment and energy meters (F3), (iv) Failure of essential electrical equipment in the distribution system and delay in rectification (F4), (v) Inadequate Operation & Maintenance of crucial equipment including LT and HT lines & distribution transformers (F5), (vi) Higher distribution losses due to the lengthy LT lines with high LT/HT ratio (F6), (vii) Non-implementation of High Voltage Distribution (HVDS) Scheme (F7) and (viii) Non-implementation of Feeder Segregation Program (F8). TANGEDCO's AT&C losses are influenced by high technical losses, as AT&C losses include both technical and commercial losses.

6.6.2 Construct 2- Power theft or theft of energy (LV2)

Power theft or theft of energy (LV2) in TANGEDCO is happening due to the four identified dependent variables viz., (i) Stealing of power by consumers by bypassing energy meter (F9), (ii) Involvement of TANGEDCO Officials in power theft [i.e., connivance of employees] (F10), (iii) Inadequate theft control measures adopted by TANGEDCO (F11) and (iv) non-implementation of technologically innovative measures to control theft viz., Smart metering & Aerial Bunched cabling (F12). As a result, a higher incidence of theft leads to commercial losses.

6.6.3 Construct 3 - The low billing efficiency (LV3)

The low billing efficiency for TANGEDCO is primarily caused due to three independent variables, viz., (i) the Absence of 100% metering in Agriculture, as meters have not been provided to Agricultural service connections, (F13), (ii) Inadequate staff to take the energy meter reading at each billing cycle regularly (F14) and (iii) Non-usage of technological interventions and other measures viz., smart metering, Automated Meter Reading (AMR). The Low

billing efficiency contributes to the high commercial loss to TANGEDCO. The commercial losses significantly contribute to high AT&C losses, as they combine technical and commercial losses.

6.6.4 Construct 4 - Low collection efficiency (LV4)

Low collection efficiency depends upon two independent variables, namely (i) inadequate measures to improve collection efficiency, including immediate disconnection of service in the event of power bills are not paid on time, automatic disconnection of service using smart metering (F16) and (ii) Absence of incentive schemes to employees & Absence of Distribution Franchisee to improve the collection efficiency (F17).

The Low collection efficiency contributes to the commercial losses of TANGEDCO. TANGEDCO has achieved 99% collection efficiency. However, TANGEDCO could improve its collection efficiency by using smart metering, immediate disconnection on non-payment and engaging distribution franchisees.

6.6.5 Construct 5 - The increase in the cost of supply (LV5)

The increase in the cost of supply to TANGEDCO is primarily due to five independent variables viz., (i) High power purchase cost due to an increase in input cost. (F18), (ii) Increase in cost of power generation of Non-Renewable Energy (especially Thermal power) (F19), (iii) Power generating plants of TANGEDCO operating with lower Plant Load Factor (PLF) (F20), (iv) Inability of TANGEDCO to procure cheaper Renewable power from power exchange or short-term power purchase due to Long-term PPA with GENCOs and Independent Power Producers (IPPs) (F21) and (v) Higher interest cost of its loans due to lower credit rating and poor financial performance (F22). The increase in the Average Cost of Supply (ACS) results in a higher gap between ACS and ARR and higher commercial loss to TANGEDCO.

6.6.6 Construct 6 - Non-cost reflective tariff (LV6)

The research finds that the tariff fixed is not reflecting its cost of power supply and there is a big gap between the average cost of supply (ACS) and the average revenue realised (ARR).

Non-cost reflective tariff for TANGEDCO is primarily caused due to four independent variables viz., (i) Non-revision of tariff upward periodically at regular intervals in line with the cost of supply (F23), (ii) Huge numbers of subsidised power consumers in consumer mix of TANGEDCO (F24), (iii) Irrational Tariff Structure with massive subsidies and cross-subsidies (F25), and (iv) Billing not based on actual power consumed by subsidised consumers, as agricultural consumers are not metered and the state government pays a lower subsidy to TANGEDCO approximately based on installed motor capacity (F26).

The non-cost reflective tariff adopted by TANGEDCO caused huge commercial losses and higher AT&C losses to TANGEDCO. The non-cost reflective tariff is the primary factor attributing to TANGEDCO's continuous substantial loss.

6.6.7 Construct 7 - Higher Tariff Subsidy (LV7)

The research finds that TANGEDCO gives huge subsidies in agriculture and some segments of domestic power consumers, leading to huge financial losses for TANGEDCO.

Higher Tariff Subsidy of TANGEDCO is primarily caused by the five independent variables, namely (i) Poor tariff subsidy policies of the state government viz., Free supply of 100 units of power to all domestic consumers in each billing cycle irrespective of their social and economic status, 100% free supply of power irrespective of the actual power consumption (F27), (ii) Un-targeted tariff subsidy (blanket subsidy given to a particular consumer category irrespective of the economic status of consumers) (F28), (iii) Under-pricing of tariff to some segments of power consumers (agriculture and domestic consumers with sub-optimally lower tariff) (F29), (iv) Free power supply to Agriculture and some segments of domestic consumers (F30) and

(v) Non-release of tariff subsidy directly to targeted consumers by limiting the subsidies only to the eligible and most needy consumers (F31).

Higher tariff subsidies result in a vast revenue shortage arising from the massive gap between ACS and ARR, resulting in substantial commercial losses and higher AT&C losses to TANGEDCO.

6.6.8 Construct 8- Delay in the tariff setting (LV8)

The Delay in the tariff setting by TNERC causes substantial financial losses and huge accumulated regulatory assets to TANGEDCO. The delay in tariff setting by TNERC is primarily due to four independent variables, namely (i) Delay in finalisation and auditing of Annual accounts by TANGEDCO (F33), (ii) Delay in filing tariff petition to TNERC & filing it in incomplete form by TANGEDCO purposefully (F34), (iii) Delay in tariff determination and the issue of tariff order by State Electricity Regulatory Commission (SERC), i.e., TNERC (F35) and (iv) SERC not issuing tariff order based on Suo-motto basis in case of delay in filing of tariff petition by TANGEDCO as per the legal provision in the tariff policy and the Electricity Act, 2003 (F36).

The regulatory delay in tariff setting and issue of tariff order by TNERC to TANGEDCO results in lower revenue realisation, substantial financial losses, and huge accumulated regulatory assets.

6.6.9 Construct 9- Building-up of regulatory assets (LV9)

The research study finds that TANGEDCO has huge accumulated regulatory assets.

Building-up of regulatory assets by the SERC is primarily caused due to the four independent variables, namely (i) SERC determines tariff by considering the subsidy receivables from the State Govt. into account, resulting in partial recovery of total cost and building up tariff liability (F37), (ii) Partial approval of the cost incurred by TANGEDCO while determining tariff by SERC (TNERC) (F38), (iii) SERC converting uncovered cost into regulatory assets

instead of increasing the tariff (F40) and (iv) Non-release/delayed release of subsidy by the Government of Tamil Nadu to TANGEDCO (F41).

The massive accumulation of regulatory assets causes substantial financial losses to TANGEDCO due to the under-recovery of cost. Revenue realisation from the vast accumulated regulatory assets of Rs.32,532 crore by TANGEDCO through future tariffs from consumers is very remote. Therefore, adopting a cost-reflective tariff without creating a regulator asset is paramount to achieving the financial viability and sustainability of the power distribution business of TANGEDCO.

6.6.10 Construct 10 - Political intervention (LV10)

The study found that there is a strong political intervention by the state government in the tariff-setting process of the State Electricity Regulatory Commission (SERC).

Political intervention in the tariff-setting process of SERC resulted in substantial financial losses to TANGEDCO. The political intervention by the state government with SERC happens due to the seven independent variables viz., (i) Strong intervention of State Govt. with SERC in tariff fixation (not allowing SERC to fix the cost-reflective tariff) (F42), (ii) Lack of political will and political support for fixing rationale tariff by SERC (F43), (iii) Political parties demanding for free power to agriculture & supply of power at a highly subsidised tariff to various consumer segments, which forces the state government to intervene with SERCs to fix non-cost reflective tariff with higher subsidies (F44), (iv) Politicians do not allow to increase power tariff (F45), (v) Lack of coordination between Central & State Govt. in implementation of power distribution reforms (e.g., Non-acceptance of central government's power sector reform policies by the state government viz., The Electricity Amendment Bill, 2014, 2020, 2021) (F46), (vi) Strong political support to consumers to get free/subsidised power (e.g. supply of free power is in the election manifesto of several political parties to increase their vote Bank) (F47) and (vii) The inability of the State Govt. to withdraw free power

policy for political reasons (politicians fear of losing their votes and forming the next government if the free power supply is withdrawn) (F48).

Due to the solid political intervention in the tariff-setting process of SERC by the state government, the SERC is unable to perform its duties to fix a rational tariff even though it is a quasi-judicial body and SERCs are subservient to the state governments, as the state government is appointing them. Hence, distancing state government intervention with SERCs is of paramount importance to achieve cost-reflective tariff and financial viability of the state-run DISCOMs, including TANGEDCO.

6.6.11 Construct 11- Inefficient Management (LV11)

The research finds that **the inefficient management** of TANGEDCO's power distribution business is primarily caused due to two independent variables, namely (1) Inefficient business operation (F49) and Mismanagement & Corruption (F50).

6.6.12 Construct 12 - Huge debts of TANGEDCO (LV12)

The study finds that **the Huge debt level of TANGEDCO** is caused primarily due to three independent variables, namely (i) The revenue shortfall results in massive defaults by TANGEDCO to the GENCOs (F52), (ii) Delay in receipt of subsidy by TANGEDCO from the State Government (F53) and (iii) High working capital dependence and huge long-term debt for Capital expenditure projects (F54) have necessitated TANGEDCO to borrow heavily, which results in the mounting of its debts, which increases the cost of supply and higher losses.

6.6.13 Construct 13 - Liquidity Problem (LV13)

The liquidity Problem of TANGEDCO is primarily caused due to three independent variables, namely, (i) Huge receivables with a more extended collection period (F55), (ii) Huge payables with longer payable days (F56) and (iii) Huge Overdue in payment of electricity bills by Govt. Dept./Municipalities (F57). The state government is not paying 100%

subsidies to TANGEDCO. Furthermore, the State government is not releasing subsidies in advance, which results in a considerable revenue gap causing a liquidity crunch.

6.7 RELATIONSHIP BETWEEN ENDOGENOUS VARIABLES AND EXOGENOUS VARIABLES FORMING FORMING 4 SECONDS, THIRD AND FOUTH-ORDER CONSTRUCTS

The research finds that sixteen endogenous variables have positive relationships with four, forming four formative constructs, as shown in Table 6.2. The relationships between the endogenous and exogenous variables in each of the constructs are discussed below:

6.7.1 Construct 14 - The gap between ACS and ARR

The research study finds that for TANGEDCO, there is a positive gap between the Average Cost of Supply (ACS) and Average Revenue Realised (ARR). The gap between the ACS and ARR leads to a huge revenue shortage for TANGEDCO. The gap between the ACS and ARR, an Endogenous Variable (EV1), is predominantly caused by the five exogenous variables viz., (i) Increase in cost of supply (LV5), (ii) Non-cost reflective tariff (LV6), (iii) higher tariff subsidies (which given on blanket basis without targeting the neediest consumers) (LV7), (iv) delay in tariff setting process including non-revision of tariff annually (LV8) and (v) building up of regulatory assets (LV9). Table-6.2 illustrates the correlation between exogenous and endogenous variables.

6.7.2 Construct 15 - Commercial loss

The research finds that the commercial losses to TANGEDCO [an Endogenous Variable (EV2)] are caused primarily by three Exogenous Variables viz., (i) Power theft (LV2), (ii) Low billing efficiency (LV3) and (iii) Low collection efficiency (LV4) as shown in Table 6.2.

Table 6.2

The relationship between endogenous variables and exogenous variables

Endogenous variables (EV)	Exogenous variables
ACS-ARR Gap (EV1)	⇐ Increase in cost of supply (LV5)
	⇐ Non-cost reflective tariff (LV6)
	⇐ Tariff subsidy (LV7)
	⇐ Delay in tariff setting (LV8)
	⇐ Building-up of regulatory assets (LV9)
Commercial Loss (EV2)	⇐ Power theft (LV2)
	⇐ Low billing efficiency (LV3)
	⇐ Low collection efficiency (LV4)
AT&C Loss (EV3)	⇐ Technical loss (LV1)
	⇐ Commercial loss (EV2)
TANGEDCO's Financial Loss (EV4)	⇐ AT&C Loss (EV3)
	⇐ ACS-ARR gap (EV1)
	⇐ Political intervention (LV10)
	⇐ Inefficient management (LV11)
	⇐ Huge debts (LV12)
	⇐ Liquidity problem (LV13)

6.7.3 Construct 16 – AT&C Loss:

As per the formula for calculation of the Aggregate Technical and Commercial loss (AT&C loss), Endogenous Variables (EV3) are caused by (i) Technical Loss (LV1) and (ii) commercial loss (EV2), as shown in Table 8.2

6.7.4 Construct 17 - The financial loss of TANGEDCO

The study finds that the sustained financial losses of TANGEDCO, [an endogenous variable (EV4)], is caused by six endogenous variables viz., (i) Higher AT&C losses (EV3), (ii) Huge gap between the ACS and ARR (EV1), (iii) Strong political intervention by the state in the tariff setting process (LV10), (iv) Inefficient management of distribution business by TANGEDCO (LV11), (v) Huge debts of TANGEDCO (LV12) and (vi) Liquidity problem faced by TANGEDCO due to the enormous revenue shortfall (LV13) as shown in Table 6.2.

6.8 CONCLUSION CHAPTER SUMMARY

The research study has determined 56 numbers of independent variables and 17 latent variables, which are causing sustained financial losses to

TANGEDCO. The interrelationship between the independent and latent variables identified from the detailed literature survey and analysis of the secondary data is used to form the 17 formative constructs viz., 13 first-order constructs, two second-order constructs, and one each of third-order and fourth-order constructs.

CHAPTER 7

DEVELOPMENT OF A THEORETICAL MODEL TO DIAGNOSE THE FACTORS CONTRIBUTING TO THE SUSTAINED FINANCIAL LOSSES OF TANGEDCO

7.1 CHAPTER OVERVIEW

This chapter describes the development of 17 constructs based on the 56 independent variables and 17 latent variables determined from the thorough literature survey in Chapter 3. All the 17 constructs developed were formative. The development of a formative construct developed was explained with an illustration. Then it elaborates on the formulation of 13 first-order constructs, two second-order constructs, one third-order construct and one fourth-order construct.

This is followed by a detailed description of how the constructs for the statistical analysis were operationalised. The operationalization of the constructs defines the variables into measurable factors by converting abstract conceptual ideas into measurable observations. The operationalization reduces subjectivity while increasing the reliability of the outcome of the research.

The scales identified from the detailed literature survey in chapter 3 were adapted to form the basis of the conceptual framework (theoretical model) developed to diagnose the factors that significantly contribute to the sustained financial losses of TNAGEDCO. The developed theoretical model for TANGEDCO is Figure 7.3. Based on the paths in the developed theoretical model, 16 hypotheses were formulated to ensure that the developed theoretical model is a fit model to diagnose the factors contributing to the financial losses of TANGEDCO.

7.2 DEVELOPMENT OF CONSTRUCTS

From the extensive literature review in chapter 3 and the detailed analysis of the secondary data collected for the state-run DISCOMs across the country and TANGEDCO in Chapters 4 and 5 respectively, 56 independent variables and 17 latent variables were determined, which were found to contribute to the continuous financial losses of TANGEDCO. Based on these research variables and the relationship between the independent and latent variables, 17 formative constructs were developed, which are explained in detail below. The formulated constructs would form the basis for the development of the conceptual framework (theoretical model) for diagnosing the factors significantly contributing to the sustained financial losses of TANGEDCO.

7.2.1 Development of 17 constructs based on the 56 identified independent variables and 17 latent variables and the relationship between them

7.2.1 Formative constructs

From the extensive literature review and analysis of the secondary data, this study has found that 56 numbers of independent variables have caused the 13 nos. of latent variables. Based on the relationship between the independent variables and the latent variables, 17 formative constructs were developed.

If the independent variables cause the latent variables, the construct formed is called the *Formative construct.*

7.2.2 Illustration of a formative construct developed

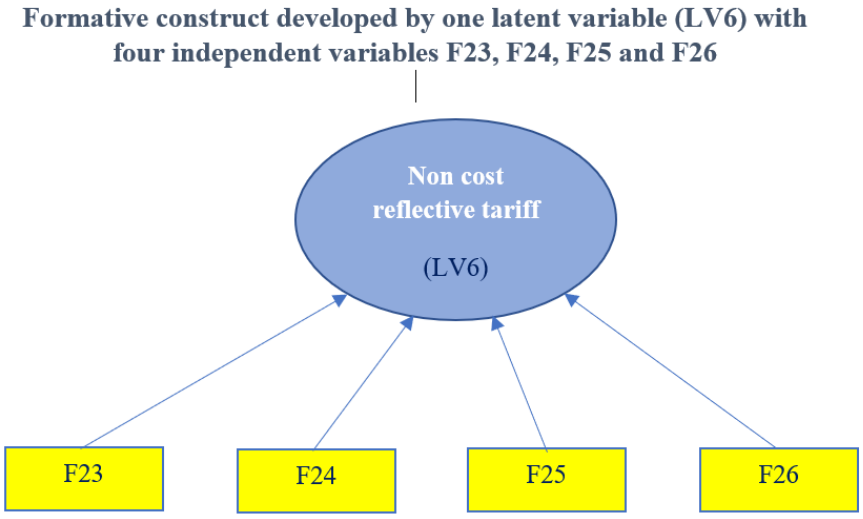
For example, the latent variable, namely Non-Cost reflective tariff (LV6), is caused due to following four independent variables:

1) Non-revision of upward revision of tariff periodically at regular intervals in consonance with the cost of supply (F23);
2) Huge nos. of subsidized power consumers in the consumer mix of TANGEDCO (F24);
3) Irrational Tariff Structure (F25); and
4) Billing is not based on subsidised consumers' actual power (F26).

The relationship of the latent variable viz., Non-Cost reflective tariff with the above four independent variables F23, F24, F25 and F26 is forming one construct as shown in Figure 7.1.

In the formative construct, the indicator variables (independent variables) cause the latent dependent variables. Thus, the arrows emerging from all four independent variables end at the Latent variable LV6, as shown in Figure 7.1

Figure 7.1



F23 - Non-revision of upward revision of tariff periodically at regular interval in consonance with the cost of supply.
F24 - Huge nos. of subsidized power consumers in consumer mix of TANGEDCO.
F25 - Irrational Tariff Structure.
F26 - Billing not based on actual power consumed by subsidized consumers.

Note: The independent variables cause the dependent latent variable in formative construct.

7.3 DEVELOPMENT OF 13 FIRST-ORDER CONSTRUCTS BASED ON THE INTERRELATIONSHIP BETWEEN THE INDEPENDENT VARIABLES AND LATENT VARIABLES

The study discovered that a set of independent variables caused each of the 13 latent variables, namely technical loss (LV1), power theft (LV2), inefficient billing (LV3), inefficient collection (LV4), increase in the cost of supply (LV5), non-cost reflective tariff (LV6), tariff subsidy (LV7), delay in tariff setting (LV8), the build-up of regulatory assets (LV9), political intervention in the SERC tariff setting process (LV10), inefficient management of DISCOM (LV11) and liquidity problem (LV13), forming 13 first-order constructs.

13 constructs have been generated based on the relationships between 13 Latent Variables (LV1 to LV13) and 56 Independent Variables (F1 to F57). Each of the 13 latent variables has a positive correlation with a set of independent variables, as shown in Table 7.2

As a result, one formative construct each has been generated based on the correlations between the latent variable and a set of independent variables, as illustrated in Figure 7.2. Each latent variable (LV1 to LV13) forms a construct with independent variables, forming 13 first-order constructs. Accordingly, based on the established relationship of the 13 latent variables with 56 independent variables, *13 First order formative constructs have been developed* as shown in Table 7.1

Table 7.1

Development of 13 first-order formative constructs based on the relationship between the 56 independent variables and 13 latent variables contributing significantly to the financial losses of TANGEDCO

Latent Variable (LV)		Independent Variables (IV)	
Technical loss (LV1)	⇦	F1	Overloading of Distribution Transformers and its failure
	⇦	F2	Inferior quality of electrical equipment
	⇦	F3	Faults in critical electrical equipment and energy meters
	⇦	F4	Failure of critical electrical equipment and delay in rectification
	⇦	F5	Inadequate Operation & Maintenance of critical equipment
	⇦	F6	Lengthy LT lines with a high LT/HT ratio
	⇦	F7	Non-implementation of High Voltage Distribution (HVDS) Scheme
	⇦	F8	Non-implementation of the Feeder Segregation Program
Power theft (LV2)	⇦	F9	Power theft by consumers by bypassing energy meters.
	⇦	F10	Involvement of TANGEDCO Officials in power theft
	⇦	F11	Inadequate theft control measures
	⇦	F12	Non-implementation of Smart metering & Aerial Bunched cabling
	⇦	F13	Absence of 100% metering in Agriculture

Low billing efficiency (LV3)	⇦	F14	Inadequate staff to take the energy meter reading at regular intervals
	⇦	F15	Non-usage of Technological interventions and other measures
Low Collection Efficiency (LV4)	⇦	F16	Inadequate measures to improve collection efficiency
	⇦	F17	Absence of incentive schemes to employees & Absence of Distribution Franchisee
Increase in cost of supply (LV5)	⇦	F18	High power purchase cost due to increase in input cost
	⇦	F19	Increase in cost of power generation of Non-Renewable Energy
	⇦	F20	Power-generating plants operating with lower Plant Load Factor (PLF)
	⇦	F21	The inability of TANGEDCO to procure cheaper Renewable power due to Long-term PPA with GENCOs/IPPs
	⇦	F22	High-interest costs for the loans
Non-Cost reflective tariff (LV6)	⇦	F23	Non-revision of tariff upward periodically at regular intervals in line with the cost of supply
	⇦	F24	Huge nos. of subsidised power consumers in the consumer mix of TANGEDCO
	⇦	F25	Irrational tariff structure
	⇦	F26	Billing is not based on actual power consumed by subsidised consumers
Tariff subsidy (LV7)	⇦	F27	Poor tariff subsidy policies
	⇦	F28	Un-targeted tariff subsidy
	⇦	F29	Under-pricing of tariff to some segments of power consumers
	⇦	F30	Free power supply to Agriculture and some segments of domestic consumers
	⇦	F31	Non-release of tariff subsidy directly to targeted consumers
Delay in tariff setting (LV8)	⇦	F33	Delay in finalisation and auditing of Annual accounts by TANGEDCO
	⇦	F34	Delay in filing tariff proposal & filing it in incomplete form by TANGEDCO
	⇦	F35	Delay in tariff determination and issue of tariff order by State Electricity Regulatory Commission (SERC)
	⇦	F36	SERC not issuing tariff order based on Suo-motto basis in case of inordinate delay in filing tariff petition by TANGEDCO
Building-up of	⇦	F37	Tariffs determined by considering the subsidy receivables from the State Govt.
	⇦	F38	Partial approval of cost in tariff by SERC (TNERC)

regulatory assets (LV9)	⇦	F39	SERC converting uncovered costs into Regulatory assets
	⇦	F40	Non-release/delayed release of subsidy by States
Political intervention (LV10)	⇦	F41	The strong intervention of the State Govt. with SERC in tariff fixation
	⇦	F42	Lack of political will and political support for fixing rationale tariff
	⇦	F43	Political parties demand free power for Agriculture & subsidised power for some consumer segments
	⇦	F44	State Govt. not agreeing to transfer subsidy directly to the targeted beneficiaries
	⇦	F45	Political sensitivity to increase power tariff
	⇦	F46	Lack of coordination between Central & State Govt. in the implementation of power distribution reforms
	⇦	F47	Strong political support to consumers for their demand for free/subsidised power
	⇦	F48	State Govt. unable to withdraw free power policy
Inefficient management (LV11)	⇦	F49	Inefficiency in business operation
	⇦	F50	Mismanagement & Corruption
	⇦	F51	Inefficiencies in billing and revenue collection
Huge debts (LV12)	⇦	F52	Huge payables to power GENCOs
	⇦	F53	Delay in receipt of subsidy from the State Govt.
	⇦	F54	High working capital dependence and huge long-term debt for Capital expenditure projects
Liquidity problem (LV13)	⇦	F55	Huge receivables with a more extended collection period
	⇦	F56	Huge payables with longer payable days
	⇦	F57	Massive Overdue in payment of electricity bills by Govt. Dept./Municipalities

Note: 56 numbers of independent variables were identified. F32 was not considered.

7.4 DEVELOPMENT OF 4 SECOND, THIRD AND FOURTH-ORDER CONSTRUCTS

7.4.1 Development of two second-order constructs

The research finds that the constructs have interrelationships amongst them, based on which second, third and fourth-order constructs were developed, which are explained in detail below:

(i) ACS-ARR Gap- Second-order construct

Based on theoretical support and analysis of the secondary data collected for the research, this research study concludes that the gap between the average cost of supply (ACS) and the average revenue realised (ARR) pertains to TANGEDCO (an Endogenous Variable EV1) primarily caused by five exogenous variables, namely (i) an increase in the cost of supply of electricity (LV5), (ii) Non-cost reflective tariff (LV6), (iii) tariff subsidy (LV7), (iv) delay in tariff setting (LV8), and (v) the accumulation of regulatory assets (LV9), as illustrated in Table 7.2

(ii) Commercial loss - Second-order construct

Similarly, based on the relationship established from the literature review and analysis of the secondary data, the study found that three Exogenous Variables viz., (i) Power theft (LV2), (ii) Low billing efficiency (LV3) and (iii) Low collection efficiency (LV4) primarily causes the Commercial loss of TANGEDCO (EV2), an Endogenic Variable. Based on this, a second-order formative construct "Commercial loss" is developed as shown in Table 7.2

Table 7.2
Development of second, third and fourth-order constructs

Endogenous Variables (EV)	Exogenous variables
ACS-ARR Gap (EV1) (Second-order construct)	⇦ Increase in cost of supply (LV5)
	⇦ Non-cost reflective tariff (LV6)
	⇦ Tariff subsidy (LV7)
	⇦ Delay in tariff setting (LV8)
	⇦ Building-up of regulatory assets (LV9)
Commercial Loss (EV2) (Second-order construct)	⇦ Power theft (LV2)
	⇦ Low billing efficiency (LV3)
	⇦ Low collection efficiency (LV4)
AT&C Loss (EV3) (Third Order construct)	⇦ Technical loss (LV1)
	⇦ Commercial loss (EV2)
TANGEDCO's Financial Loss (EV4) (Fourth order construct)	⇦ AT&C Loss (EV3)
	⇦ ACS-ARR Gap (EV1)
	⇦ Political intervention (LV10)
	⇦ Inefficient management (LV11)
	⇦ Huge debts (LV12)
	⇦ Liquidity problem (LV13)

7.4.2 Development of third-order construct

Based on the theoretical support and analysis of the secondary data, this research study finds that two Exogenous Variables viz., (i) Technical Loss (LV1), and (ii) Commercial loss (EV2) primarily cause the high AT&C losses of TANGEDCO, an Endogenous Variable (EV3), thus *forming one third-order formative construct viz., "AT&C Losses"* and is shown in Table 7.2.

7.4.3 Development of fourth-order construct

Based on the theoretical support and analysis of the secondary data, this study concluded that six exogenous variables primarily contribute to TANGEDCO's financial losses, an Endogenous Variable (EV4). The study found that six constructs viz., (i) AT&C Loss (EV3), (ii) the gap between the ACS-ARR (EV1), (iii) Political intervention (LV10), (iv) Inefficient Management (LV11), (v) Massive Debts (LV12), and (vi) Liquidity Problem (LV13) primarily causes the sustained financial losses to TANGEDCO, an Endogeneous variable (EV4), *forming one fourth-order construct viz., "Financial Loss to TANGEDCO"*. Accordingly, based on the relationship of the endogenous variable (EV4) with six Exogenous variables viz., EV3, EV1, LV10, LV11, LV12 and LV13, one fourth-order construct has been developed and is shown in Table 7.2.

7.5 OPERATIONALIZATION OF 17 CONSTRUCTS

7.5.1 Operationalization

The process of strictly defining variables into measurable factors and converting abstract conceptual ideas into measurable observations is known as operationalization. The process of operationalisation defines vague concepts and enables them to be empirically and quantitatively measured. We can collect data on processes and phenomena that are not directly observable using operationalization, and we can measure variables consistently across different contexts.

Operationalization demonstrates precise definitions for each variable, which improves the quality of the findings and the robustness of the design. In

quantitative research, it is very important to precisely define the variables to be studied. Operationalization reduces subjectivity while increasing research reliability. In experimental research where interval or ratio measurements are used, scales are clearly and strictly defined.

