

CHAPTER 3

RESEARCH METHODOLOGY

3.1 INTRODUCTION

The approach and methodology of undertaking the research is outlined. The need for research, the research gap, the statement of the research problem, research questions, objectives of the study, the scope of research, the research methodology and the framework for research design, the theoretical underpinning derived through literature survey and method for analysis of data are explained.

3.2 RESEARCH GAP

Through literature survey, research gap is identified as follows.

- **Absence of reliable data on actual cost to serve the consumers in India.** Actual cost should form the basis of any pricing decision-making. However, with imperfect understanding of the cost to serve the various segments, policy decisions on important aspects of cross-subsidy and related issues are being taken:
 - Subsidy provision for large chunks of consumers,
 - Continuity of cross-subsidy to the detriment of industrial consumers,
 - Exit of large consumers through open access and impact thereof on remnant consumers,
 - Introduction of competition,
 - Proposal to separate the wire business (carriage) and retail business (content),

- Introduction of renewable power in a substantial scale,
- Choice of grid-connected generation with expensive network requirements in remote areas vis-à-vis off-grid distributed generation.
- While there are many approaches on cross-subsidy understanding and determination in different sectors, most sectors are still under governmental control in India with non-transparent pricing system. There is an apparent gap in understanding of a suitable approach on cost-of-supply based tariff / cross-subsidy determination for power sector.
- For successful reform model, tariffs are re-aligned with costs prior to regulatory reforms and introduction of competition. However, there is no specific study available on extent of progression of tariff towards cost and consequent cross-subsidy reduction in Indian electricity market within the framework of policy instruments.
- Reform of the electricity sector is expected to erode cross-subsidies and not create new ones. Study on experience of intra-category costs is not available and consequently, the realistic cost to serve the vulnerable consumers is not known, together with methodology of protecting the poor consumers in a cost-reflective reform model.

3.3 RESEARCH FOCUS

Accordingly, this research focuses on determination of cross-subsidy based on cost-of-supply of consumer segments as also imparts special focus of appreciating the need for protecting vulnerable consumers from tariff shock.

3.4 RESEARCH PROBLEM

Determination of cross-subsidy based on cost of supply of the consumer segment is necessary – together with the need for understanding the protection issue of vulnerable consumers to fulfil welfare objectives.

3.5 RATIONALE OF STUDY

Distribution licensees are already in deep financial distress and the absence of cost-reflective tariff accentuates this problem. Realistic determination of cross-subsidy is essential in the context of flight of consumers from the beleaguered distribution licensees with worsening financial conditions, which has the potential of destabilising Indian power sector. It is essential to undertake an estimate of cost-of-service, to arrive at any realistic assessment of cross-subsidy and to make associated policy decisions. The connected welfare issue of protecting vulnerable consumers is needed to be addressed to arrive at a comprehensive solution. Need for research is to primarily fill this research gap.

3.6 RESEARCH QUESTIONS

1. What is the suitable approach to determination of cross-subsidy, with special focus on electricity tariff in India?
2. What has been the experience of progression of category-wise electricity tariff prevailing for Indian regulated tariff frameworks, towards average cost-of-supply, to achieve the mandated objective of cross-subsidy reduction?
3. What approach should be adopted to determine cross-subsidy based on a cost-of-supply model, while also addressing the welfare issues of serving the vulnerable segments?

3.7 RESEARCH OBJECTIVES

1. Arriving at a suitable approach on determination of cross-subsidy, with special focus on electricity tariff in India.
2. Assessment of the experience of progression of category-wise electricity tariff prevailing for Indian regulated tariff frameworks, towards average cost-of-supply, to achieve the mandated objective of cross-subsidy reduction.

3. Development of a suggestive approach on cross-subsidy determination based on cost-of-supply along with a suggestive approach on addressing the welfare issues of serving the vulnerable segments.

3.8 SCOPE OF RESEARCH AND PARADIGM

3.8.1 Scope of Research

This study concentrates on cross-subsidy in the end-tariff to the consumers. Distribution (integrated with retail supply) in India is the final activity to reach the consumers and end-tariff of the distribution licensees contains elements of generation, transmission and distribution activities as well as (\pm) cross-subsidy elements. Pricing of generation and transmission segments of Indian power sector are not being studied separately. Since literature survey suggests that agricultural cross-subsidy has been covered in some detail and the same is both an acknowledged problem and a separate subject on its own, the same is not repeated through this study. It is recognised that need for agricultural subsidy emanates from State-specific issues; Punjab could be an example. End-tariff fixation also entails socio-cultural political compulsions as well as India-specific concerns like regional imbalances and electricity pricing in public vis-à-vis private ownership. These issues are beyond the scope of this research.

3.8.2 Paradigm

The research problem has been identified as determination of cross-subsidy based on cost of supply of the consumer segment, together with the need for understanding the protection issue of vulnerable consumers to fulfil welfare objectives.

The identified research objectives are arriving at an approach for cross-subsidy determination, development of a workable cost-of-supply model for proper quantification of cross-subsidy, possible ways to protect the vulnerable class of the society while computing cost of supply in accordance with the developed cost-of-supply model as well as historical movement of cross-subsidy in the context of Indian regulated tariff framework.

Needless to mention, there cannot be a unique model to determine cost-of-supply and consequent cross-subsidy. Depending on assumptions, variables, extent of complexity and other pertinent aspects, multiple options can be developed. The researcher is interested in developing a workable model, which can be widely used to determine cost-of-supply in real world, with its constraints. Also, identification of the vulnerable section of the population is a subjective matter. There is no single way to determine vulnerability.

Under the pragmatic paradigm, the research problem takes the central seat, and multiple approaches are taken to understand the research problem (Creswell, 2013), (Mackenzie & Knipe, 2006).

