FINANCIAL IMPLICATIONS OF SOLAR PENETRATION FOR ELECTRICITY GENERATION IN SRI LANKA

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Degree of Master of Science

Department of Electrical Engineering

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Dissertation submitted in partial fulfillment of the requirements for the degree Master of Science in Electrical Engineering

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DECLARATION PAGE OF THE CANDIDATE & SUPERVISOR

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Prof. W. D. A. S. Wijayapala Date:

Dr. H. M. Wijekoon Date

ABSTRACT

It is important to have an uninterrupted, economical, and reliable electricity supply contributing to economic and social development of a country. Due to the environmental impacts of fossil fuel based conventional power generation, the world is moving towards power generation from renewable sources like wind, solar, biomass etc. Solar is one of the fast growing and economical renewable power generation source. The intention of development of solar power generation is to promote clean energy while addressing the basic requirement of uninterrupted and reliable electricity supply.

Going with world trend, the Government of Sri Lanka promotes the development of solar PV based electricity through subsidies. Hence, the market graduated with many consumers willing to install solar rooftop and they were ably supported by solar power service providers. On the other hand, the utility is obliged to absorb the solar power generated as per the different subsidized schemes available. The benefit for the utility is that the expensive oil-fired generation during the daytime can be avoided, however in contrast, the utility needs to maintain sufficient capacity to compensate the intermittent and non-dispatchable electricity generation.

Extensive research had been carried out on technical challenges and opportunities due to the technical constraints of solar power generation. However, only a limited number of studies have been carried out examining the financial and economic impact of solar penetration to the national grid of Sri Lanka.

One-year historical system dispatch data for year 2019 and rooftop solar generation data for a period of 6 months of year 2019 considered for the analysis. The model compares the financials of two scenarios to estimate the impact to the utility. The base case scenario, which is business as usual with the already installed solar generation in the system. No solar scenario, which assume there is no solar in the system and therefore the demand is met by other available generation capacities in the system.

This research examines the two scenarios with careful calculations of how the system can still run without solar in the system. Daily demand patterns were analyzed and then expanded to months and summarized for the year. This research focuses the financial impact of solar electricity penetration to the national grid and how everyone can still be beneficial.

ACKNOWLEDGEMENT

I would like to express my gratitude to my supervisors, Prof. W.D. A. S. Wijayapala and Dr. H. M. Wijekoon for the guidance and encouragement throughout the research.

I sincerely appreciate the extensive support and guidance extended by Mr. Ranishka Wimalasena; who was my former supervisor at the Asian Development Bank and has been a good friend throughout my career in the Energy Sector, to successfully complete the research.

I am grateful to Ceylon Electricity Board (CEB) management, Deputy General Manager, Mr. Ronald Comester from RCL branch and Chief Engineer Mr. Eranga Kudahewa from the System Control Center for allowing me to use the rooftop solar and dispatch data and the given support throughout the study. Also, I would like to express my gratitude to Mr. Sulakshana Jayawardana, former Director General, Sri Lanka Sustainable Energy Authority, Additional Secretary to the president at Presidential Secretariat at present to allow me to access data from Ministry of Power.

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CHAPTER 01

BACKGROUND

1.1 Introduction

It is important to have an uninterrupted, economical, and reliable electricity supply contributing to economic and social development of a country. Due to the environmental impacts of fossil fuel based conventional power generation, the world is moving towards power generation from renewable sources like wind, solar, bio-mass etc. Solar is one of the fast growing and economical renewable power generation source. The intention of development of solar power generation is to promote clean energy while addressing the basic requirement of uninterrupted and reliable electricity supply.

Going with world trend, the Government of Sri Lanka promotes the development of solar PV based electricity through subsidies. Hence, the market graduated with many consumers willing to install solar rooftop and they were ably supported by solar power service providers. On the other hand, the utility is obliged to absorb the solar power generated as per the different subsidized schemes available. The benefit for the utility is that the expensive oil-fired generation during the day demand can be avoided, however in contrast, the utility needs to maintain sufficient capacity to compensate the intermittent and non-dispatchable electricity generation.

Despite the numerous initiatives introduced by the government of Sri Lanka and the CEB, there is enormous potential to develop more solar energy to support the growing energy demand. CEB has been criticized for been slow in absorbing renewable energy and having many barriers. Main reason for slow progress emphasized by CEB is the technical constraints and the higher tariff offered by the government. Although, extensive research had been carried out on challenges and opportunities due to the technical constraints of solar power generation, only a limited studies have been carried out examining the financial and economic impact of solar penetration to the national grid to support CEB’s argument.

The question of whether the solar generation can resolve the energy demand at the lowest cost and at the minimum burden to the economy is unanswered.

This research focuses to assess the financial impact of solar electricity penetration to the national grid. The study discussed the direct impact to CEB due to solar penetration and the impact to CEB revenue from the solar generating consumers. The study recommends the changes required to the solar tariff and also the changes required to the tariffs of rooftop solar consumers.

1.2 Scope

This study is conducted to estimate the financial impact on the national utility due to solar generation. Only the financial implications considered. Sensitivity analysis has been conducted for solar capacity and solar unit cost to check the changes on impact to CEB

1.3 Objectives

To estimate the financial impact to the national utility:

- by absorbing embedded solar generation and replacing existing generation technologies (thermal/hydro)
- by foregoing high tariff paying customers by absorbing solar rooftop generation under different schemes (net metering/net accounting)

1.4 Thesis outline

This thesis contains a study on financial impact due to solar penetration in Sri Lanka.

Chapter 01 is the background of the study and also contains the objectives and scope of the study.

Chapter 02 consists of the literature review done during the research. It contains the background of solar generation in Sri Lanka, renewable energy integration, renewable energy with traditional planning. Renewable energy generation and financial performance of the utility etc., and the concepts used in other similar studies and research.

Chapter 03 discusses the methodology used throughout the study. The methodology has two sections. Therefore the 3rd chapter contains two main sections.