7.5.2 Operationalization of 17 constructs developed

The scales identified from the detailed literature survey in chapter 3 were adapted to form the basis of the conceptual model developed to diagnose the factors that significantly contribute to the sustained financial losses of TANGEDCO, which comprises 17 constructs. Table 7.3 shows the operationalisation of 17 constructs developed.

Table 7.3

Operationalization of 17 constructs developed to diagnose the factors significantly contributes to the sustained financial losses of TANGEDCO

Sl. No.	Constructs	Operational definition of the constructs	Sources/References
1	**Technical losses (LV-1)**	*Technical losses are primarily caused due to the eight independent variables (IVs) viz.,* (i) Overloading of Distribution Transformers and its failure **(F1),** (ii) Inferior quality of electrical equipment used in the power distribution system **(F2),** (iii) Faults in critical electrical equipment and energy meters **(F3)**, (iv) Failure of essential electrical equipment in the	Adapted from several authors and study reports viz., Ritual Thakur et al (2015) [51]; World Bank Study reports of Indian power sector [60] [61] [62] [63] [72]; Bhattacharyya S.C. (2007) [9]; Govt. of Andhra Pradesh. Report on HVDS (2016) [19]

		distribution system and delay in rectification **(F4)**, (v) Inadequate Operation & Maintenance of crucial equipment including LT and HT lines & distribution transformers **(F5)**, (vi) Higher distribution losses are due to the lengthy LT lines with high LT/HT ratio **(F6)**, (vii) Non-implementation of High Voltage Distribution (HVDS) Scheme **(F7)**, and (viii) Non-implementation of Feeder Segregation Program **(F8)**.	
2	**Power theft (LV2)**	*Power theft is caused due to the four independent variables viz.*, (i) Stealing of power by consumers by bypassing energy meter **(F9)**,	Adapted from several authors and study reports viz., Pradip Chattopadhyay. (2004) [47]; Bhattacharyya S.C. (2007) [9]; Meeta Dasgupta (2013) [24], Tripta Thakur *et al* (2017) [65]; World Bank Study reports of Indian power sector [60] [61]

		(ii) Involvement of DISCOM Officials in power theft [i.e., connivance of employees] **(F10)**, (iii) Inadequate theft control measures adopted by DISCOMs /TANGEDCO **(F11),** and (iv) Non-implementation of technologically innovative measures to control theft viz., Smart metering & Aerial Bunched cabling **(F12).**	[62] [63] [72]; World Research Institute study report on TANGEDCO (2020) [72]
3	**Low billing efficiency (LV3)**	*Low billing efficiency is primarily caused due to three independent variables,* viz., (i) the Absence of 100% metering in Agriculture, as meters have not been provided to Agricultural service connections, **(F13)**, (ii) Inadequate staff to take the energy meter reading at each billing cycle regularly **(F14)**, and (iii) Non-usage of technological interventions and other measures viz., smart metering, Automated Meter	Adapted from World Bank Study reports of the Indian power sector [61] [62] [63]; PFC study reports [42] [43] 44]: Meeta Dasgupta (2013) [24]: Bhattacharyya S.C. (2007)[9]: International Energy Agency Report (2021) [71]

		Reading (AMR) **(F15)**	
4	**Low collection efficiency (LV4)**	***Low collection efficiency is due to the*** *two independent variables*, namely (i) inadequate measures to improve collection efficiency, including immediate disconnection of service in the event of power bills are not paid on time, automatic disconnection of service using smart metering **(F16),** and (ii) Absence of incentive schemes for employees & Absence of Distribution Franchisee to improve the collection efficiency **(F17).**	Adapted from World Bank Study reports of the Indian power sector [61][62][63]; PFC study reports [42][43][44]; Meeta Dasgupta (2013) [24]; Bhattacharyya S.C. (2007)[9]: Tripta Thakur *et al* (2017) [65]; Auroville consulting. (2020) [6]; International Energy Agency Report (2021) [71].
5	**Increase in the cost of supply (LV5)**	*Increase in the cost of supply (LV5) is primarily due to five independent variables viz.*, (i) High power purchase cost due to an increase in input cost. **(F18)**, (ii) Increase in cost of power generation of Non-Renewable Energy (especially Thermal power) **(F19)**, (iii) Power generating plants of TANGEDCO operating	Adapted from several authors and study reports viz., Subhas C. Bhattacharya. (2006)[9] ; Shunglu V.K. (2011)[53]; World Research Institute study report on TANGEDCO (2020); Ajay Nirula. (2019); Auroville consulting. (2020)[6]; International Energy Agency Report (2021)[71]; World Bank Study reports of the Indian power

		with lower Plant Load Factor (PLF) **(F20)**, (iv) Inability of TANGEDCO to procure cheaper Renewable power from power exchange or short-term power purchase due to Long-term PPA with GENCOs and Independent Power Producers (IPPs) **(F21)**, (v) Higher interest cost of its loans due to lower credit rating and poor financial performance **(F22)**.	sector (2013) (2014) (2015) [61][62] [63]; PFC study reports on the performance of the state power utilities (2013-2019)[42][43][44]; Veluchamy A *et al* (2018) [66]
6	**Non-cost reflective tariff (LV6)**	*Non-cost reflective tariff i.e. the tariff fixed does not align with the cost of supply is the result of four independent variables viz.,* (i) Non-revision of tariff upward periodically at regular intervals in line with the cost of supply **(F23)**, (ii) Huge numbers of subsidised power consumers in the consumer mix of TANGEDCO **(F24)**, (iii) Irrational Tariff Structure with massive subsidies and cross-subsidies **(F25)**, and (iv) Billing is not based on actual power consumed by subsidised consumers, as agricultural consumers are not	Adapted from several authors and study reports viz., Bhatia B, Gulati M. (2004). Pradip Chattopadhyay. (2004); Electricity Act, 2003[37]; Pritchard R. (2005) ; Subhas C. Bhattacharya. (2006); National Tariff Policy (2006); Shunglu V.K. (2011)[53]; World Bank Study reports of Indian power sector (2013) (2014) (2015)[61][62][63]; Auroville consulting. (2020)[6]; World Research Institute study report on TANGEDCO (2020)[72]; International Energy Agency report on India

		metered and the state government pays a lower subsidy to TANGEDCO approximately based on installed motor capacity **(F26)**.	Energy Outlook (2021) [71]
7	**Higher tariff subsidy (LV7)**	*Higher Tariff Subsidy of TANGEDCO is primarily caused by the five independent variables*, namely (i) Poor tariff subsidy policies of the state government viz., Free supply of 100 units of power to all domestic consumers in each billing cycle irrespective of their social and economic status, 100% free supply of power irrespective of the actual power consumption **(F27)**, (ii) Un-targeted tariff subsidy (blanket subsidy given to a particular consumer category irrespective of the economic status of consumers) **(F28)**, (iii) Under-pricing of tariff to some segments of power consumers (agriculture and domestic consumers with sub-optimally lower tariff) **(F29)**, (iv) Free power supply to Agriculture and some segments of domestic consumers **(F30)**, and	Adapted from several authors and study reports viz., Pradip Chattopadhyay (2004) [44]; Pritchard R. (2005) [49]; Subhas C. Bhattacharya. (2006) [56]; Pargal S., Banerjee S.G. (2014)[40]; PFC study reports on the performance of the state power utilities (2013-2019) [42][43][44]; World Bank study reports on Indian power sector (2004) (2013) (2014) (2015) [60][61][62][63]; Ajay Nirula (2019) [2]; TNERC order (2020)[58]; India's energy transition report (2020) [20]; International Energy Agency Report (2021) [71]; World Research Institute study report on TANGEDCO (2020)[72].

		(v) Non-release of tariff subsidy directly to targeted consumers by limiting the subsidies only to the eligible and most needy consumers **(F31)**.	
8	**Delay in the tariff setting (LV8)**	*Delay in the tariff setting by the state power regulator is primarily caused by the four independent variables, namely* (i) Delay in finalisation and auditing of Annual accounts by TANGEDCO **(F33)**, (ii) Delay in filing tariff petition to TNERC & filing it in incomplete form by TANGEDCO purposefully **(F34)**, (iii) Delay in tariff determination and the issue of tariff order by the SERC **(F35)**, and (iv) SERC not issuing tariff order based on Suo-motto basis in case of delay in filing of tariff petition by TANGEDCO as per the legal provision in the tariff policy and the Electricity Act, 2003 **(F36)**.	Adapted from several authors and study reports viz., Subhas C. Bhattacharya. (2006) [56]; Bhattacharyya S.C. (2007)[9]; Ministry of Power report on Seventh Integrated Rating for State Power Distribution Utilities (2019)[33]; World Bank study reports on Indian power sector (2013) (2014) (2015) [61][62][63].

9	**Building-up of regulatory assets (LV9)**	*Building-up of regulatory assets by the SERC is primarily caused due to the four independent variables, namely* (i) SERC determines tariff by considering the subsidy receivables from the State Government into account, resulting in partial recovery of total cost and building tariff liability **(F37)**, (ii) Partial approval of the cost incurred by TANGEDCO while determining tariff by SERC (TNERC) **(F38)**, (iii) SERC converting uncovered cost into regulatory assets instead of increasing the tariff **(F40)**, and (iv) Non-release/delayed release of subsidy by the Government of Tamil Nadu to TANGEDCO **(F41)**.	Adapted from several authors and study reports viz., Abraham. (2006)[1]; Subhas C. Bhattacharya. (2006) [56]; Bhattacharyya S.C. (2007)[9]; Shunglu V.K. (2011[53]; World Bank study reports on Indian power sector (2013) (2014) (2015)[61][62][63]; PFC study reports on the performance of the state power utilities (2013-2019)[42][43][44]; Ministry of Power reports on UDAY Scheme (2017)[27]; The Electricity Act 2003 [37]; World Research Institute study report on TANGEDCO (2020)[72]; International Energy Agency report on India Energy Outlook (2021) [71].
10	**Political intervention (LV10)**	Political intervention in the tariff-setting process of SERC resulted in substantial financial losses to TANGEDCO. *The political intervention by the state government with SERC happens due to the seven*	Adapted from several authors and study reports viz., Abraham. (2006)[1]; Subhas C. Bhattacharya. (2006) [56]; Bhattacharyya S.C. (2007)[9]; Shunglu V.K. (2011) [53]; World Bank study reports on

	independent variables viz., (i) Strong intervention of State Govt. with SERC in tariff fixation (not allowing SERC to fix the cost-reflective tariff) **(F42)**, (ii) Lack of political will and political support for fixing rationale tariff by SERC **(F43)**, (iii) Political parties demanding free power to agriculture & supply of power at a highly subsidised tariff to various consumer segments, which forces the state government to intervene with SERCs to fix non-cost reflective tariffs with higher subsidies **(F44)**, (iv) Politicians do not allow to increase in power tariff **(F45)**, (v) Lack of coordination between Central & State Govt. in the implementation of power distribution reforms (e.g., Non-acceptance of central government's power sector reform policies by the state government viz., The Electricity Amendment Bill, 2014, 2020, 2021) **(F46)**,	Indian power sector (2013) (2014) (2015) [61][62][63]; Pargal S., Banerjee S.G. (2014)[40]; Atul Agarwal *et al* (2017)[5]; World Research Institute study report on TANGEDCO (2020) [72]; Veluchamy A *et al* (2020) [69]; International Energy Agency report on India Energy Outlook (2021)[71]; Sustainable Energy Transformation Series Report. (2020) [57].

		(vi) Strong political support to consumers to get free/subsidised power (e.g. supply of free power is in the election manifesto of several political parties to increase their vote Bank) **(F47)**, and (vii) The inability of the State Govt. to withdraw free power policy for political reasons (politicians fear losing their votes and forming the next government if the free power supply is withdrawn) **(F48)**.	
11	**Inefficient management** **(LV11)**	Inefficient management of the power distribution business results in huge financial losses. Inefficient *management is primarily caused to the two independent* variables, namely (1) Inefficient business operation **(F49)**, and (2) Mismanagement & Corruption **(F50)**	Adapted from several authors and study reports viz., Bhatia B, Gulati M. (2004) [8]; Abraham. (2006) [1]; Subhas C. Bhattacharya. (2006) [56]; Bhattacharyya S.C. (2007) [9]; Shunglu V.K. (2011)[53]; World Bank study reports on Indian power sector (2013) (2014) (2015) [61][62][63]; Pargal S., Banerjee S.G. (2014)[40]; Report of NITI AAYOG, Government of India. (2017)[39].

12	**Huge debts of TANGEDCO (LV12)**	*Huge debt level of TANGEDCO results in substantial financial losses to TANGEDCO, which is caused primarily due to three independent variables, namely* (i) The revenue shortfall to TANGEDCO **(F52)**, (ii) Delay in receipt of subsidy by TANGEDCO from the State Government **(F53)**, and (iii) High working capital dependence and huge long-term debt for Capital expenditure projects **(F54)** have necessitated TANGEDCO to borrow heavily, which results in the mounting of its debts.	Adapted from several authors and study reports viz., Abraham. (2006)[1]; Subhas C. Bhattacharya. (2006) [56]; Bhattacharyya S.C. (2007)[9]; Shunglu V.K. (2011)[53]; World Bank study reports on Indian power sector (2013) (2014) (2015) [61][62][63]; Pargal S., Banerjee S.G. (2014) [40]; PFC study reports on the performance of the state power utilities (2013-2019) [42] [43][44]; World Research Institute study report on TANGEDCO (2020) [72].
13	**Liquidity Problem (LV13)**	The liquidity Problem of TANGEDCO is primarily caused due to three independent variables, namely, (i) Huge receivables with a more extended collection period **(F55)**, (ii) Huge payables with longer payable days **(F56)**, and (iii) Huge Overdue in payment of electricity bills by	Adapted from several authors and study reports viz., Shunglu V.K. (2011) [53]; World Bank study reports on Indian power sector (2013) (2014) (2015) [61][62][63]; Pargal S., Banerjee S.G. (2014)[40]; PFC study reports on the performance of the state power utilities (2013-2019)[42][43][44];

		Govt. Dept./Municipalities **(F57)**.	Ministry of Power report (2019) retrieved from https://praapti.in/ [31];
14	**Gap between the ACS & ARR**	The gap between the Average Cost of Supply (ACS) and Average Revenue Realised (ARR) results in huge financial losses for TANGEDCO. *The positive between the ACS and ARR is primarily caused by the four independent variables, namely* (i) Increase in cost of supply **(LV5)**, (ii) Non-cost reflective tariff **(LV6),** (iii) Higher tariff subsidies (which are given on a blanket basis without targeting the neediest consumers) **(LV7)**, (iv) Delay in tariff setting process including non-revision of tariff annually **(LV8)**, and	Adapted from several authors and study reports viz., Subhas C. Bhattacharya. (2006)[56]; Bhattacharyya S.C. (2007)[9]; Shunglu V.K. (2011)[53]; World Bank study reports on Indian power sector (2004) (2013)(2014)(2015)[60][61][62][63]; Pargal S., Banerjee S.G. (2014)[40]; Ministry of Power report on UDAY Scheme for operational and financial turnaround of Power Distribution Companies (2015)[15]; PFC study reports on the performance of the state power utilities (2013-2019)[42][43][44]; Ministry of Power report on Integrated rating of state power utilities (2019)[33]; World Research Institute study report on TANGEDCO (2020)[72]; International Energy Agency report on India

		(v) Building up of regulatory assets **(LV9).**	Energy Outlook (2021)[71].
15	**Commercial losses (EV2)**	*Commercial losses to TANGEDCO [an Endogenous Variable (EV2)] are caused primarily by three Exogenous Variables* viz., (i) Power theft **(LV2),** (ii) Low billing efficiency **(LV3),** and (iii) Low collection efficiency **(LV4)**	Adapted from several authors and study reports viz., Subhas C. Bhattacharya. (2006) [56]; Shunglu V.K. (2011) [53]; World Bank study reports on the Indian power sector (2004)(2013)(2014)(2015) [60][61][62][63]; Pargal S., Banerjee S.G. (2014)[40]; Ministry of Power report on UDAY Scheme for operational and financial turnaround of Power Distribution Companies (2015)[15]; PFC study reports on the performance of the state power utilities (2013-2019) [42][43][44]; Ministry of Power report on Integrated rating of state power utilities (2019) [33]; World Research Institute study report on TANGEDCO (2020) [72]; International Energy Agency report on India Energy Outlook (2021) [71].
16	**AT&C losses**	*The Aggregate Technical and Commercial losses (AT&C) losses occur primarily caused by the two latent*	Adapted from several authors and study reports viz., Subhas C. Bhattacharya. (2006) [56]; Shunglu

	(EV3)	*variables viz.,* (1) Technical losses **(LV1)** (2) Commercial losses **(EV2)**	V.K. (2011) [53]; World Bank study reports on the Indian power sector (2004)(2013)(2014)(2015)[60][61][62][63]; Pargal S., Banerjee S.G. (2014)[40]; Ministry of Power report on UDAY Scheme for operational and financial turnaround of Power Distribution Companies (2015)[15]; PFC study reports on the performance of the state power utilities (2013-2019)[42][43][44]; Ministry of Power report on Integrated rating of state power utilities (2019)[33]; World Research Institute study report on TANGEDCO (2020)[72]; International Energy Agency report on India Energy Outlook (2021)[71].
17	**TANGEDCO's financial losses**	*The huge financial losses to TANGEDCO are primarily caused by the four variables viz.,* **(1)** AT&C losses **(EV3)**	Adapted from several authors and study reports viz., Subhas C. Bhattacharya. (2006) [56]; Shunglu V.K. (2011)[53]; World Bank study reports on the

	(2) The gap between the ACS and ARR **(EV1)** ***(3)*** Political intervention **(LV10)** (4) Inefficient management **(LV11**) (5) Huge debt level **(LV12)** **(6)** Liquidity problem **(LV13)**	Indian power sector (2004)(2013)(2014)(2015) [60][61][62][63] ; Pargal S., Banerjee S.G. (2014)[40]; Ministry of Power report on UDAY Scheme for operational and financial turnaround of Power Distribution Companies (2015) [15]; PFC study reports on the performance of the state power utilities (2013-2019) [42][43][44]; Ministry of Power report on Integrated rating of state power utilities (2019) [33]; World Research Institute study report on TANGEDCO (2020)[72]; International Energy Agency report on India Energy Outlook (2021) [71].

7.6 DEVELOPMENT OF A THEORETICAL MODEL

Conceptual Framework (Theoretical model)

The conceptual model is a logic model that describes the theoretical expectations and predictions and can be thought of as a type of structural model in Structural Equation Modelling. The conceptual model represents the constructs and the relationships.

To achieve research objective 3 (RO3) of redesigning a financially viable business model for TANGEDCO, it is very crucial to identify the factors significantly contributing to the sustained financial losses of TANGDECO.

Based on the 56 identified independent variables and 17 latent variables, 17 constructs developed for TANGEDCO based on the interrelationship between the research variables, a conceptual framework (theoretical model) has been developed to diagnose the factors significantly contributing to the sustained financial losses of TANGEDCO.

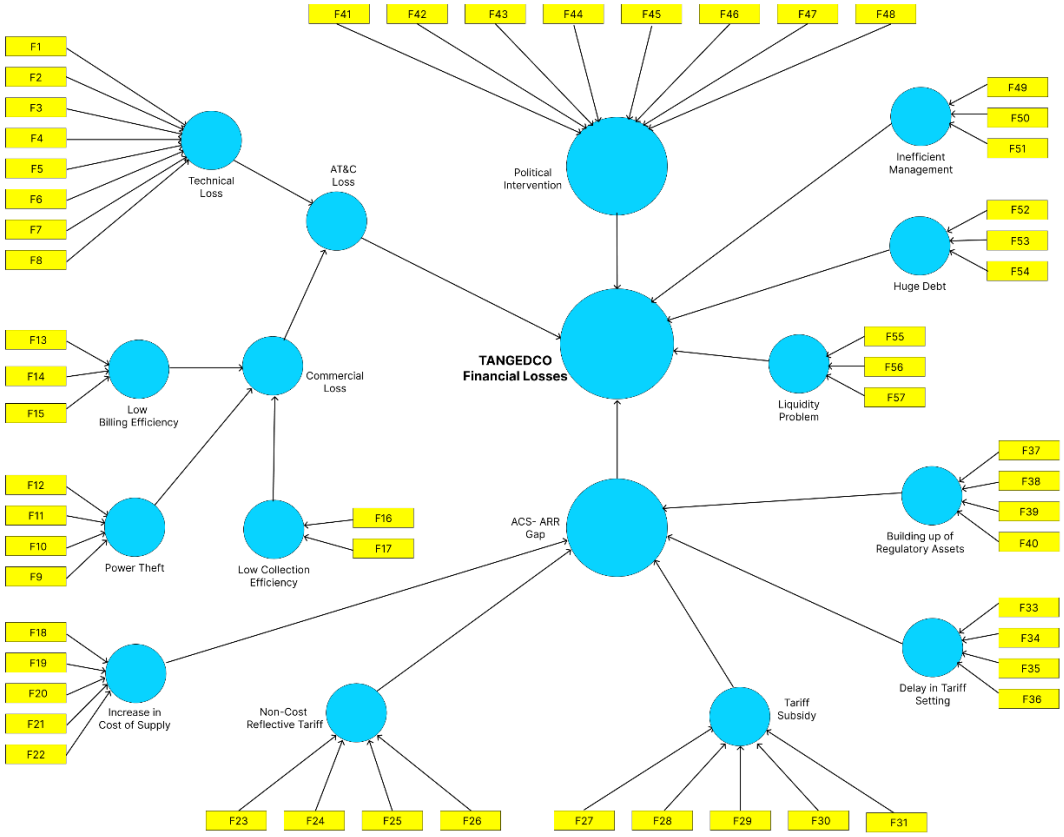
7.7 THE THEORETICAL MODEL DEVELOPED TO DIAGNOSE THE FACTORS CONTRIBUTING TO THE SUSTAINED FINANCIAL LOSSES OF TANGEDCO

Based on the relationships between 56 identified independent variables and 17 latent variables, and 17 constructs developed (13 first-order constructs and two second-order constructs, one third-order construct and one fourth-order master construct), a conceptual framework was developed to diagnose the factors significantly contributing to the sustained financial losses of TANGEDCO.

The final conceptual framework (theoretical model) developed for TANGEDCO to diagnose the factors significantly contributing to its financial losses of TANGEDCO is a complex theoretical model having 17 interlinked formative constructs with 56 independent variables and 16 latent variables. The theoretical model developed for TANGEDCO is shown in Figure 7.2.

Figure 7.2

The Conceptual Framework developed for TANGEDCO for diagonosing the factors contributing to the sustained business losses of TANGEDCO



Interrelationship between the 56 independent variables and 16 latent variables forms 17 formative constructs (13 first order constructs, 2 second order constructs, 1 third order construct, and 1 fourth order construct).

List of 16 Latent (Dependent) Variables:

Technical loss, Power theft, Low billing efficiency, Low collection efficiency, Increase in cost of supply, Non-cost reflective tariff, Tariff subsidy, Delay in tariff setting, Building up of regulatory assets, Political intervention, Inefficient management, Huge debts, Liquidity problems, ACS-ARR gap, Commercial loss, and AT&C loss.

56 Independent variables & 16 latent variables causing sustained financial losses to TANGEDCO

List of 56 Independent Variables

F1 : Overloading of Distribution Transformers and its failure
F2 : Inferior quality of electrical equipment
F3 : Faults in critical electrical equipment and energy meters
F4 : Failure of critical electrical equipment and delay in rectification
F5 : Inadequate Operation & Maintenance of critical equipment
F6 : Lengthy LT lines with high LT/HT ratio
F7 : Non-implementation of High Voltage Distribution (HVDS) Scheme
F8 : Non-implementation of Feeder Segregation Program
F9 : Power theft by consumers by bypassing energy meters.
F10 : Involvement of TANGEDCO Officials in power theft
F11 : Inadequate theft control measures
F12 : Non-implementation of Smart metering & Aerial Bunched cabling
F13 : Absence of 100% metering in Agriculture
F14 : Inadequate staff to take the energy meter reading at regular interval
F15 : Non-usage of Technological interventions and other measures
F16 : Inadequate measures to improve collection efficiency
F17 : Absence of incentive schemes to employees & Absence of Distribution Franchisee
F18 : High power purchase cost due to increase in input cost
F19 : Increase in cost of power generation of Non-Renewable Energy
F20 : Power generating plants operating with lower Plant Load Factor(PLF)
F21 : The inability of TANGEDCO to procure cheaper Renewable power due to Long-term PPA with GENCOs/IPPs
F22 : High-interest costs for the loans
F23 : Non-revision of tariff upward periodically at regular intervals in line with the cost of supply
F24 : Huge nos. of subsidised power consumers in the consumer mix of TANGEDCO
F25 : Irrational tariff structure
F26 : Billing is not based on actual power consumed by subsidised consumers
F27 : Poor tariff subsidy policies
F28 : Un-targeted tariff subsidy
F29 : Under-pricing of tariff to some segments of power consumers
F30 : Free power supply to Agriculture and some segments of domestic consumers
F31 : Non-release of tariff subsidy directly to targeted consumers
F33 : Delay in finalisation and auditing of Annual accounts by TANGEDCO
F34 : Delay in filing tariff proposal & filing it in incomplete form by TANGEDCO
F35 : Delay in tariff determination and issue of tariff order by State Electricity Regulatory Commission (SERC)
F36 : SERC not issuing tariff order based on Suo-motto basis in case of inordinate delay in filing tariff petition by TANGEDCO
F37 : Tariffs determined by considering the subsidy receivables from the State Govt.
F38 : Partial approval of cost in tariff by SERC (TNERC)
F39 : SERC converting uncovered costs into Regulatory assets
F40 : Non-release/delayed release of subsidy by States
F41 : The strong intervention of the State Govt. with SERC in tariff fixation
F42 : Lack of political will and political support for fixing rationale tariff
F43 : Political parties demand free power to Agriculture & subsidised power to some consumer segments
F44 : State Govt. not agreeing to transfer subsidy directly to the targeted beneficiaries
F45 : Political sensitivity to increase power tariff
F46 : Lack of coordination between Central & State Govt. in the implementation of power distribution reforms
F47 : Strong political support to consumers for their demand for free/ subsidised power
F48 : State Govt. unable to withdraw free power policy
F49 : Inefficiency in business operation
F50 : Mismanagement & Corruption
F51 : Inefficiencies in billing and revenue collection
F52 : Huge payables to power GENCOs
F53 : Delay in receipt of subsidy from the State Govt.
F54 : High working capital dependence and huge long-term debt for Capital expenditure projects
F55 : Huge receivables with a more extended collection period
F56 : Huge payables with longer payable days
F57 : Massive Overdue in payment of electricity bills by Govt. Dept./ Municipalities

Note: F32 Not considered

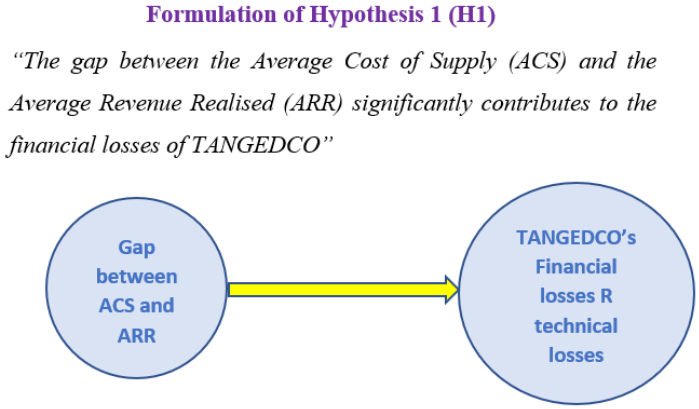
7.8 FORMULATION OF HYPOTHESIS TO ESTABLISH THE RELATIONSHIP BETWEEN CONSTRUCTS

The final conceptual framework (theoretical model) developed for TANGEDCO to diagnose the factors contributing to its financial losses of TANGEDCO is a complex theoretical model having 17 interlinked formative constructs. To ensure the theoretical model developed for TANGEDCO its validity and its acceptance, the predicted relationships between the constructs are to be tested by way of hypothesis.

7.8.1 An illustrative example of the formation of a hypothesis H1

For example, an arrow starting from the construct *'the gap between ACS & ARR"'* ends at *'Financial loss of TANGEDCO'* implies that the gap between the Average Cost of Supply (ACS) and the Average Revenue Realized (ARR) significantly contributes to the financial losses of TANGEDCO.