Therefore, keeping the central focus on the research problem, the researcher has undertaken / evaluated multiple methods to understand the problem, by adopting the pragmatic paradigm. Both quantitative and qualitative data have been obtained, analysed and assessed to fulfil the research objectives.

3.9 RESEARCH METHODOLOGY

This research, conducted under the pragmatic paradigm, has used both quantitative and qualitative methodology, as appropriate (Johnson & Onwuegbuzie).

3.9.1 Methodology for addressing first objective

The objective of arriving at a suitable approach for cross-subsidy measurement after evaluating the available approaches, has been carried out in two steps.

Objective 1: Step 1

In this step, literature survey is done to compile information on available approaches on cross-subsidy evaluation *inter alia* through academic literature, international reports / documents publicly available, regulatory websites, policy documents of the Indian Government (Ministry of Power, Ministry of Finance, the Planning Commission), Indian State Electricity Regulatory Commissions, judicial pronouncements of the Supreme Court of India and the Appellate Tribunal for Electricity, India, documents / reports of Forum of Regulators (FOR), Forum of Indian Regulators (FOIR), The Energy and

Resources Institute (TERI), Administrative Staff College of India (ASCI), other relevant reports / documents, as publicly available.

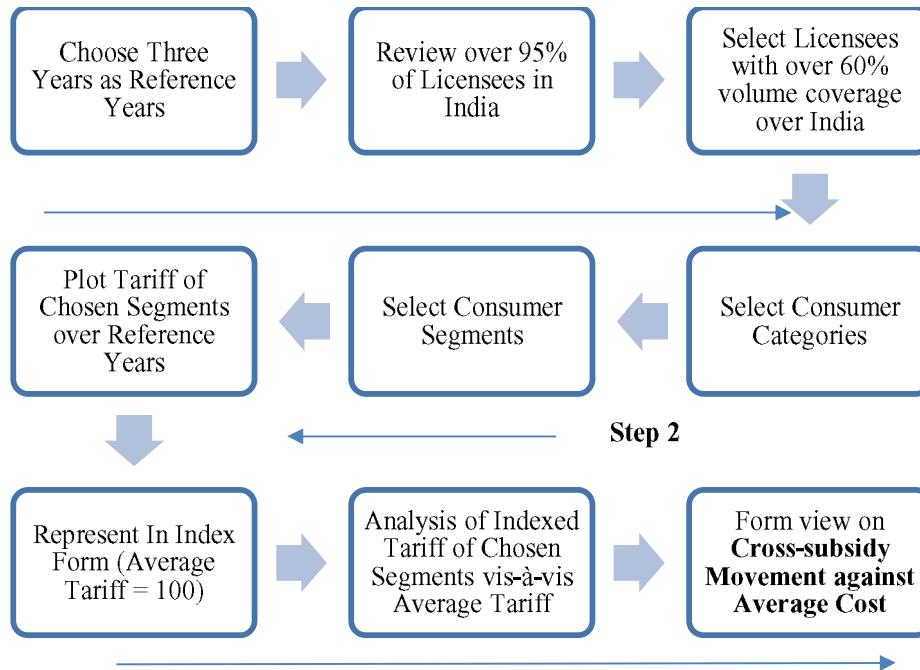
Objective 1: Step 2

In this step, critical evaluation of the available approaches on cross-subsidy determination is done through analysis of literature, reports and documents gathered in Step 1, to arrive at a suitable approach. Special emphasis is given to the Indian electricity sector, with reference to the Indian context. Confirmation vis-à-vis Indian policy documents is carried out at this stage.

3.9.2 Methodology for addressing second objective

To achieve the second objective, an analysis is carried out in three steps to assess progression of segment-wise electricity tariff prevailing for Indian regulated tariff frameworks, towards average cost-of-supply, to achieve the mandated objective of cross-subsidy reduction, through literature survey for three different years –

- 2004-05 (before introduction of National Tariff Policy)
- 2008-09 (interim period) and
- Latest available year for which tariff has been determined (2015-16 or 2014-15, as available) post completion of the time period as mandated by the erstwhile National Tariff Policy.

Diagram 3.1: Methodology of Objective 2**Objective 2: Step 1**

In this step, sources are identified, relevant reports collected, variables identified and choice of the distribution licensees made, in preparation for extraction of the requisite data for subsequent steps.

Sources of secondary information related to retail tariff studied are documents available in the public domain for Indian State Electricity Regulatory Commissions, judicial pronouncements of the Supreme Court of India and Appellate Tribunal for Electricity, India, documents / reports of the Planning Commission, India, Forum of Regulators (FOR), Forum of Indian Regulators (FOIR), The Energy and Resources Institute (TERI), Administrative Staff College of India (ASCI), other relevant reports / documents publicly available. Institutional coverage and choice of the distribution licensees are made at this stage.

Objective 2: Step 2

In this step, the basic categories and segments are identified, and the parameters defined on the basis of the relevant reports collected in Step 1, to

prepare for the Analysis in Step 3. The analysis in Step 3 is carried out on a number of defined consumption types (consumer categories and segments) and on the basis of identified tariff parameters.

