
**PUBLIC UTILITIES COMMISSION OF SRI LANKA
TARIFF METHODOLOGY FOR EXEMPTED ENTITIES**

**USER GUIDE FOR
ELECTRICITY PRICING AND TARIFF DETERMINATION
MODEL FOR EXEMPTED PERSONS**

21ST AUGUST 2017

Abbreviations

CPF	Contribution to Peak Factor
EP	Exempted Person
GP	General Purpose customer category
I	Industrial customer category
kWh	kilowatt-hour
LV	Low voltage
MV	Medium Voltage
PUCSL	Public Utilities Commission of Sri Lanka
SBG	Standby Generator
TOU	Time of Use

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1 OVERVIEW

Objective of this Model is to provide a platform to determine the sales tariffs to customer installations in Exempted persons' premises.

The Model calculates the approximate cost of delivery of electricity to customer installations in the exempted persons' premises on monthly basis and uses it to propose a tariff to be used as the sales tariff for the customer installations in such premises.

Public Utilities Commission of Sri Lanka may make this Model available for the exempted persons to determine the approximate costs.

It is the responsibility of the Exempted Person to use the appropriate data in the calculations with the approval from the PUCSL.

1.1 Model Dimensions

Model dimensions were selected to ensure that the primary objective of developing the Model would be fulfilled. Accordingly, the Model dimensions are as follows:

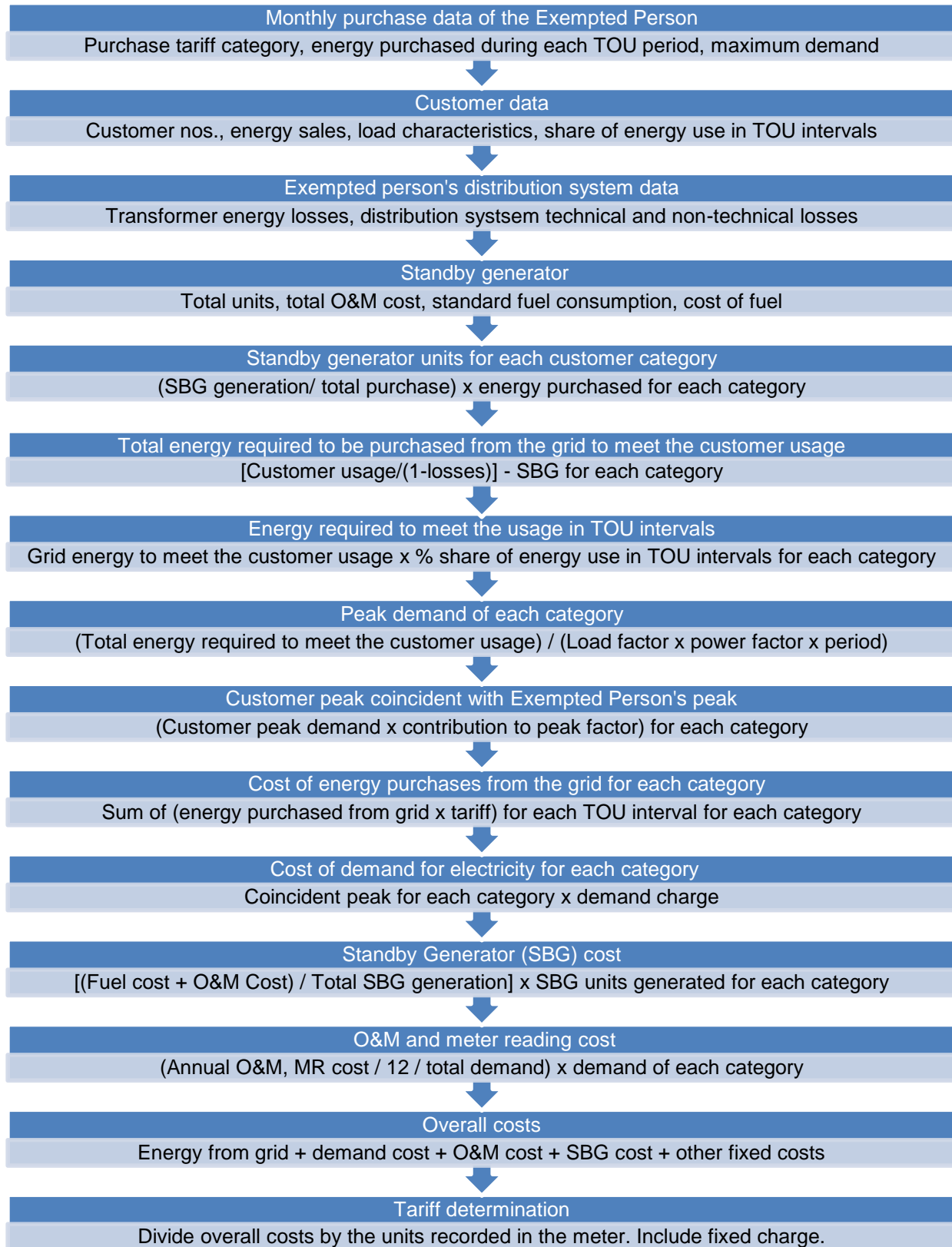
Number of exempted persons that could be analysed	One (1)
Voltage levels of supply to end-use customers	LV retail
Period of analysis	Twelve (12) months
Number of customer categories ¹	Three (3)
Methodology	Basic principles of electricity cost calculation

1.2 Basic Methodology

Figure 1 explains the basic steps implemented in the Model to calculate the cost reflective tariffs for customers served by each Exempted Person. These will be explained in detail in the ensuing sections.