Chapter 04 describes the financial model used and analysis in detail and presents the results of the analysis of the data for the year 2019.

Chapter 05 concludes the study outcomes and way forward of the findings and future research options.

CHAPTER 02

LITERATURE REVIEW

2.1 Background

To identify the financial implications, first need to study the background of the solar generation and the technical background of similar studies. Further, need to study the dispatch model in the power generation and the future generation plan in Sri Lanka.

"The planned RE capacity as contained in this plan for the period beyond 2030 is expected to be further enhanced in successive generation plans with consideration of progress of implementation and advancement in renewable energy and storage technologies. In the event of further increase to RE capacities beyond 2030, a corresponding reduction is expected from natural gas fired generating capacities. Replacement of conventional technologies need to be made gradually, and proportionately with the development of enabling grid support technologies and hence the generation mix beyond 2030 is expected to change significantly in favor of RE though cannot be quantified at this stage. The indigenous renewable energy-based generation is to dominate in both capacity and energy terms throughout the planning period with a further 3,500 MW of additions envisaged by 2030 and 9,500 MW by 2040." – CEB LTGEP (2022-2041).

It is clear that the policy level planning encourages the renewable energy enhancement, though there is no clear measurements on the capacity enhancement. The CEB Long Term Generation Expansion Plan emphasize, that there is a plan to increase Solar PV capacity up to 2,024 MW by 2025 and 2,874 MW by 2030. As of 2020 it was 425MW both small and larger installations.

In Sri Lanka primary energy sources are biomass, petroleum, coal, major hydro and other renewable energy. Petroleum is the main source of energy supply, and it is approximately 40%, which is direct import as a finished product to the country. Sapugaskanda refinery is the only refinery in the country and imported crude oil converts to refined products at Sapugaskannda refinery. Ninety six percent (96%) of the total coal imports uses for electricity generation.

The maximum peak demand recorded in the year 2020 is 2,717 MW. Average demand growth per year approximately 5.7% from 2015 to 2020. It was recorded the total electricity generation as 15,714 GWh and the installed generating capacity as 4,615MW including rooftop solar in 2020, which includes renewable energy 2,447 MW and Thermal 2,168 MW.

Major hydro, mini hydro, solar, wind and biomass are renewable energy technologies which contributes to power generation in Sri Lanka and thermal power generation includes reciprocating engines, open cycle and combined cycle turbines and steam plants which are operated on imported coal and oil. Nevertheless, due to lack of capability of generating firm power, plants are sub categorized as dispatchable and non-dispatchable. All thermal plants are designed to operate as dispatchable plants. Though major hydro power plants are dispatchable, there are constraints due to hydrological conditions and other multipurpose usage such as irrigation purposes. Renewable energy plants are certainly non-dispatchable. By 2020, dispatchable generation capacity is 3551 MW and 1064 MW is non-dispatchable other renewable energy generation [1].

2.2 Solar energy and its role

The intention of development of solar generation, is to promote clean energy while addressing the basic requirement of uninterrupted and reliable electricity supply. Present consumption of level of electricity is about 12,000 GWh, with an increase rate of 6.5% to 9% annually.

Ceylon Electricity Board (CEB) had identified that Sri Lanka needs additional 4000 GWh by end of 2025. This amount is planned to be generated through solar energy, other renewable energy, and other indigenous energy resources. By increasing renewable energy generation, the foreign exchange spend on fossil fuels will be remain in the country.

There is an analysis done by A. G. H. D. Wijesena, which establish the importance of renewable energy generation, specifically solar by comparing the generation cost of different technologies in the Sri Lankan electricity network. In addition, this study discusses the future electricity demand and the significant contribution needed by solar energy to meet the demand by 2025. It also discusses and concludes that installing a rooftop solar PV is financially beneficial for a consumer. Based on a simple financial model and calculation, the study concludes that solar PV is beneficial in terms of economic and environment aspects for the country [2].

There are three schemes is Sri Lanka for Solar Rooftop consumers.

Net metering

This model allows customers to offset the consumed electricity with the electricity they generate from their rooftop solar systems. At the end of monthly billing cycles, if the customers consume more than they have generated from their rooftop solar systems, they are billed at the electricity tariff rates based on their net consumption level. If the customers generate more electricity than they consume, the electricity surplus balance is carried over to the next month. The surplus balances can be kept for up to 10 years.

Net accounting

This model allows customers to be paid in cash for any surplus they generate at the end of their monthly billing cycles at the following rates: (a) year 1 to year 7 at SLRs22.0/kWh, and (b) year 8 to year 20 at SLRs15.5/kWh.

Net plus

this allows customers to separate electricity consumption and electricity generation. The customers pay for the electricity they consume based on the existing tariff structure. At the same time, the customers can also sell whatever electricity they generate from their rooftop solar photovoltaic systems at the following rates: (a) year 1 to year 7 at SLRs22.0/kWh, and (b) year 8 to year 20 at SLRs15.5/kWh.

2.3 Renewable energy growth and financial performance of utilities

There is a pressure inserted on electricity utilities to increase clean energy production. Although there is an improvement of environmental performance of the utilities through adoption of renewable energy it questions the fundamental issue of impact on economic performance. A study on “Renewable energy growth and the financial performance of electric utilities” uses two data analytics methods, regression analysis and Granger casualty test, using data of 66 large electric utilities.

The results of the study show a negative correlation between the renewable energy increase and the financial performance of the utility. However, the utilities carbon intensity moderates the relationship. Figure 1 and figure 2 shows the above findings.

The study confirms the same negative correlation even for a country wide performance of utilities for increase in renewable energy [3].