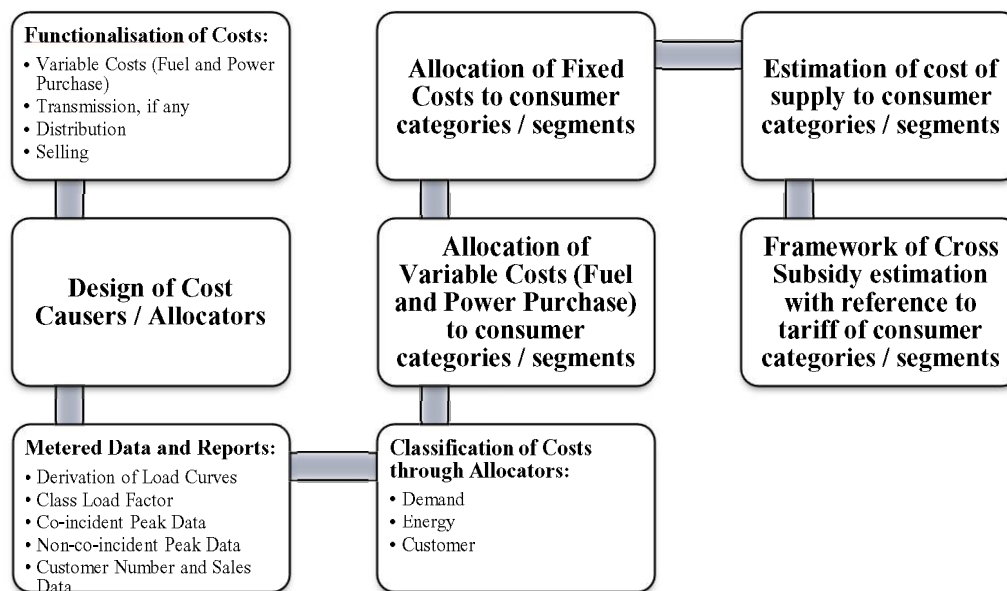
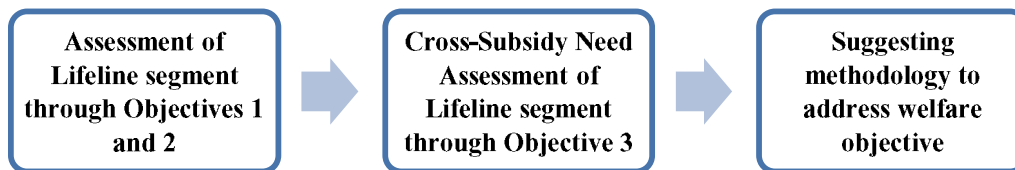
Objective 2: Step 3

A study of progression of segment-wise electricity tariff prevailing for Indian regulated tariff frameworks, towards average cost-of-supply, to achieve the mandated objective of cross-subsidy reduction, is carried out on the basis of focus category and focus segments (chosen consumption types) across the selected distribution licensees under the jurisdiction of different Regulatory Commissions across India, chosen in Step 1, for the Three Years of Reference as defined in Step 1.

3.9.3 Methodology for addressing third objective

To achieve the final objective, cost-of-supply is assessed through development of a model and a suggestive approach towards realistic estimation of cross-subsidy is made along with development of a suggestive approach on addressing the welfare issue of providing electricity service to the vulnerable segments.

Adopted methodology starts with the finding that virtually all empirical studies start from cost allocation (Heald, 1996). It follows the cost allocation theory and processes available through literature on the subject (Conkling, 2011). While the structure of functionalisation, classification and allocation of costs (for natural gas supply, adapted for energy pricing) is followed, choice has been made for “Seaboard Formula” as cost allocation principle and appropriate use of both “co-incident demand peak-responsibility” (system peak) and “non-co-incident demand peak-responsibility” (class peak) methods, as recommended in theory, for demand allocation, as appropriate. The model has a built-in flexibility to adopt choice of different allocators within its broad framework. In fact, any of the formulae discussed (Conkling, 2011) can be adopted by changing allocator choice.

Diagram 3.2: Methodology of Objective 3: Part 1**Diagram 3.3: Methodology of Objective 3: Part 2****Objective 3: Step 1**

A licensee has been chosen from the distribution licensees selected for Objective 1

Objective 3: Step 2

Cost of supply has been assessed through development of a model and a suggestive framework has been developed for estimation of realistic cross-subsidy through comparison with prevalent tariff regime.

The theory behind the cost-of-supply model is available through literature survey. The elements of the model, in the Indian context, are indicated in a study commissioned by the Forum of Indian Regulators for assessment of cost-of-supply for agricultural consumers (The Energy and Resources Institute and Dhiya Consulting Private Limited, 2010). Similar model was discussed in another study by the Forum of Regulators, though they eventually recommended a simpler model due to data gaps (Forum of Regulators assisted by PricewaterhouseCoopers Private Limited, 2015). The structure developed follows the more detailed approach (such study is not available in the Indian context), with necessary enhancements and applied in an Excel worksheet format. Development and assessment of cross-subsidy is made through use of a segment-wise cost-of-supply model developed through the study, with refined data collection and granularity. Secondary data is used for this purpose.