¹ Period of analysis and number of categories can be increased with a simple modification. Customer installations in exempted persons' premises belong mainly to industrial, commercial and residential. Customers in each category are believed to have similar load characteristics.

Figure 1 – Flow Chart of Electricity Pricing Model

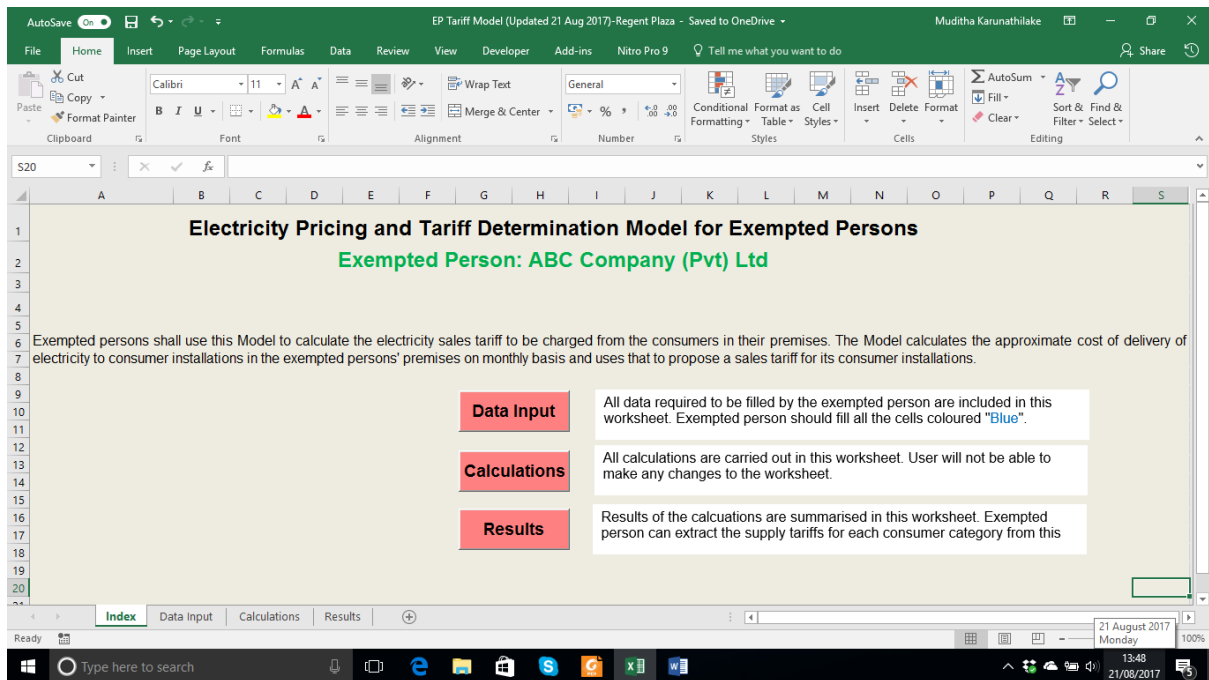


1.2.1 How the Model Works

Electricity Pricing Model for Exempted Entities is spreadsheet-based, developed using MS Excel 2013.

This document provides explanations on the working of the Model. Once the input information is entered, the Model calculates the costs of supplying electricity, and also determines a two part tariff for the three different categories considered.

2 WORKSHEET “INDEX”

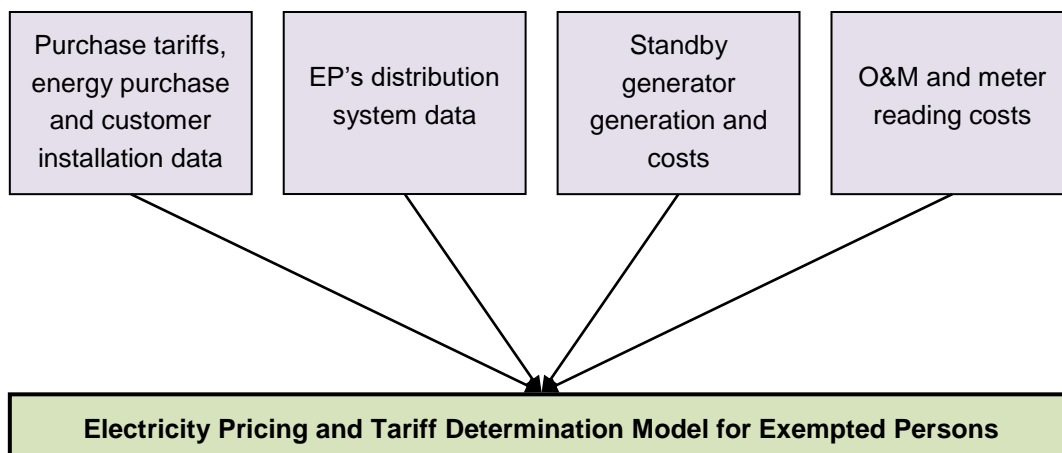


Worksheet 'Index' contains an introduction to the Model and also briefly explains the functions of each worksheet. By clicking the appropriate cell, the user can select the appropriate worksheet viz 'Data Input', 'Calculations' or 'Results'.