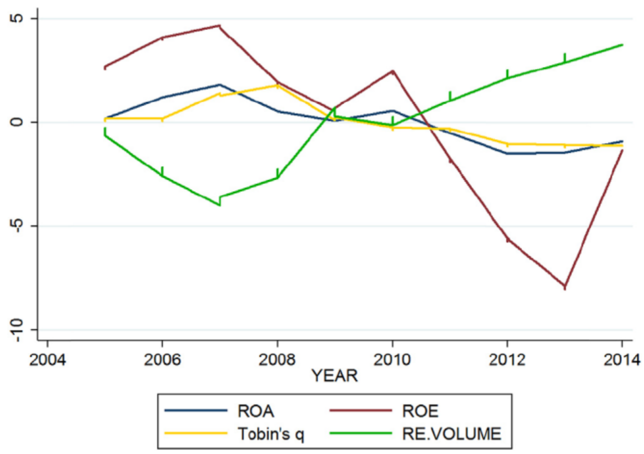

Figure 1: Average change of renewable energy production

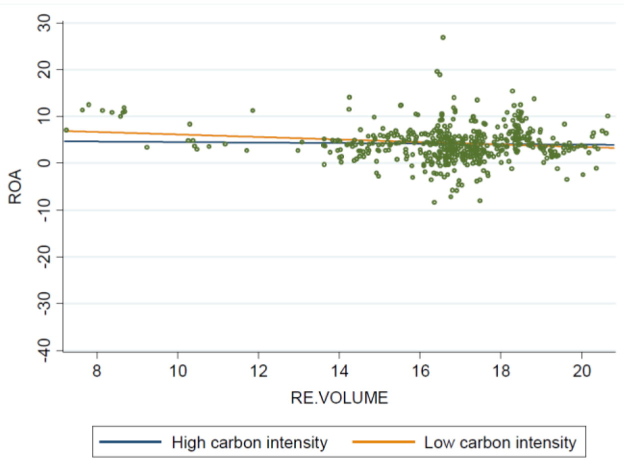

Figure 2: Moderating effect of carbon intensity.

There are studies presents the results indicating potential capability of renewable energy sources to reduce production cost while achieving minimum system reserve requirements.

A study on "Coordinated Operation of Concentrated Solar Power and Wind Resources for the Provision of Energy and Reserve Services" presents the results indicating potential capability of renewable energy sources to reduce production cost while achieving minimum system reserve requirements. In addition, the analysis verifies the benefits of complementary effect of solar and wind energy resources on power system operation. For this study, researchers used, stochastic two stage day ahead unit commitment model and rolling look ahead economic dispatch model with the integration of solar and wind resources [4].

2.4 Environmental management with renewable energy

At present electric utilities are under pressure to increase clean energy production. Although the adoption of renewable energy can improve the environmental performance, a fundamental question is, if it also improves the economic performance. Over the decades a number of studies have focused on relationship between corporate Environment Performance (EP) and Financial Performance (FP). The results of this research are contractionary. A slightly majority of studies have shown that better EP is positively corelated to a firm's FP. [5]

There are grid integration studies undertaken to support in identify the need of increase in renewable energy capacity additions to contribute Green House Gas (GHG) emission reduction. It is a recognized tool to make policy decisions on renewable energy targets on climate change mitigation goals. Following figure 3 presents the potential renewable capacity additions and GHG emission reductions identified from a grid integration study in 2019. [6]

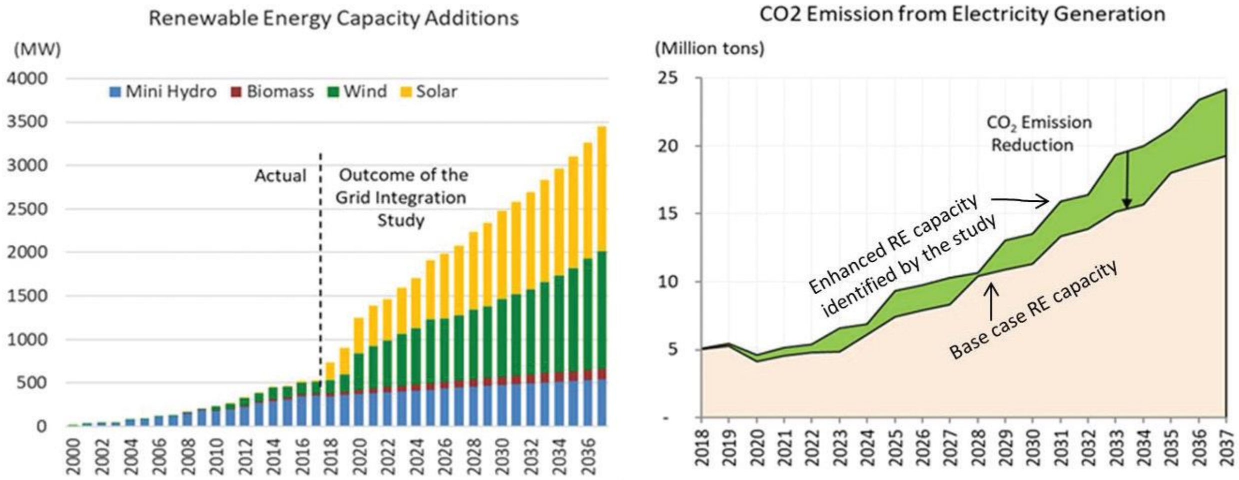

Figure 3: Potential renewable capacity addition and GHG emission reduction

2.5 Renewable energy and traditional planning

The renewable energy generation is varying due to weather conditions. However, renewable energy such as solar and wind are more attractive at present due to the contribution of the availability improvements of the power generation. To mitigate this variation a paper proposed, day a head market and real time pricing in multi generator system. The day ahead market provides the opportunity for trading electrical power which is surplus or absence power in each power system. Real time pricing can level the forecasted load demand curve in order to shift the load demand. This method can improve the efficiency of the operation of distribution generation and can reduce the operation cost [7].

There are various methodologies to mainstream Non-Conventional Renewable Energy (NCRE) technologies in the long-term generation expansion planning (LTGEP) process.