Diagram 3.4: Block Diagram of Cost-of-Supply Model

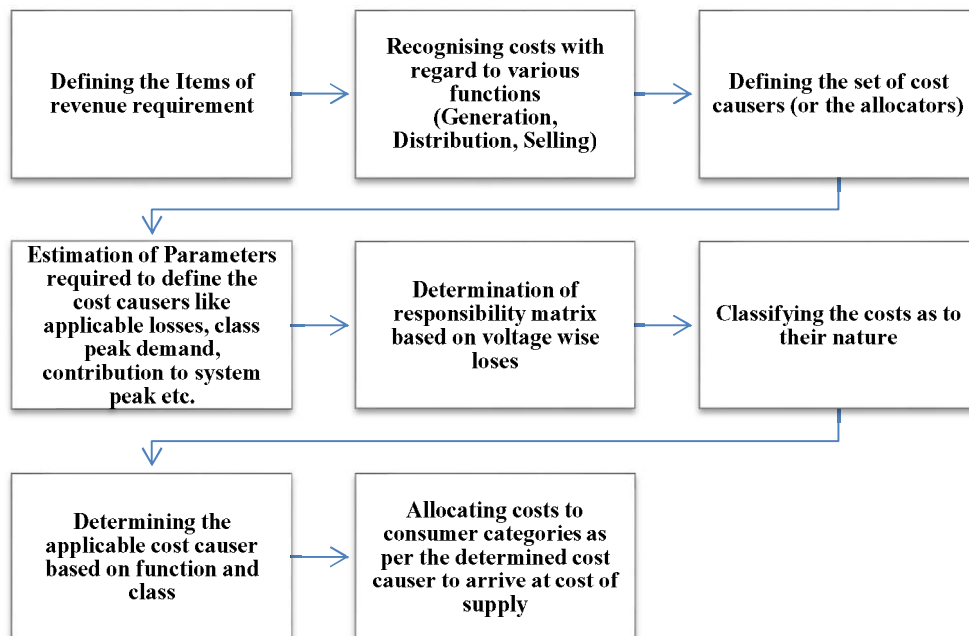
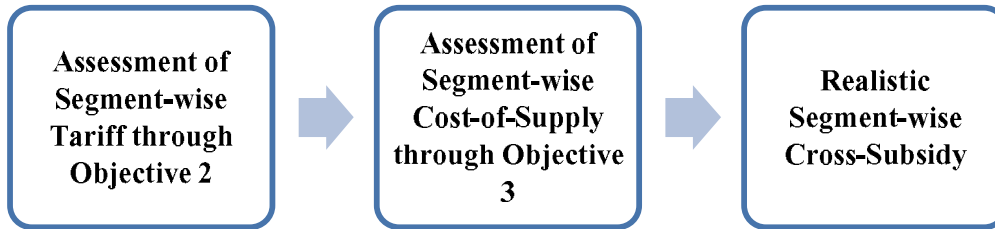


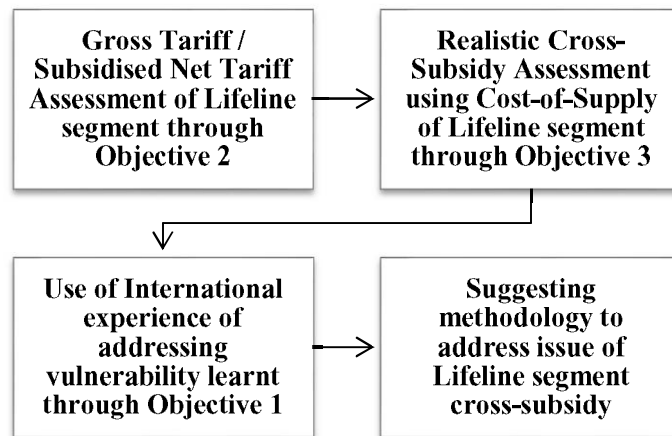
Diagram 3.5: Block Diagram of Cross-subsidy Assessment through Cost-of-Supply Model in Indexed Format



Objective 3: Step 3

Realistic cross-subsidy needed to protect the lifeline segment has been assessed and a suggestive framework to address the issue has been developed, using results / learnings from Objectives 1, 2 and 3 (in first two steps).

Diagram 3.6: Block Diagram for Vulnerability Assessment Strategy



3.10 FRAMEWORK FOR RESEARCH DESIGN

Research design is an arrangement of conditions for collection and analysis of data which aims at giving relevance to the research purpose (Selltiz, Jahoda, Deutsch, & Cook, 1959).

3.10.1 Research design framework for first objective

An evaluation of the available approaches on cross-subsidy measurement to arrive at a suitable approach has been carried out in two different steps.

Objective 1: Step 1

In this step, literature survey has been done to compile information on available approaches on cross-subsidy evaluation *inter alia* through academic literature, international reports / documents publicly available, regulatory websites, policy documents of the Ministry of Power and Ministry of Finance, Government of India, Planning Commission and State Electricity Regulatory Commissions, judicial pronouncements of the Supreme Court of India and Appellate Tribunal for Electricity, India, documents / reports of the Forum of Regulators (FOR), Forum of Indian Regulators (FOIR), The Energy and Resources Institute (TERI), Administrative Staff College of India (ASCI) and other publicly available relevant reports / documents.

Objective 1: Step 2

In this step, critical evaluation of the available approaches on cross-subsidy determination is done thorough analysis of literature, reports and documents gathered in Step 1, to arrive at a suitable approach. Special emphasis has been given to the Indian electricity sector, with reference to the Indian context. Confirmation vis-à-vis Indian policy documents has also been carried out at this stage. Additional inputs are gathered at this stage, with particular emphasis on international literature, to form a view on the research problem in the context of harmonising the problem of flight of consumers with the issue of protecting vulnerable consumers. The process of selection of the licensees to form a view on Objective 1 (population used for selection of licensees for Objective 2 as well) is detailed.

Process:

- Population of 55 distribution licensees have been chosen, covering over 97% of supply met in India by volume of sales. Remnant 3% comprises Jammu & Kashmir, which is not covered under the Electricity Act, 2003, Goa, Sikkim and North-eastern states which are insignificant by volume (excluding Assam and Tripura, which are covered under the study).

- Cluster sampling has been done to group the 55 licensees into respective States. These licensees have been reviewed with reference to the following variables:
 - ▶ Representation of adequate tariff categories
 - ▶ Regularity of tariff revisions
 - ▶ Representative mix of consumer categories
 - ▶ Impact in terms of volume of energy
 - ▶ Ownership – *public or private*
 - ▶ Socio-political influence

Sales and tariff periodicity details of the population of licensees chosen for study under Objective 1 is furnished in Table 3.1. These details have also been used in selecting the utilities for in-depth study under Objective 2.

Table 3.1: Licensee-wise Energy Sales and Periodicity of Tariff Revisions

Sl. No.	Region	State	Licensee ²⁷	Sales in Million kWh (FY 16)	Periodicity of Tariff Orders
1.	Northern Region	Delhi	BRPL	10683	Being revised frequently
2.			BYPL	5629	
3.			TPDDL	7988	
4.		Haryana	DHBVNL	21471	Revised every year from FY 11
			UHBVNL	14513	
5.		Himachal Pradesh	HPSEBL	8438	Being revised frequently
6.		Punjab	PSPCL	43200	Being revised frequently
7.		Rajasthan	JVVNL	21145	Revised every year from FY 12 (Sales for FY 15)
8.			AVVNL	14487	
9.	JdVVNL		16776		

²⁷ Shortened names of the licensees commonly used are furnished; full names are available in the List of Abbreviations.