3 WORKSHEET: “DATA INPUT”

All data that are required for the determination of electricity tariffs for customer electrical installations in the exempted entities are given in this Worksheet and these are the sources of input to the Model.

Figure 2 - Information Inputs to the Model



User should fill all the cells coloured “Blue” in this Worksheet with the relevant data.

3.1 Purchase Information

3.1.1 Purchase tariff, monthly energy and demand information

Purchase tariff is the applicable tariff for the exempted entity, as determined by the Licensee. It can be either Industrial I1, I2, I3 or General Purpose GP1, GP2 or GP3. Tariff applicable has to be selected from the drop down list by clicking the relevant cell.

Electricity Purchase tariff		
Select Tariff Category		GP2
Maximum demand charge	Rs/kVA	1,100
Energy charge -Peak	Rs/kWh	26.60
Energy charge -Day	Rs/kWh	21.80
Energy charge -Off-peak	Rs/kWh	15.40
Fixed charge	Rs/Month	3,000
Exemption processing fee paid to PUCSL	Rs	

		Jan	Feb	March	April	May	June	July	August
Maximum demand	kVA	308	318	354	354	346	340	340	32
Time at which maximum demand is recorded	Hrs	19:30							
Total energy purchased from the grid	kWh	87,480	84,650	102,420	94,030	99,940	96,920	94,370	98,980
Peak	kWh	8,040	7,820	9,120	9,130	8,880	8,300	8,640	8,780
Day	kWh	69,000	66,800	81,530	74,040	80,060	77,910	74,630	78,740
Off-peak	kWh	10,440	10,030	11,770	10,860	11,000	10,710	11,100	11,460

Monthly energy and demand data shall be extracted from the bills submitted by the Distribution Licensee. EP shall request the Licensee to provide the time at which the maximum demand occurs for the installation.

3.2 Customer Installation Data

3.2.1 Customer numbers, monthly usage and share of energy use

Number of consumers		35	35	35	35	35	35	35	35	
Residential	No	16	16	16	16	16	16	16	16	
Commercial	No	19	19	19	19	19	19	19	19	
Industrial	No	-	-	-	-	-	-	-	-	
Total energy sales	kWh	69,655	69,805	84,172	68,224	95,407	74,204	68,233	83,994	61
Energy sales-Residential	kWh	4,199	4,786	4,568	2,877	5,542	4,099	3,632	4,200	3
Energy sales-Commercial	kWh	65,456	65,018	79,605	65,347	89,865	70,106	64,601	79,794	57
Energy sales-Industrial	kWh	-	-	-	-	-	-	-	-	-
Share of energy use		Peak	Day	Off-peak						
Residential		20%	50%	30%						
Commercial		8%	88%	4%						
Industrial		0%	0%	0%						
Load characteristics		Load factor	Power factor	Peak contributory factor						
Residential		0.15	0.95	0.3						
Commercial		0.4	0.95	0.7						
Industrial		0	0.95	0						

Number of customers in each category, their monthly usage and the share of energy use during “peak”, “day” and “off-peak” need to be entered. Number of customers in each category and their energy consumption data can be extracted from the data normally available with the EP. But the share of energy use at different time intervals have to be determined by carrying out field tests².

Peak, day and off-peak time periods are as follows.

Peak: 18:30 – 22:30

Day: 05:30 – 18:30

Off-peak: 22:30 – 05:30

Share of energy use for the three customer categories at different time intervals can be calculated as shown in the example equation below.

$$\text{Share of energy use during peak for residential consumers} = \frac{\text{Energy use during peak}}{\text{Total energy use}} \times 100\% \dots\dots(3.1)$$

3.2.2 Load factor, power factor and contribution to peak factor

The User will be required to carry out load research and determine the relevant values for the above coefficients. Relevant definitions are given in the equations (3.2) to (3.7).

² It is the normal practice to derive this information by carrying out load surveys of customer installations of each category. However, more acceptable data could be obtained by carrying out such surveys on individual feeders transporting power to each category of customers. In a condominium, generally separate floors are reserved for residential, commercial and industrial customers.

Load characteristics	Load factor	Power factor	Contribution to peak factor
Residential	0.15	0.95	0.3
Commercial	0.4	0.95	0.7
Industrial	0	0.95	0

Load factor

$$Load\ factor_{Res} = \frac{Total\ residential\ energy\ during\ the\ month}{Peak\ Demand_{Res} \times Power\ factor_{Res} \times 24 \times 30} \dots\dots\dots(3.2)$$

$$Load\ factor_{Com} = \frac{Total\ commercial\ energy\ during\ the\ month}{Peak\ Demand_{Com} \times Power\ Factor_{Com} \times 24 \times 30} \dots\dots\dots(3.3)$$

$$Load\ factor_{Ind} = \frac{Total\ industrial\ energy\ during\ the\ month}{Peak\ Demand_{Ind} \times Power\ Factor_{Ind} \times 24 \times 30} \dots\dots\dots(3.4)$$