The peak period capacity factor method can be used to calculate the capacity credit of NCRE generation in Sri Lanka and Run of River (ROR) hydro equivalent model can be used to model intermittent and variable NCRE generation in capacity expansion models such as Wien Automatic System Planning Package (WASP) – which is currently being used by many utilities including the CEB.

"The Wien Automatic System Planning Package (WASP) model permits the user to find an optimal expansion plan for a power generating system over a long period and within the constraints defined by the planner, which is maintained by the International Atomic Energy Agency (IAEA). It is a software tool geared toward power planners in developing countries."

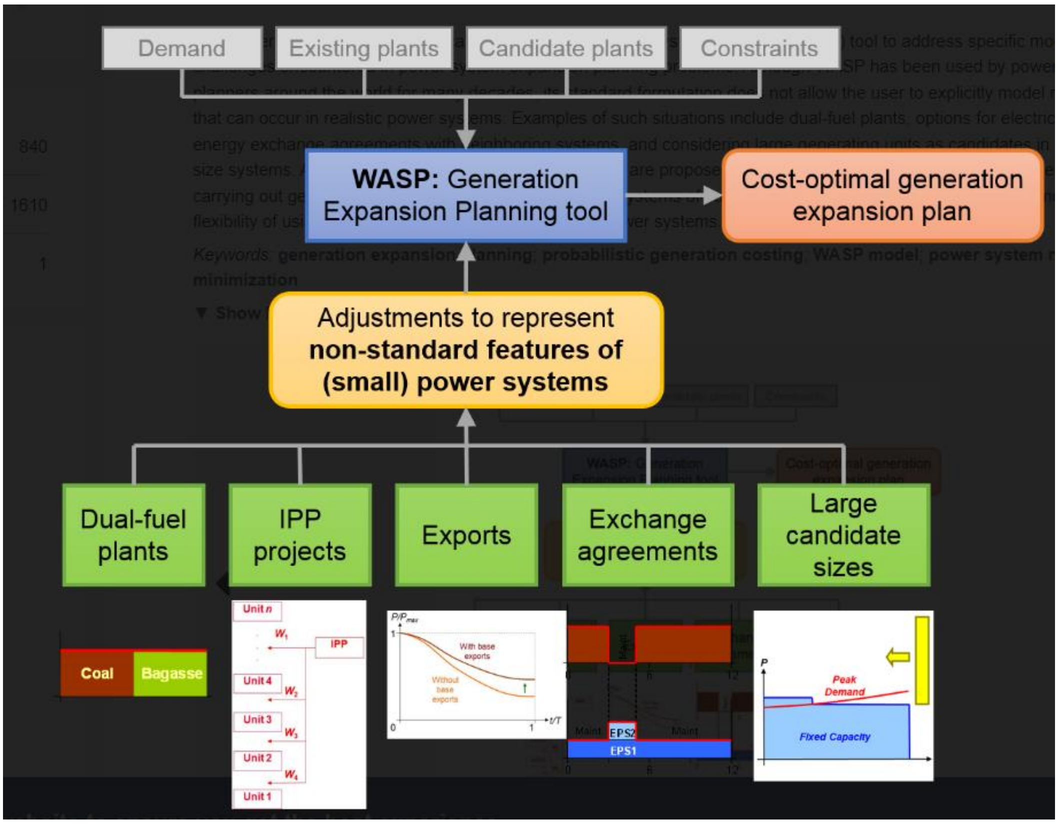

Figure 4:Applications of WASP model (Source online)

Average Incremental Cost (AIC) can be used to evaluate the energy and capacity cost savings from modeled NCRE plants. Sample applications of WASP model shows in Figure 4 [8].

2.6 Demand side management and renewable energy integration

One possibility to facilitate system integration of renewable energy sources (RES) is demand side management (DSM). The electricity market model ELTRAMOD is used to analyze interdependencies between different low-carbon technologies (especially regarding flexibility options) in the European electricity system.

It considers amongst others the temporal adjustment of consumer load patterns in response to price signals, the installation of storage capacities, the reinforcement of the transmission grid as well as the expansion of flexible electricity generation capacities.

ELTRAMOD is a bottom-up electricity market model with a temporal resolution of 8760 hours. It calculates the cost minimal generation dispatch, taking techno-economic characteristics of generation facilities into account [9].

2.7 Opportunities and challenges for Solar power generation in Sri Lanka

Geographical location of Sri Lanka which is closer to equator has substantial potential in solar resources. Solar irradiation has no significant variation throughout the country. Therefore, there is a huge opportunity for solar power generation. However, there are considerations for grid integration, institutional barriers, financial barriers and regulatory barriers for installing of solar power plants in Sri Lanka [10].

There are studies identified the gaps for renewable energy enhancement in Sr Lanka. Following considerations are some of the key aspects on it.

- Infrastructure development for RE resources
- Seasonality nature of RE resource
- System stability requirements
- Network constraints
- Load variation
- Lack of flexibility on operation
- Constraint in national policy on energy mix [11]

2.8 Methodology of Merit order dispatch

The system operator is responsible for system operations including plan operations and identify expected generation resources required to meet the forecasted demand. It should be considered the limitations for generation availability, transmission constraints according to the performance standards under the Grid code. Also, the system operator should optimize the system operation, by coordinating real time operation of the system. The systems operation plan is based on following considerations.

- Load forecasts
- Generation and availability
- Reservoir levels and water availability for power generation
- Transmission constraints
- Must run generation
- Risk of shortage or surpluses, including the risk of spilling

There are three categories for planning: year ahead, monthly update and week ahead. Year a head planning is to decide the optimal allocation of hydro generators through out the year to minimize the costs of transmission and generation. Thereby minimize the risks of non-availability of power and provide provisions for maintenance planning. Monthly planning is to revise the schedules according to the actual situation until the end of the previous month of the reservoirs or other plants. Week ahead plan supports to coordinate maintenance outages and availability of hydro generation. Then the operator will forecast the possible constraints and it will help to alarm the possible matters which can affect the smooth operation of the system.