Sl. No.	Region	State	Licensee ²⁷	Sales in Million kWh (FY 16)	Periodicity of Tariff Orders
10.		Uttar Pradesh	DVVNL	17985	Being revised frequently
11.			PVVNL	24337	
12.			PuVVNL	17244	
13.			MVVNL	14435	
14.			NPCL	1551	
15.		Uttarakhand	UPCL	10422	Being revised frequently
16.	Western Region	Chhattisgarh	CSPDCL	18735	Being revised every year except FY09
17.		Gujarat	TPL - Ahmedabad	7483	Being revised frequently
18.			TPL - Surat	3247	
19.			MGVCL	8001	
20.			DGVCL	13910	
21.			PGVCL	20028	
22.			UGVCL	16848	
23.		Madhya Pradesh	East Discom	15897	Being revised frequently
24.			West Discom	17805	
25.			Central Discom	16535	
26.		Maharashtra	BEST	5735	Being revised frequently
27.			RInfra	7767	
28.			MSEDCL	93261	
29.			TPC	4169	
30.	Southern Region	Telangana	TSSPDCL	30019	Being revised frequently
31.			TSNPDCL	11583	
32.		Andhra Pradesh	APEPDCL	16510	Being revised frequently
33.			APSPDCL	30876	
34.		Karnataka	BESCOM	25342	Being revised frequently
35.			GESCOM	6436	

Sl. No.	Region	State	Licensee ²⁷	Sales in Million kWh (FY 16)	Periodicity of Tariff Orders	
36.			HESCOM	9469		
37.			MESCOM	4524		
38.			CESC - Karnataka	5745		
39.		Kerala	KSEB	18494		Revised every year from FY 13 (Sales for FY 15)
40.		Tamil Nadu	TANGEDCO	64844	FY 04, FY 11, FY 13 and every year afterwards. In between, only subsidy orders were given (Sales for FY 15)	
41.	Eastern Region	Bihar	NBPDCL	4926	Being revised frequently	
42.			SBPDCL	6287		
43.		Jharkhand	JBVNL	8246	From FY11, revised every year	
44.			TSL - Jamshedpur	2869		
45.		Odisha	CESU	6761	Being revised frequently	
46.			NESCO	4287		
47.			WESCO	5909		
48.			SOUTHCO	2548		
49.		West Bengal		WBSEDCL	27232	Being revised frequently
50.				CESC	9424	
51.				IPCL	854	
52.				DPL	2940	
53.				DVC	9127	
54.	North-Eastern Region	Assam	APDCL	6383	Being revised frequently	
55.		Tripura	TSECL	784	Revised every year from FY 13 (Sales for FY 15)	
		Total		822144		

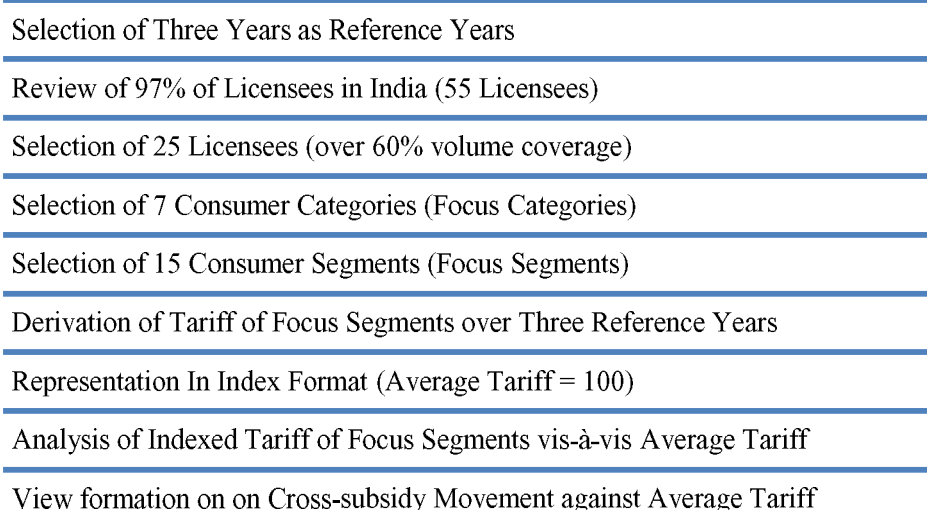
Source: Present study.

3.10.2 Research design framework for second objective

An analysis has been carried out in three different steps to assess progression of category-wise electricity tariff prevailing for Indian regulated tariff frameworks, towards average cost-of-supply, through literature survey for three different years –

- 2004-05 (before introduction of National Tariff Policy)
- 2008-09 (interim period) and
- Latest available year for which tariff has been determined (2015-16 or 2014-15, as available) post completion of the time period as mandated by the erstwhile National Tariff Policy.

Diagram 3.7: Process Diagram for Objective 2



Objective 2: Step 1

In this step, sources have been identified, relevant reports collected, variables identified and choice of the distribution licensees made, in preparation for extraction of the requisite data for subsequent steps. Tariff orders and corresponding Regulations of the State Electricity Regulatory Commissions, have been found to be the repository of most of the data required for this process.

Sources of secondary information related to retail tariff studied are the Indian State Electricity Regulatory Commissions, Supreme Court of India, Appellate Tribunal for Electricity, India, Forum of Regulators (FOR), Forum of Indian Regulators (FOIR), The Energy and Resources Institute (TERI), Administrative Staff College of India (ASCI), other relevant publicly available reports / documents. Institutional coverage and choice of the distribution licensees have been made at this stage.