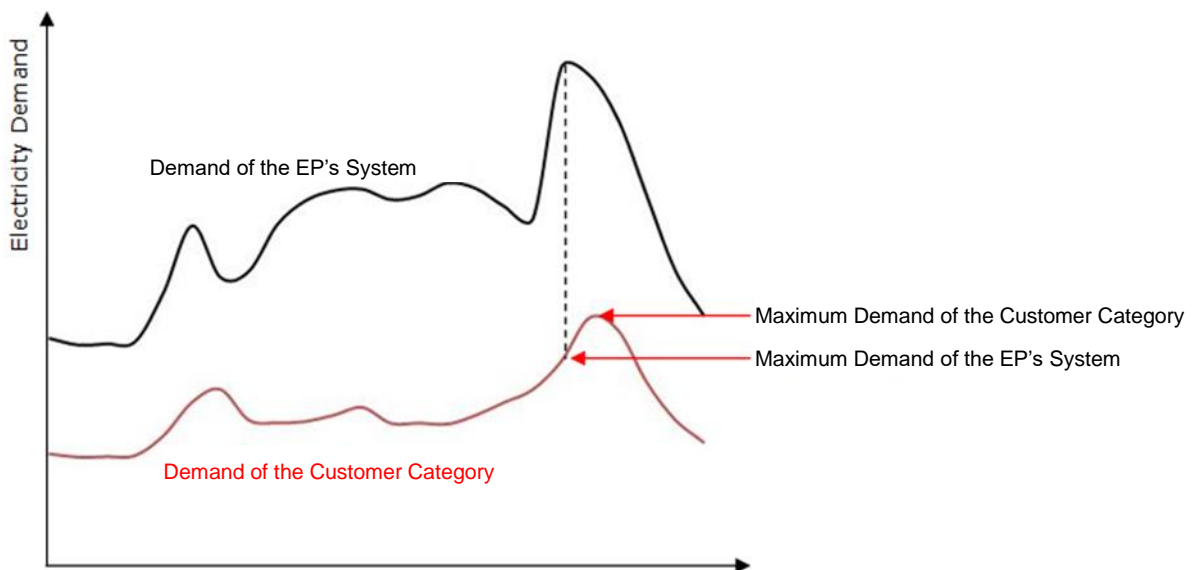
Contribution to peak factor

$$CPF_{Res} = \frac{Demand\ at\ EP's\ peak_{Res}}{Peak\ demand_{Res}} \dots\dots\dots(3.5)$$

$$CPF_{Com} = \frac{Demand\ at\ EP's\ peak_{Com}}{Peak\ demand_{Com}} \dots\dots\dots(3.6)$$

$$CPF_{Ind} = \frac{Demand\ at\ EP's\ peak_{Ind}}{Peak\ demand_{Ind}} \dots\dots\dots(3.7)$$

Figure 3 - Electricity Demand Profile of the System and the Customer



Power Factor

Average power factor of each customer category should be entered to the Model. Usually, as residential customers do not have large inductive equipment, their power factor should be close to 1. However, it is the responsibility of the EP to maintain a high power factor and therefore, power factor is capped at 0.95.

3.3 Exempted Person's Distribution System

3.3.1 Energy and demand losses

Distribution system			
Transformer energy losses	%	1.0%	If you are a GP1, GP2, I1, or I2 customer please enter 0%
Technical losses	%	1.0%	
Non technical losses	%	0.5%	
Total O&M, billing cost per annum	Rs	147,800	

Energy losses include the technical and non-technical losses incurred during the process of transporting electrical energy from the purchasing point to customer installations. Technical losses are the I^2R losses, and the metering errors fall into the category of non-technical losses. A maximum of 2% shall be allowed for technical losses and 0.5% for the non-technical losses³.

In the case of MV bulk customers such as GP3 and I3, transformer losses should be considered as they are metered before the transformer at the MV side. A maximum of 2% transformer loss shall be allowed for this. For GP1, GP2, I1, and I2 EPs, transformer energy loss shall be 0.

Demand losses are assumed negligible in the calculations.

3.4 Other Costs

Operation and maintenance (O&M) costs, meter reading costs, PUCSL exemption processing fee, and capital remuneration are the other costs incurred. EP may have outsourced or employed its own staff to carry out O&M and meter reading.

Capital remuneration (depreciation and rate of return) does not arise as customers in the condominiums pay all capital costs upfront.

3.5 Standby Generator

Total capacity of the standby generators installed by the EP should be entered to the model. Annual O&M cost of the standby generators is standardized at 750 LKR/kVA/year according to the international norms.

³ Assumes that the customer installation revenue meters are of Class 2 and Purchase point meters are of at least Class1 and instrument transformers are at least of Class 1.

Fuel consumption rate of the standby generator shall be equal or less than the standard value (0.32 liters/kWh). Other data to be entered are self-explanatory.

If the EP has cusytomer meters capable of measuring the electricity delivered when standby generators were in operation, EP should select the appropriate option from the drop down list.