Figure 7.3



Formulation of Hypothesis 1 (H1) based on the relationship between the constructs (1) the Gap between the ACS and ARR, and (2) Financial losses of TANGEDCO

7.8.2 Formulation of 16 hypotheses

In the conceptual model developed for TANGEDCO (shown in Figure 7.2), it is seen that each construct has an interrelationship, which is shown by the path by an arrow.

Formulation of hypothesis 1 (H1)

Figure 7.4, which is a part of the theoretical model developed for TANGEDCO shows the relationship between the two constructs (1) the Gap between the ACS and ARR, and (2) the Financial losses of TANGEDCO forming another construct. To establish this relationship, the following **alternate hypothesis (H1)** is formulated:

Alternate hypothesis 1 (H1)

"The gap between the Average Cost of Supply (ACS) and the Average Revenue Realised (ARR) significantly contributes to the financial losses of TANGEDCO"

The null hypothesis for H1 is stated as under:

Null Hypothesis

"There is no relationship between the constructs i.e. (1) The gap between the Average Cost of Supply (ACS), and the Average Revenue Realised (ARR) and (2) the financial losses of TANGEDCO"

Table 7.4

Formulation of 16 hypotheses (H1 to H16) based on the predicted relationship between the constructs shown by the arrow in the paths of the conceptual model developed for TANGEDCO

Path in the construct showing the relationship between the constructs	Alternate hypothesis	Hypothesis no.
ACS-ARR Gap ⇨ TANGEDCO's Financial Loss	The gap between the Average Cost of Supply (ACS) and the Average Revenue Realised (ARR) significantly contributes to the financial losses of TANGEDCO	H1
AT&C Loss ⇨ TANGEDCO's Financial Loss	The Aggregate Technical & Commercial Loss (AT&C loss) significantly contributes to the financial losses of TANGEDCO.	H2
Building-up of Regulatory Assets ⇨ ACS-ARR Gap	Building up of the regulatory assets significantly contributes to an increase in the gap between the Average Cost of Supply (ACS) and the Average Revenue Realised (ARR)	H3

Commercial Loss ⇨ AT&C Loss	Commercial losses significantly contribute to the AT&C losses of TANGEDCO	H4
Delay in Tariff setting ⇨ ACS-ARR Gap	Dealy in tariff setting increases the gap between the Average Cost of Supply (ACS) and the Average Revenue Realised (ARR)	H5
Huge debt ⇨TANGEDCO's Financial loss	The huge debt owed by TANGEDCO significantly contributes to its financial losses of TANGEDCO.	H6
Increase in cost of supply ⇨ ACS-ARR Gap	An increase in the average cost of supply significantly contributes to the gap between the Average Cost of Supply (ACS) and the Average Revenue Realised (ARR)	H7
Inefficient management ⇨ TANGEDCO's Financial loss	Inefficient management significantly contributes to the financial losses of TANGEDCO	H8
Liquidity Problem ⇨ TANGEDCO's Financial loss	The liquidity problem of TANGEDCO significantly contributes to its financial losses of TANGEDCO	H9
Low Billing Efficiency ⇨ Commercial Loss	Low billing efficiency significantly contributes to the commercial losses of TANGEDCO	H10
Low Collection Efficiency ⇨ Commercial Loss	Low collection efficiency significantly contributes to the commercial losses of TANGEDCO	H11
Non-Cost Reflective Tariff ⇨ ACS-ARR Gap	Non-cost Reflective tariff significantly contributes to an increase in the gap between the Average Cost of Supply (ACS) and the Average Revenue Realised (ARR)	H12
Political Intervention ⇨ TANGEDCO Financial loss	Political intervention (State Government's intervention) in tariff setting process of TNERC significantly contributes to the financial losses of TANGEDCO	H13
Power Theft ⇨ Commercial Loss	Power theft significantly contributes to commercial losses of TANGEDCO	H14
Tariff Subsidy ⇨ ACS-ARR Gap	The high level of tariff subsidies significantly contributes to an increase in the gap between the Average Cost of Supply (ACS) and the Average Revenue Realised (ARR) to TANGEDCO	H15
Technical loss ⇨ AT&C Loss	The technical losses significantly contribute to the AT&C losses of TANGEDCO	H16

The other 15 alternate hypotheses developed to establish the relationship between the constructs as shown by the arrow in the path of the constructs in Figure 7.2 and Table 7..4 are as under:

Hypothesis 2 (H2)

"The Aggregate Technical & Commercial Loss (AT&C loss) significantly contributes to the financial losses of TANGEDCO"

Hypothesis 3 (H3)

"Building up of the regulatory assets significantly contributes to an increase in the gap between the Average Cost of Supply (ACS) and the Average Revenue Realised (ARR)"

Hypothesis 4 (H4)

"Commercial losses significantly contribute to the AT&C losses of TANGEDCO"

Hypothesis 5 (H5)

"Dealy in tariff setting increases the gap between the Average Cost of Supply (ACS) and the Average Revenue Realised (ARR)"

Hypothesis 6 (H6)

"The huge debt owed by TANGEDCO significantly contributes to its financial losses of TANGEDCO".

Hypothesis 7 (H7)

"An increase in the average cost of supply significantly contributes to the gap between the Average Cost of Supply (ACS) and the Average Revenue Realised (ARR)"

Hypothesis 8 (H8)

"Inefficient management significantly contributes to the financial losses of TANGEDCO"

Hypothesis 9 (H9)

"The liquidity problem of TANGEDCO significantly contributes to its financial losses of TANGEDCO"

Hypothesis 10 (H10)

"Low billing efficiency significantly contributes to the commercial losses of TANGEDCO"

Hypothesis 11 (H11)

"Low collection efficiency significantly contributes to the commercial losses of TANGEDCO"

Hypothesis 12 (H12)

"Non-cost Reflective tariff significantly contributes to an increase in the gap between the Average Cost of Supply (ACS) and the Average Revenue Realised (ARR)"

Hypothesis 13 (H13)

"Political intervention (State Government's intervention) in tariff setting process of TNERC significantly contributes to the financial losses of TANGEDCO"

Hypothesis 14 (H14)

"Power theft significantly contributes to commercial losses of TANGEDCO"

Hypothesis 15 (H15)

"High level of tariff subsidies significantly contributes to an increase in the gap between the Average Cost of Supply (ACS) and the Average Revenue Realised (ARR) to TANGEDCO"

Hypothesis 16 (H16)

"The technical losses significantly contribute to the AT&C losses of TANGEDCO"

The above 16 formulated hypotheses were tested by Partial Least Square-Structural Equation Modelling using SmartPLS-3 software. Chapter 20 discusses the evaluation of the measurement and structural models developed for TANGEDCO, including hypothesis testing.

7.9 Chapter summary

Based on the relationships between 56 identified independent variables and 17 latent variables, and 17 constructs developed (13 first-order constructs and two second-order constructs, one third-order construct and one fourth-order master construct), a conceptual framework was developed to diagnose the factors significantly contributing to the sustained financial losses of TANGEDCO. The operationalization of 17 constructs developed to diagnose the factors significantly contributes to the sustained financial losses of TANGEDCO is shown in Table 7.2.

The theoretical model developed for TANGEDCO is a complex theoretical model having 17 interlinked formative constructs with 56 independent variables and 17 latent variables. The theoretical model developed for TANGEDCO is shown in Figure 7.2. To ensure the validity and acceptance of the developed theoretical model for TANGEDCO, based on the relationship between the constructs 16 hypotheses were formulated for testing the hypothesis as shown in Table 7.4.

CHAPTER 8

EVALUATION OF THE THEORETICAL MODEL DEVELOPED FOR TANGEDCO USING STRUCTURAL EQUATION MODELLING

CHAPTER OVERVIEW

In this chapter, to ensure the theoretical model developed for diagnosing the factors significantly contributing to the sustained financial losses of TANGEDCO is a valid and acceptable model, the theoretical model is evaluated using Partial Least Square Structural Equation Modeling (PLS-SEM) by using SmartPL-3 software. First, the measurement model is evaluated. And then, the structural model is evaluated. Convergent validity (Average Variance Explained (AVE), Construct Reliability (Cronbach's Alpha), and Composite Reliability (CR) of the measured constructs were estimated to test the measurement model of TANGEDCO has acceptable convergent validity and reliability.

Then, the structural model is evaluated by Bootstrapping technique by resampling method to evaluate the research model's fitness and acceptance. 't' statistics and path coefficient ('p' values) are calculated for acceptance of the conceptual model and establish that the conceptual model developed is a fit model. Then predictive accuracy of the developed theoretical model is measured by the Squared Multiple Correlation (R^2). The effect size (f^2) is estimated to evaluate whether a latent predictor variable has a small, moderate, or large effect. The collinearity statistics (VIF) are evaluated for accepting the theoretical model.

Finally, hypothesis testing is done for evaluating the 16 hypotheses formulated to confirm that the hypothesis formulated for all the 16 paths, i.e., H1 to H16, has been supported.

8.1 ANALYSIS OF THEORETICAL MODEL DEVELOPED FOR TANGEDCO USING PARTIAL LEAST SQUARE-STRUCTURAL EQUATION MODELLING (PLS-SEM)

The following statistical analytical techniques are frequently used to determine the relationship between a set of variables:

1. Factor analysis
2. Path Analysis
3. Multiple regression analysis
4. Structural Equation Modeling (SEM) – Covariance Based
5. Partial Least Square Structural Equation Modelling (PLS-SEM)

For evaluation of the structural model developed for TANGEDCO, PLS-SEM is used in this research.

8.1.1 Partial lease square structural equation modelling

"Partial least square structural equation modelling (PLS-SEM) is a variance-based SEM technique used to evaluate composite path models. PLS-SEM is an expressly approximate approach that provides only large consistency. PLS does not assume normal distributions. It is built on the principle that all observed measure variance is useful (James Gaskin)" [21].

IBM-SPSS software was used to analyze the primary data. The primary data collected is found to follow the **non-normal distribution.** Further, the conceptual model developed is a complex model with 56 measured variables (indicators), and 17 latent variables forming **17 Formative constructs** (indicators cause construct), as shown in Figure 7.2.

8.1.2 Formative Vs reflective construct

"A formative construct is a numerical representation of the weighted sum of variables. The indicator variables (independent variable) cause the construct in a formative construct, whereas the latent variable causes the indicator variables in a reflective construct. Conceptually, a reflective model happens when that construct causes a construct's indicators."

Latent constructs are quantified and estimated using factor analysis, thereby excluding any causal relationship between latent constructs. While covariance-based SEM measures reflective constructs, *latent constructs can be evaluated formatively or reflectively using PLS-SEM.*

8.1.3 Reasons for using PLS-SEM for the evaluation of the developed model

"PLS-SEM is a frequently utilized technique in management research for analyzing complex structural models with non-normally distributed data and formative constructs." "The partial least square method has a significant benefit over covariance-based SEMs, as it needs fewer data points to estimate loadings accurately. The Covariance-based SEMs require ten times the number of parameters or variables in the model. *(James Gaskin)"* *[21].*

"PLS can handle much more complex models than Structural Equation Modelling based on covariance (CB-SEM). PLS can handle formative models, whereas CB-SEM cannot. PLS focuses on prediction, whereas CB-SEM focuses on shared variance. Prediction (data reproduction) is considered more critical than parameter estimation. Structural Equation models can be tested and falsified, while PLS models, like regression models, cannot. PLS models do not have a Degree of Freedom (DF)." *(James Gaskin)* *[21]*

"PLS does not presume any distributional form of measured variables. PLS is distribution-free; hence, suitable for data from non-normal or unknown distributions. In the G&S article/replication study, most measurement items are perception-based and measured on a Likert scale. They are of unknown distribution, and since normality cannot be demonstrated, PLS-SEM was considered preferable to covariance-based SEM." *(James Gaskin)* *[21]*

Measurement model and structural model

Structural Equation Modeling (SEM) has the unique ability to separate structural models from measurement models. The measurement models describe aspects of the operationalization's reliability and validity, whereas the

structural models are solely concerned with the constructs (the latent variables) and their associations. Thus, measurement models describe a study's operational layer, whereas structural models describe the study's theoretical layer. We can inspect the structural model once we are convinced that the operationalization is valid.

8.2 EVALUATION OF THE MEASUREMENT MODEL

Measurement model

The measurement models describe aspects of the reliability and validity of the operationalization. Thus, the measurement models describe the operational layer of a study.

The conceptual model developed for TANGEDCO has been evaluated using SmartPL-3 software. **Convergent validity** (Average Variance Explained (AVE), **Construct Reliability** (Cronbach's Alpha), and **Composite Reliability** (CR) were estimated. The values of AVE, CA and CR are shown in Table 8.1

8.2.1 Convergent validity

"Internal consistency is determined using convergent validity. Convergent validity is used to evaluate internal consistency. It is estimated that the items assumed to measure each latent variable measure that latent variable and not another latent variable". Two tests viz., (i) **Cronbach's Alpha (CA) and Composite Reliability (CR)** and **(ii) Convergent Validity,** are used in this research to estimate the convergent validity of the measured constructs."

8.2.2 Reliability analysis and convergent validity analysis

The composite Reliability method is superior

"Composite Reliability (CR) outperforms Cronbach's Alpha as a measure of internal consistency. However, Cronbach's Alpha frequently underestimates the internal consistency reliability of latent variables in PLS models; it is more appropriate to use a different measure – the composite reliability. Cronbach's

Alpha, on the other hand, weights all items equally regardless of their factor loadings *(Werts, Linn, & Joreskog, 1974)."*

Table 8.1

Evaluation of Measurement Model
Assessment of reliability and convergent validity

Latent Variables	Independent variables	Mean Value	Standard Deviation	Convergent Validity	Construct Reliability	
				Average Variance Extracted (AVE)	Cronbach's Alpha (CA)	Composite Reliability (CR)
Technical loss	F1	3.77	1.039	0.417	0.685	0.641
	F2	3.25	1.074			
	F3	3.38	1.093			
	F4	3.62	0.999			
	F5	3.72	1.012			
	F6	3.97	0.878			
	F7	3.63	0.904			
	F8	3.48	1.099			
Power theft	F9	4.12	0.795	0.650	0.682	0.806
	F10	3.57	0.961			
	F11	3.90	0.898			
	F12	3.91	0.870			
Low billing efficiency	F13	3.98	0.901	0.814	0.501	0.902
	F14	3.30	1.018			
	F15	4.23	0.727			
Low collection efficiency	F16	3.80	1.032	0.850	0.548	0.902
	F17	3.66	0.929			
Increase in cost of supply	F18	3.95	0.929	0.528	0.639	0.724
	F19	3.53	1.003			
	F20	3.87	0.874			
	F21	3.88	0.915			
	F22	4.03	0.831			
Non-cost reflective tariff	F23	4.01	1.021	0.642	0.702	0.801
	F24	3.87	0.948			
	F25	3.79	0.948			
	F26	4.02	0.902			
Tariff subsidy	F27	3.77	0.878	0.56	0.821	0.748
	F28	3.89	0.905			
	F29	3.84	0.914			

Delay in tariff setting	F30	3.94	0.914	0.540	0.641	0.735
	F31	3.97	0.799			
	F32	3.56	0.961			
	F33	3.64	0.910			
	F34	3.47	0.955			
	F35	4.09	0.812			
Building-up of regulatory assets	F36	3.75	0.758	0.428	0.764	0.654
	F37	3.73	0.752			
	F38	3.87	0.746			
	F39	4.05	0.683			
Political intervention	F40	4.08	0.834	0.521	0.772	0.719
	F41	4. 25	0.803			
	F42	4.13	0.884			
Inefficient management	F43	3.89	0.857	0.642	0.699	0.801
	F44	3.66	0.949			
	F45	3.67	0.989			
	F46	4.04	0.958			
	F47	3.89	1.043			
	F48	3.68	0.978			
	F49	3.99	0.894			
Huge debt	F50	3.56	1.019	0.513	0.743	0.716
	F51	3.98	0.692			
	F52	4.05	0.742			
Liquidity problem	F53	3.86	0.698	0.542	0.680	0.736
	F54	3.96	0.724			
	F55	3.99	0.684			
	F56	4.20	0.767			

8.2.3 Results of composite reliability and Cronbach's alpha

"*Nunnally [1978]* recommends a benchmark of 0.7 for 'modest' Composite Reliability for both Composite Reliability and Cronbach's Alpha". "Cronbach's Alpha (CA) value of 0.6 is recommended by *Churchill (1979).*" Cronbach's Alpha (CA), Composite Reliability (CR), and Convergent validity [Average Variance Extracted (AVE)] values for the theoretical model developed for TANGEDCO are listed in Table 8.1.

All constructs have Composite Reliability values greater than 0.641. As a result, the conceptual model developed for TANGEDCO is acceptable. Furthermore, the Convergent validity (AVE) values were within the benchmark value for all the constructs. **Therefore, the measurement model of TANGEDCO has acceptable convergent validity and reliability.**

8.3 MODEL VALIDATION: ANALYSIS OF THE STRUCTURAL MODEL USING STRUCTURAL EQUATION MODELLING

8.3.1 Model validation by bootstrapping ('t' Statistics)

Bootstrapping technique

"Bootstrapping and Jack-knifing estimate the variability of that statistic between sub-samples instead of making parametric assumptions. (Chin et al., 1998). Bootstrapping is a flexible technique that can be used to assess any statistical distribution for any distribution *(Jack et al.)."*

Regression Analysis or bootstrap methods

In regression analysis or (bootstrap methods), the reliability and validity of each operationalization, as applied in the present sample, are inspected. If each operationalization is sufficiently valid, we may consider the associated data series as valid proxies for the associated target constructs.

Model validation by a resampling method

The structural model was validated by determining the significance of the 't' values of the paths by employing resampling methodology using bootstrapping technique. TANGEDCO's structural model was validated using the bootstrapping method in PLS-SEM with the Smart PLS3 software. Results of t-statistics, path coefficient, model's predictive accuracy '$R^{2'}$ and effect strength '$f^{2'}$ were obtained. In the evaluation, *it is found that interrelationships exist between the independent variables in the structural model.* The latent variable was validated to determine whether the model's predicted values are likely to predict future sample responses accurately.

The calculated ‘t’ values for all the paths in the theoretical model developed for TANGEDCO are shown in Figure 7.2. ‘t’ values for all the constructs’ paths were estimated using the bootstrapping method in PLS-SEM using SmartPLS3 software. *The absolute for two-tailed ‘T’ statistics for each path in the developed constructs are above 1.96 with a 95% confidence level, except for the path of F3, F43, and F44 as shown in* Figure 7.2, ***implying that the conceptual model developed for TANGEDCO is valid.***

8.3.2 Model validation by bootstrapping

Path coefficient (‘p’ values)

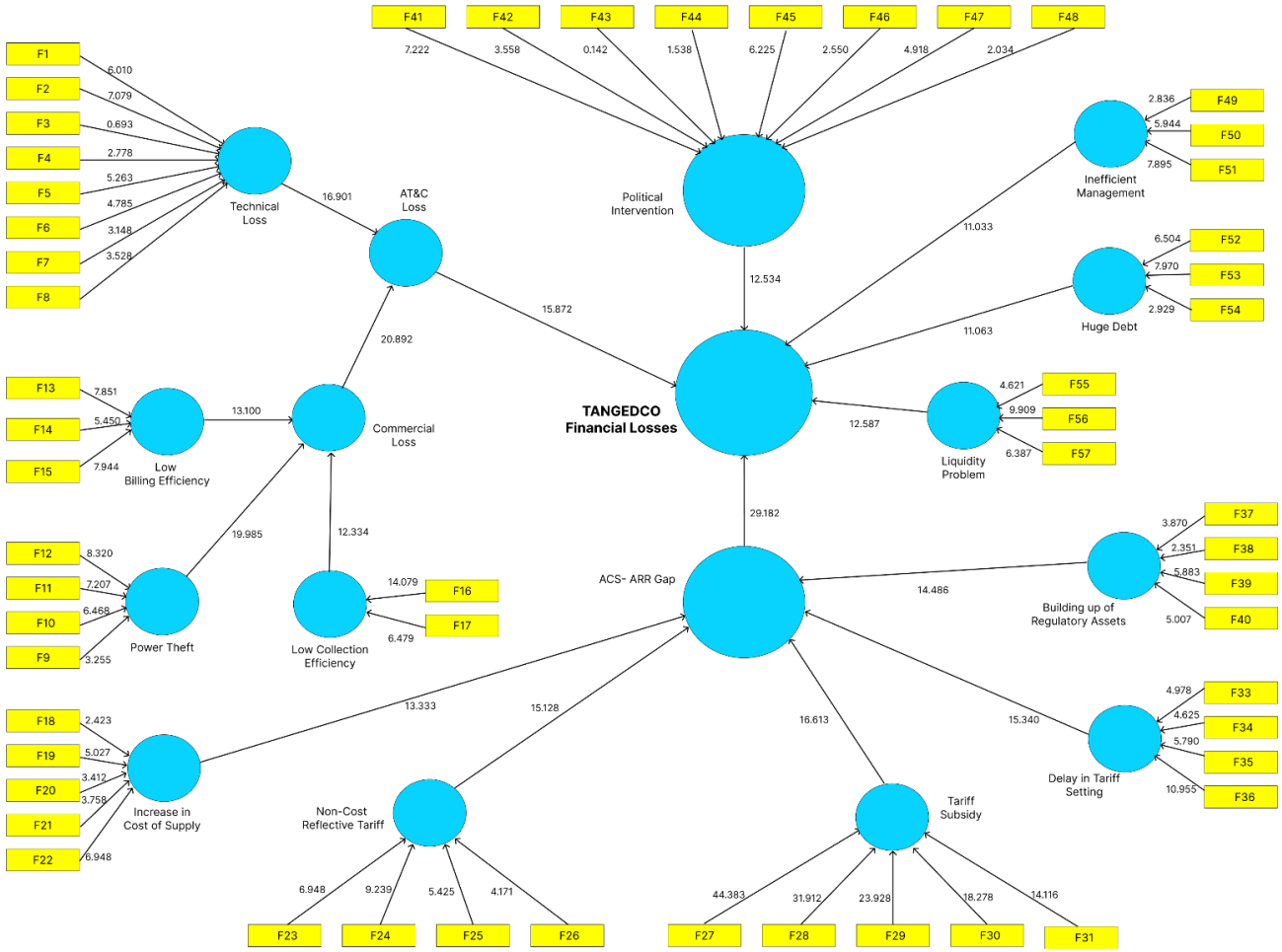
The bootstrapping methodology was used to compute the path coefficient ‘p’ values for all latent variables using PLS-SEM, as illustrated in Figure 10.3. “The strength of the ‘p-value is directly proportional to the sample size. As a result, a bigger sample is required to obtain a stronger ‘p’-value.” [21]. A sample size of 400 was used for the primary data collection. The analysis by a bootstrapping method *found that the* ‘p’ *values of all 16 latent variables (dependent variables) are below 0.001***. Hence, this study concludes that the model developed for TANGEDCO is an acceptable and fit model**.

Figure 8.1

TANGEDCO Structural Model Evaluation using Bootstrapping- 'T' Statistics

Evaluation of Structural Model developed for TANGEDCO

Model Validation using Bootstrapping ('T' Statistics)



Result of Model Evaluation:

'T' Values for all the paths in the constructs has been calculated by Bootstrapping. The absolute for two tailed T statistics for each path in the developed construct are above 1.96 with 95 % confidence level, except for 3 paths viz., F3, F43 and F44.

'p' values of all the 16 Latent Variables (Dependent variables) are below 0.001. Hence, the developed conceptual model for TANGEDCO is an acceptable and fit model.

8.4 EFFECT SIZE (f^2) VALUE TEST TO EVALUATE THE STRUCTURAL MODEL

8.4.1 Effect strength (f^2)

"The effect size (f^2) is estimated for each effect in the path of the constructed model. The effect size (f^2) is defined as the increase in R2 relative to the unexplained variance of the endogenous latent variable. The effect size values of 0.02, 0.15, and 0.35 indicate small, moderate, and large effects, respectively *(Cohen (1988)*. Thus, the effect size can be used to evaluate whether a latent predictor variable has a small, moderate, or large effect."

8.4.2 Test results of the effect strength (f^2)

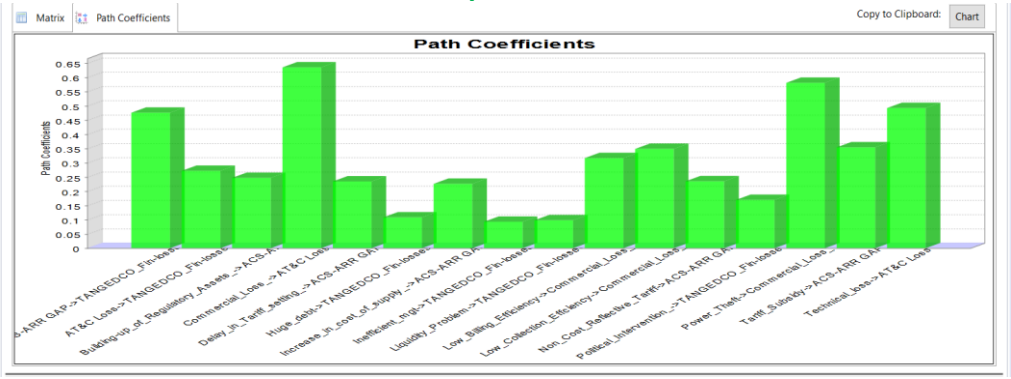
The test result of the effect size f^2 value of sixteen constructs of the theoretical model developed for TANGEDCO is shown in Figure 8.2. *It is found that the f^2 value for all 16 constructs is more than 0.35,* **implying that all the latent variables have a more significant effect in the Structural model developed for TANGEDCO.**

Figure 8.2

Assessment of Structural Model developed for TANGEDCO

Effect Size: f Square for the Structural Model developed

f Square value of all the Latent Variables in the 16 constructs is > 0.35 indicating all the latent variables have a larger effect on the Structural Model developed for TANGEDCO



Note:

Effect size (f Square) can be viewed as a gauge of whether the predictor Latent Variable has a weak, medium or larger effect on the structural model developed.

8.5 EVALUATION OF THE INNER MODEL

8.5.1 Assessment of Structural model: Squared multiple correlations (R^2) for endogenous latent variables

The predictive accuracy of the developed theoretical model is measured by the Squared Multiple Correlation (R^2). "R^2 is used to estimate the degree of variance in the dependent constructs induced by independent constructs, according to *Hair et al.* (2013). For dependent variables, R^2 values of 0.75, 0.50, or 0.25 imply a significant, moderate, or weak coefficient of determination, respectively." "*Chin* (1998) classifies R^2 values of 0.67, 0.33, and 0.19 as substantial, moderate, and weak for endogenous latent variables in the Inner route model."

8.5.2 Results of evaluation of inner model (R^2)

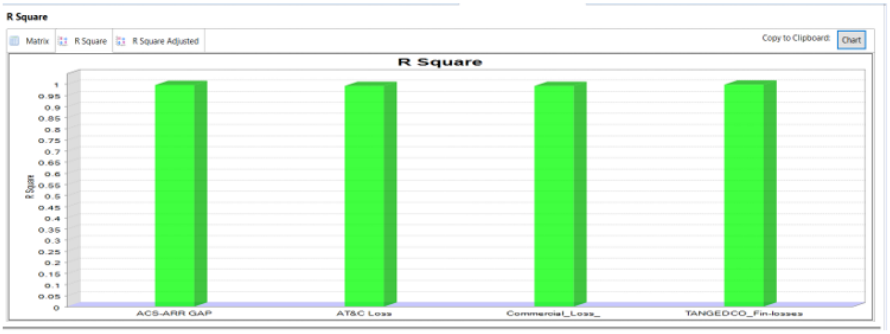
The explanatory power of the model is evaluated using the software viz., SamrtPLS3, by examining the dependent variables' amount of variance. The PLS-SEM method was used to calculate the predictive accuracy (R^2) of all four endogenous variables in relation to the second and third-order constructs in the inner path model for the conceptual model developed for TANGEDCO. The result of the PLS-SEM for the squared multiple regression (R^2) is plotted in Figure 8.3.

Figure 8.3

Assessment of Structural Model developed for TANGEDCO

Squared multiple correlations (R^2) of Endogenous Latent Variables in the 2nd and 3rd Order in the Formative constructs of TANGEDCO Model

R Square value of all the endogenous Latent Variables (Dependent Variables) in the inner path model for 2nd and 3rd Order construct of TANGEDCO model is > 0.67 implying that the explanatory power of the model developed is statistically significant, demonstrating the predictive relevance of the structural model.



Note:
The explanatory power of the structural model evaluated in SmartPLS3 by examining the amount of variance in the dependent variable which can be explained by the model.

R Square values of 0.67, 0.33 and 0.19 for endogenous latent variables in the inner path model are described as substantial, moderate or weak by Chin (1998, p.323).