Process:

- Population of 55 distribution licensees selected for study Under Objective 1 have been chosen, with State-wise clustering is referred (Table 3.1).
- Choice of 25 licensees have been made based on the identified variables. At least one licensee has been selected from each State, where the above variables are satisfied. Where there are co-existing public and private owners in a State, two licensees (from each sector) have been chosen from that State.
 - ▶ Over 60% of the identified licensees have been covered through this process (based on the volume of sale) and over 45% by number.

Details of 25 Licensees chosen for study is detailed in Table 3.2.

Table 3.2: Licensees Selected on the basis of Specified Criteria

Sl.No.	Region	State	Licensee ²⁸	Sales in Million kWh (FY 16)	Periodicity of Tariff Orders
1.	Northern Region	Delhi	BRPL	10683	Being revised frequently
2.		Haryana	DHBVNL	21471	Revised every year from FY 11
3.		Himachal	HPSEBL	8438	Being revised frequently

²⁸ Shortened names of the licensees commonly used are furnished; full names are available in the List of Abbreviations.

Sl.No.	Region	State	Licensee ²⁸	Sales in Million kWh (FY 16)	Periodicity of Tariff Orders
		Pradesh			
4.		Punjab	PSPCL	43200	Being revised frequently
5.		Rajasthan	JVVNL	21145	Revised every year from FY 12 (Sales for FY 15)
6.		Uttar Pradesh	MVVNL	14435	Being revised frequently
7.		Uttarakhand	UPCL	10422	Being revised frequently
8.	Western Region	Chhattisgarh	CSPDCL	18735	Being revised every year except FY09
9.		Gujarat	TPL-Ahmedabad	7483	Being revised frequently
10.			MGVCL	8001	
11.		Madhya Pradesh	Central Discom	16535	Being revised frequently
12.		Maharashtra	RInfra	7767	Being revised frequently
13.			MSEDCL	93261	
14.		Southern Region	Telangana	TSSPDCL	30019
15.	Andhra Pradesh		APSPDCL	30876	Being revised frequently
16.	Karnataka		BESCOM	25342	Being revised frequently
17.	Tamil Nadu		TANGEDCO	64844	FY 04, FY 11, FY 13 and every year afterwards. In between, only subsidy orders were given (Sales for FY 15)
18.	Eastern Region	Bihar	NBPDCL	4926	Being revised frequently
19.			SBPDCL	6287	
20.		Jharkhand	JBVNL	8246	From FY11 revised every year
21.		Odisha	CESU	6761	Being revised frequently
22.		West Bengal	WBSEDCL	27232	Being revised frequently
23.			CESC	9424	

Sl.No.	Region	State	Licensee ²⁸	Sales in Million kWh (FY 16)	Periodicity of Tariff Orders
24.	North-Eastern Region	Assam	APDCL	6383	Being revised frequently
25.		Tripura	TSECL	784	Revised every year from FY 13 (Sales for FY 15)
		Total		502700	

Source: Present study.

The extent of coverage details of the chosen licensees are furnished in Table 3.3.

Table 3.3: Coverage Details of the Selected Licensees

Number of Licensees	55
Total Sales	822144
No. of selected Licensees	25
Selected Utilities Sales	502700
% Contribution in terms of Sales	61%
% Coverage in terms of No. of Utilities	45%

Source: Present study.

Objective 2: Step 2

The analysis in Step 3 has been carried out on a number of defined consumption types (focus consumer categories and focus segments) and on the basis of identified tariff parameters. In this step, the basic categories and segments have been identified, and the parameters defined on the basis of the relevant reports collected in Step 1, to prepare for the analysis in Step 3.

Process:

- Choice has been made on the basis of the following guiding principles-
 - ▶ Relevance of individual consumption types for all-India comparison as revealed by analysis in Step 1
 - ▶ Inclusion of the chosen consumption type in specific regulator-defined consumption category / sub-category
 - ▶ Unambiguous regulator-specified tariff for such consumption

-
- ▶ Coverage of some of the factors subsequently listed for each of the individual consumption characteristic
 - ▶ Coverage of majority of the factors subsequently listed in aggregate in the number of consumption characteristics considered
 - *Focus category – choice of the basic category*
 - ▶ Factors mandated by law for categorisation
 - Voltage of supply - *high or low voltage*
 - Load factor
 - Power factor
 - Consumption during a specified time - *time-of-the-day tariff*
 - Overall consumption - *consumption strata or slabs*
 - Geographical location - *urban or rural*
 - Nature of supply - *intermittent or continuous*
 - Purpose of supply - *residential, commercial, industrial etc.*
 - ▶ Other technical factors influencing extent / discipline of consumption
 - Demand or connected load
 - Implication of drawal at the comparable consumption level
 - Implication of availability of supply for the category
 - Incentive associated with the efficiency / economy of consumption
 - Seasonal variations

- ▶ Commercial factors
 - Impact of rebate
- *Focus segment – choice of consumption segment / consumption parameters*
 - ▶ For analysis of parameters, experience regarding in-depth study of at least one licensee has been adopted. This is necessary to arrive at typical behaviour of the consumer category under study, to ensure parity.

Objective 2: Step 3

A study of cross-subsidy has been carried out on the basis of focus category and focus segments (chosen consumption levels) across the selected distribution licensees under jurisdiction of different Regulatory Commissions across India, chosen in Step 1, for the Three Years of Reference as defined in Step 1.