Standby generator								
Total capacity of standby generators	kVA	600						
Total no of units generated	kWh	7,263	7,263	7,263	7,263	7,263	7,263	7,263
Total operation and maintance cost per annum	Rs	361,769						
Standard fuel consumption	l/kWh	0.32	0.32	0.32	0.32	0.32	0.32	0.32
Price of Diesel	Rs/l	95	95	95	95	95	95	95
Fuel cost	Rs/kWh	30.40	30.40	30.40	30.40	30.40	30.40	30.40
Operation and maintenance cost	Rs/kWh	4.151	4.151	4.151	4.151	4.151	4.151	4.151
Can your consumer electricity meters measure grid electricity and electricity from the standby generator seperately?	No							

4 WORKSHEET “CALCULATIONS”

All calculations are carried out in this Worksheet and the User will not be able to do any changes to the Worksheet, as all cells are protected. Password to unprotect the cells will be in the possession of the PUCSL, and only the PUCSL is authorized to make changes/modifications/improvements in the Worksheet.

4.1 Purchase Tariff

Applicable purchase tariff for each month will appear as shown, in accordance with the selection made in the “Data Input” worksheet.

	Unit	Jan	Feb	March	April	May	June
Applicable purchase tariff							
Fixed charge	Rs/Month	3,000	3,000	3,000	3,000	3,000	3,000
Demand charge	Rs/kVA/Month	1,100	1,100	1,100	1,100	1,100	1,100
Energy charge - Peak	Rs/kWh	26.60	26.60	26.60	26.60	26.60	26.60
Energy charge - Day	Rs/kWh	21.80	21.80	21.80	21.80	21.80	21.80
Energy charge - Off-peak	Rs/kWh	15.40	15.40	15.40	15.40	15.40	15.40
Total sales		69,655	69,805	84,172	68,224	95,407	74,204

4.2 Energy Requirement by Various Categories

4.2.1 Energy required to meet customer usage

Energy purchased by the customers are recorded in the kWh meters installed at their respective installations. However, energy purchased by the EP exceeds the recorded amount, as losses are incurred in the transportation. In addition metering also may give rise to losses or surpluses. Energy required by the EP to meet the usage by the customers for each category can be defined by the equations (4.1), (4.2) and (4.3).

$$Energy_{Res} = \frac{E_{Res}}{(1-\%losses)} \dots\dots\dots(4.1)$$

$$Energy_{Com} = \frac{E_{Com}}{(1-\%losses)} \dots\dots\dots(4.2)$$

$$Energy_{Ind} = \frac{E_{Ind}}{(1-\%losses)} \dots\dots\dots(4.3)$$

$Energy_{Res}$, $Energy_{Com}$, $Energy_{Ind}$ are the total volumes of energy required to meet the demand of the residential, commercial and industrial customers during a definite period. E_{Res} , E_{Com} , E_{Ind} are the energy usage as recorded in the energy meters of the three categories of customers.

Total sales		69,655	69,805	84,172	68,224	95,407	74,204	68,233
Residential consumers	kWh	4,199	4,786	4,568	2,877	5,542	4,099	3,632
Commercial consumers	kWh	65,456	65,018	79,605	65,347	89,865	70,106	64,601
Industrial consumers	kWh	-	-	-	-	-	-	-
Total energy required to meet the consumer usage								
Residential consumers	kWh	4,374	4,986	4,758	2,997	5,772	4,269	3,783
Commercial consumers	kWh	68,183	67,728	82,921	68,069	93,610	73,027	67,292
Industrial consumers	kWh	-	-	-	-	-	-	-

4.2.2 Energy supplied by the grid to meet the customer usage

Almost all condominiums are equipped with standby generators (SBG) and hence the energy volume calculated includes the SBG generated energy as well. Calculation of the SBG energy generated is explained in the Section 4.4.4.

Hence the energy supplied by the grid can be defined by the equations (4.4 - 4.6).

$$Energy_{Grid\ Res} = Energy_{Res} - SBG_{Res} \dots\dots\dots(4.4)$$

$$Energy_{Grid\ Com} = Energy_{Com} - SBG_{Com} \dots\dots\dots(4.5)$$

$$Energy_{Grid\ Ind} = Energy_{Ind} - SBG_{Ind} \dots\dots\dots(4.6)$$

4.2.3 Share of energy sales during each TOU interval

Cost of supply calculations will require the energy purchased from the grid to meet the demand of each customer category during each interval in the Time of Use (TOU) regime. Equations (4.7), (4.8) and (4.9) define the derivation of these values for the residential category of customers. Similar calculations are done for the other categories.

$$Energy_{Peak,Res} = Energy_{Grid\ Res} \times \%Peak \dots\dots\dots(4.7)$$

$$Energy_{Day,Res} = Energy_{Grid\ Res} \times \%Day \dots\dots\dots(4.8)$$

$$Energy_{OP,Res} = Energy_{Grid\ Res} \times \%Off - Peak \dots\dots\dots(4.9)$$

Usage of grid energy in TOU intervals						
Residential - Total	kWh	4038	4592	4443	2782	5381
Residential - Peak	kWh	808	918	889	556	1,076
Residential - Day	kWh	2,019	2,296	2,222	1,391	2,691
Residential - Off-peak	kWh	1,212	1,377	1,333	835	1,614
Commercial - Total	kWh	62,956	62,376	77,431	63,189	87,268
Commercial - Peak	kWh	5,037	4,990	6,194	5,055	6,981
Commercial - Day	kWh	55,402	54,891	68,139	55,606	76,795
Commercial - Off-peak	kWh	2,518	2,495	3,097	2,528	3,491
Industrial - Total	kWh	-	-	-	-	-
Industrial - Peak	kWh	-	-	-	-	-
Industrial - Day	kWh	-	-	-	-	-
Industrial - Off-peak	kWh	-	-	-	-	-