The R^2 value of each of the four endogenous latent variables (dependent variables), namely (i) the gap between ACS and ARR, (ii) AT&C losses, (iii) Commercial losses and (iv) Financial losses, pertains to the inner model in the second and third-order constructs for the structural model developed for TANGEDCO is more than 0.95 as shown in Figure 8.5 implying **a significant coefficient of determination for the theoretical model developed for TANGEDCO.**

The test result of the inner model, i.e., the R^2 value, confirms that 95% of the variance for the factors significantly contributing to the sustained financial losses of TANGEDCO can be predicted by three latent factors, namely (1) the Gap between ACS and ARR, (2) AT&C Loss and (3) commercial losses.

8.6 COLLINEARITY STATISTICS (VIF) FOR OUTER AND INNER MODEL

For the acceptance of the model, there should not be any collinearity. Collinearity Statistics evaluated the structural model using SmartPLS3 software in Partial Least Square-SEM. The VIF value calculates collinearity Statistics in the SmartPLS3. If the VIF values for the outer and inner model variables are less than 3, there is no multicollinearity. [19]

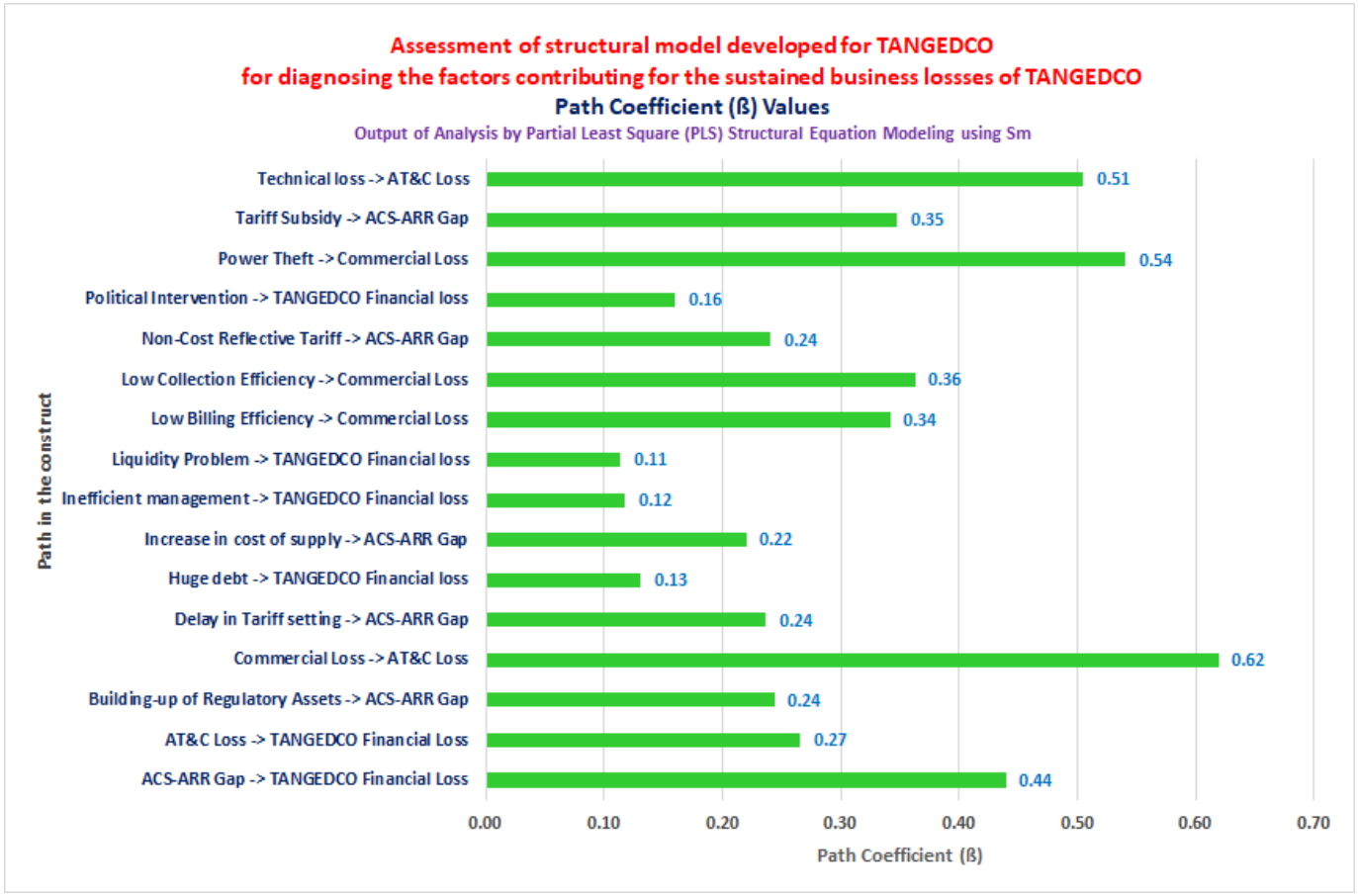
8.6.1 Test result of collinearity statistics (VIF) of TANGEDCO's model

The VIF value of the Outer and Inner Models for all the variables are less than 3, **implying no multicollinearity. Hence, the developed model is acceptable.**

8.7. HYPOTHESIS TESTING

The constructed constructs' path coefficient (ß), 't' values and 'p' were determined to test the sixteen hypotheses formulated. Figure 8.4 illustrates the path coefficient (ß) values for all 16 constructs in the conceptual framework developed for TANGEDCO.

Figure 8.4


Assessment of structural model developed for TANGEDCO
for diagnosing the factors contributing for the sustained business lossses of TANGEDCO
Path Coefficient (ß) Values
Output of Analysis by Partial Least Square (PLS) Structural Equation Modeling using Sm
Path in the construct
Technical loss -> AT&C Loss
Tariff Subsidy -> ACS-ARR Gap
Power Theft -> Commercial Loss
Political Intervention -> TANGEDCO Financial loss
Non-Cost Reflective Tariff -> ACS-ARR Gap
Low Collection Efficiency -> Commercial Loss
Low Billing Efficiency -> Commercial Loss
Liquidity Problem -> TANGEDCO Financial loss
Inefficient management -> TANGEDCO Financial loss
Increase in cost of supply -> ACS-ARR Gap
Huge debt -> TANGEDCO Financial loss
Delay in Tariff setting -> ACS-ARR Gap
Commercial Loss -> AT&C Loss
Building-up of Regulatory Assets -> ACS-ARR Gap
AT&C Loss -> TANGEDCO Financial Loss
ACS-ARR Gap -> TANGEDCO Financial Loss
0.51
0.35
0.54
0.16
0.24
0.36
0.34
0.11
0.12
0.22
0.13
0.24
0.62
0.24
0.27
0.44
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
Path Coefficient (ß)

A larger path coefficient value implies that the predictor latent variable has a stronger influence on the dependent variable.

8.7.1 Hypothesis testing results

Table 8.2

	Hypothesis	path coefficient (ß)	't' value	Results
H1	ACS-ARR Gap ⇨ TANGEDCO Financial Loss	0.440	28.851***	Supported
H2	AT&C Loss ⇨ TANGEDCO Financial Loss	0.266	17.356***	Supported
H3	Building-up of Regulatory Assets ⇨ ACS-ARR Gap	0.244	16.271***	Supported
H4	Commercial Loss ⇨ AT&C Loss	0.619	23.886***	Supported
H5	Delay in Tariff setting ⇨ ACS-ARR Gap	0.237	16.262***	Supported
H6	Huge debt ⇨ TANGEDCO Financial loss	0.131	11.467***	Supported
H7	Increase in cost of supply ⇨ ACS-ARR Gap	0.220	13.794***	Supported
H8	Inefficient management ⇨ TANGEDCO's Financial loss	0.118	12.544***	Supported
H9	Liquidity Problem ⇨ TANGEDCO Financial loss	0.114	13.556***	Supported
H10	Low Billing Efficiency ⇨ Commercial Loss	0.342	17.139***	Supported
H11	Low Collection Efficiency ⇨ Commercial Loss	0.363	14.518***	Supported
H12	Non-Cost Reflective Tariff ⇨ ACS-ARR Gap	0.241	16.925***	Supported
H13	Political Intervention ⇨ TANGEDCO Financial loss	0.160	12.545***	Supported
H14	Power Theft ⇨ Commercial Loss	0.541	21.251***	Supported
H15	Tariff Subsidy ⇨ ACS-ARR Gap	0.348	18.291***	Supported
H16	Technical loss ⇨ AT&C Loss	0.505	20.745***	Supported

Note: *p < 0.05, **p < 0.01, ***p<0.001

Each path in the constructed model for TANGEDCO has a hypothesis connected with it. "While testing all the 16 hypotheses, the sign, intensity and statistical significance of the path coefficients (ß) were considered. The significance of the path coefficients ß1 to ßi was determined by assessing the significance of the 't' value for the path coefficients." [14].

Under the AT&C loss factor, commercial loss (ß = 0.619, p < 0.001), Technical loss (ß = 0.505, p < 0.001) were found to significantly contributes to the AT&C loss. Under commercial loss, low billing efficiency (ß = 0.342, p < 0.001), low collection efficiency (ß = 0.363, p < 0.001), and power theft (ß = 0.541, p < 0.001) were found to significantly contributes to the commercial loss. Under the gap between ACS and ARR factor, non-cost reflective tariff (ß = 0.241, p < 0.001), Tariff subsidy (ß = 0.348, p < 0.001), Increase in cost of supply (ß = 0.220, p < 0.001), Building-up of regulatory assets (ß = 0.244, p <

0.001), Delay in tariff setting (ß = 0.237, p < 0.001) were found to significantly contributes for the gap between ACS and ARR. *[21]*

Under the Financial loss of the TANGEDCO factor, the gap between ACS and ARR (ß = 0.440, p < 0.001), AT&C loss (ß = 0.266, p < 0.001), political intervention (ß = 0.160, p < 0.001), Inefficient management (ß = 0.118, p < 0.001), Huge debt (ß = 0.131, p < 0.001) and Liquidity problem (ß = 0.1144, p < 0.001) significantly contributes for the financial loss of TANGEDCO.

Thus, the hypothesis formulated for all the 16 paths, i.e., H1 to H16, has been supported.

8.8 CONCLUSION CHAPTER SUMMARY

The theoretical model developed for diagnosing the factors significantly contributing to the sustained financial losses of TANGEDCO is evaluated using Partial Least Square Structural Equation Modeling (PLS-SEM) by using SmartPL-3 software. On the evaluation of the measurement model, the *result confirms that the measurement model of TANGEDCO has acceptable convergent validity and reliability.*

Then, the structural model is evaluated by Bootstrapping technique by resampling method to evaluate the research model's fitness and acceptance. 't' statistics and path coefficient ('p' values) are calculated for acceptance of the conceptual model. Then, the predictive accuracy of the developed theoretical model is measured by the Squared Multiple Correlation (R^2). The effect size (f^2) is estimated. The results of the evaluation of the structural model confirm that *the conceptual model developed for TANGEDCO is valid.* The VIF value of the Outer and Inner Models for all the variables are less than 3, *implying no multicollinearity. Hence, the developed model is acceptable. The results of the hypothesis test confirm that the hypothesis formulated for all the 16 paths, i.e., H1 to H16, has been supported.* **Hence, this study concludes that the model developed for diagnosing the factors contributing to the financial losses of TANGEDCO is a valid, acceptable and fit model**.

CHAPTER 9

SUMMARY OF FINDINGS FROM THE RESEARCH

The following most important findings emerged from this innovative research conducted in the state-owned DISCOMs across the country and at the distribution business of TANGEDCO.

In the post-liberalization era since 1991, several reforms have been implemented in India's power sector to address major challenges in the power sector, including a huge demand-supply gap, power outages, mounting financial losses of state power utilities, a large number of un-electrified villages, inefficiencies in power distribution, and rampant power theft. In addition, India's power sector has undergone a revolutionary change since the enactment of 'The Electricity Act, 2003,' which includes the introduction of competition and private sector investment into the power generation and transmission sectors, generation capacity quadrupling from 84,000 MW in 1997 to 3,88,000 MW now, power surpluses, electrification of all villages, and the establishment of a unified synchronous national grid.

Despite multiple rounds of reforms in the power and distribution sectors and the grant of several reforms and bailout packages, state-owned DISCOMs continue to incur substantial financial losses. Sustained losses, mounting debt, erosion of net worth, and mounting payment defaults to power generation companies have made DISCOM's power supply business financially unviable and unsustainable. The prolonged deterioration of the state-owned DISCOMs' financial health has impacted the generation and transmission sector and other sectors of the economy, including the banking and finance sector, which is hindering the nation's economic development in a big way and is posing a major threat to India’s energy security.

The present business model of the state-owned DISCOMs failed to make its business financially and commercially viable, and sustainable, as it is unable to create and deliver value to its customers, owners, and stakeholders. Detailed research was conducted to discover the root cause of the state-owned DISCOMs' chronic losses and make its business financially viable and sustainable. In addition, an in-depth study of the distribution business of TANGEDCO, Tamil Nadu's state-owned power utility, was conducted.

The research finds that while the average supply cost grows yearly, the tariff fixed by SERC and adopted by DISCOMs does not cover the total supply cost. Thus, tariff underpricing and non-cost reflective tariffs contribute significantly to the state-run DISCOMs' massive revenue shortfall and financial losses, resulting in financial insolvency. The study finds that the vast gap between the Average Cost of Supply and the Average Revenue Realized is the single most significant factor contributing significantly to the sustained financial unsustainability of the state-owned DISCOMs. There is a lack of reforms at the state level to improve the financial performance of DISCOMs. Unsustainable tariff subsidy, non-receipt of 100% subsidy from the state by DISCOMs, and non-cost reflective tariff have led to a massive gap between the ACS and ARR, resulting in the financial insolvency of state-run DISCOMs.

In 2015, the Government of India launched the UDAY Scheme to strengthen the financial health and sustainability of state-owned DISCOMs. The participating State-run DISCOMs implemented UDAY Scheme from FY 2016 to FY 2019. This research finds that although the UDAY Scheme has helped state-owned DISCOMs meet a majority of their operational performance targets of the Scheme. However, with the implementation of the UDAY Scheme, the goal of making DISCOM's operation financially viable and sustainable had not been accomplished. The state-owned DISCOMs have failed to meet the target of reducing AT&C losses to 15% and achieving zero gaps between ACS and ARR under the UDAY Scheme despite the state

governments taking over a substantial portion of the DISCOMs debts and losses.

There is a lack of reforms at the state level to improve the financial performance of DISCOMs. Unsustainable tariff subsidy, non-receipt of 100% subsidy from the state by DISCOMs, and non-cost reflective tariff have led to a massive gap between the ACS and ARR, resulting in the financial insolvency of state-run DISCOMs.

There is an inordinate delay in the regulatory process in determining the tariff and issuing tariff orders to DISCOMs by the appropriate regulatory commission, which results in the gap between the average cost of supply and the average revenue realized and huge revenue shortages to the state-run DISCOMs. The regulatory delay caused by the non-submission of the tariff petition by DISCOMs or submitting it with an inordinate delay resulting in tariff fixation not happening annually at regular intervals results in a vast revenue shortage for DISCOMs.

State Electricity Regulatory Commission (SERCs) are subservient to the state government and are unable to do their tariff determination independently despite their quasi-judicial authority. The study found that there is a strong state government intervention with the SERCs in the tariff-setting process resulting in a non-cost reflective tariff.

Even though the Electricity Act, 2003, Electricity Regulatory Commission Act, 1998 and the Tariff Policy 2016 contain provisions requiring the regulator to fix an adequate tariff aligning with the cost of supply regularly and to determine the tariff on a sue moto basis in the event of a delay in filing the tariff petition by distribution licensees, many SERCs fail to comply with these necessary legal provisions, resulting in mounting losses to DISCOMs and the creation of regulatory assets. SERCs have created huge regulatory assets. However, recovery from huge regulatory assets by way of future tariffs is very remote, which would result in tariff shock.

Non-compliance with the legal provisions of the Electricity Act, 2003 and the Tariff Policy 2016 about cost-reflective tariffs and limiting to cross-subsidies within 20 % of the cost of supply results in huge losses to DISCOMs. "The Electricity Act, 2003 provides that the state government needs to give subsidies upfront at the beginning of the financial year to the DISCOMs for the power supplied at lower than its cost price". However, most state governments are not releasing the subsidies upfront, which results in massive revenue shortages and financial losses to DISCOMs.

So far, several reforms implemented in the power distribution sector have focused primarily on reducing technical losses. However, reform programs have not been successfully implemented to contain the substantial commercial losses mainly arising from the non-cost reflective tariff, massive subsidies, and non-realization of subsidy dues from the state government fully and timely, regulatory delay in timely fixing the tariff and issue the tariff order and the state government intervention in the tariff setting process of SERC. The regulatory delay in determining the tariff and the issue of tariff orders occurs due to the non-submission and delayed submission of tariff petitions by DISCOMs, resulting in burgeoning financial losses to DISCOMs.

Untargeted and unfunded massive subsidies are causing huge losses to the state-run DISCOMs. The state-run DISCOMs are highly subsidy-dependent. Therefore, the subsidy issue remains crucial to achieving the financial viability of state-run DISCOMs and India's power sector. Poor subsidy policies of the several state governments resulted in massive losses to the state-run DISCOMs.

Free supply of power to agriculture and supply of power to domestic consumers with massive subsidies and only partial realization of subsidies from the state government results in financial insolvencies of the DISCOMs. Free power to agricultural consumers and supply of 100 units of free power supply to each billing cycle to all domestic consumers of TANGEDCO

irrespective of their socio-economic status resulted in substantial financial losses to TANGEDCO. SERCs take into account the subsidy receivable while determining the tariff. Non-receipt, delayed receipt and partial receipt of subsidies from the state governments resulted in massive losses to the DISCOMs.

TANGEDCO charges tariffs to industries and commercial power customers by significantly exceeding the prescribed cross-subsidy limit of 20%. The higher tariff to industrial and commercial consumers results in the migration of industries and commercial establishments to other states and migration of these consumers to open access, adversely affecting industrial development in the state and reducing tax revenue for the state government and job losses.

The Public-Private Participation (PPP) model in the DISCOMs business operation has yielded promising results in the distribution business of DISCOMs in Delhi and Mumbai by two private players, who have made its DISCOMs business financially viable and sustainable. Since 2014, the Government of India has made numerous attempts to bring private investors into the power distribution business through various measures to achieve financial viability of the state-run DISCOMs, viz., (1) Separation of Carriage & Content part of the power distribution business and to open up the distribution sector for private participation for the power supply business (2) Privatization of DISCOMs and (3) Delicensing distribution business by amending the Electricity Act, 2003 through the Electricity Amendment Bill, 2014 (EAB, 2014), EAB, 2020 and EAB, 2021. *However, the reform proposed by the Government of India through the privatization of DISCOMs is not acceptable to most states.* The Govt. of India's plan to privatize state-run DISCOMs is not acceptable to the state governments, politicians, DISCOMs, and their employees and is a politically sensitive issue. Further, private investors are keen to take the distribution business only in urban areas, where the consumer's paying capacity is more than the rural areas.

This research study found that 56 independent variables and 17 latent variables contribute significantly to the sustained financial losses of TANGEDCO. In this research, based on the independent and latent variables and the relationship between the independent and latent variables, a theoretical model was successfully developed created to diagnose the factors significantly contributing to the sustained financial losses of TANGEDCO. The conceptual model is a complex model having 56 independent variables, and 17 latent variables forming 17 constructs. The measurement model and the structural model developed were evaluated by Partial Least Square Structural Equation Modelling (PLS-SEM), a multi-variate statistical technique by using SmartPLS3 software. The evaluation results found that the conceptual model developed is found to be an acceptable, valid and fit model.

There are inherent weaknesses in the current business model of the state-run DISCOMs including TANGEDCO. Based on the identified factors contributing to the sustained financial losses of TANGEDCO, the interrelationship between independent and latent variables, findings from the research study, and the weaknesses of the present business model of TANGEDCO, a financially viable and sustainable business model has been redesigned for TANGEDCO using the concept of Dynamic Business Model for Sustainability (DBMS).

Electricity is listed on India's concurrent list, and its distribution by DISCOMs is highly regulated. The state-owned DISCOMs operate their power distribution business in almost similar business environments, viz., regulatory, legal, environmental, social, economic and political, and the factors causing the financial losses of the state-run DISCOMs are also typical. Only the intensity of the factors varies from DISCOMs to DISCOMs. Hence, the redesigned business model for TANGEDCO could be adopted by other state-run DISCOMs across the country to make its business model financially, commercially viable and sustainable. The implementation of the redesigned business model would help to achieve a vibrant and sustainable power sector in India.

To achieve the financial viability and business sustainability of the state-owned DISCOMs, it is crucial to implement reforms by focusing on tariff rationalization, cost-reflective tariff, direct transfer of subsidy to consumers, rationalization of subsidy, and cross-subsidy, and improvement in operational performance of DISCOMs.

CHAPTER 10

REDESIGNING THE BUSINESS MODEL OF TANGEDCO TO ACHIEVE FINANCIAL VIABILITY AND BUSINESS SUSTAINABILITY

Chapter overview

In this chapter, based on the findings from the research study, and considering the inherent weaknesses of the present business model of TNAGEDCO, a financially and commercially viable and sustainable business model was redesigned for TANGEDCO.

Introduction

The past reforms in the distribution sector have not succeeded in achieving tariff rationalization, bringing down the subsidies and phasing out of cross-subsidies as expressly stated in the Electricity Act of 2003 despite several rounds of reforms in the power distribution sector, which are crucial to bringing the power sector back on the development track.

The research has also diagnosed the factors contributing to the sustained financial losses leading to the poor financial health of TANGEDCO and its unsustainable business operation.

On perusal of the factors significantly contributing to the unsustainable financial operation, TANGEDCO could improve its operational and financial efficiencies by controlling the factors under its control. The research finds that the state-run DISCOMs, including TANGEDCO, could improve their financial performance by enhancing the revenue generation adequately and reducing its supply cost by properly setting tariffs reflecting its cost of supply,

reducing subsidies, and cross-subsidies, which requires radical reform in the power distribution sector.

"Reform can be considered sustainable if it is financially viable, commercially efficient, socially desirable, politically acceptable, environmentally benign, and acceptable as a project". [62]

This research finds that 'the current business model adopted by TANGEDCO is financially and commercially unviable and unsustainable despite several rounds of reforms in the power distribution sector. TANGEDCO is incurring substantial financial losses on a sustainable basis, and its financial position has highly deteriorated. Moreover, the present business model of TANGEDCO has not created value for itself and its various stakeholders, viz., customers, state government, central Government, power suppliers, vendors, and employees. Therefore, there is a dire need to redesign its business model to achieve financial viability and business sustainability.

This research has identified the factors significantly contributing to the sustained financial losses of TANGEDCO from the detailed analysis of the secondary and primary data collected using scientific methodology.

Based on the identified variables (independent variables) and their relationship to the dependent variables (latent variables), as well as expert interviews, a conceptual framework (theoretical model) was developed using Partial Least Square Structural Equation Modelling (PLS-SEM) to diagnose the factors causing sustained financial losses. The conceptual framework created for TANGEDCO was tested for convergent validity, construct reliability and composite reliability using scientific methodology and SmartPL-3 software.

This research has diagnosed 56 independent variables (comprising internal and external factors) and 17 latent variables that significantly contribute to the sustained financial losses of TANGEDCO, as shown in Table 7.2 and Table 7.3 in Chapter 7. The developed theoretical model is a complex model having

17 interlinked formative constructs. The evaluation of the measurement model developed has been tested for reliability and convergent validity using SmartPL-3 software. The test results found that the measurement model developed using the identified factors (independent variables) and latent variables represents an acceptable convergent validity and reliability, as shown in Table 8.1. Furthermore, the structural model developed for TANGEDCO (shown in Figure 7.2) has been evaluated and validated using Bootstrapping (T-Statistics) technique, Test for Effect Size (f^2) and Squared multiple Correlation test (R^2). The test results have confirmed the developed model's validity, as shown in Figures 8.4 and 8.5, respectively.

Further, Hypothesis testing was done for validating the 16 constructs in the structural model developed for TANGEDCO. The test result confirms that the hypothesis formulated for all 16 paths in constructing the theoretical model developed for TANGEDCO supported and established its validity, as shown in Table 8.2. "Further, the test result of 'R^2' has confirmed that 95% of the variance for the factors significantly contributing to the sustained financial losses of TANGEDCO can be predicted by three latent variables, namely (1) positive gap between Average cost of supply (ACS) and Average Revenue Realized (ARR), (2) AT&C Loss and (3) Commercial losses. Therefore, there is a dire for TANGEDCO to reduce the gap between ACS and ARR, Commercial losses and reduce AT&C losses significantly to improve the financial, and operational performance to improve the financial viability of TANGEDCO."

10.1 REDESIGNING TANGEDCO's BUSINESS MODEL FOR FINANCIAL VIABILITY AND BUSINESS SUSTAINABILITY

While redesigning a financially, commercially viable and sustainable business model for TANGEDCO, the following points have been taken into account:

1. Present financially and commercially unviable and unsustainable business model of TANGEDCO and the weakness of its current business models viz., inability to generate adequate revenue and profit,

failure to create value for itself and its various stakeholders viz., customers, state government, Central Government, power suppliers, vendors, and employees, failure to capture the value and deliver to different consumer segments.

2. Notable findings from this research include identifying 56 diagnosed independent variables, 17 latent variables, the interrelationships between the independent and latent variables, and 16 hypotheses forming 16 constructs in the complex conceptual framework developed for TANGEDCO to analyse the factors significantly contributing to the company's sustained financial loss.
3. The current business environment in which TANGEDCO operates its business viz., financial, commercial, social, economic, political, and
4. Experience gained from several reform programmes implemented to improve state-owned DISCOMs' financial positions and business sustainability.
5. Different business models of DISCOMs adopted in the power distribution business in India and developed nations, business models being in use in the Indian power distribution sector viz., wholly owned by the state government, distribution business model involving private players investing alongside the public sector (PPP model of Delhi & Maharashtra), Distribution Franchisee model and its benefits and challenges in implementation in the Indian power sector.
6. Various distribution reforms schemes planned by the Government of India, including the separation of 'Career' and 'Content' in the power distribution business and delicensing of the distribution business.
7. Benefits and challenges in adapting different business models and the experience in India and developed/developing countries.
8. Various amendments were proposed in the Electricity Amendment Bill, 2014, Electricity Amendment Bill, 2020/2021 by amending the Electricity Act, 2003.
9. Expert opinion through this research.
10. The recommendation suggested is based on the research findings from the research work carried out in the power distribution sector by the

Government of India, International Financial Institutions viz., World Bank, and Asian Development Bank.