Process:

- Determination of amounts to be recovered through tariff as per the respective Regulatory Commissions by appropriate consideration of the Annual Revenue Requirements²⁹ and adjustments thereof, for unfulfilled gap, Regulatory Assets and other relevant factors evident from literature review and determination of average tariff rate for the licensee
- Average tariff has been utilised for Indexation (Average Tariff = 100)
- Tariff has been worked out for consumption segments arrived at through Step 2, and expressed as a ratio of overall tariff as above (Indexed Tariff)

²⁹ Revenue requirement, in a regulated framework, is the total revenue that the licensee is allowed to recover. This is worked out on the basis of utility-wide cost of regulated service (Conkling, 2011).

- Assessment of cross-subsidy modification over the period and comparison with respect to the provisions under the erstwhile National Tariff Policy (comparison with Average Tariff / Average Cost-of-Supply)
- Forming a view on deviation with respect to the mandated position under the policy instruments.

Descriptive Statistics and Indexed Numbers are used for the Analysis.

3.10.3 Research design framework for third objective

In three different steps, cost of supply has been assessed through development of a model in Excel using secondary data and approach for realistic estimation of cross-subsidy has been outlined. A suggestive approach on addressing the welfare issues of providing electricity service to the vulnerable segments has also been developed.

Objective 3: Step 1

A licensee has been chosen from the distribution licensees selected for Objective 1.

Process:

- Choice has been made on the basis of the following guiding principles-
 - ▶ Availability of all chosen consumption segments
 - ▶ Availability of required system and cost related information, including load curves for the consumer categories
 - ▶ Volume
 - ▶ Availability of tariff order from the regulator
 - ▶ Annual consumption of energy for different consumer segments
 - ▶ Distribution loss with bifurcation of technical and commercial losses voltage level-wise

- ▶ Assessment of average and peak losses
- ▶ Consumer segment-wise co-incidental peak demand, non-co-incidental peak demand and contribution to system peak / class peak demand at suitable voltage levels
- ▶ Number of consumers bifurcated into different defined segments
- ▶ Regulator approved items of Annual Revenue Requirement for the year and other related adjustments, if any
- ▶ Regulator approved tariff for different consumer segments and related terms and conditions therefor.

Objective 3: Step 2

Assessment of cost of supply is done through development of a model in Excel and estimation of realistic cross-subsidy is made through variance check with the tariff regime for the Reference Year for the licensee selected in Step 1.

Process:

- Study of the system information, Annual Reports, tariff submissions before the Regulatory Commission, load curves, cost data sheets, other available reports derived from Management Information System and regulatory orders has been done with respect to the **Third Reference Year** to assess -
 - ▶ Defining items of applicable cost (Annual Revenue Requirement)
 - ▶ Functional allocation of costs to each functions such as variable cost (fuel and power purchase cost) and transmission, if any, distribution, etc. and defining the basis of allocating the same
 - ▶ Identification of cost inducers from the consumer perspective
 - ▶ Estimation of parameters required to use the cost inducers such as energy consumption (grossed up for average losses for

applicable segment), co-incident / non-co-incident peak demand (grossed up for applicable peak losses for the relevant segment), consumer numbers etc.

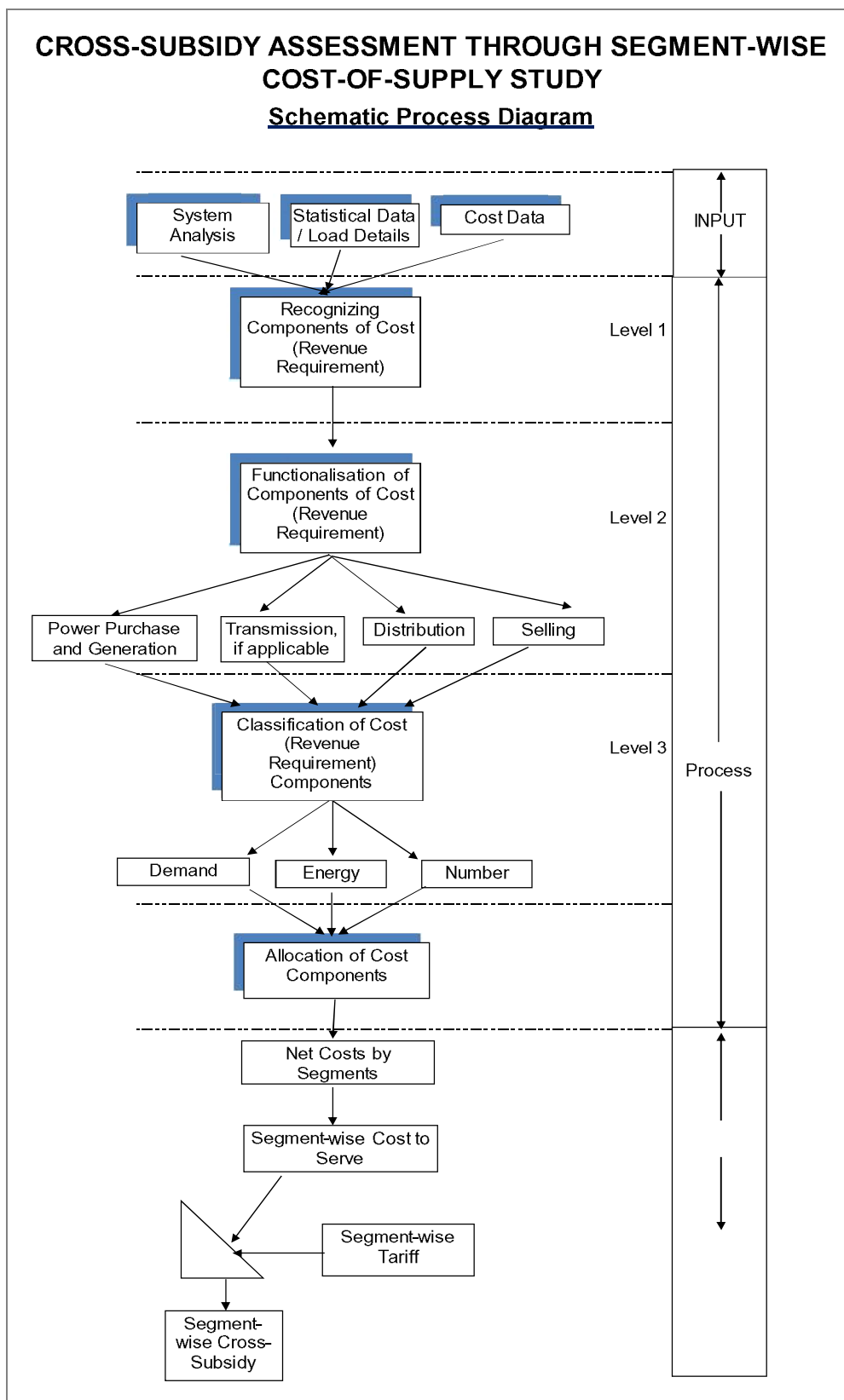
- ▶ Classification of above defined functional costs for each consumer segment based on their relationship to demand, energy or consumer numbers as applicable
- ▶ Determining applicable cost allocator based on functions and segment
- ▶ Allocating cost to each consumer segment based on above
- ▶ Derivation of cost-of-supply of each segment in indexed format
- ▶ Derivation of tariff of each segment in indexed format (from Objective 2 analysis)
- ▶ Critical view on cross-subsidy as difference between cost-to-serve and tariff of each segment.