The dispatch methodology consists with following conditions.

- According to the requirements of the system operator, licensees should submit the information on day ahead dispatch and real time dispatch.
- The system operator should clearly communicate the dispatch process including day ahead schedule and ancillary services schedule.
- The system operator is responsible for issuing dispatch instructions, including requests for disconnection during real time operation.

Based on the results of the week ahead plan, the operator should process a day ahead security concerned economic dispatch daily, in order to supply the optimized demand. It helps to fulfill the performance standards under Grid code, which emphasize to schedule sufficient transmission and generation capacity to meet the required load. Also, this day ahead economic dispatch helps to process maintenance requests and load shedding when required. To produce a proper day ahead dispatch, the security constrained dispatch model is most suitable and following are main considerations for such dispatch model.

- Generation availability and restrictions for operations
- Load forecast at each connection node
- Energy prices (in the contracts) for thermal generators
- Fuel and environmental constraints

- Daily water requirement as per the Water management secretariat and other users
- Reserve margins and voltage control according to the Grid Code
- Losses and constraints of transmission system [12]

CHAPTER 03

METHODOLOGY

3.1 Introduction

This study is conducted to estimate the financial impact to the utility CEB due to penetration of solar generation in the system. The study contains two parts.

- Financial impact due to the cost of generation.
- Financial impact due to the loss of revenue from solar rooftop customers.

To estimate the financial impact to CEB due to the cost of generation, the study compares two scenarios of the typical demand curve.

- Base case scenario

  Base case scenario is the typical demand curve of a day as shown in figure 5. The supply is dominated by hydro, coal, thermal which includes CEB as well as IPP. There is a considerable solar generation meeting the demand during the day.

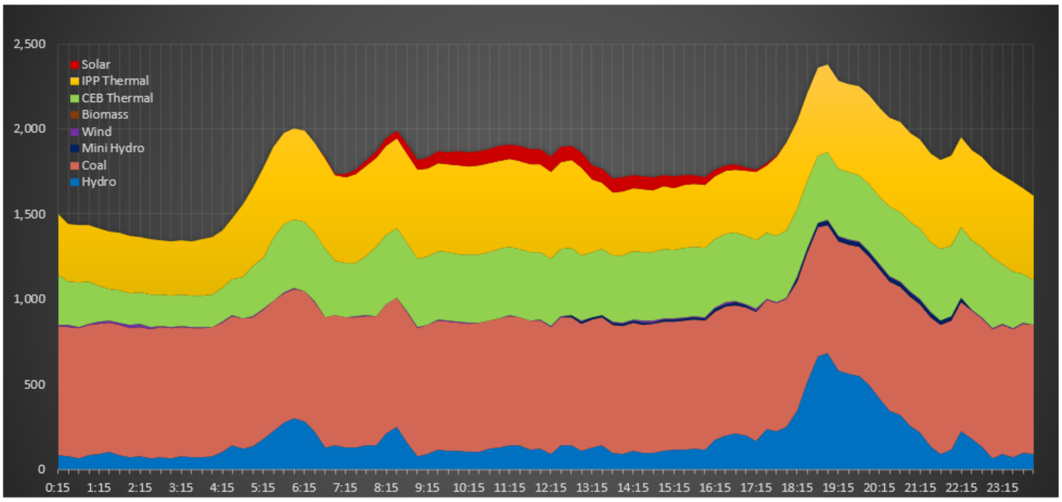

Figure 5:Base case scenario (Typical demand curve)

- No solar scenario

  The contribution from the solar generation is displaced using the other sources of generation in the "No solar scenario" as shown in Figure 6. Merit order dispatch of CEB is used to displace the solar generation.[1]

[1] Technically referred to as *Security concerned merit order dispatch.*

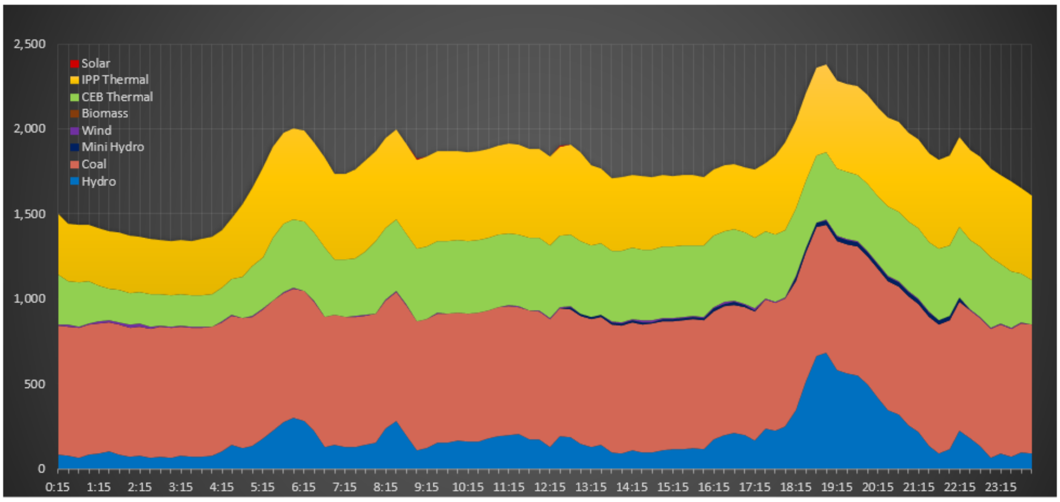

Figure 6:No Solar Scenario (Solar is replaced by other generation)

3.2 Financial impact due to the cost of generation

Results of this study is based on a financial model, which compares the generation cost of base case scenario and no solar scenario.

Actual data from CEB is collected and used as the input to the financial model. The data fed into the model are as follows;

- Merit order dispatch details for each month. This consist of the order of dispatch for each generation available and the cost of generation for different types for each kWh (unit cost).
- Actual generation data for every 15 minutes for each day.
- Monthly rooftop solar generation.
- Distribution network loss.