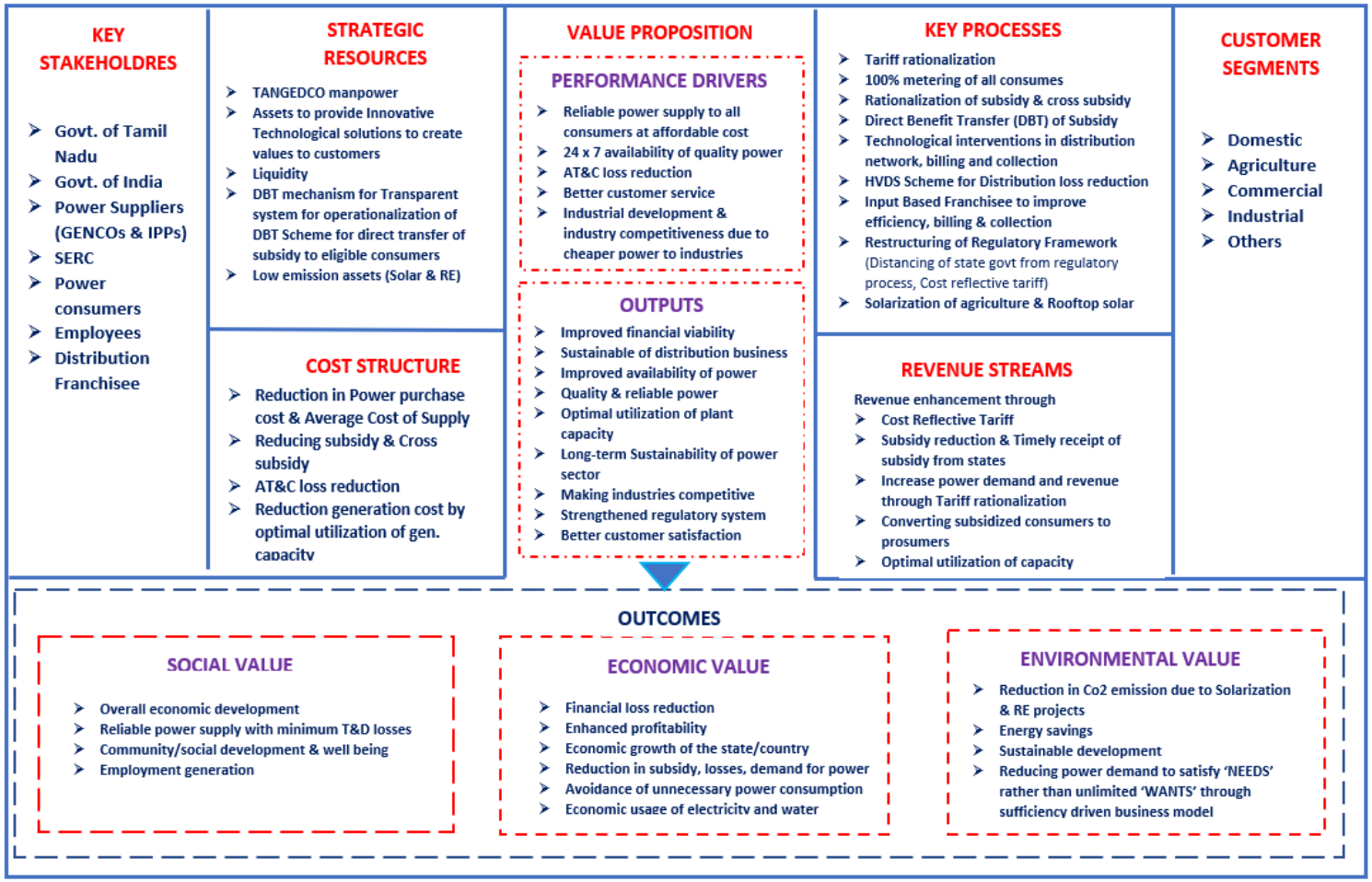
11. The committee report of the special committee constituted by the Govt of India for carrying out reform in the power sector viz., The Abraham Committee, B K Chaturvedi Committee, VK Shunglu panel
12. The scholarly research work carried out in the Indian power sector was published in leading International, Scopus-indexed journals.
13. Different laws, Acts and rules, regulations and Government guidelines are applicable in the Indian power sector.
14. The fact that there is a dire need to redesign the business model of TANGEDCO to achieve financial viability.
15. "Business model literature on business model generation, value proposition design and business model canvass devised by Alexander Osterwalder & Yves Pigneur".
16. Dynamic Business Model for Sustainability (DBMS).

Based on the above, redesigned, financially & commercially viable and sustainable business model was suggested to TANGEDCO in line with the Dynamic Business Model for Sustainability (DBMS). The proposed business model for TANGEDCO is in Figure 10.1.

Figure 10.1

Financially viable and sustainable business model developed for TANGEDCO

Suggested financially viable and sustainable business model for TANGEDCO



10.2 Suggested solutions to achieve the financial viability of TANGEDCO

To achieve economic viability in the highly regulated environment, TANGEDCO needs to:

(1) Generate adequate revenue through correctly set tariffs and minimizing the cost of providing services.

(2) Perform its commercial operation efficiently with an improved operating and financial performance to reduce commercial losses by taking prudent investment decisions.

(3) Reduction in support in the form of revenue subsidy and capital support.

10.3 Redesign the components of the business model

Its business model components will need to be significantly redesigned to enhance TANGEDCO's financial and operational efficiency and ensure its financial viability and sustainability. A major redesign is necessary for the building blocks, revenue stream, cost structure, key activities, value proposition, strategic resources, and the Strategic Resources and Key Stakeholder building blocks.

10.3.1 Redesigning the components of business models needs major reform in the distribution sector

To achieve financial viability, a significant reform in the distribution sector is the need of the hour. "The power distribution sector in India is highly regulated, as power is on the concurrent list in the Constitution of India. As a result, both the federal and state governments will have regulatory authority in this domain." TANGEDCO may have control over the factors, which are under its control. However, many factors that are not under TANGEDCO's control require changes and amendments to the Electricity Act of 2003 and Tariff policies and are discussed in detail.

To improve the financial and operational efficiency and achieve financial viability and sustainability of TANGEDCO, the business model components viz., **Revenue Stream, Cost Structure, Key Processes, Value proposition,**

and **Key Assets** building blocks need significant redesign. To adopt and implement the suggested business model for TANGECO to achieve financial viability, a robust reform in the distribution sector is the need of the hour.

10.4 REFORM FOCUS AREAS

To improve the financial efficiency and to achieve the financial viability of TANGEDCO in the redesigned business model of TANGEDCO, the reform should focus on the following areas:

- **Improvement in operational efficiency**
  (Reduction in AT&C losses, to bring the ACS-ARR gap to zero, improving Billing and collection efficiency)
- **HVDS Scheme for Distribution loss reduction**
- **100% metering of all consumers**
- **Implementation of smart and pre-paid metering**
- **Feeder Segregation**
- **Tariff rationalization**
- **Rationalization of subsidies and & cross-subsidies**
- **Cost Reflective Tariff**
- **Direct Benefit Transfer (DBT) of tariff subsidy**
- **Targeted subsidies only for deserving consumers.**
- **Technological interventions for value creation, capture, and delivery.**
- **Input-based franchisee to enhance efficiency, billing & collection.**
- **Restructuring of Regulatory Framework**
  (Distancing of state govt from the regulatory process)
- **Power purchase cost reduction**

10.5 IMPROVEMENT IN OPERATIONAL EFFICIENCY

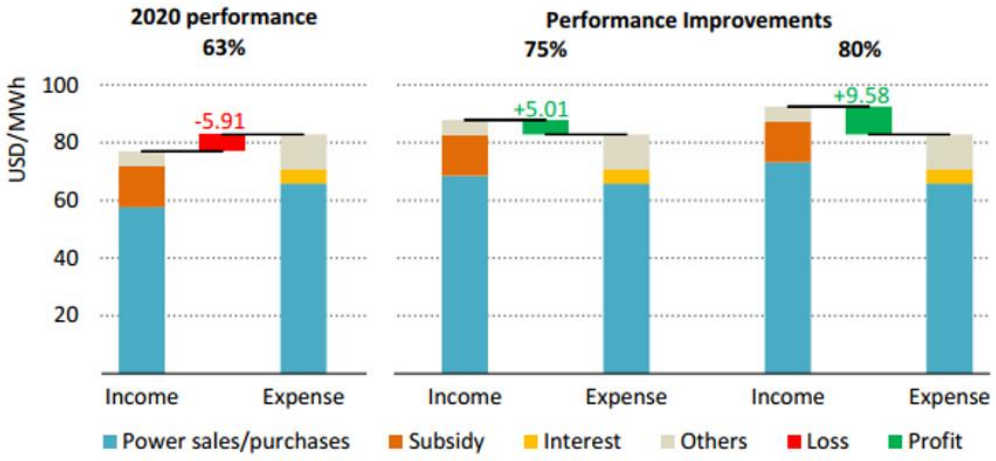
This research found that the poor financial performance of TANGEDCO is primarily attributed to the enormous revenue gap, which is caused by poor operational performance (1) High AT&C Losses, (2) Low Billing Efficiency, (3) Irrational tariff structure, and (4) massive tariff subsidy. As per PFC Report, the key operational performance parameters of TANGEDCO for the

FY 2018-19 are (1) AT&C loss: 17.29% (2) Billing Efficiency: 83.47%, and (3) Collection Efficiency: 99.10%.

In the India Energy Outlook report 2021 [71], the International Energy Agency reported that Indian DISCOMs can monetize only 63% of their electricity in 2020. Raising this to 75% or more would bring them back to profitability. With the improvement in operational performance to 80% from the current level of 63%, the state-run DISCOMs could earn a profit of USD 9.58 per MWh (69 paise per kWh) from the loss level of USD 5.91 per MWh (43 paise per kWh) as shown in Figure 10.2.

Figure 10.2

State-run DISCOM income and impact on enhanced operational performance in Billing, collection and reduction in AT&C losses



Source: International Energy Agency Report on 'India Energy Outlook 2021'

Note: Operational performance is estimated based on the current value of state-run DISCOMs at 63%, i.e., with Key Performance Indicators (KPI) of AT&C loss of 21%; Billing Efficiency: 85%; Collection Efficiency: 93%. Improvements in KPIs are assumed to benefit each consumer category on a pro-rata basis with sales.

Therefore, the Indian DISCOMs should focus more efforts to reduce AT&C losses, and improving billing and collection efficiency.

10.5.1 Better operational performance - Key to improving financial viability and business sustainability of TANGEDCO

This research finds that better operational performance through reduction in AT&C loss, billing, and collection efficiency improvement would sharply narrow down the cost-revenue gap and improve the financial viability and business sustainability of state-run DISCOMs, including TANGEDCO. As a result, improving operational efficiency is critical for TANGEDCO's financial viability and long-term business sustainability.

TANGEDCO has performed well in revenue collection over time, and the collection efficiency for the FY 2018-19 stood at 99.10%. However, TANGEDCO needs to drastically reduce its high AT&C loss from 17.29% and improve its billing efficiency, which is significantly lower at 83.47% for FY 2018-19 as per the PFC report 2019 [37]. Due to higher AT&C losses and substantially lower billing efficiency, TANGEDCO can only monetize 68.42 per cent of the electricity it distributes.

10.5.2 Rs.12,729 crore increase in profitability of TANGEDCO on 80% operational performance

TANGEDCO could drastically reduce its financial losses to the tune of Rs.7,253 crore (from Rs.17,962 crore in 2018-19 to Rs.10,709 crore) by raising its operational performance to 75% (with AT&C loss: 15%; Billing Efficiency: 88.68%; and Collection Efficiency: 99.5%) from 68.42% in FY 2018-19. Similarly, TANGEDCO could drastically reduce its financial losses to the tune of Rs.12,729 crore by raising its operational performance to 80% (with AT&C loss: 13%; Billing Efficiency: 92.42%; and Collection Efficiency: 99.5%) from 68.42% in FY 2018-19 as shown in Table 10.1.

10.6 IMPACT OF ENHANCED OPERATIONAL PERFORMANCE ON TANGEDCO'S FINANCIAL PERFORMANCE

'Table 10.1 shows the impact of operational performance on financial performance by reducing AT&C losses and enhancing billing efficiency and collection efficiency.'

The present operational performance of TANGEDCO at 68.42%

The Operational performance is calculated based on AT&C losses, Billing Efficiency, and Collection Efficiency. TANGEDCO presently operates with an operational efficiency of 68.42% in FY 2018-19 (with AT&C loss: 17.29%; Billing Efficiency: 83.47%; and Collection Efficiency: 99.10%). At this level of operational performance, TANGEDCO incurred a financial loss of Rs.17,962 crore. By substantially reducing the AT&C losses and enhancing billing and collection performance, more power is available for sale to TANGEDCO, resulting in more revenue and profit, as shown in Tables 10.1, 10.2, and 10.3.

Operational performance improvements at 75%

TANGEDCO could achieve operational efficiency of 75% by reducing its AT&C losses to 15%, increasing the billing efficiency to 88.68% (from 83.47), and increasing the collection efficiency to 99.10% (from 99.50%), which would result in additional revenue of Rs.7,253 crore and a reduction of financial losses from Rs.17,962 crore to Rs.10,709 crore as shown in Table 10.1.

At the 75% operational performance, TANGEDCO's sale of power will increase to 79,681 Million Units (MU) from 74,999 MU (at the present operational performance of 68.42% in FY2018-19), which results in a drastic reduction in loss from 76 paise per kW-Hr to 7 paise per kW-Hr as shown in Table 13.1.

Operational performance improvements at 80%:

TANGEDCO could achieve operating efficiency of 80% by reducing its AT&C losses to 13%, increasing the billing efficiency to 92.42% and collection efficiency by 99.50%, which results in additional revenue of Rs. 12,729 crores, and would reduce financial losses to Rs.5.233 crore from Rs.17,962 crore, as shown in Table 10.1

At the 80% operational performance, TANGEDCO's sale of power will increase to 83,041 Million Units (MU) from 74,999 MU (at the present operational performance of 68.42% in FY 2018-19), which would result in TANGEDCO earning a profit of Rs. 0.46 on each unit of energy sold, as shown in Table 10.2.

Table 10.1

Impact of enhanced operational performance due to AT&C loss reduction improved billing and collection on TANGEDCO's financial performance

Scenario	Operational Performance	AT&C Loss (%)	Billing Efficiency (%)	Collection Efficiency (%)	Total Income on subsidy received basis (Rs. Crore)	Total Expenses (Rs. Crore)	Profit / (Loss) (Rs. Crore)
1	Operational Performance 2018-19* **(68.42%)**	17.29	83.47	99.10	56,330	74,290	(17,962)
2	Performance Improvements **(75%)**	15.00	⇧ 88.68	⇧99.50	⇧ 63,581	74,290	⇧ (10,709)
3	Performance Improvements **(80%)**	13.00	⇧ 92.42	⇧99.50	⇧69,057	74,290	⇧ (5,233)

Source: As per PFC Report for the FY 2018-19 [37]

Note: Operational performance is calculated based on AT&C losses, Billing Efficiency, and Collection Efficiency. Operational performance value of 68.42% for the FY 2018-19 (with AT&C loss: 17.29%; Billing Efficiency: 83.47%; and Collection Efficiency: 99.10%). The improvements in operational performance with two improved scenarios, i.e., at 75% and 80%, are assumed to benefit all consumer categories (Domestic, industrial, commercial, Agricultural, and others) on a pro-rata basis without a tariff increase.

Table 10.2

TANGEDCO's Income on sale of power and profitability under present & improved Scenarios

Scenario	Operational Performance	Sale of Power (MU)	Income from the sale of power (Rs. /kWh)	Subsidy income (Rs. /kWh)	Other Income (Rs. /kWh)	Total Income (Rs. /kWh)	Total Expense (Rs. /kWh)	Profit / (Loss) (Rs. /kWh)
1	Operational Performance 2018-19* **(68.42%)**	74,999	6.19	1.03	0.29	7.51	8.27	(0.76)
2	Performance Improvements **(75%)**	⇧ 79,681	⇧ 6.58	1.09	0.31	7.98	8.05	⇧ (0.07)
3	Performance Improvements **(80%)**	⇧ 83,041	⇧ 6.86	1.14	0.32	8.32	8.32	⇧ 0.46

Source: As per PFC Report for the FY 2018-19 [37]

10.6.1 Impact of enhanced operational performance on reduction of power purchase expenses

The research finds that on the improvement of operational performance, the net input energy available for sale to TANGEDCO increases, resulting in a reduction in power purchase cost and total expenses reduction, as shown in Table 10.3.

Table 10.3
TANGEDCO's Expenses on purchase of power under present & improved Scenarios

Scenario	Operational Performance	Net input energy (MU)	Expenses on power purchase (Rs. /kWh)	Interest expense (Rs. /kWh)	Other expense (Rs. /kWh)	Total Expense (Rs. /kWh)
1	Operational Performance 2018-19 **(68.42%)**	⇧ 89,852	5.97	0.92	1.38	**8.27**
2	Performance Improvements **(75%)**	⇧ 92,340	⇩ 5.81	0.89	1.35	⇩ **8.05**
3	Performance Improvements **(80%)**	⇧ 94,512	⇩ 5.67	0.87	1.32	⇩ **7.86**

Source: PFC Report for the FY 2018-19 [44]

Operational performance improvements at 75%

At 75% operational efficiency, the net input energy will increase to 92,340 MU (from 89,852 MU at 68.42% operational efficiency in FY 2018-19), which result in a reduction of power purchase expenses from Rs.5.97 per kWh (at 68.42% operational efficiency) to Rs.5.67 per kWh and decrease in total costs from Rs.8.27 per kWh to Rs.7.96 per kWh as shown in Table 10.3

Operational performance improvements at 80%

Net-input energy will increase at 80 per cent operational efficiency to 94,512 MU (up from 89,852 MU at 68.42 per cent operational efficiency in FY 2018-19). The increase in net-input energy decreases power purchase expenses from Rs.5.97 per kWh to Rs.5.81 per kWh and reduces total costs from Rs.8.27 per kWh to Rs.8.05 per kWh, as shown in Table 13.3.

10.7 POLICY PRESCRIPTIONS TO IMPROVE THE OPERATIONAL PERFORMANCE OF STATE-RUN DISCOMS

To achieve financial viability, TANGEDCO must improve its operational performance by focusing its efforts on reducing AT&C losses and improving billing and collection efficiency. This will have a more significant impact on reducing revenue shortages and improving profitability drastically. Hence, policy developments to improve the operational performance of the State-run DISCOMs is of paramount importance to achieve the financial viability of DISCOMs.

In the UDAY Scheme, the Govt of India has set a target for the participating DISCOMs to reduce the AT&C loss below 15% and enhance the billing and collection efficiency. However, most DISCOMs have failed to meet the AT&C loss target set by the states in the Memorandum of Agreement with the Ministry of Power, and there is no penalty for states or DISCOMs failing to meet the set performance targets. However, some states have successfully brought down the AT&C loss level below 15%, and many DISCOMs have improved their performance on billing and collection.

Therefore, for future reform policies to improve financial viability, TANGEDCO should focus more on achieving the Key Operational Performance Indicators (KOPI). This KOPI includes a reduction in AT&C loss, improvement in billing and collection efficiency with stringent penal provisions to the State/DISCOMs viz., conversion of the government grants into loans, denial of reform packages, concessional loans & grants from the Govt. in case of non-achievement of the agreed KOPIs.

10.8 IMPLEMENTATION OF HVDS SCHEMES TO REDUCE DISTRIBUTION LOSS

High-voltage (HV) transmission lines (400/220/132 kV) and substations make up an appropriate transmission grid. At the 132/33 kV substation level, the transmission network intersects the distribution network. The power is then transmitted through 33 kV lines to the load centres. Then the voltage is stepped

down to 11 kV in the substation and distributed through distribution transformers to various power consumers.

The power is delivered from the 11 kV feeder through 11 kV HT lines close to load centres and distribution transformers. The voltage is reduced from 11,000 V to 415 V in the distribution transformer. The power is supplied through LT lines with a voltage level of 240 V to domestic and commercial consumers and at 415 V to industrial consumers with a 3-phase supply.

Successful implementation of HVDS in Andhra Pradesh drastically reduced the AT&C losses

There are significant technical losses in the Transmission and Distribution network. This research also finds that the primary reasons for the higher distribution losses are lengthy LT lines in the distribution network, Poor HT/LT ratio, higher capacity DTRs underutilized, improper maintenance of distribution transformers, and higher transformer losses.

Commonly, large capacity DTRs of 100 kVA or 63 kVA capacity serve many consumers from a single DTR to minimize the investment cost in the distribution infrastructure. This system is beneficial when catering to high-load density urban areas where many consumers necessitate LT lines to cover only short distances. However, consumer concentration is scattered over a broader geographical area in rural locations. As a result of the long LT lines, considerable line losses and voltage swings occur. Furthermore, consumers at the tail end of the LT line face low voltage issues. Farmers try to compensate for the low voltage by utilizing the higher capacity motors, which overload the LT line.

"The current for a 100 kVA load at 11 kV is 5 Amperes (Amps), but it is 140 Amps at an LT voltage of 415 Volts, which is twenty times higher than 11 kV. Distribution losses are higher on LT lines due to the high current. Technical losses could be drastically reduced by extending the HT line with 11 kV very close to the consumer end by converting the LT line into the HT line." [51]

High Voltage Distribution System (HVDS) has been successfully implemented in many states to reduce the higher distribution losses in lengthy LT lines. Andhra Pradesh is a pioneer in implementing HVDS Scheme first time in India.

Existing 100/63 kVA transformers are replaced with a significant number of lesser capacity 3-phase Distribution Transformers (16/25 kVA) located closer to consumer load points in the HVDS system. In addition, upgrading the voltage on LT) lines to 11 kV lines and replacing the existing conductors with LT Aerially Bunched (AB) cables connected to the 3-phase transformers [19].

The Low Voltage Distribution System (LVDS) has the disadvantage of higher distribution losses due to the lengthy LT Lines, and frequent overloading of DTRs. In addition, higher voltage fluctuations and lower tail-end voltage resulted in the frequent failure of DTRs and motors used for agriculture and a higher incidence of power theft.

10.8.1 Advantages of the HVDS system

- The HVDS system implementation drastically reduced the distribution losses due to the LT/HT ratio reduction, as the 11 kV line is taken near consumers.
- HVDS results in tail-end voltage improvements, improved quality and reliable supply of power supply, and better consumer satisfaction.
- LT overhead line is avoided, and instead, LT Aerial Bunched cable is used from the distribution transformer up to the consumer field, thus eliminating LT line faults.
- The investment made in the HVDS system has a low payback period (3 to 4 years).
- The failure rate of DTRs is reduced drastically, as there is no overloading of DTRs.
- Every farmer has an individual transformer, so there are less load and better voltage.

- It is easier to prevent overload/theft as each farmer is responsible for their transformer. Similarly, if a transformer fails, it will affect only one farmer and not everyone.

The HVDS project has been efficient and economical in reducing AT&C losses drastically. "As per the Government of Andhra Pradesh Report 2016 on "Environment and Social Management Plan for rural HVDS project" [15], Andhra Pradesh DISCOMs have started the implementation of the HVDS Scheme in 2006 and completed HVDS schemes across the State under World Bank schemes and REC funding". Successful implementation of HVDS Schemes and other system improvement schemes successfully reduced its AT&C losses below 9% and stood as one of the best performing DISCOM.

The HVDS Scheme has been successfully implemented by BSES Ltd, a Reliance Energy joint venture company with the Delhi Government, and New Delhi Power Ltd (NDPL), a JV company of Tata Power Delhi Distribution Ltd and the Delhi Government. "With private participation, both the companies have replaced three-phase transformers of 100 or 630 kVA or greater capacity with single-phase/three-phase transformers of 16 or 25 kVA and reaped the benefits of the HVDS scheme." [50].

Other states/UTs that have successfully implemented HVDS Schemes to benefit from HVDS Schemes in their farming sector include Greater Noida, Madhya Pradesh, Haryana, and Punjab.

10.8.2 The dire need to implement HVDS Scheme by TANGEDCO

TANGEDCO has not implemented the HVDS Scheme so far. TANGEDCO needs to adopt proven technologies such as HVDS Scheme and significantly reduce the AT&C loss.

In rural Tamil Nadu, TANGEDCO has installed a higher capacity Distribution Transformer of capacity viz., 63 kVA, 100 kVA, and 250 kVA in the distribution network in agriculture, which usually connects 15 to 25 pump sets

in one distribution transformer. However, due to the above, the LT line's length (440 V) is more than the HT line length (11 kV line), resulting in higher distribution losses.

TANGEDCO shall need to implement HVDS Schemes by replacing higher capacity DTRs with 16 kVA capacity and connecting 3 to 4 pump sets. By decreasing the LT line's length and increasing the length of the HT lines, TANGEDCO could substantially reduce distribution losses in the distribution network in agriculture and reap all the benefits of the HVDS scheme.

10.8.3 Rs.5,000 crores additional revenue to TANGEDCO by HVDS Scheme

As per the tariff subsidy order No.6, 2019 of TNERC, TANGEDCO has an estimated connected agricultural load of 1,45,12,810 HP (about 145 lakhs HP connected load under Agricultural- Normal and SFS category) as of March 2019-20 [58], As per Govt. of Tamil Nadu Energy Department Policy Note 2019-20, TANGEDCO is servicing 21.10 lakhs of agricultural consumers, 7% of the total power consumers in the state. [19]

As per the PFC report 2018-19 [44], the power consumption by the agricultural consumer of Tamil Nadu in 2018-19 is 13,078 Million Units (MU), which is 17.18% of the total power sold by TANGEDCO. The average revenue realized out of the sale of power by TANGEDCO stood at Rs.7.11 per kW-Hr. It is estimated that implementing the HVDS Scheme in Agriculture lines in rural feeders. TANGEDCO will achieve a minimum of a 3-3.5 per cent decrease in technical and AT&C losses by implementing HVDS in the agricultural distribution network. This will increase the available capacity of around 5,000 MU and increase the revenue of approximately Rs.3,500 crore per annum based on electricity's current average selling price. On the other hand, HVDS schemes in rural areas for domestic consumers may bring about Rs.1,500 crore. Therefore, due to implementing the HVDS Scheme, TANGEDCO may generate an additional Rs.5,000 crore in revenue.

10.8.4 Compulsory 100% metering of all consumers

A radical redesign in the **REVENUE STREAM building block** is required to financially turn around TANGEDCO and make its distribution business financially viable and sustainable. TANGEDCO's redesigned business model includes mandatory 100 per cent metering of all consumers. The way forward to enhance revenue generation is suggested hereunder:

As per the Govt. of Tamil Nadu Energy Department Policy Note 2019-20 [15], the total energy consumed by all the consumers in 2018-19 stood at 1,13,495 MU. While the total energy sold in 2018-19 is only 76,126 MU as per the PFC report 2018-19. i.e., only 67% of the total energy consumed by all the categories was sold by TANGEDCO.

TANGEDCO has an estimated connected agricultural load of 145 lakhs HP as of March 2019-20, serving 21.1 lakh agricultural consumers, according to TNERC tariff subsidy order No. 6, 2019 [58]. Each agricultural consumer is connected to a motor with an average capacity of about 7 HP, which receives power free of charge and without metering. TANGEDCO has not installed meters for the agricultural connections given by it.

10.8.5 Loss of revenue to TANGEDCO due to the blanket subsidy and free supply of power to agricultural consumers

"According to the Electricity Act of 2003, the State Government must pay DISCOM a subsidy for the difference between the tariff and the Average Cost of Supply (ACS)." As per the TNERC Tariff subsidy order No.6, dated 6.9.2019 [59], the Govt. of Tamil Nadu has requested TNERC to approve a tariff subsidy of Rs.3,261.49 crore for the FY 2019-20 to be given to TANGEDCO for the free power being supplied by it to agricultural consumers under the normal category. TNERC has approved the same.

Most of the agricultural connections in Tamil Nadu have no energy meters, and the energy supplied to agriculture is also not metered. The power is

supplied to agricultural consumers with a 100 per cent subsidy irrespective of the energy consumed. For the unmetered agricultural connections, Govt. of Tamil Nadu pays subsidies to TANGEDCO based on the connected load on the HP rating of the motor basis. TNERC vide its Tariff subsidy order No.6, 2019, has approved the blanket subsidy of Rs.3,261.49 crores based on the subsidy estimation by TANGEDCO @ Rs.2,875 per HP per annum for the estimated connected agricultural load of 1,13,44,315 HP under normal agricultural category.

Traditionally, TANGEDCO is submitting the tariff petition to TNERC, in which the tariff subsidy has been arrived approximately based on the subsidy of Rs.2,875/HP/per annum. TNERC is approving the same every year, even though the cost of power increases by 11% on a year-on-year basis [58].

TANGEDCO is not metering the actual power consumed by agricultural consumers. The simple calculation shows that the GoTN pays the approximate subsidy to TANGEDCO, far less than the actual subsidy payable. For example, one HP motor will consume 0.746 kW-hr per hour. If on average, the agricultural motor runs for 8 hours a day and 12 days in a month, the expected power consumption per annum is about 860 kW-Hr/HP/per annum. As a result, even if only the energy charge is considered, the Government of Tamil Nadu needs to pay TANGEDCO an approximate subsidy of Rs.6,110 per HP per annum based on the average supply cost (excluding fixed charge). TANGEDCO, on the other hand, receives a lower subsidy of about Rs.3,235 crore from the Tamil Nadu government for supplying free electricity to agricultural consumers.

10.9 100% METERING OF AGRICULTURAL CONSUMERS TO IMPROVE REVENUE REALIZATION

The subsidy payable by the Government of Tamil Nadu to TANGEDCO is estimated not based on the actual power consumed by the agricultural consumers as per the TNERC approval of subsidy. As a result, the GoTN pays about Rs.3,235 crore lower than the actual subsidy payable to TANGEDCO

for the free power supplied to agricultural consumers per annum. Therefore, TANGEDCO is incurring a massive loss due to inflated power consumption.

To avert the substantial financial losses arising from lower subsidy receipt from the state government for the free power supplied to agricultural consumers, TANGEDCO needs to install energy meters for all 21 lakh agricultural consumers on a war footing basis. Unless the energy supplied is measured, TANGEDCO cannot control the cost, which results in substantial financial loss.

The Govt. of India plans to directly introduce the Direct Benefits Transfer (DBT) scheme to pay the tariff subsidy directly to the targeted consumers by the concerned state government. To pay the correct subsidy to the targeted consumers, measuring the actual power consumed is mandatory.

10.9.1 Additional subsidy revenue to TANGEDCO

State Government may supply free power to agriculture consumers and deserving domestic consumers. However, on the other hand, the difference between the average cost of supply and the average selling price must be paid in full by the state government based on the actual electricity consumed by the subsidized consumers. Therefore, TANGEDCO is expected to receive an additional subsidy revenue of about Rs.3,235 crore from the GoTN for the free power supplied.