For Objective 3, a single licensee, fulfilling the necessary criterion has been chosen as CESC, West Bengal.

A detailed schematic process diagram follows.

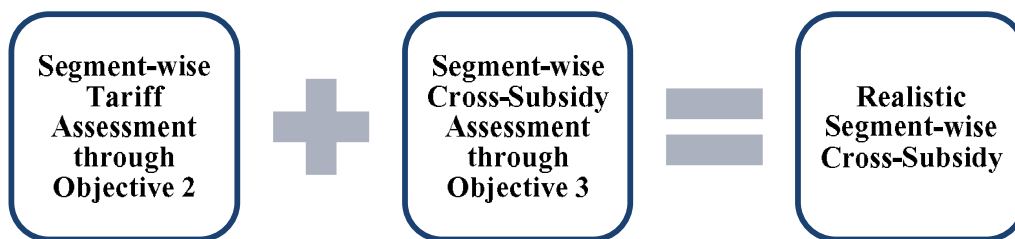
Diagram 3.8: Schematic Process Diagram of Cost-of-Supply Model:

Objective 3: Step 2: Part 1



- The cost-of-supply model (CoS Model) is developed in Excel, which has been validated independently by three well-known experts (two individuals and an expert body). The validation was done following a methodology akin to the Delphi technique (constraint was the number of experts, which is limited in this field; data sensitivity issue was another concern). The Administrative Staff College of India, Hyderabad, Mr. Rakesh Nath, former member of the Appellate Tribunal for Electricity and former Chairman, Central Electricity Authority and Dr. Geeta Gouri, former member of the Competition Commission of India are the experts who validated the model.

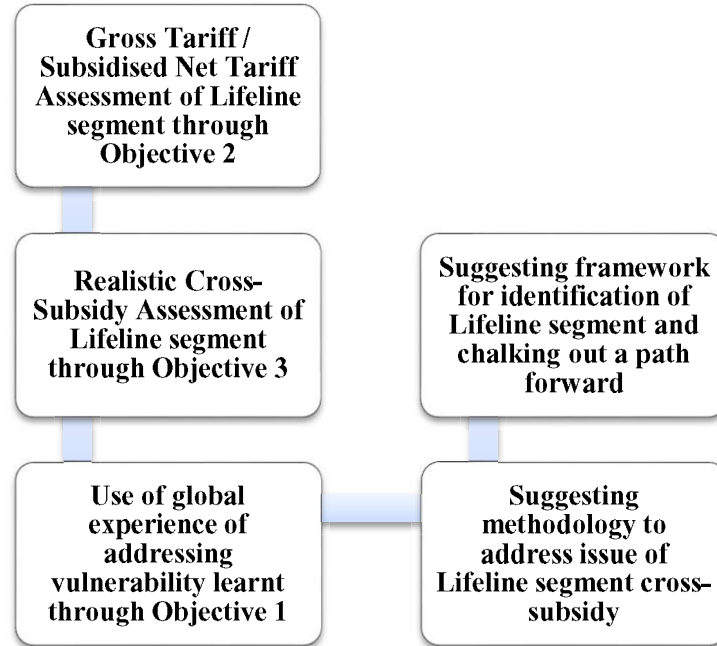
Diagram 3.9: Process Diagram: Objective 3: Step 2: Part 2



- Using the results from Objective 2, an assessment of cross-subsidy in Index Form has been done.

Objective 3: Step 3

Realistic cross-subsidy needed to protect the lifeline segment has been assessed and a suggestive framework to address the issue has been developed, using results / learnings from Objectives 1, 2 and 3 (in first two steps).

Diagram 3.10: Process Diagram: Objective 3: Step 3

3.11 CHAPTER SUMMARY

Cross-subsidy assessment based on cost of supply of the customer segment, together with understanding on the protection issue of vulnerable consumers to fulfil welfare objectives, were found to be the major gaps in research, leading to the research problem that “determination of cross-subsidy based on cost of supply of the consumer segment is necessary – together with the need for understanding the protection issue of vulnerable consumers to fulfil welfare objectives.” The three research questions and objectives were accordingly framed in this chapter, with development of a suggestive approach on cross-subsidy determination based on cost-of-supply along with a suggestive approach on addressing the welfare issues of serving electricity to the vulnerable segments, being the pivotal final (third) objective. The research methodology is detailed in this chapter and the research design framework has been established step-wise for each of the objectives.