3.2.1 Analysis for a day

The financial impact is calculated for a day based on the following methodology.

Actual generation data of each 15-minute interval from each generator is tabulated and categorized under different generation type (hydro, coal, thermal, mini hydro, biomass, wind, solar and rooftop solar) and also according to the ownership (CEB or IPP). Actual data of rooftop solar generation for 15-minute interval is not available, therefore an assumption-based calculation is used.

For base case scenario, the total cost of generation of the day is calculated as a simple product of energy from different types of generators multiply by unit cost of each generator.

For no solar scenario, the generation of solar is displaced from other available generators (the generators which are not fully dispatched), based on the merit order dispatch. The displacement methodology (displacement calculation) is explained in the next section. After the solar generation (ground mounted solar and rooftop solar) is displaced from other generators, a revised generation for each 15-minute for each generator is tabulated. The total cost of generation for no solar scenario is then calculated as a simple product of energy from different types of generators multiply by unit cost of each generator. The costs of two scenarios are compared to assess the impact to the utility. Flowchart in figure 7 depicts the basic aspects of the methodology.

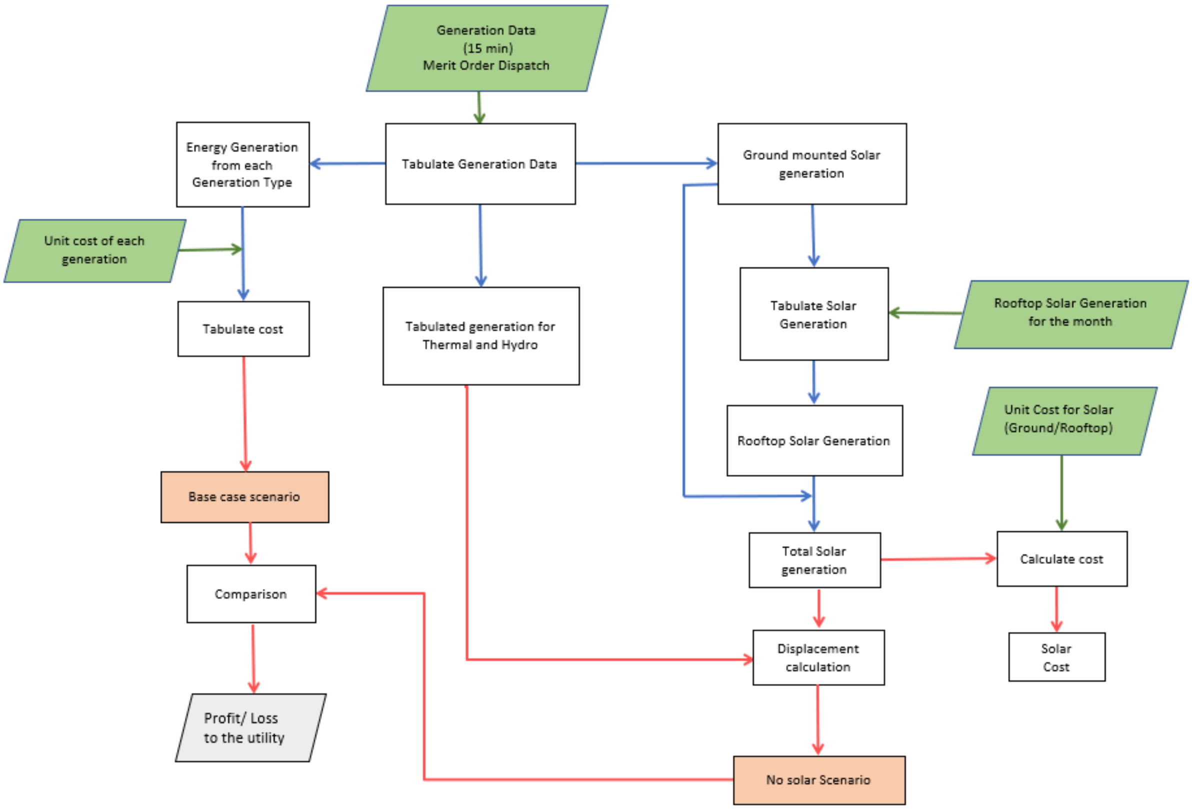

Figure 7: Flow chart - Analysis for a day

3.2.2 Displacement calculation

The displacement calculation is only relevant to the no solar scenario. The model considers each 15-minute interval for the solar displacement calculation. The main purpose of the model is to see how the demand can be met if solar generation is removed/displaced. This displaced generation from solar will be loaded to thermal and hydro power plants based on the merit order and the available capacity of each generator in the merit order. The following steps are used in the displacement calculation.

- The maximum capacity for each generator (thermal and hydro) is disregarded, and the maximum generation within the day for each plant is considered. This is to factor in any technical limitations in loading generators up to the maximum capacity for that particular day. These limitations could be the technical capacity constraints in the generator itself or network constraints.
- Generation plants which were not dispatched during the day were not considered to displace solar generation. It is assumed that there could have been technical reason for not loading these plants during the particular day.
- If a generation plant is loaded up to 95% of the maximum generation capacity during the 15-minute interval, these plants are not used to allocate additional load. Assumed that there could be technical or unavoidable reason for not to load up to 100%. Only the generation plants loaded below 95% are considered to displace the solar generation.
- Once these filters are completed, the rest of thermal generators are loaded according to the merit order up to the maximum generation of the day.
- If the full solar capacity cannot be allocated using thermal generators, dispatchable hydro plants are also considered for loading.
- When hydro plants are considered for additional loading the marginal cost of the system at that 15-minute interval is considered as the cost of hydro, but not the real cost of hydro.

Flowchart in figure 8 depicts the basic steps of the displacement calculation.