To make TANGEDCO's distribution financially and commercially viable and sustainable, TANGEDCO needs to get revenue in consonance with the cost either by way of tariff collected from consumers or subsidy from the GoTN. Therefore, the blanket payment of subsidy by the GoTN based on approximation should be averted in toto.

By implementing 100% metering and the DBT scheme, limiting the subsidy to the power supplied to the agricultural consumers for each consumer, and

directing the subsidy to the most needed, TANGEDCO could achieve a financial turnaround by reducing the losses substantially.

10.10 100% FEEDER METERING & DISTRIBUTION TRANSFORMER METERING

TANGEDCO needs to implement compulsory 100% metering of all Distribution Transformers (DTR) and Feeders. Further, TANGEDCO needs to manage each feeder efficiently. TANGEDCO needs to carry out the auditing of all the feeders and DTRs regularly to improve revenue collection and arrest leakage. High loss-making feeders must be identified, and action must be taken promptly to avert leakages and losses.

TANGEDCO has agreed with the Ministry of Power to achieve various operational performance targets under the UDAY Scheme, including Feeder metering and DTR metering in urban and rural areas. As per the UDAY portal, the Ministry of Power (MoP), TANGEDCO has achieved almost 100% DTR metering in 69,948 urban feeders out of 70,000. However, TANGEDCO has achieved only 18,430 numbers of DTR metering in rural areas against the target of 1,80,748, achieving a meagre 1% as of September 2020 [34].

10.11 SEGREGATION OF AGRICULTURAL FEEDERS

TANGEDCO does not have separate feeders for domestic, agricultural, and industrial use in most distribution networks. As a result, TANGEDCO supplies 100% power free of cost to agricultural consumers. Hence, to effectively control the power supplied free of cost to agriculture consumers, TANGEDCO needs to implement feeder segregation across the state to bring down its loss significantly.

TANGEDCO has agreed with the Ministry of Power to achieve various operational performance targets under UDAY Schemes, including Feeder Segregation. However, TANGEDCO has taken up the feeder segregation works only in 29 feeders out of the total target of 1,920 as of December 2020 as per the health card of TANGEDCO in the UDAY portal [34].

10.11.1 Management of feeders as a strategic business unit

To efficiently manage each distribution feeder or group of feeders needs to be addressed as a separate Strategic Business Unit (SBU) headed by a Feeder Manager. Therefore, TANGEDCO shall appoint Feeder Managers to oversee the revenue collections feeder-wise. Furthermore, TANGEDCO may adopt the best practices followed by a few state-run DISCOMs, viz., an incentive system for the feeder managing team as implemented in Bihar.

TANGEDCO may identify loss-making high feeders based on the feeder metering, DTR metering, revenue realization, and system availability. TANGEDCO shall need to take immediate steps to improve the revenue by arresting the leakage by the theft of power-enhancing the system availability by attending to the faults timely.

Energy audit in feeders

TANGEDCO needs to regularly carry out the Energy Audit in each feeder to improve operational efficiency and revenue collection.

10.11.2 Rs.2,200 crore revenue on Feeder segregation

By implementing 100% metering, feeder segregation, feeder metering, and DTR metering, the expected reduction in T & T&D loss is about 4.3%, translating to Rs.2,200 crore.

10.12 TARIFF RATIONALIZATION

10.12.1 Irrational tariff structure, a significant contributor to DISCOMs' financial distress

This research finds that the irrational tariff structure of TANGEDCO, which includes high cross-subsidy, is one of the critical factors for its sustained financial losses, financially unviable business operation, and the present deep liquidity crisis. As a result, TANGEDCO, as of 2018-19, have A high accumulated loss of Rs.87,895 crore, accumulated debt of Rs.1,13,438 crore, a negative net worth of Rs.62,124 crore as of FY 2018-19 [33][44]. In addition,

selling electricity much below its cost price has led to a growing revenue gap, as shown in Table 10.4

Table 10.4
TANGEDCO's Growing approved cumulative revenue gap

Financial Year	2011-12	2012-13	2013-14	2014-15	2015-16
Approved Cumulative Revenue gap (Rs Crore)	7,378	12,146	19,351	25,642	30,884

Source: TNERC 2017

10.12.2 The Dire need to reduce untargeted subsidies to LT consumers

TANGEDCO receives no revenue from 17 per cent of the total power sold to agricultural power customers due to the electricity supply free of cost to agricultural power consumers. For all the consumer categories under LT power supply, except for commercial and temporary supply, TANGEDCO incurs a vast revenue loss on the sale of power. This is because TANGEDCO cross-subsidizes the domestic and agricultural power consumers from industrial and commercial consumers. Besides, Govt. of Tamil Nadu subsidizes domestic and agricultural consumers. Nonetheless, TANGEDCO's revenue shortfall is exacerbating, despite a combination of state subsidies and massive cross-subsidies.

10.12.3 Consequences of irrational tariff structure of TANGEDCO

TANGEDCO faces the following consequences as a result of its irrational tariff structure with massive cross-subsidies:

- TANGEDCO losses revenue to the tune of Rs.7,965 crore for the 100% free power supplied to the agricultural consumers and Rs.10,679 crore for the power sold at a subsidized price well below its average cost. Supply of power at a subsidized tariff has resulted in an Rs.18,644 crore subsidy burden borne by the Government of Tamil Nadu in FY 2018-19, when the State Government is facing massive debt, further straining the state government's finances.

- TANGEDCO has charged a higher tariff for industrial and commercial consumers to subsidize domestic and agricultural consumers. As per the PFC report, the average tariff set to industrial and commercial consumers in 2018-19 is Rs.13.91 per kW-Hr and Rs.9.02 per kW-Hr [37]. Because of TANGEDCO's higher tariff, industrial and commercial entities have migrated to other states with lower tariff rates.
- Massive dislocation of textile mills from Coimbatore and other parts of Tamil Nadu to Andhra Pradesh is a live example, resulting in loss of tax revenues and reduced employment in the state besides industrial deceleration.
- Vast numbers of HT power consumers migrated to open access to purchase powers, resulting in revenue loss to TANGEDCO, further disturbing the cross-subsidy mechanism.
- Massive revenue shortage resulting in defaults in payments by TANGEDCO to the power generators for the power supplied. TANGEDCO's overdue payments to the power generators as of January 2021 are Rs.19,326 crore, equal to 16 months of power purchase. TANGEDCO got a sanction of Rs.30,000 crore loan from REC and PFC under Govt. of India's liquidity package viz., Admanirbhar Bharat Abhiyan to clear the power generators overdue.
- The accumulated outstanding payments to the power generators resulting in the investors' reluctance to participate in the competitive bidding for various power projects of TANGEDCO affected the investment in the power sector. They impacted employment opportunities, State GDP, and the power sector value chain.
- The massive accumulation of payments to TANGEDCO vendors results in higher costs, as they will factor in the delayed payments.

10.13 RECIPE TO ACHIEVE FINANCIAL VIABILITY OF TANGEDCO BY RATIONALIZATION OF TARIFF, SUBSIDIES, AND CROSS-SUBSIDIES

TANGEDCO suffers a significant revenue loss due to the irrational tariff structure, including massive subsidies and cross-subsidies. As a result, there is an urgent need for a rationalized tariff structure and a complete revamp in subsidy and cross-subsidy state policies in the redesigned business model to make TANGEDCO's business financially viable and sustainable. Therefore, a detailed study on the current tariff structure, subsidies, and cross-subsidies to various consumer tariff categories and their impact on the financial performance of TANGEDCO was made and is considered while redesigning the business model for TANGEDCO.

10.14 RATIONALIZATION OF SUBSIDIES AND CROSS-SUBSIDIES

10.14.1 Subsidies and cross-subsidies in LT domestic consumer tariff

TANGEDCO provides 13 different tariff categories to Low Tension (LT) customers connected to 240 V single-phase or 415 V three-phase power. TANGEDCO has 2.1 crore numbers of domestic service connections. TANGEDCO supplies LT power supply to domestic consumers under four slab categories depending on the power consumption quantum, as detailed in Table 10.5. The total subsidy allocation by the Govt. of Tamil Nadu for domestic consumers in FY 2018-19 was Rs.3,073 crore.

Table 10.5
Domestic consumer tariffs of TANGEDCO and subsidy disbursement in FY 2019

Domestic tariff categories	Power consumption per month	Percentage	Subsidy per service connection per year (Rs.)
Slab 1	Up to 50 kWh	12%	735
Slab 2	100 kWh	31%	1,845
Slab 3	250 kWh	31%	1,800
Slab 4	More than 250 kWh	26%	1,500
Total domestic		**100%**	**5,880**

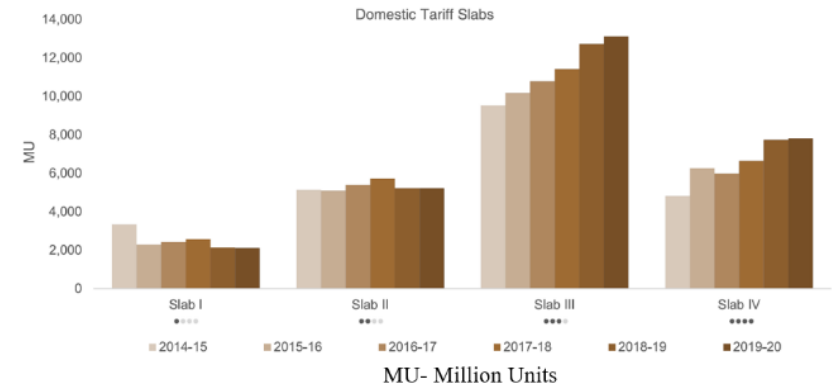
Source: TANGEDCO Tariff

10.14.2 Irrational allocation of subsidies by the state government

The intention of the Government of Tamil Nadu in allocating subsidies to domestic consumers is to assist economically disadvantaged consumers. Consumers in Slab-1, who consume less than 50 kWh per month, are financially disadvantaged and require a subsidy. However, it is to note that Slab 2 and Slab 3 consumers get the maximum subsidy benefit of Rs.1,845 and Rs.1,800 per service connection per year, respectively, as shown in Figure 10.3.

Figure 10.3

Category-wise total power consumption of the domestic tariff slabs of TANGEDCO from 2014-15 to 2019-20



Source: TNERC

Category-wise total power consumption under the domestic tariff of TANGEDCO

The State Government's subsidy allocation for domestic consumers in Slabs 1, 2, 3, and 4 is 17.22%, 35.30%, 39.95%, and 7.53%, respectively, out of the total subsidy allocation. Thus, consumers under Slabs 1 and 2 are getting more subsidy allocation. Thus, tariff Slab-1 provides subsidy support to economically disadvantaged domestic consumers who consume less energy. Subsidies allocated to Slab-2, Slab-3, and Slab-4 consumers who consume more energy, on the other hand, are not economically weaker consumers and do not deserve subsidies, but they receive a total annual subsidy of Rs.2,543 crore.

Furthermore, the Tamil Nadu government provides 100 units of free power bi-monthly to every domestic consumer, regardless of economic status, resulting in a revenue shortfall of Rs.3,654 per domestic consumer per year in the FY

2018-19 cost price of electricity. As a result, TANGEDCO is suffering a net revenue loss of Rs.7,373 crore each year due to the Government of Tamil Nadu's policy of providing 100 units of electricity supplied freely to every 2.1 crore domestic consumers.

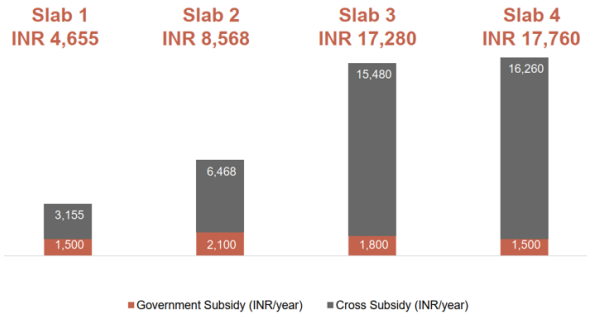
"As indicated in Figure 13.3, the subsidy allocation for Slab-1, Slab-2, Slab-3, and Slab-4 domestic consumers for FY 2019-20 is Rs.529 crore, Rs.1,085 crore, Rs.1,226 crore, and Rs.230 crore, respectively."

10.14.3 High subsidies and cross-subsidies to Slab-2, Slab-3, and Slab-4 domestic consumers

The average total annual subsidy and cross-subsidy enjoyed by domestic consumers in Slab-2, Slab-3, and Slab-4, as per the TNERC subsidy order dated 3.12.2018, are Rs.8,568, Rs.17,280, and Rs.17,760, respectively. As shown in Figure 10.4, consumers in Slabs 3 and 4 receive the highest subsidy and cross-subsidy in the range of Rs.17,000 per year.

Figure 10.4

Slab-wise average annual subsidy and cross subsidy to domestic consumers of TANGEDCO

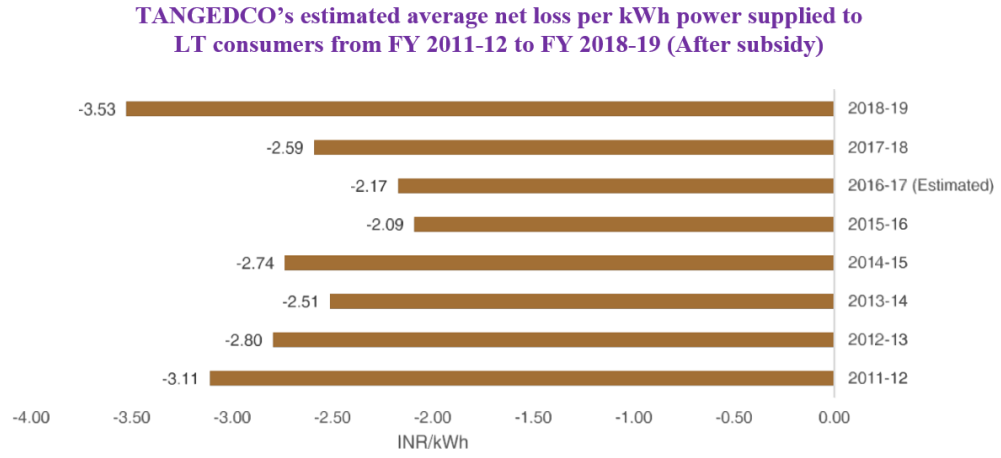


Source: TNERC Subsidy order 3.12.2018

The Government of Tamil Nadu incentivizes higher electricity consumption by granting more subsidies. However, this irrational subsidy disbursement undermines the purpose of subsidizing the weaker section, resulting in waste and uneconomical energy consumption, resulting in massive losses to the exchequer and TANGEDCO.

Net revenue loss is the difference between the supply cost and revenue from sales. Figure 13.5 shows an increase in net revenue loss per unit of power sold to LT consumers from FY 2011-12 to FY 2018-19. A higher revenue gap of Rs.3.53 per kWh in FY 2018-19 indicates the LT tariff reduction for domestic consumers compared to the previous years.

Figure 10.5



Increase in net revenue loss to TANGEDCO from FY 2015-16 to FY 2018-19

Source: India Research Ratings (2014), TNERC

10.15 DIRE NEED TO ARREST THE HUGE REVENUE LOSS DUE TO THE SALE OF ELECTRICITY TO LT CONSUMERS

The revenue loss from the sale of electricity for 13 different LT consumer categories is in Table 13.6. Except for two categories, viz., LT V (commercial) and LT VI (Temporary lighting and lavish illumination), TANGEDCO is incurring a revenue loss from selling power to 11 categories of LT consumers in FY 2017-18 both before and after subsidy. As a result, TANGEDCO incurs an average net loss of Rs.3.86/kWh before subsidy and an average net loss of Rs.2.59/kWh after subsidy.

This research finds that TANGEDCO incurs huge revenue loss consistently by supplying power to Domestic LT supply IV and Agricultural supply V categories, as TANGEDCO supply power at much below the Average Cost of

Supply (ACS). The subsidy granted to agriculture and domestic consumers increases year on year, as shown in Table 10.7.

The subsidy granted to agriculture and domestic consumers stood at Rs.1,590 and Rs.19,709 per consumer per annum. The combined subsidy given to agriculture and domestic consumers in 2018-19 is Rs.18,644 crore, 34% of the total power sold. The agricultural power consumers get a 100% subsidy, and the domestic consumers get a 64% subsidy.

Power supplied to these two categories is causing a considerable revenue shortage to TANGEDCO despite the cross-subsidies and part subsidy provided by the State Government.

Table 10.6

"Revenue loss to TANGEDCO from the sale of power under 13 LT categories for FY 2018

	LT Consumer Categories	Revenueloss from sales (Before subsidy) Rs. /kWh	Revenueloss from sales (After subsidy) Rs. /kWh
LT I-A	Domestic, Handloom, Old age homes, Consulting rooms, Nutritious Meals Centers, etc.	-5.31	-3.91
LT I-B	Huts in Village Panchayats, TAHDCO, etc.	-7.71	-4.73
LT I-C	Bulk Supply	-3.16	-3.16
LT II-A	Public Lighting, Public Water Supply &Sewerage	-0.81	-0.81
LT II-B (1)	Govt. Educational Institutions, Hospitals,Water supply, etc.	-0.87	-0.87
LT II-B (2)	Private Educational Institutions, Cinematheatre & Studios	0.63	0.63
LT II-C	The actual place of public worship, Mutts andReligious Institutions	-1.5	-0.3
LT III-A (1)	Cottage and Tiny Industries	-2.65	-2.65
LT III-A (2)	Power loom	-4.04	-0.69
LT III-B	Coffee grinding and Ice factories etc. andIndustries not covered under LT Tariff IIIA	-0.9	-0.9
LT IV	Agriculture and Govt. seed farms etc.	-7.71	-4.64

LT V	Commercial and all categories not covered un-der IA, IB, IC, IIA, II B1, II B2, II C IIIA 1, III A2, IIIB and IV	1.04	1.04
LT VI	Temp. supply (a) Lighting and combinedinstallations, (b) Lavish illuminations	13.02	13.02
	Average	**-3.86**	**-2.59**

Source: India Research and Ratings (2014), TNERC"

Table 10.7

Subsidy granted to Agriculture and Domestic consumers in Rs. /per consumer/per annum

FY	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-2020
Domestic	1,094.02	1,146.38	1,158.50	1,425.06	1,606.99	2,402.81	1,875.65	1,498.18	1,580.08
Agriculture	1,469.59	9,803.93	12,977.40	14,584.20	16,168.28	16,195.78	16,545.13	19,454.35	19,709.16

Source: TNERC

Hence, to make TANGEDO's business model financially viable and sustainable, there is a dire need to rationalize the tariff structure and reduce subsidies and cross-subsidies, especially to agriculture and domestic consumer categories.

10.16 REGULAR ANNUAL TARIFF REVISION

Another critical factor for the poor financial performance of TANGEDCO is the electricity tariff policy of the Government of Tamil Nadu and the state's unwillingness to revise the annual tariff revision while the cost of electricity is growing year-on-year basis. Non-revision of annual tariff causing substantial financial loss to TANGEDCO. TNERC has issued retail tariff orders only up to FY 2018-19.

"As per a report by the Ministry of Power on key regulatory parameters governing DISCOMs, 12 states/UTs, including Tamil Nadu, have issued True-Up Tariff Orders in FY 2017 or earlier. TANGEDCO has not filed a tariff petition for the yearly revision of tariff for the years 2020 and 2021." TNERC issued the last tariff order for TANGEDCO in 2017, including 2018 and 2019. However, the tariff is not trued up. The repeated omission in determining annual tariff revision has caused a vast accumulation of revenue gap resulting in the poor financial performance of TANGEDCO.

10.17 IMPACT OF HIGH HT TARIFF ON THE FINANCIAL PERFORMANCE OF TANGEDCO

Migration of HT consumers to open access

The industrial consumers of TANGEDCO contribute to the highest revenue, while domestic consumers contribute to the highest sales. In FY 2018-19, the average income from the power sale of power to industrial consumers is Rs.13.91 / kWh, which is 632% higher than the average revenue from the power sale of LT power to domestic consumers Rs.2.20 / kWh. It happens due to the industrial consumer pays a tariff much higher than the Average Cost of Supply by heavily cross-subsidizing to supply power free of cost to agriculture and a lower price to domestic consumers. Therefore, the higher tariff to industrial consumers yielded high revenues for TANGEDCO.

Due to an irrational tariff structure, many industrial and commercial establishments have either shifted to other states or migrated to open access to purchase power with lower tariffs. This results in the loss of revenue TANGEDCO from these migrated customers, loss of tax revenue to the state, and loss of employment opportunities.

As per TNERC, the aggregate open access HT consumption in 2016-17 has increased to 15,172 MU from 10,835 MU in 2015-16, an increase of 6%.

10.18 SUGGESTED TARIFF RATIONALIZATION, REDESIGN IN SUBSIDY, AND CROSS-SUBSIDY MECHANISM

To make its distribution business financially viable and sustainable in the redesigned business model of TANGEDCO, the **KEY PROCESS building block** and the **REVENUE STREAM building block** needs a radical change; Significant reform is required to implement a cost-reflective tariff structure and rationalize subsidies and cross-subsidies.

10.18.1 Irrational tariff structure of TANGEDCO

The present tariff structure of TANGEDCO is irrational. **Firstly**, the tariff charged to many consumer categories does not reflect its supply cost.

Secondly, there are enormous subsidies and cross-subsidies. For example, TANGEDCO provides free power to all agricultural consumers, regardless of their economic status or energy usage. Furthermore, a sizable portion of household electricity consumers pay tariffs significantly less than the cost of electricity. This has resulted in significant financial losses and energy waste due to uneconomic usage caused by untargeted subsidies and electricity supply at below-cost prices.

Thirdly, TANGEDCO, to compensate for the enormous subsidies given to agriculture and domestic power consumers, sell electricity to industrial and commercial consumers at a significantly higher price by highly cross-subsidizing the tariff.

Fourthly, subsidies are given on a blanket basis and are not given only to targeted consumers resulting in uneconomic usage of electricity, and wastage causing massive leakage in the Government Coffer.

Fifth, there are many tariff slabs and several categories within each slab in the present tariff structure, leading to delays in fixing and adopting the tariff, inefficiency in the collection, and complexity in understating the tariff structure.

10.18.2 Tariff reform to rationalize tariff structure

To address the above issue, the rationalization of tariff structure is of paramount importance to enhance financial insolvencies and achieve the financial viability of TANGEDCO and build a vibrant power sector in the state.

The Tariff reform to achieve the rationalized tariff structure should ensure the following:

(i) **Cost reflective tariff**

"Stringent provision needs to be made by amending Section 61 (g) of the Electricity Act 2003 so that SERC shall need to fix the tariff, which should reflect its cost in every tariff fixation."

(ii) **Limiting Cross Subsidies**

"Cross-subsidies should not be more or less than 20 per cent of the Average Cost of Supply (ACS) to any consumers and shall be categories, and the cross-subsidy needs to be phased out in 2 to 3 years."

(iii) **Targeting subsidies**

The subsidy should go only to the most needed and deserving consumers. TANGEDCO loses an aggregate revenue of Rs.10,679 crore in 2018-19 by selling electricity to domestic consumers at sub-optimal prices, as all the 1.2 crore domestic customers are getting 100 units of free power bi-monthly in each billing cycle

(iv) **Multi-Year Tariff (MYT)**

TANGEDCO needs to adopt the MYT structure to improve the tariff revenue by improving the billing and collection efficiency.

(v) **Simple Tariff Structure**

"Tariff structure should be simple, with no more than three to four categories."

(vi) Compulsory annual Tarif revision

TANGEDO incurred substantial financial losses due to the non-revision of tariffs periodically. Therefore, TANGEDCO needs to file the tariff petition to TNERC. Power is the prime mover and is essential for the sustained growth of the country's economy, for which the financial viability and sustainability of DISCOMs are of paramount importance.

In the national interest, appropriate amendments to the Fiscal Responsibility and Budget Management (FRBM) Act are required, establishing a stringent condition stating that failure to implement periodic and timely tariff revisions will result in FRBM Act fund allocations withholding. The tariff structure shall have timely variations in tariff on increases/decreases in fuel cost.

(vii) Non-creation of regulatory assets:

Due to the Non-cost reflective Tariff, and non-revision of tariff regularly each year, TANGEDCO has created a regulatory asset of Rs.32,532 crore. Therefore, stringent provision needs to be made in the proposed tariff policy. Thus, in the Electricity Amendment Bill 2012, SERCs shall not approve the creation of regulatory assets, ensuring timely revisions and drastically reducing the revenue gap.

10.19 COST-REFLECTIVE TARIFF

To achieve a financial turnaround, the state power regulator will need to issue a tariff order with a tariff charged to each consumer that reflects its cost of supply and has an Average Billing Rate (ABR) that is somewhat higher than TANGEDCO's cost of supply. Therefore, to accomplish the cost-reflective tariff, the support of the state government is essential.

10.19.1 Rs.10,793 crore additional revenue from domestic tariff to TANGEDCO by adopting cost-reflective tariff

With massive tariff subsidies and cross-subsidies, the present tariff structure results in TANGEDCO selling power below its average supply cost. Therefore, to improve the financial health of TANGEDCO and do its business financially and commercially viable and sustainable, a rational tariff structure is of paramount importance. Furthermore, subsidies should be paid directly to most in-need consumers, based on their socio-economic status, and blanket distributions of subsidies should be stopped immediately. Accordingly, the following rational tariff structure is suggested for domestic consumers:

1. The bi-monthly free supply of 100 units to all domestic consumer categories must be discontinued immediately, as it results in substantial financial losses to TANGEDCO. In the fiscal year 2018-19, domestic consumers paid an average tariff of Rs.2.20 per kWh, compared to an average supply cost of Rs.6.09 per kWh. As a result, TANGEDCO incurs a revenue loss of Rs.3.89 per kWh and a total revenue loss of Rs.10,669 crore due to the sale of 27,421 MUs to domestic consumers result of the extreme tariff reduction.

2. The tariff for all four domestic tariff slabs needs to be increased to Rs.7.00 per kW-Hr in line with its average supply cost.
3. The Government of Tamil Nadu gives blanket subsidies to all 1.2 crore domestic consumers. All do not deserve to receive subsidies, which results in massive loss to the state exchequer and loss of tariff revenue to TANGEDCO. Limiting subsidies only to the domestic consumer under Slab-1 leads to a reduction of Rs 2,543 crore in subsidies and an increase of Rs 10,793 crore in Income every year.
4. Govt. of Tamil Nadu may directly transfer the subsidies to THE most needed consumers under LT categories through direct benefit transfer. However, all domestic consumers shall be charged a cost-reflective tariff. There is a dire need to carry out this reform by the Government of Tamil Nadu to come out of the financial mess and make TANGEDCO's business financially viable.
5. Fixed/demand charges collected by TANGEDCO have not recovered the fixed costs incurred; hence, the collection of demand charges must be rationalized according to the cost.
6. As a substitute to cross-subsidies, Govt. of Tamil Nadu may raise the resources by imposing electricity duty, and subsidies can be given only to the most needed consumers based on their economic status of the consumers.
7. The tariff should be designed to collect fixed costs through demand charges and variable costs through energy charges to cover the Average Revenue Required (ARR).

10.20 DIRECT BENEFIT TRANSFER (DBT) SCHEME

10.20.1 Regulatory flaws in tariff determination

"Section 29 (2) of the Electricity Regulatory Commission Act 1998 requires the State Electricity Regulatory Commission (SERC) to set the terms and conditions for tariff fixation by regulations. Furthermore, it shall adhere to Sub-clause (c) in ensuring that *the tariff represents the price of energy supply at an acceptable and increasing efficiency*."

"According to Section 61 (g) of the Electricity Act 2003, *tariffs must gradually reflect the cost of power supply progressively and reduce or remove cross-subsidies within a period defined by the commissions."* [37]

However, in actual practice, SERCs fix the tariff below the average cost level, resulting in substantial financial losses to DISCOMs. The cost-reflective tariff fixation remains in law and not in practice. As a result, the unrecovered cost has been booked as the regulatory assets in the DISCOMs balance sheet.

"As of June 2020, the total regulatory assets of state-owned DISCOMs stood at Rs. 1,40,000 crores, i.e., money owed to Discoms which was not collected through prompt tariff revisions in line with its cost price." [36].

The state power regulators (SERC) determine the tariff by considering the expected tariff subsidy from the state government, resulting in the fixation of tariff at a lower price than the cost of supply, leading to an under-recovery of cost.