4.3 Peak Demand Charges

4.3.1 Individual peak demand of different categories

Individual peak demand of the consumers						
Residential consumers	kVA	38.1	47.9	41.9	27.1	50.8
Commercial consumers	kVA	222.7	244.3	273.9	231.0	308.7
Industrial consumers	kVA	0.0	0.0	0.0	0.0	0.0

Customers are required to bear the part of peak demand charges incurred by the EP. To be fair by all parties, it is necessary to determine the peak demands of each customer category.

$$Peak\ demand_{Res} = \frac{Energy_{Grid,Res}}{LF_{Res} \times PF_{Res} \times 24 \times 30} \dots\dots\dots(4.10)$$

$$Peak\ demand_{Com} = \frac{Energy_{Grid,Com}}{LF_{Com} \times PF_{Com} \times 24 \times 30} \dots\dots\dots(4.11)$$

$$Peak\ demand_{Ind} = \frac{Energy\ Grid,Ind}{LF_{Com} \times PF_{Com} \times 24 \times 30} \dots\dots\dots(4.12)$$

4.3.2 Coincident peak demand

Consumer's peak coincident with EP peak		223.0	246.4	272.8	227.5	308.5
Residential consumers	kVA	11.4	14.4	12.6	8.1	15.2
Commercial consumers	kVA	211.5	232.1	260.2	219.4	293.2
Industrial consumers	kVA	0.0	0.0	0.0	0.0	0.0

Peak demand charges of the EP have to be apportioned according to the demands of the customer groups. This is achieved by multiplying the peak demand of the customer groups by the CPF for each category (Section 3.2.2)

$$Coincident\ peak_{Res} = Peak\ demand_{Res} \times CPF_{Res} \dots\dots\dots(4.13)$$

$$Coincident\ peak_{Com} = Peak\ demand_{Com} \times CPF_{Com} \dots\dots\dots(4.14)$$

$$Coincident\ peak_{Ind} = Peak\ demand_{Ind} \times CPF_{Ind} \dots\dots\dots(4.15)$$

4.4 Calculation of Costs

4.4.1 Energy from grid

Energy (from grid) cost calculation		Rs	Rs	Rs	Rs	Rs
Residential	Rs	84,161	95,690	92,595	57,977	112,147
Commercial	Rs	1,380,505	1,367,773	1,697,897	1,385,600	1,913,603
Industrial	Rs	-	-	-	-	-

Energy purchased by the EP to meet the demand of the three categories of customers during each TOU intervals are multiplied by the respective TOU tariffs to determine the cost.

$$A_{Res} = (Energy_{Day,Res} \times Day\ tariff) + (Energy_{Peak,Res} \times Peak\ tariff) + (Energy_{OP,Res} \times OP\ tariff) \dots\dots\dots(4.16)$$

$$A_{Com} = (Energy_{Day,Com} \times Day\ tariff) + (Energy_{Peak,Com} \times Peak\ tariff) + (Energy_{OP,Com} \times OP\ tariff) \dots\dots\dots(4.17)$$

$$A_{Ind} = (Energy_{Day,Ind} \times Day\ tariff) + (Energy_{Peak,Ind} \times Peak\ tariff) + (Energy_{OP,Ind} \times OP\ tariff) \dots\dots\dots(4.18)$$

4.4.2 Maximum demand

Demand cost calculation						
Residential consumers	Rs	12,570	15,823	13,830	8,948	16,750
Commercial consumers	Rs	232,701	255,257	286,202	241,345	322,561
Industrial consumers	Rs	-	-	-	-	-

Apportioned maximum demands (coincident peak demand) of the three categories of customers are multiplied by the maximum demand charge to arrive at the maximum demand charges.

$$B_{Res} = \text{Coincident peak}_{Res} * \text{Demand Charge} \dots \dots \dots (4.19)$$

$$B_{Com} = \text{Coincident peak}_{Com} * \text{Demand Charge} \dots \dots \dots (4.20)$$

$$B_{Ind} = \text{Coincident peak}_{Ind} * \text{Demand Charge} \dots \dots \dots (4.21)$$

4.4.3 Operation & Maintenance, meter reading and other fixed charges

Cost of O&M and meter reading is apportioned among the three categories as per the share of sales, while EP's fixed charge for grid purchases and fees paid to PUCSL are divided among the total number of customers as given in equations (4.22), (4.23) and (4.24).

$$C_{Res} = \left(\frac{\text{Total O\&M cost} \times \text{Peak demand}_{Res}}{12 \times \text{Maximum demand}} \right) + \frac{(\text{Fixed charge}_{Grid} + \frac{\text{PUCSL Charge}}{12}) \times N_{Res}}{N_{Total}} \dots \dots \dots (4.22)$$

$$C_{Com} = \left(\frac{\text{Total O\&M cost} \times \text{Peak demand}_{Com}}{12 \times \text{Maximum demand}} \right) + \frac{(\text{Fixed charge}_{Grid} + \frac{\text{PUCSL charge}}{12}) \times N_{Com}}{N_{Total}} \dots \dots \dots (4.23)$$

$$C_{Ind} = \left(\frac{\text{Total O\&M cost} \times \text{Peak demand}_{Ind}}{12 \times \text{Maximum demand}} \right) + \frac{(\text{Fixed charge}_{Grid} + \frac{\text{PUCSL charge}}{12}) \times N_{Ind}}{N_{Total}} \dots \dots \dots (4.24)$$