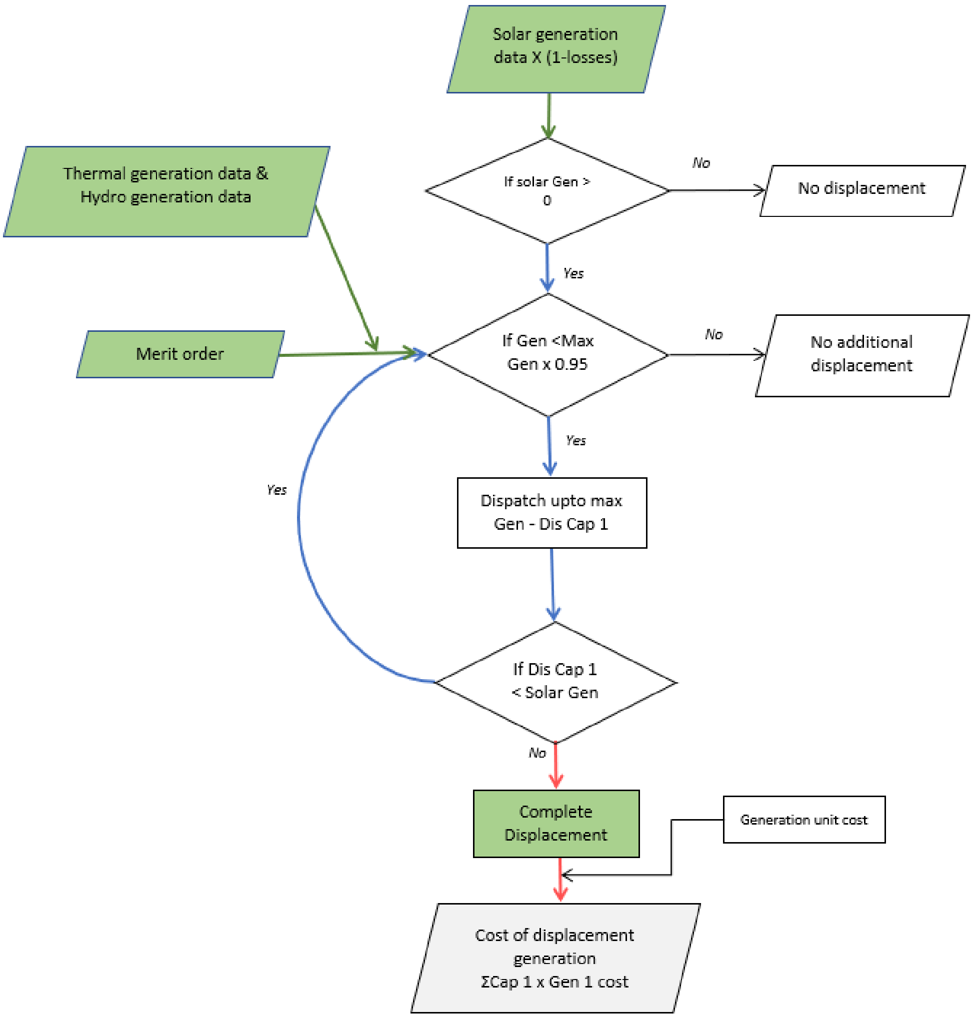

Figure 8: Flow chart - Displacement calculation

3.2.3 Analysis for a month

The model considered weekdays, Saturdays, Sundays and holidays to get a probable sample of demand types. Based on the sample days selected, the financial impact is extrapolated for a month. The comparison of the two scenarios is presented as the impact to the utility. This methodology is repeated for 12 months of 2019.

3.2.4 Annual Summary

The same monthly analysis is repeated for all the months in 2019.

3.3 Assumptions

- Maximum generation of a particular generator during the day is considered the maximum possible capacity
- If the generators are loaded up to 95% of the maximum capacity, the generators are not loaded further for “no solar scenario”
- Actual solar rooftop data for each 15-minute interval is not available to be fed into the model. However, the total monthly rooftop solar energy generation data is available. Therefore, generation curve of ground mounted solar generation is assumed as similar to the rooftop generation curve and the monthly total solar rooftop energy generation is matched with actual data
- The priority to dispatch generators will be based on the type of month
    - For thermal dominant months, thermal generators are displaced on the “base case scenario” to absorb solar before hydro generators are dispatched
    - For hydro dominant months, hydro generators will be dispatched before thermal generators are considered for replacement

3.4 Financial impact due to the loss of revenue from rooftop solar consumers

Considered a sample of 168 consumers of net metering and net accounting schemes, using available data for 2019, to calculate the revenue impact to the utility from the rooftop solar consumers.

The electricity bill, based on the net consumption is compared with the electricity bill, if the total consumption is billed without considering the solar generation. This difference is averaged to the number of units generated for all the 168 samples. Average revenue loss per unit generated has been used to calculate total revenue loss for the utility.

Monthly actual bill, actual number of units imported, and actual number of units exported considered to calculate this average revenue loss per unit generated.

Distribution network loss factor for rooftop solar generation was obtained from the utility and factored into the model. Inhouse consumption from the self-generation during the day, is also factored in the calculation and was assumed as 25%. It is also assumed that 40% of the solar rooftop capacity as net plus scheme. Therefore only 60% of the total solar energy is considered to calculate the revenue loss to CEB from the rooftop solar consumers. Figure 9 flow chart is presented the methodology of revenue loss calculation.