"According to Section 65 of the Electricity Act of 2003, the State Government is required to pay DISCOMs subsidies in advance, i.e., at the beginning of the Financial Year." However, most state governments do not pay the total subsidy upfront to DISCOMs. This research finds that the delayed payment of subsidies and non-payment of subsidies by the state government results in a vast revenue shortage to the state-run DISCOMs, which results in defaults in payment of dues payable by DISCOMs to the power generator due to liquidity crisis. To bridge the enormous revenue gap, Discoms are resorting to borrowing Short-term loans heavily from Banks and Financial Institutions, which further adds to the cost of electricity supply and are to be borne by the consumers.

"As of January 2021, the aggregate overdue payable by state-owned DISCOMs to power generating companies for the power purchase stood at Rs.1,26,559 crore" [29]. "This research finds that '" non-cost reflective tariff is

one of the main reasons for the more significant gap between the Average Cost of Supply (ACS) and Average Revenue Realized (ARR), resulting in substantial commercial losses DISCOMs." Therefore, the Government of India has approved s.1,20,000 crore liquidity package in the form of loans from PFC and REC to bail out the DISCOMs from a deep liquidity crisis and clear the vast overdue payable by state-owned DISCOMs to the power generating companies.

"Both central and state governments must recognize that a robust reform through policy framework in the power distribution sector is critical to achieve the sustainability of the Indian power sector and to make the power distribution business of state-run DISCOMs financially viable and sustainable. The repeated bailouts cannot be the solution to the perennial problems of the DISCOMs."

10.20.2 DBT Scheme - A breakthrough policy initiative of the Government of India

"In the Electricity Amendment Bill, 2020, the Government of India proposed implementing the Direct Benefit Transfer (DBT) Scheme to transfer subsidies directly to beneficiaries. The DBT scheme is aimed at addressing the issue of state-owned DISCOMs' sustained financial losses due to non-cost reflective tariffs, which would be a game-changing reform in the Indian power distribution sector." [36]. The principles of DBT were also incorporated in the Tariff Policy 2018.

As per the proposed DBT Scheme, the state government will pay the subsidy amount directly to the consumer account maintained with the DISCOMs. Therefore, DBT Scheme would be the single most significant regulatory reform of the central Government. If properly implemented, it will help state-run DISCOMs achieve financial sustainability by replacing cross-subsidies with direct subsidies to consumers while fostering transparency and accountability.

Mandating SERCs through amendment in the Electricity law to determine and fix the full cost tariff without considering the subsidies would bridge the gap between ACS and ARR. Subsidies must be paid directly to targeted customers by the state government through DISCOMs. Implementing the DBT scheme would further help state-owned DISCOMs solve their chronic cash flow and liquidity problems and pave the way for their power supply businesses' financial and commercial sustainability.

DBT pilots implemented in Punjab and Andhra Pradesh agriculture

Before the proposed Electricity Amendment Bill (2021), the Government of Andhra Pradesh and the Govt. of Punjab started implementing the DBT Schemes on a pilot basis. As an agrarian state, approximately 25% of electricity is consumed by agriculture consumers, and the Punjab government pays approximately Rs.6,800 crore to Punjab State Power Corporation Ltd (PSPCL) as a subsidy for providing free electricity to the agricultural sector. Free supply of electricity results in excessive water and energy consumption due to its uneconomical usage.

In addition, Punjab faces a severe challenge of depletion of groundwater. Therefore, Punjab has implemented a pilot DBT scheme under Phase-I in six feeders in three districts and started implementing the DBT Scheme under phase II in 250 feeders in 11 districts. Under the DBT Scheme of Punjab, incentives are given to farmers to use electricity and power more efficiently while maintaining a free power policy for agriculture. The DBT plan in Punjab limits how much electricity each feeder can use. For each unit of energy saved, the agricultural consumer would receive Rs.4.00 per kWh as an incentive paid into their bank account.

Under the DBT Scheme, about 5 per cent of farmers enrolled, and PSPCL has disbursed an incentive of Rs.48 lakhs and Rs.9 lakhs under Phase-I and II, respectively. In addition, the World Bank is providing field-based implementation support. Furthermore, meter reading devices are installed on the registered farmers' feeders to monitor power use as part of the scheme's

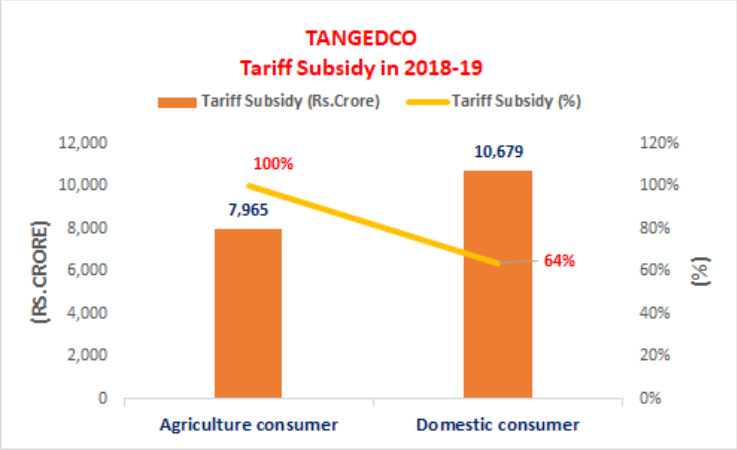
implementation. According to the World Bank, on-time transfer of cash incentives to farmers with regular communication is essential to maintain their interest and build trust [62].

10.21 DBT SCHEME FOR TANGEDCO

"As per the PFC report 2019 [44], TANGEDCO has incurred a massive loss of revenue loss of Rs.18,644 crore in FY 2018-19 due to selling the electricity free of cost to all agricultural consumers and at a highly subsidized tariff to domestic consumers as shown in Figure 10.6. In 2018-19, the revenue loss to TANGEDCO on the sale of power free of cost to agriculture consumers was Rs.7,965 crore and revenue loss of Rs.10,679 crore by selling electricity at 64% subsidy to domestic consumers."

The above colossal subsidy is mainly funded by charging higher tariffs to industrial and commercial consumers with high cross-subsidy and partly through the State Subsidy.

Figure 10.6



Source: PFC Report 2018-19 [37]

Tariff subsidy of TANGEDCO in farm and domestic sector in 2018-19

By implementation of DBT Scheme and by giving subsidies only to deserving customers, TANGEDCO's revenue collection will improve drastically, which would enhance its financial viability in a big way as detailed below:

1. Targeted subsidy to domestic consumers

TANGEDCO may earn an additional income of Rs.10,793 crore per year by selling power to domestic consumers if it only provides subsidies to Slab-1 customers (i.e., consuming 50 kWh units per month).

2. TANGEDCO may follow the best practice of Kerala

TANGEDCO may follow the best practice at KSEB Ltd in Kerala to pass subsidies to domestic consumers. KSEB allows 100% subsidy to domestic consumers based on satisfaction of all three conditions viz., (i) The consumer should be Below the Poverty Line consumers (ii) The total connected load should be less than 1 kW (1,000 Watts) and (iii) 20 kWh is free per month. If the power consumed by the consumer increases above this threshold limit, the consumer needs to pay for the entire consumed units of energy. The revenue collection and financial performance have drastically improved due to the implementation Multi-Year Tariff (MYT), reflecting the cost of power and targeted subsidies.

According to the PFC report [44], in 2018-19, agricultural consumers received 100 per cent free power, accounting for 17 per cent of total consumption (13,078 MU), resulting in an annual tariff revenue loss of Rs.7,965 crore for TANGEDCO, which is financially unsustainable and has impacted state finances.

TANGEDCO does not have energy meters for almost 20 lakhs of agricultural consumers. The state government is paying agricultural subsidies to TANGEDCO based on approximate estimation at the rate of Rs.2,875/HP/per annum, which needs to be discontinued. TNERC shall determine the state government's tariff subsidy based on the agricultural consumers' actual power. TANGEDCO can not control costs and reduce losses unless each power used is measured.

3. 100% metering of all consumers

Un-targeted blanket subsidy with 100% free supply to all agricultural consumers irrespective of their economic status resulting in wastage and uneconomical use of electricity and is against the sustainable development goal, resulting in substantial financial loss.

4. Subsidies only to Small and Marginal farmers

TANGEDCO needs to implement DBT Scheme. The free power supply is to be provided only for the deserving farmers, small and marginal farmers. The quantum of free energy shall be provided with an upper ceiling limit per month to these targeted customers to avert the wastage of power and water level depletion, as the water table in many districts has gone below 1,000 feet. TANGEDCO must install smart meters for about 20 lakhs of unmetered agricultural consumers to conserve water and economical use of electricity. Each unit of energy consumed by all consumers needs to be metered and billed. Deserving customers shall be given subsidies under DBT Scheme. TANGEDCO is expected to get additional revenue of about Rs.5,000 crore and save on subsidy to the state government of about Rs.1,500 crore on implementing the DBT scheme. The State Government may improve the state GDP by increasing agricultural production and may consider giving higher subsidies.

The Government of Tamil Nadu must pay the subsidy monthly through the Direct Benefits Transfer (DBT) scheme to consumers through TANGEDCO to allow the company's power distribution business to be financially and commercially viable and sustainable. Implementing the DBT scheme would enable TANGEDCO to restructure its finances and pay its power bills to the GENCOs on time. This would significantly increase its billing and collection efficiency. Additionally, by lowering losses, TANGEDCO can fund the necessary capital expenditure to operate its distribution network efficiently.

TANGEDCO may implement telescopic tariffs (i.e., different tariffs based on consumption slabs) based on its supply cost to agricultural consumers, say up to 100 units, 101-250 units, and above 250 units with a higher tariff rate for higher consumption. This would result in energy and water conservation besides making it business sustainable.

Govt. of India in the budget for the FY 2021-22 has allocated an amount of Rs.3.04 lakh crore for the implementation of the reform-based result-oriented distribution scheme called Restructured Distribution sector Scheme (RDSS) to improve the financial viability and operational efficiency of DISCOMs, out of which about 50 per cent of the fund allocated for implementation of smart metering/pre-paid metering. Therefore, TANGEDCO needs to avail capital subsidy available under the reform scheme to implement 100% metering of Feeders, Distribution Transformers, and consumer metering, including 100% metering of all agriculture consumers to improve the collection efficiency.

By rationalizing the tariff, implementing the DBT Scheme, establishing the metering infrastructure, implementing the HVDS Scheme, and strengthening the distribution infrastructure, TANGEDCO could achieve a reduction in AT&C loss below 10% and a zero gap between the ACS and ARR within five years, significantly improving the company's financial viability.

10.22 REDUCTION OF UNFUNDED SUBSIDIES

10.22.1 Unsustainable subsidy- flaws in the regulatory process

Massive, unsustainable, and unfunded subsidies are significant contributors to the financial losses of TANGEDCO. The major flaw in the regulatory process in tariff determination by SERC is that it considers the subsidy receivable from the state government while determining the tariff. In that case, the tariff will not reflect the cost of supply. Secondly, State Government rarely releases the subsidy at the start of the financial year as per the mandate, resulting in a considerable revenue shortfall and a severe liquidity crisis for DISCOMs. Thirdly, SERCs, instead of increasing the tariff regularly, sometimes chose to book regulatory assets to cover the tariff under-pricing.

10.22.2 Blanket subsidy- A significant factor causing financial loss to TANGEDCO

The subsidy should not be granted as a blanket subsidy to all. In Tamil Nadu's case, the power supply to the agricultural consumers is free irrespective of the economic status of the farming consumers. Similarly, as per the govt policy, every domestic consumer shall get 100 units of electricity free of charge in each billing cycle irrespective of their socioeconomic status. The blanket subsidy given by the state government for their political gains ruins the financial viability of the state-run DISCOMs, hampers the development of power sectors and other sectors of the economy, and acts as a huge stumbling block to economic growth. Why does a wealthy person also enjoy a subsidy of 100 units free of cost at the cost of deterioration of the power sector's financial health?

10.22.3 Rationing of subsidy

Subsidies to customers should be limited in the number of units, as in the case of cooking gas subsidies (9 cylinders per year) to selected consumers, to improve efficiency and plug leaks, which would pave the way for energy conservation and efficient use of electricity.

10.22.4 Targeted subsidy

Of course, the state government needs to subsidize the neediest people and economically weaker sections. However, it should be given only to the most disadvantaged people like Below Poverty Line (BPL) consumers, poor agriculturists, and economically weaker sections.

10.22.5 Direct transfer of subsidy to the beneficiaries

The research finds that massive subsidy, non-receipt of subsidy on time as provided in the Electricity Act, 2003, inadequate receipt of subsidy, and delayed receipt of subsidy from the state government has significantly contributed to the severe liquidity crisis, financially unviable and unsustainable business of TANGEDCO. Therefore, determining and fixing a

cost-reflective tariff by TNERC and adopting the same by DISCOMS would significantly reduce the losses of TANGEDCO. Thus, the subsidy component should not be considered when determining the tariff to achieve the cost-reflective tariff.

Suppose the state government or the Central Government wants to give a subsidy. In that case, it should be given directly to the targeted consumers through the Direct Benefit Transfer of Subsidy (DBT) scheme as in the case of targeted subsidy being given to the targeted beneficiaries of cooking gas. There is strong opposition from almost all the states for not implementing the DBT Schemes for political reasons. However, it needs to be implemented in the nation's interest and arrest leakage, which requires strong political will.

10.23 TECHNOLOGICAL INTERVENTIONS FOR VALUE CREATION, CAPTURE, AND DELIVERY

TANGEDCO needs to adopt technological innovations viz., Smart meters/pre-paid meters, AMR metering, Global System of Mobile (GSM) communication, SCADA, and Distribution Management systems in urban areas to drastically improve billing and collection efficiency. Online Customer Relationship Management (CRM) by TANGEDCO helps detect and attend to faults quickly. Improved power availability results in better customer delivery and improved customer satisfaction. TANGEDCO needs to implement HVDS and Feeder segregation scheme in agriculture, which would help it to reduce its AT&C level by about 3%.

Tata Power and Reliance Energy have implemented all the above technological interventions in Delhi and Mumbai, which helped improve the billing efficiency and collection efficiency to nearly 100% and reduce the AT&C loss to below 8% level. The use of technological interventions by TANGEDCO paves the way to create, capture and deliver values to its customers and pave the way for revenue enhancement to TANGEDCO.

TANGEDCO shall take the opportunity to implement the above schemes under the Government of India's new Revamped Distribution Sector Scheme by availing capital subsidy and reaping the innumerable benefits to improve its operational efficiency.

10.24 INPUT-BASED FRANCHISEE TO ENHANCE BILLING & COLLECTION EFFICIENCY

TANGEDCO has not provided energy meters to all agricultural customers, and TANGEDCO is receiving subsidies from the Tamil Nadu government based on installed motor capacity rather than actual power consumption, which results in substantial losses to TANGEDCO.

Given TANGEDCO's weak financial position and the Government of Tamil Nadu's high debt level, stressed financial position, and sustainability of TANGEDCO's power supply business, TANGEDCO must measure and bill 100% of all energy consumed by all consumers, including agricultural consumers, to increase revenue collection and sustain in its power supply business.

It is not sustainable to provide free electricity to all agricultural consumers without limiting the amount of subsidy. Hence the state government should offer the subsidy directly to qualified consumers through the DBT Scheme. Further, TANGEDCO shall need to engage an input-based franchisee in agricultural and rural areas to drastically improve its billing and collection efficiency.

10.25 RESTRUCTURING OF REGULATORY FRAMEWORK

According to this study, the state government's solid political intervention with TNERC in fixing tariffs irrationally with massive subsidies and cross-subsidies, non-revision of tariffs regularly results in the vast gap between ACS and ARR to the tune of Rs.1.82 per Kw-Hr. This huge cap between ACS and ARR led to massive financial losses for TANGEDCO.

Implementing a cost-reflective tariff, compulsory tariff revision every year, and DBT Scheme would help avert the state's interference with TNERC in the tariff-setting process. In addition, the Government of India proposed Electricity Amendment Bill, 2021, which would help achieve the most needed reform.

In addition, the Government of India proposed in the proposed Electricity Amendment Bill, 2021, that the Chairman and members of SERCs be chosen by a Selection Committee consisting of an equal number of members from the State and Central Governments, chaired by the Chief Justice of the State's High Court. This would pave the way for the state government's involvement in the SERC's regulatory process to be separated.

10.26 POWER PURCHASE COST REDUCTION

TANGEDCO's average supply cost has increased due to higher power purchasing costs. Therefore, TANGEDCO needs to reduce its power purchase cost by purchasing power exchange and renewable energy generators at a lower price. TANGEDCO should gradually phase out high-cost thermal power, which costs more than Rs.4 per kW-Hr and shall procure power from renewable energy sources as it costs less than Rs.3 per kW-Hr.

TANGEDCO should phase out the old, inefficient thermal plant. Further, it should not renew the PPAs signed with power generators, which supply high-cost thermal power. As per the report published by M/s Auroville consulting in August 2020 based on a case study made in TANGEDCO, by replacing the high-cost thermal with low-cost renewable power, TANGEDCO shall save Rs.6,000 crore annually by reducing power purchase cost and regular tariff revision.

10.26.1 Solarisation of agricultural pump sets and rooftop solar

To reduce its power purchase cost, TANGEDCO and reduce agriculture subsidy, TANGEDCO needs to implement solarisation of agriculture pump

sets, as was implemented successfully in Andhra Pradesh. Further, it would help achieve the Renewable Power Purchase Obligation (RPO).

10.27 CREATION OF ECONOMIC, SOCIAL AND ENVIRONMENTAL VALUES

10.27.1 Economic values

The redesigned business model of TANGEDCO by drastically reducing the financial losses and improving its profitability would significantly contribute to its overall economic development and socio-economic development. The redesigned business model decreases the subsidy dependence and additional demand for power by reducing avoidable power consumption and government money losses and leakage. It paves the way for the economical usage of the scarce commodity viz., electricity and water and helps to achieve the conservation of electricity and water, resulting in sustainable development as shown in Figure 13.1

10.27.2 Social values

The redesigned business models shall significantly contribute to society by creating and delivering social values and paving the way for social development, employment generation, community development, and Tamil Nadu's people's well-being, as depicted in the redesigned business model (Figure 10.1).

10.27.3 Environmental value

By implementing schemes such as solarization of agriculture pump sets, rooftop solar, and the Government of India's KUSUM Scheme, more renewable energy capacity in TANGEDCO's energy mix would reduce the average supply cost while creating environmental values. This would result in even more drastic reductions in carbon dioxide emissions and a reduction in power consumption through targeted subsidies, all of which would enable India to achieve its sustainable development goals and a sustainable power sector, as shown in Figure 10.1.

10.28 CONCLUSION CHAPTER SUMMARY

Based on the findings from the research and considering the inherent weaknesses in the business model of TANGEDCO, a financially and commercially viable and sustainable business model has been redesigned for TANGEDCO. The needed reform to implement the redesigned business model is prescribed to the Government of India. Successful implementation of the business model by TANGEDCO would drastically improve the financial and operational performance of TANGEDCO and would make the distribution business of TANGEDCO financially, and commercially viable and sustainable. It would help TANGEDCO to reduce the AT&C losses below 15% and to reduce the gap between the ACS and ARR to negative, thus TANGEDCO could make a profit out of their power distribution business.

Implementation of HVDS would help TANGEDCO drastically reduce the distribution losses, and improve the tail and voltage, thus enhancing the quality of the power supply, the possibility of a 24 x 7 power supply and improved customer satisfaction. Implementation of the needed rationalisation of subsidies, cross-subsidies and tariff rationalization would help TANGEDCO to contain the huge financial losses and improves the billing and collection efficiency and financial position. On implementation of the redesigned business model, the financial position of the company and liquidity position and cash flow positions would improve, which would help TANGEDDO to make the needed investment in the distribution business to strengthen the power infrastructure, besides attracting the private investment in the renewable generation to meet out the future power demand.

Electricity is listed on India's concurrent list, and its distribution by DISCOMs is highly regulated. The state-owned DISCOMs operate their power distribution business in almost similar business environments, viz., regulatory, legal, environmental, social, economic and political, and the factors causing the financial losses of the state-run DISCOMs are also typical. Only the intensity of the factors varies from DISCOMs to DISCOMs. Hence, the redesigned business model for TANGEDCO could be adopted by other state-

run DISCOMs across the country to make its business model financially, and commercially viable and sustainable. The implementation of the redesigned business model would help to achieve a vibrant and sustainable power sector in India.

CHAPTER 11

RESEARCH CONTRIBUTION

11.1 THEORETICAL CONTRIBUTION

This novel research study made in the Indian power distribution sector and an in-depth study made at TANGEDCO have successfully diagnosed 56 independent variables and 17 latent variables that significantly contribute to the sustained financial losses to the state-run DISCOMs in India. This study also successfully diagnosed the interrelationship between the independent and latent variables. Based on the relationships between 56 identified independent variables (measured variables) and 17 latent variables, 17 formative constructs have been developed (13 first-order constructs and two second-order constructs, one third-order construct and one fourth-order master construct). Using the 56 measured variables and 17 latent variables, and the interrelationship amongst independent and latent variables, a theoretical model (conceptual framework) was successfully developed using Partial Least Squares Structural Equation Modeling (PLS-SEM) for diagnosing the factors contributing significantly to the sustained financial loss of TANGEDCO. The theoretical model developed for TANGEDCO is a complex model having 17 formative constructs, 56 independent variables, and 17 latent variables (which include 4 endogenous variables and 13 exogenous variables) contributing to the sustained financial loss of TANGEDCO. The theoretical model developed was evaluated by the bootstrapping method in PLS-SEM using SmartPLS3 software and the model developed is found to be a fit and acceptable model.

The research conducted so far in the Indian power sector has identified several factors causing the financial losses of the state-run DISCOMs, scattered in several research reports, theme papers and findings from numerous reforms implemented in the Indian power distribution sector. However, by using the identified factors, no theoretical model has been developed for the state-owned

DISCOMs to diagnose the factors that significantly contribute to their sustained financial losses.

By developing a theoretical model for diagnosing the factors contributing significantly to the sustained financial loss of TANGEDCO, this research has contributed significantly to the development of the theory. The theoretical model developed for the state-run DISCOMs in India to diagnose the factors significantly contributing to its sustained financial losses is a unique model developed for the first time in the research world.

11.1.1 Contribution to the development of business model generation

There was a dearth of research done for redesigning the business models of financially unviable state-owned Indian DISCOMs. A successful business model for the state-run Indian DISCOMs was not developed or redesigned to make the power distribution business financially viable and sustainable.

By this innovative research study, based on the diagnosed factors contributing to the sustained financial loss of TANGEDCO and the interrelationship amongst the latent variables and formative constructs, a financially viable and sustainable business model for TANGEDCO was developed using the concept of Dynamic Business Model for Sustainability (DBMS) by redesigning various components of the business model. Quantitative and qualitative analysis proved that by making the changes suggested in the business model of TANGEDCO, it could achieve financial viability in five years, and its power distribution business will become financially and commercially viable and sustainable. On implementation of the redesigned business model suggested for TANGEDCO, its operational and financial efficiency of TANGEDCO would drastically improve.

Successfully rebuilding a financially viable and sustainable business model for TANGEDCO, Is unique in the research parlance, which **contributed significantly to the theory of rebuilding in the concept of 'business model generation', 'value creation and sustainable business models.**

11.1.2 Contribution to the development of theories & concepts

The electricity supply business of DISCOMs in India is highly regulated. Electricity is a concurrent subject in the Indian constitution. Hence, the Government of India and state governments shall exercise legislative powers in the power supply business of the state-run DISCOMs. The State-run DISCOMs in India are operating in a similar business environment viz., regulatory, legal, social, economic and political environments. Therefore, all the state-run DISCOMs in India shall adopt the business model developed for TANGEDCO by making suitable changes in the business model through a similar study.

A financially viable and sustainable business model redesigned for TANGEDCO has significantly **contributed to the theory of developing a sustainable business model and the concept of business sustainability.**

11.1.3 Contribution to the energy policy and power sector reforms

Both the government of India and the state governments have implemented several reforms in the power distribution sector since 2003 to improve the financial viability of the state-run DISCOMs, which is one of the prime objectives of the Electricity Act, 2003. However, the past reforms implemented in the distribution sector have not achieved this prime objective and the power distribution business is financially unviable and unsustainable. In this landmark research work, the business model of TANGEDCO has been redesigned to achieve its financial viability and business sustainability.

The redesigned business model shall be adopted by other state-run DISCOMs to improve their financial viability, which would lead to achieving a sustainable and robust power sector in India. *The most needed reforms to be implemented in the power distribution sector to achieve the financial viability of the state-run DISCOMs. Thus, this innovative and landmark research has contributed significantly to the energy policy and implementation of the needed reforms in the Indian power sector.*

11.2 PRACTICAL CONTRIBUTIONS/IMPLICATIONS

On implementation of the redesigned business model by TANGEDCO and all the state-run DISCOMs, would result in making the power supply business of the state-run DISCOMs financially and commercially viable and sustainable, which would pave the way for the development of power sectors and all the sectors of the economy and the socio-economic development of the country.

11.2.1 Implication to TANGEDCO

Successful implementation of the business model by TANGEDCO would drastically improve the financial and operational performance of TANGEDCO and would make the distribution business of TANGEDCO financially, and commercially viable and sustainable. It would help TANGEDCO to reduce the AT&C losses below 15% and to reduce the gap between the ACS and ARR to negative, thus TANGEDCO could make a profit out of their power distribution business.

Implementation of HVDS would help TANGEDCO drastically reduce the distribution losses, and improve the tail and voltage, thus enhancing the quality of the power supply, the possibility of a 24 x 7 power supply and improved customer satisfaction. Implementation of the needed rationalisation of subsidies, cross-subsidies and tariff rationalization would help TANGEDCO to contain the huge financial losses and improves the billing and collection efficiency and financial position. On implementation of the redesigned business model, the financial position of the company and liquidity position and cash flow positions would improve, which would help TANGEDDO to make the needed investment in the distribution business to strengthen the power infrastructure, besides attracting the private investment in the renewable generation to meet out the future power demand.

11.2.2 Implications to the State-run Indian DISCOMs

Electricity is listed on India's concurrent list, and its distribution by DISCOMs is highly regulated. The state-owned DISCOMs operate their power distribution business in almost similar business environments, viz., regulatory,

legal, environmental, social, economic and political, and the factors causing the financial losses of the state-run DISCOMs are also typical. Only the intensity of the factors varies from DISCOMs to DISCOMs. Hence, the redesigned business model for TANGEDCO could be adopted by other state-run DISCOMs across the country to make its business model financially, and commercially viable and sustainable. The implementation of the redesigned business model would help to achieve a vibrant and sustainable power sector in India.

11.2.3 Implication to the Central & State Governments

The sustained financial losses of the state-run DISCOMs have necessitated the central government to pump in crores of money to make the state-run DISCOMs business financially viable and sustainable, which is not needed if the DISCOM business is made financially viable. Thus, huge savings to the exchequer. This fund could be utilized for the implementation of most needed projects. It is noted that under UDAY schemes, the state governments were forced to take over the huge debts owed by the state-run DISCOMs due to its deterioration of financial position and acute liquidity crunch and the huge defaults made by DISCOMs to the power generator. These could be averted, thus huge savings to the state government.

In FY 2020-21 and FY 2021-22, the state-run DISCOMs defaulted in making the payment to their power suppliers (both state-owned and Independent Power Producers) to the tune of Rs.1,10,000 crore and Rs.1,20,000 crore respectively. Ultimately, the Government of India has infused Rs.Rs.1,20,000 crore bailout packages to the ailing state-run DISCOMs. Such huge bailout packages to the state-run DISCOMs shall not be needed once the state-run DISCOMs' businesses are financially viable and sustainable. Thus, there would be huge savings for the exchequer.

Rationalization of subsidies and cross-subsidies and rationalization of tariffs suggested in the redesigned business model would bring more revenues to the

DISCOMs and hence, the state and central government need not necessarily sanction huge financial restructuring packages to the ailing discoms.

11.2.4 Implication to the Indian power sector

Power is the prime mover of the economy. The state-run DISCOMs are making huge financial losses continuously, as their business becomes financially unviable and sustainable, which has heavily impacted the development of power sectors and the overall economic development of India besides posing a major threat to the nation's energy security. Govt. of India and the state government are infusing lakhs of crores of rupees to reform the power distribution sector and to make the state-run discoms business financially and commercially viable and sustainable. Thus, making the state-run DISCOMs business financially viable and sustainable is very crucial for the economic development of India. DISCOM is the weakest link in the entire power sector value chain. Making the discoms business financially viable and sustainable through the implementation of the business model suggested would help to achieve the development of the Indian power sector and make it a vibrant and robust power sector.