4.4.4 Standby generator (SBG)

Standby generation (SBG) cost calculation						
Standby generation/(total purchases+standby gen)		0.0767	0.0790	0.0662	0.0717	0.0677
SBG Units - Residential	kWh	335.29	393.97	315.08	214.88	391.08
SBG Units - Commercial	kWh	5,226.93	5,351.85	5,490.90	4,880.77	6,342.05
SBG Units - Industrial	kWh	-	-	-	-	-
SBG Energy Cost - Residential	Rs	11,767	13,826	11,058	7,541	13,725
SBG Energy Cost -Commercial	Rs	183,441	187,826	192,706	171,293	222,577
SBG Energy Cost - Industrial	Rs	-	-	-	-	-

SBG usually has an energy meter to measure its energy generated, but the energy flow into the customer installations takes place through the same kWh meter used for grid energy inflow. Hence, direct measurement of SBG generated energy consumed by the customers is not possible. In view of the above, an approximation has to be made to assess the SBG units consumed by the customer installations and the Model uses the formulae (4.28)-(4.30) for this purpose.

$$SBG_{Res} = \frac{\text{Total SBG units} \times \text{Energy}_{Res}}{\text{Total EP purchases}} \dots\dots\dots(4.25)$$

$$SBG_{Com} = \frac{\text{Total SBG units} \times \text{Energy}_{Com}}{\text{Total EP purchases}} \dots\dots\dots(4.26)$$

$$SBG_{Ind} = \frac{\text{Total SBG units} \times \text{Energy}_{Ind}}{\text{Total EP purchases}} \dots\dots\dots(4.27)$$

Cost of provision of such energy is determined by the equations (4.28) to (4.31).

$$D_{Res} = SBG_{Res} \times SBG_{cost} \dots\dots\dots(4.28)$$

$$D_{Com} = SBG_{Com} \times SBG_{cost} \dots\dots\dots(4.29)$$

$$D_{Ind} = SBG_{Ind} \times SBG_{cost} \dots\dots\dots(4.30)$$

$$SBG_{cost} = \frac{(\text{Fuel costs} + \text{O\&M costs})}{\text{Total units generated}} \dots\dots\dots(4.31)$$

4.5 Total Cost

Overall energy cost calculation						
Residential consumers	Rs	108,499	125,340	117,483	74,466	142,622
Commercial consumers	Rs	1,796,648	1,810,856	2,176,804	1,798,238	2,458,741
Industrial consumers	Rs	-	-	-	-	-

Total cost of meeting the cost of supplying electricity to the customers hence can be defined by the equations (4.32 – 4.34).

$$\text{Total cost of supply to Residential customers} = A_{Res} + B_{Res} + C_{Res} + D_{Res} \dots\dots\dots(4.32)$$

$$\text{Total cost of supply to Commercial customers} = A_{Com} + B_{Com} + C_{Com} + D_{Com} \dots\dots\dots(4.33)$$

$$\text{Total cost of supply to Industrial customers} = A_{Ind} + B_{Ind} + C_{Ind} + D_{Ind} \dots\dots\dots(4.34)$$

4.6 Tariff Proposed

Tariff proposed for consumers						
Fixed charge - Residential	Rs/Month	132.12	138.50	127.49	118.18	130.43
Fixed charge - Commercial	Rs/Month	694.88	689.51	698.78	706.62	696.31
Fixed charge - Industrial	Rs/Month	-	-	-	-	-
Energy charge - Residential	Rs/kWh	25.84	26.19	25.72	25.88	25.74
Energy charge - Commercial	Rs/kWh	27.45	27.85	27.35	27.52	27.36
Energy charge - Industrial	Rs/kWh	-	-	-	-	-

4.6.1 Fixed charge

A fixed charge is always recommended and this should cover the installation maintenance costs and other fixed charges of the EP.

$$\text{Fixed charge for residential consumers per month} = \frac{C_{Res}}{N_{Res}} \dots\dots\dots(4.35)$$

$$\text{Fixed charge for Commercial consumers per month} = \frac{C_{Com}}{N_{Com}} \dots\dots\dots(4.36)$$

$$\text{Fixed charge for residential consumers per month} = \frac{C_{Ind}}{N_{Ind}} \dots\dots\dots(4.37)$$

4.6.2 Energy charge

If the EP has not installed customer meters which have the facility to measure the SBG units separately, energy charge is calculated as given in the equations (4.38) – (4.40).

$$\text{Cost of a kWh for residential consumers} = \frac{A_{Res}+B_{Res}+D_{Res}}{E_{Res}} \dots\dots\dots(4.38)$$

$$\text{Cost of a kWh for commercial consumers} = \frac{A_{Com}+B_{Com}+D_{Com}}{E_{Com}} \dots\dots\dots(4.39)$$

$$\text{Cost of a kWh for industrial consumers} = \frac{A_{Ind}+B_{Ind}+D_{Ind}}{E_{Ind}} \dots\dots\dots(4.40)$$

For EP entities with SBG units measuring capability, $(D_{Res}, D_{Com}, D_{Ind})$ should be deducted from equations (4.38), (4.39) and (4.40). SBG energy charge is calculated as given in equation (4.41) irrespective of the customer category.

$$\text{SBG energy charge per kWh} = SBG_{Cost} \dots\dots\dots(4.41)$$

These calculations have to be carried out for each month in the preceding year. Average value is proposed to be used as the flat tariff for the ensuing year.

5 RESULTS SUMMARY

Results are extractions from the two previous worksheets. Cells are password protected. If the User has entered all the relevant data, results will be shown.

Tariff proposed for consumers			
Fixed charge - Residential	RstMonth		128
Fixed charge - Commercial	RstMonth		699
Fixed charge - Industrial	RstMonth		-
Energy charge - Residential	RstKwh		24.01
Energy charge - Commercial	RstKwh		25.70
Energy charge - Industrial	RstKwh		-
SBG Energy charge - All	RstKwh		35.10

Comparison			
Average price of grid electricity	RstKwh		25.40
Average supply tariff-Residential	RstKwh		24.53
Average supply tariff-Commercial	RstKwh		25.89
Average supply tariff-Industrial	RstKwh		-

Applicable purchase tariff			
Fixed charge	RstMonth		3,000
Demand charge	RstVA/Month		1,100
Energy charge - Peak	RstKwh		26.60
Energy charge - Day	RstKwh		21.80
Energy charge - Off-peak	RstKwh		15.40

Purchase data		Jan	Feb	March	April	May	June	July	August	September	October	November	December
Maximum demand	kVA	308	318	354	354	346	340	340	326	324	332	320	300
Time at which maximum demand is recorded	Hrs	19:30											
Total energy purchased from the grid	kWh	87,480	84,650	102,420	94,030	99,940	96,920	94,370	98,980	94,350	96,020	89,670	85,350
Peak	kWh	8,040	7,820	9,120	9,130	8,880	8,300	8,640	8,780	8,520	8,580	7,910	7,730
Day	kWh	69,000	66,800	81,530	74,040	80,060	77,910	74,630	78,740	74,500	76,010	71,340	67,030
Off-peak	kWh	10,440	10,030	11,770	10,860	11,000	10,710	11,100	11,460	11,330	11,430	10,420	10,590

Number of consumers		Jan	Feb	March	April	May	June	July	August	September	October	November	December
Residential	No	16	16	16	16	16	16	16	16	16	16	16	16
Commercial	No	19	19	19	19	19	19	19	19	19	19	19	19
Industrial	No	0	0	0	0	0	0	0	0	0	0	0	0

Energy sales		Jan	Feb	March	April	May	June	July	August	September	October	November	December
Total energy sales	kWh	69,654.68	69,804.60	84,172.48	68,223.59	95,406.70	74,204.15	68,232.50	83,994.25	61,098.40	83,548.45	73,923.00	66,178.00
Energy sales-Residential	kWh	4,138.80	4,786.20	4,567.90	2,877.00	5,541.50	4,098.50	3,632.00	4,200.30	3,229.60	4,108.60	4,554.70	3,084.00
Energy sales-Commercial	kWh	65,455.88	65,018.40	79,604.58	65,346.59	89,865.20	70,105.65	64,600.50	79,793.95	57,868.80	79,439.85	69,368.30	63,094.00
Energy sales-Industrial	kWh	-	-	-	-	-	-	-	-	-	-	-	-

6 DATA VALIDATION

Model uses several data validation rules to ensure accurate data input to the Model.

Validating the share of energy use by each customer category at different TOU intervals

Sum of total shares should be equal to 100% for each customer category. Model calculates the total energy use of the EP at different TOU intervals with the use of the energy shares entered by the User and it should be equal or less than the EP's billed energy amount. If these criteria are not met, "Red" coloured cells will appear with a message to correct the energy shares as shown in the figure below.

Share of energy use	Peak	Day	Off-peak	
Residential	20%	50%	40%	
Commercial	8%	88%	4%	
Industrial	0%	0%	0%	
				Please adjust the respective percentages of energy use

Validating the customer load factors and contribution to peak factors

Model calculates the maximum demand of the EP with the use of customer load factors and CPFs. If the calculated maximum demand exceeds the billed maximum demand of the EP, User will be asked to correct these factors.

Load characteristics	Load factor	Power factor	Contribution to peak factor	
Residential	0.15	0.95	0.3	
Commercial	0.4	0.95	0.7	
Industrial	0	0.95	0	
				Please adjust the Load factor and Contribution to peak factor

If the User neglects the above messages and proceed to the "Results" worksheet with the incorrect data, results will not be displayed in the Model.

Tariff proposed for consumers		
Fixed charge - Residential	Rs/Month	128
Fixed charge - Commercial	Rs/Month	699
Fixed charge - Industrial	Rs/Month	-
Energy charge - Residential	Rs/kWh	-
Energy charge - Commercial	Rs/kWh	-
Energy charge - Industrial	Rs/kWh	-
SBG Energy charge - All	Rs/kWh	35.10

There is a problem with the data you have input. Please re-check the "Data Input" sheet

Comparison		
Average price of grid electricity	Rs/kWh	25.40
Average supply tariff-Residential	Rs/kWh	26.39
Average supply tariff-Commercial	Rs/kWh	25.89
Average supply tariff-Industrial	Rs/kWh	-