Govt. of India has planned to add a generation capacity addition of 500 GW in renewable energy by 2030 to achieve the sustainable development goal target, which requires an approximate investment of about Rs.18 lakh crore, out of which about 70 per cent is expected to come from private investors. Since the state-run discoms are making huge financial losses and discoms are the cash register for the entire power sector value chain, private investors are risk averse and are hesitant to make a huge investment in the massive renewable energy capacity addition program planned by the Government, which would be a major roadblock in achieving the sustainable development goal. Once the state-run DISCOMs power distribution business is made financially viable and sustainable, the Indian power sector could attract the most needed private investment in the renewable energy generation sector, which would help to achieve the sustainable development goal of the country.

11.2.5 Implication to the banking & finance sector

State-run DISCOMs have made huge defaults to the loan given to the DISCOMs, which results in huge Non Performing Assets (NPA) in the loan book of the Banks and Financial Institutions, which would not arise if the DISCOM's business are made financially viable and sustainable.

11.2.6 Implications to the socio-economic development & Nation building

Power is the prime mover of the economic development of any nation. The redesigned financially viable and sustainable business model of the state-run DISCOMs would make its business sustainable and would help achieve a sustainable power sector in India by supplying reliable and quality power around the clock, would contribute significantly to the nation's overall socio-economic development and help the nation to achieve the sustainable development goal. Therefore, this research study is of national importance and would pave the way to contain the burgeoning financial losses of the state-run DISCOMs and build a vibrant power sector. *Thus, this innovative research would substantially contribute to the economic growth of the nation and nation-building.*

11.2.7 Implications on value creations to the stakeholders of DISCOMs & power sector

State-run DISCOMs have defaulted in making payments to its several stakeholders viz., Defaults made to the tune of Rs.1,20,000 crore for the power procured by DISCOMs, defaults in making the transmission charges, payment defaults to its various suppliers and creditors and many state-run DISCOMs are unable to pay the salary and pension payments to its employees due to its severe liquidity crunch due to unviable DISCOMs business. By implementing the redesigned business model, the discoms would become cash rich and its financial position would improve and its business would become financially viable, thus it would create value for all its stakeholders.

Economic values

The redesigned business model of TANGEDCO by drastically reducing the financial losses and improving its profitability would significantly contribute to its overall economic development and socio-economic development. The redesigned business model decreases the subsidy dependence and additional demand for power by reducing avoidable power consumption and government money losses and leakage. It paves the way for the economical usage of scarce commodities viz., electricity and water and helps to achieve the conservation of electricity and water, resulting in the sustainable development of the nation.

Social values

The redesigned business models shall significantly contribute to society by creating and delivering social values and paving the way for social development, employment generation, community development, and Tamil Nadu's people's well-being, as depicted in the redesigned business model in Figure 7.2.

Environmental value

By implementing schemes such as solarization of agriculture pump sets, rooftop solar, and the Government of India's KUSUM Scheme, more renewable energy capacity in TANGEDCO's energy mix would reduce the average supply cost while creating environmental values. This would result in even more drastic reductions in carbon dioxide emissions and a reduction in power consumption through targeted subsidies, all of which would enable India to achieve its sustainable development goals and a sustainable power sector, as shown in Figure 7.2.

11.2.8 Implication to the power consumers and public at large

The redesigned business model would make DISCOM’s business financially viable and sustainable. Due to the acute revenue shortage, and liquidity crunch due to its deteriorated financial position, DISCOMs have resorted to frequent load shedding, which affects all the sectors of the economy. In making its

business financially viable, DISCOMs could supply quality power around the clock to all its power consumers in domestic, industrial, commercial and agricultural, leading to economic development and better customer service.

CHAPTER 12

CONCLUSION & FUTURE RESEARCH

12.1 CONCLUSION

The state-run DISCOMs' current business model is financially, commercially, unviable and unsustainable. There is a dire need to implement robust reforms in the power distribution sector to make the State-run DISCOMs business financially and commercially viable and sustainable.

Based on the findings from the research, a financially viable, and sustainable business model has been redesigned for TANGEDCO to improve its financial and operational performance significantly and achieve financial viability. The business model redesigned for TANGEDCO shall be adopted with minor modifications by other state-run DISCOMs as state-run DISCOMs operate in the same business environment. Mounting DISCOMs dues to power generators and poor DISCOM finance have significant repercussions and if the issue remains unaddressed, it could pose hurdles in meeting the Government of India's clean energy targets of 5,00,000 MW by 2030, as well as dent investor's confidence going forward.

The subsidy issue remains crucial to achieving the financial viability of state-run DISCOMs and the sustainability of India's power sector. The subsidies granted on a blanket basis are not given only to the neediest and deserving customers. Electricity tariff subsidies are mostly misused, resulting in the wastage of scarce resources, viz., power and water, due to their uneconomical usage. The present system of giving blanket subsidies by TANGEDCO and many DISCOMs for all consumers within a particular category benefits big consumer who consumes more energy and is not deficient.

The subsidies granted to such consumers tend to consume more subsidized power resulting in massive losses to DISCOMs. Unless and until agricultural

and household consumers pay a cost-reflective tariff, the subsidy burden will continue to grow, posing serious concerns about the viability of the power sector reforms. SERCs may impose cost-based tariffs in the absence of state subsidies. Nonetheless, such a confrontational stance is rarely adopted, as the state power regulators are subservient to the state governments.

A major reform in the power distribution sector by focusing the reforms on the implementation of cost-reflective tariffs, rationalization of subsidies and cross-subsidies, and improving the operational efficiencies of the state-run DISCOMs as suggested in the redesigned business model is crucial and is the need of the hour to achieve self-sustained power sector, the overall economic development and India to achieve the Sustainable Development Goal.

To implement the above most needed reforms in the distribution sector, several provision of the Electricity Act, 2003 needs to be amended. The state government's strong support is very crucial for the Government of India to implement these reforms. Both the Government of India and state governments must collaborate to implement the most needed reforms in the distribution sector to make the self-sustained and vibrant power sector.

12.2 LIMITATIONS OF THE RESEARCH

The scope of the present research is limited to developing a business model for TANGEDCO. Therefore, the implementation part is out of the scope of the study. However, the research study has diagnosed the nitty-gritty factors, i.e., 56 independent variables and 17 latent variables, significantly contributing to the sustained financial loss of TANGEDCO. Based on the identified factors and the inter-relationship between latent and independent variables, a conceptual framework (theoretical model) was developed for TANGEDCO to diagnose the factors significantly contributing to its sustained financial losses.

Based on the identified independent variables, latent constructs and the relationship between the independent and latent variables, findings from the research and considering the inherent weaknesses in the business model of

TANGEDCO, and take into account the success story of several reforms implemented in many states viz., Implementation of HVDS, Direct Benefit Transfer of Subsidies, cost reflective tariff, which has yielded very good benefits in enhancing the operational efficiency and improving the financial performance of the DISCOMs, a financially viable and sustainable business model has been redesigned for TANGEDCO.

As all the state-run DISCOMs are operating their power distribution business in the same business and regulatory environment, the business model redesigned for TANGEDCO could be adopted by other state-run Indian DISCOMs, as the factors contributing to the sustained financial losses of the state-run DISCOMs are almost same for all the state-run DISCOMs. Only the intensity of the factors will differ from DISCOM to DISCOM. For example, power theft in Bihar and Uttar Pradesh is more as compared with the southern states, hence, the commercial losses associated with power theft will be more in these states. Similarly, states like Tamil Nadu and Andhra Pradesh are giving free power supply to agricultural power consumers irrespective of the economic status of the consumers. Such blanket subsidies granted to the agricultural and some sections of domestic consumers result in huge revenue leakage and uneconomical usage of power and groundwater resulting in the groundwater table going deeper.

So, while implementing the redesigned business model, strategy and measures to control power theft viz., Aerial punched cable, implementation of smart metering, franchisee model for collection of revenue etc could be implemented. So, depending upon the intensity of the factors contributing to the sustained financial losses of the particular DISCOMs of the state, the business model and the strategy needs to be modified accordingly to achieve the financial viability of the state-run DISCOMs.

12.3 SCOPE FOR FURTHER RESEARCH

Adoption of the business model of TANGEDCO by other DISCOMs by making a similar research study

The electricity supply business of DISCOMs in India is highly regulated. Electricity is a concurrent subject in the Indian constitution. Hence, both governments of India and the states have legislative authority over the state-run DISCOMs' electricity supply business. The state-run DISCOMs in India are operating in a similar business environment viz., regulatory, legal, social, economic and political environments. Most of the state-run DISCOMs have almost identical business models. Therefore, all the diagnosed factors causing sustained financial losses are common to nearly common to all the state-run DISCOMs. Only the weightage of factors varies across the DISCOMs.

Therefore, for the successful implementation of the redesigned business model by other states' DISCOMs, they need to carry out a similar research study by keeping these research findings and the factors diagnosed for the sustained financial losses of TANGEDCO. Other state-owned DISCOMs in India may adopt the TANGEDCO business model by making appropriate changes to the revenue stream and cost component to make their power distribution businesses financially viable and sustainable based on the findings from the research carried out in the particular DISCOMs.

Rebuilding business model - a dynamic process

Rebuilding a business model is a dynamic process. Organisations need to redesign their business model to sustain their business by capturing and creating value for their customers and various stakeholders. State-owned DISCOMs must continuously innovate and redesign their business models to generate and capture value for themselves and their stakeholders. To ensure financial viability and sustainability, it should emphasise revenue growth, create new income sources, and define value propositions for customers, vendors, and business associates.

* * * * *

CHAPTER 13

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13.1 REFERENCE

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13.2 Survey Questionnaire used for collecting primary data

Appendix A

Survey for Redesigning the business model of TANGEDCO, a Govt. of Tamil Nadu-owned power utility for its business sustainability and vibrant power sector

Why this survey:

India's state-owned power distribution companies (DISCOMs) are making huge financial losses year after year. The power distribution business of DISCOMs becomes financially and commercially unviable and unsustainable and is holding back the overall economic development of India. The power distribution sector has been the weakest link in the entire power sector value chain, viz., Power Generation, Power Transmission and Power Distribution. The present business model of DISCOMs has become unsustainable. Tamil Nadu Generation and Distribution Company Ltd (TANGEDCO), owned by the Govt. of Tamil Nadu, is no exception.

Research work is being carried out to find out the critical factors contributing to the continuous losses of TANGEDCO, find a permanent solution to the perennial problem, and make its power distribution business financially and commercially viable.

This survey is to get the opinion, and expert advice from various stakeholders of TANGEDCO, Serving and retired officials of State Power utilities of Tamil Nadu viz., TNEB, TANGEDCO, TANTRANSCO, Govt. of Tamil Nadu, Govt. of India, TNERC, CERC, SERCs, FOR, experts in Power, Finance, Banking sector and Academic fields including all categories of power consumers.

I kindly request you to participate in the survey, which is of national importance. Please give your expert opinion, and valuable input and contribute to re-design the business model for TANGEDCO for ITS business sustainability. The survey is for academic purposes. All the input, including personal information in this survey, shall be kept confidential. It will take about 10 minutes to complete the survey. Sincere thanks for participating in the National level survey.
Please proceed with the survey.

Part- I: Personal Information:

(Please fill in the following information)

1. Name:

2. State:

3. Which of the following categories do you belong to:

Please select/tick to which group/category you belong to

Serving/retired Official of TNEB/TANGDCO /TANTRANSCO/Expert in the power sector	Serving/retired Official of PFC/REC/Banks and Financial Institutions	Serving/retired Officials of TNERC/ CERC/JERC/ SERC/FOR	Serving/retired Officials of State Govt./ Central Govt./CEA	Academic Experts	Power consumer
1	**2**	**3**	**4**	**5**	**6**

Abbreviations:

DISCOM – State-owned Power Distribution Company

TNEB – Tamil Nadu Electricity Board

TANGEDCO - Tamil Nadu Generation and Distribution Company Ltd

TANTRASNCO- Tamil Nadu Transmission Company Ltd

PFC – PFC Ltd. (Formerly Power Finance Corporation Ltd)

REC – REC Ltd. (Formerly Rural Electrification Corporation Ltd)

CERC – Central Electricity Regulatory Commission

SERC – State Electricity Regulatory Commission

TNERC- Tamil Nadu State Electricity Regulatory Commission

JERC – Joint Electricity Regulatory Commission

CEA – Central Electricity Authority

FOR – Forum of Regulators

4. a **Total number of years of experience** in Power, Finance, Electricity Regulation, State Government, Central Government and Academic field:

1-5 Years	6-10 Years	11-15 Years	15-20 Years	More than 20 Years
1	**2**	**3**	**4**	**5**

Introduction to Part 2 of the Survey:

Electricity is very crucial for the economic development of any nation. Both Govt. of Tamil Nadu and the Govt. of India have implemented several power sector reforms schemes in the State of Tamil Nadu since the enactment of the Electricity Act 2003 viz., Power generating capacity addition programme, Non-RE & Renewable Energy projects, System Improvement schemes for reducing the Transmission & Distribution (T&D) losses, Govt of India Schemes viz., Rajiv Gandhi Grameen Vidyuthikaran Yojana (RGGVY), Decentralised Distributed Generation Scheme (DDUGJY), Accelerated Power Development and Reform Programme (APDRP), Integrated Power Development Scheme (IPDS). However, these Schemes have significantly contributed to the development of power infrastructure in Tamil Nadu. On the other hand, TANGEDCO, the State-owned power Utility, is making huge losses year on year on a sustainable basis.

As per the PFC report, in FY 2018-19, TANGEDCO made a financial loss of Rs.13,965 crore. The financial loss (on a subsidy received basis excluding UDAY grant and Regulatory income) stood at Rs.16,831 crore. The accumulated regulatory assets stood at Rs.32,532 crore. The aggregate borrowings, including borrowings from Govt. of Tamil Nadu, stood at Rs.92,693 crore. The overdue payable by TANGEDCO for the power purchased from power generators stood at Rs.18,866 crore as of July 2020 (Source: Ministry of power portal: www. https://praapti.in). Against this backdrop, this survey is of paramount importance for the business sustainability of TANGEDCO.

Part II: Survey Questionnaire:

The survey Questionnaire consists of a set of statements. For each statement, please give your response/opinion by choosing (by clicking) only one out of the five options provided. That is **(1) Strongly Disagree (2) Disagree (3) Neither Agree nor Disagree (Neutral) (4) Agree (5) Strongly Agree**

Please proceed with answering Questionnaires. Please answer all the questions so that the input shall be submitted in the Google Form.

How much do you agree with the statements/factors mentioned below significantly contributing to the huge financial losses of TANGEDCO, a Govt. of Tamil Nadu-owned State Power utility and its unsustainable business operation?

Please give your response by choosing (clicking) any one of the five options for each Statement viz., **(1) Strongly Disagree (2) Disagree (3) Neither Agree nor Disagree (4) Agree (5) Strongly Agree.**

Sl. No.	Statements	**Strongly Disagree**	**Disagree**	**Neither Agree nor Disagree (Neutral)**	**Agree**	**Strongly Agree**
		1	**2**	**3**	**4**	**5**
Q1	TANGEDCO is facing a power outage due to the failure of Power Distribution Transformers, resulting in a loss of revenue. The overloading of					

	Distribution Transformers is primarily due to the drawl of excess power beyond its rated capacity.					
Q2	TANGEDCO faces an outage of power Distribution Transformers due to their inferior quality resulting in revenue loss.					
Q3	Failure of energy meters results in improper metering of actual power consumed by consumers, leading to revenue losses for TANGEDCO.					
Q4	Delay in replacement or rectification of critical equipment viz., Distribution transformers, and energy meters results in revenue loss to TANGEDCO.					
Q5	There are inadequacies in taking up the needed Operation and Maintenance & (O&M) of the critical electrical equipment in the distribution system for want of funds, resulting in revenue loss to TANGEDCO due to power outage, resulting in a power outage and revenue loss to TANGEDCO.					
Q6	More distribution losses occur in the Low Tension (LT) side of the power distribution line than in 11 kV High Tension (HT) lines, resulting in higher distribution losses, especially in Agriculture lines. In addition, the length of LT Lines is more than HT Lines due to a higher LT/HT ratio.					
Q7	TANGEDCO has not implemented the High Voltage Distribution System (HVDS), especially in agriculture power lines, to reduce LT lines' length to minimise the technical losses in power distribution.					

Q8	TANGEDCO do not have separate feeders for feeding power to domestic, agricultural and commercial consumers. Non-implementation of the Feeder Segregation Scheme by DISCOMs has resulted in higher distribution losses.					
Q9	Some power consumers are stealing electric power by bypassing the energy meter resulting in a loss of revenue for TANGEDCO.					
Q10	There are cases where the staff of the state power utility are involved in stealing power from some power consumers.					
Q11	heft control measures are inadequate to stop power theft.					
Q12	TANGEDCO has not implemented Smart metering, Pre-paid metering, or Aerial Bunched Cable in the powerline to reduce power theft and improve revenue collection.					
Q13	TANGEDCO is not billing 100% of the actual energy consumed by some categories of power consumers. For example, billing for agriculture consumers is not being billed, or billing is based on a fixed load. The lower billing efficiency resulted in substantial revenue losses for TANGEDCO.					
Q14	TANGEDCO is not taking the energy meter reading periodically at a regular interval (monthly or once in two months) due to inadequate manpower resulting in low billing efficiency					

Q15	TANGEDCO could further improve revenue collection through technological intervention viz., smart and prepaid meters, and establish more bill collection centres.					
Q16	TANGEDCO needs to improve bill collection through various measures viz., Overdue recovery team, establishing more bill collection centres, and using technological interventions viz., smart meters.					
Q17	Implementation of an incentive system for employees or Distribution Franchisees could improve revenue collection and reduce the losses of TANGEDCO significantly.					
Q18	The purchase of power is a significant cost component in the Average Cost of Supply (ACS) for TANGEDCO.					
Q19	The cost of power generation from Non-Renewable sources, viz., coal, oil and gas, has increased, which increases the overall Average Cost of Supply (ACS), resulting in a decrease in revenue.					
Q20	Power generation costs decrease if power generation is increased by utilizing its maximum installed capacity and increasing the Plant Load Factor (PLF). However, since the existing power-generating plants of TANGEDCO are operating with lower PLF at a sub-optimal level, the cost of power generation and the Average Cost of Supply (ACS) increased, resulting in significant revenue loss to TANGEDCO.					

Q21	Recently, the cost of power generation from Renewable Energy sources, viz., solar, and wind, has decreased drastically. However, TANGEDCO has entered into a long-term Power Purchase Agreement (PPA) with power generating companies to purchase power at a higher price, which prevents it from purchasing cheaper renewable Power through Power Exchange. It needs to pay the fixed charges as per PPAs.					
Q22	TANGEDCO borrows loans from Banks and Financial Institutions at a higher interest rate due to its poor financial health, huge debt level and lower credit rating, which increases the Average cost of Supply (ACS) of power.					
Q23	Retail power tariff is not increased regularly at a periodical interval every year by the State power regulator/TNERC-Failure to revise and fix tariffs with due frequency results in huge revenue loss to TANGEDCO.					
Q24	TANGEDCO has a higher nos. of subsidized consumers in its consumer mix. As a result, it supplies power free of cost or at a highly subsidized price resulting in huge revenue loss to TANGEDCO.					
Q25	The tariff structure of TANGEDCO is irrational. TANGEDCO charges industrial and commercial tariffs at a significantly higher rate to compensate for the massive subsidy in tariff given to agriculture and domestic power					

	consumers.					
Q26	TANGEDCO does not measure the actual quantum of power consumed by some consumer segments, agriculture. Therefore, it is not raising power bills based on the actual energy consumed, resulting in substantial financial losses to TANGEDCO.					
Q27	The tariff policy of TNAGEDCO is irrational, as there is a considerable cross-subsidy, and the tariff is not reflecting the cost of supply.					
Q28	TANGEDCO supplies power free of cost to agriculture consumers and at a highly subsided rate to some segments of domestic power consumers by giving blanket subsidies irrespective of the socio-economic status of the consumers.					
Q29	TANGEDCO sells power to some segments of power consumers at lower than its supply cost by under-pricing. Therefore, TANGEDCO is not revising the tariff upward for these subsidized power consumers.					
Q30	TANGEDCO supplies power free of cost to agriculture power consumers. It also provides power for free for power loom consumers, Below Poverty Line (BPL) Households. Further, it gives 100 units free of cost to every domestic power consumer in each billing cycle.					
Q31	State governments & political parties do not agree to transfer tariff subsidies					

	directly to the most needed consumers (beneficiaries) through the Direct Benefit Transfer (DBT) Scheme for political reasons.					
Q32	Deleted and not considered					
Q33	There is a delay in finalising and auditing of annual accounts of TANGEDCO, which delays the entire process of determination of tariffs and fixing the tariff by the state power regulator/SERC.					
Q34	Delayed submission of tariff proposals and incomplete proposals without proper supporting data by TANGEDCO delays the fixation of tariffs by the State power regulator/SERC timely. As a result, by the time the tariff order was issued by TNERC, the input cost had increased, resulting in a revenue shortage for TANGEDCO.					
Q35	TNERC is not determining tariffs on a Suo-moto basis in case of an inordinate delay in submitting the tariff petition by TANGDCO, resulting in a delay in the issue of the tariff order.					
Q36	TNERC is not determining tariffs on a Suo-moto basis in case of inordinate delay in submitting the tariff petition by TANGDCO, resulting in a delay in the issue of tariff order					
Q37	SERC considers the subsidy receivables from the State Government while determining and fixing the power tariff. Thus, all the actual cost of the power					

	supply has not been fully covered in the power tariff, resulting in a non-cost reflective tariff causing considerable losses to TANGEDCO.					
Q38	SERC is not approving all the actual costs incurred by TANGEDCO while determining and fixing the retail tariff. Partial approval of the cost of supply by SERC based on benchmarks and efficiency parameters created regulatory assets and substantial financial loss to TANGEDCO.					
Q39	The tariff increase is not incommensurate with the ever-increasing cost of power. State power regulator/TNERC is converting the uncovered price into regulatory assets; TANGEDCO may or may not realize such receivables by way of the future tariff hike, resulting in a substantial financial loss to TANGEDCO.					
Q40	The State Govt. is supposed to release the entire tariff subsidy amount granted to consumers to TANGEDCO upfront during the start of the financial year. However, Govt. Tamil Nadu is not releasing subsidy as the whole amount to TANGEDCO at the beginning of the Financial Year. Non-adherence of the State Govt. in the release of subsidies to TANGEDCO timely results in a substantial revenue shortage.					
Q41	The State Government is intervening with TNERC in the tariff fixation. Moreover, TNERC is issuing tariff orders as directed by the state government, especially in non-revision of tariffs periodically and issuing					

	cost-reflective tariff orders.					
Q42	There is a lack of political will and political support for fixing rational tariffs reflective of the actual cost of supply.					
Q43	There is strong political support for the demand for free power by a few categories of power consumers, viz., Agriculture and some domestic power consumers, resulting in a loss of revenue to TANGEDCO.					
Q44	The Tamil Nadu government does not agree to transfer subsidies directly to the targeted beneficiaries for political reasons.					
Q45	Political parties resorted to not increasing the power tariff for political reasons. The supply of free power finds a place on the agenda for the political party.					
Q46	There is a lack of coordination between Central and State Governments in framing and implementing power sector reform policies to make the sustainable and vibrant power sector.					
Q47	There is strong political support for the demand for free power by a few categories of power consumers, viz., Agriculture and some domestic power consumers, resulting in a loss of revenue to TANGEDCO.					
Q48	It becomes tough to withdraw the free power policy by the Government of Tamil Nadu for the supply of power to agricultural and some domestic					

	categories of consumers, which has drastically affected the financial position of TANGEDCO and the State Govt.					
Q49	There are inefficiencies in the business operation of TANGEDCO, resulting in financial losses to TANGEDCO.					
Q50	Inefficient management, mismanagement and corruption have resulted in substantial financial losses to TANGEDCO.					
Q51	There are inefficiencies in billing and collection of overdue bills resulting in a revenue shortfall for TANGEDCO.					
Q52	TANGEDCO is unable to pay the bills for the power purchased from CPSU generating companies & private power generators, and the overdue payable by TANGEDCO is mounting and has reached an unsustainable level.					
Q53	TANGEDCO receives subsidies from the State Government with a delay, which affects the cash flow.					
Q54	TANGEDCO's Current Liabilities are more than its current assets due to the big gap between its cost and revenue, resulting in massive borrowing of Short-Term Working Capital loans from Banks & Financial Institutions					
Q55	TANGEDCO often faces liquidity problems due to the massive revenue shortage and delayed receipt of subsidies from the State Govt. The delayed receipt of electricity supplied to the state government Departments and					

	municipalities.					
Q56	TANGEDCO often faces liquidity problems due to its vast dues payables to the power generating companies for its power. As a result, TANGDECO is unable to pay the dues timely, and there is an inordinate delay in the settlement of dues payable by it for the power purchased.					
Q57	TANGEDCO faces problems in recovering dues from the state Govt. Departments, Municipal Corporations, and Panchayat for the bill for the power supplied, resulting in the building up of huge receivables and consequent liquidity problems and financial crisis.					

Thank you so much for participating in the important survey in the national interest.

* THE END *

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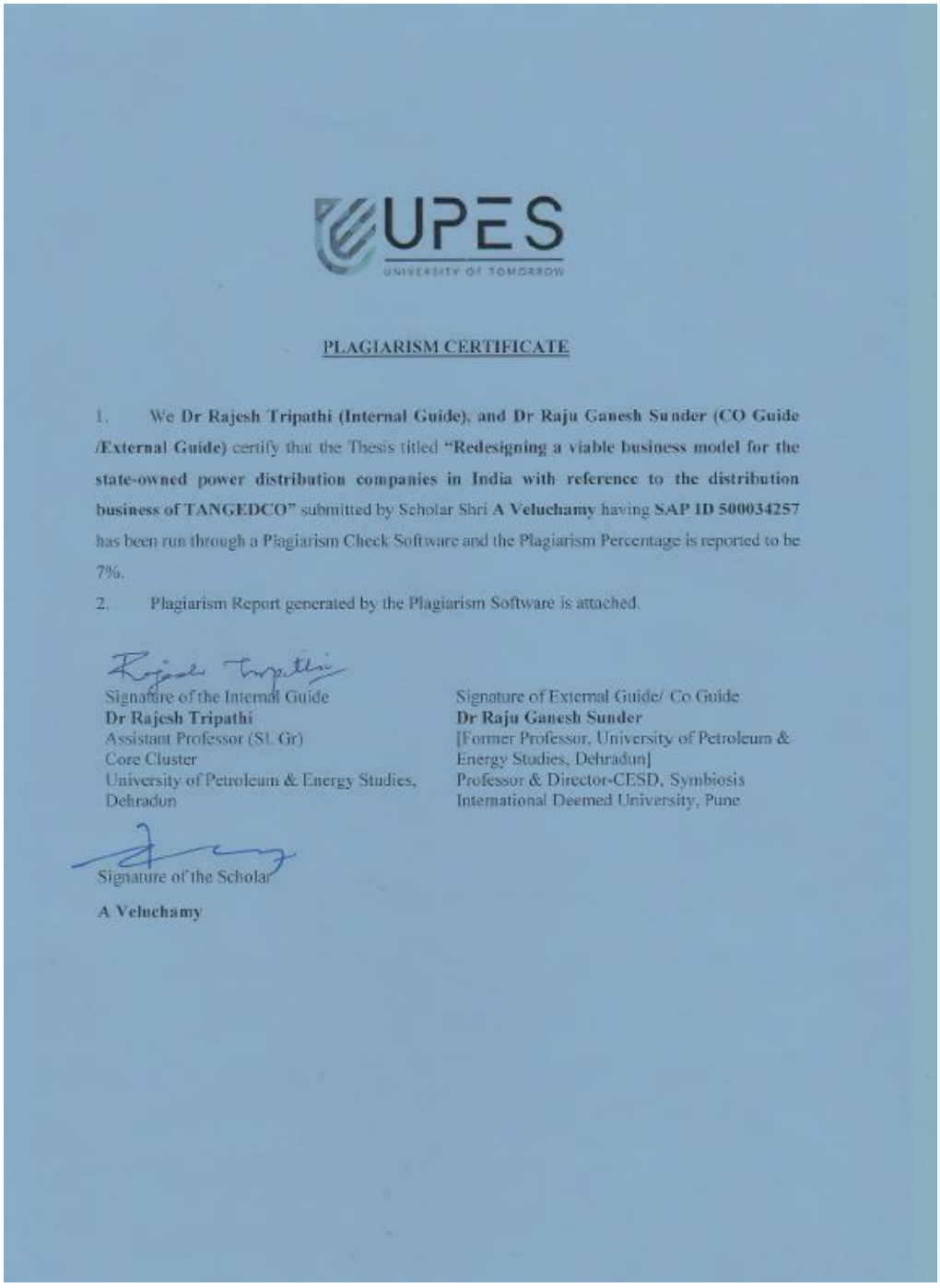

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