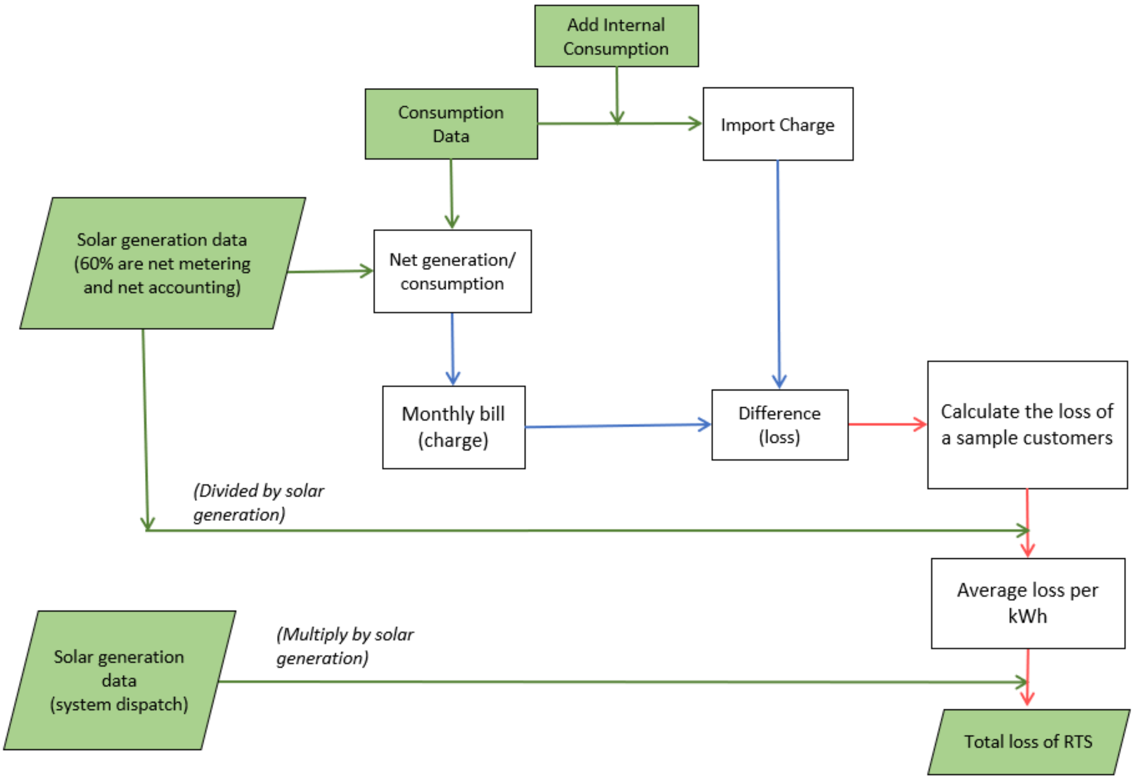

Figure 9: Flow chart - Revenue loss calculation

CHAPTER 04

ANALYSIS

There are two parts of this analysis.

1. The impact on generation cost due to solar penetration
2. The impact due to revenue loss from solar rooftop customers

4.1 The impact of solar in the generation

4.1.1 Data sheet

Data sheet changes monthly and consists of the variable data for the daily and monthly analysis. It gives the details such as, type of month of the hydro generation, estimated hydro capacity, Unit cost of the rooftop solar, rooftop solar distribution loss, average rooftop solar capacity for the month etc. Figure 10 is a sample of data sheet in the model.

Data

Month	January
Year	2019
Loading Factor	0.95
Hydro Average Cost (Rs)	2.00
Type of Month	Average Hydro
Hydro Max Capacity (MW)	1000
Rooftop Solar Cost (Rs)	22.00
Rooftop PV Distribution Loss (%)	2%
Rooftop PV Capacity (MW)	60

Figure 10: Data sheet

Other important data of the data sheet is the merit order of the thermal plants and the cost of unit generated for the particular month for each thermal plant obtained from Ceylon Electricity Board, given as the figure 11. It is visible that the merit order starts with low-cost thermal generators and gradually ends up with high-cost thermal generators. The merit order derived based on the lowest marginal costs.

Merit Order	Type	Complex	Plant Name	Max Capacity (MW)	Unit Cost (LKR)
1	Coal	CEB	Lakvijiya 03	270	7.82
2	Coal	CEB	Lakvijiya 02	270	7.86
3	Coal	CEB	Lakvijiya 01	270	8.17
4	Thermal	CEB	Sapugaskanda B	72	20.80
5	Thermal	CEB	Barge	60	21.31
6	Thermal	CEB	KCCP (GT)	110	22.15
7	Thermal	CEB	KCCP (ST)	55	22.15
8	Thermal	IPP	Sapugaskanda A	72	22.21
9	Thermal	CEB	Uthuru Janani	24	22.41
10	Thermal	CEB	Sojitz	163	22.83
11	Thermal	IPP	West Coast	270	24.43
12	Thermal	IPP	ACE Embilipitiya	90	24.84
13	Thermal	IPP	KPS(GT7)	115	36.84
14	Thermal	IPP	KPS (GTT)	51	48.10

Figure 11: Merit order per a sample month

As discussed in the methodology section, the unit cost of each generator uses to calculate the total cost for the month. A sample of fifteen minutes interval data is presented in table 1 and displacement capacities presented in table 2. The summation of each technology (hydro, thermal, NCRE, Solar RT, Solar PV etc.) presented as in table 3 for the month. This table shows the total energy generated in kilowatt-hour (kWh) for January 2019, generation costs for base case scenario and no solar scenario in LKR. Then the comparison of those two values gives the impact to the utility.

The table 4 shows the summary of each month in 2019 and revenue loss to the utility from the rooftop solar customers (All the monthly summaries in 2019 are attached as appendices). Based on those two values, final profit/loss to the utility presented in same table. As a summary CEB would have spent additional Rs. 603 million for generation in the year 2019, if solar was not available in the system. However, revenue loss to the CEB is 4 billion and net loss is 3.4 billion.

Table 1: Sample of fifteen minutes interval data

Generation Capacity (MW)																								
Type	**Complex**	**Details**	**Merit Order**	**Max Capacity**	**Max Generation**	**Unit Cost**	**Total Energy**	**Total Cost**	**0:15**	**0:30**	**0:45**	**1:00**	**1:15**	**1:30**	**1:45**	**2:00**	**2:15**	**2:30**	**2:45**	**3:00**	**3:15**	**3:30**	**3:45**	**4:00**
Coal	CEB	Lakvijiya 03	1	270	0.00	7.82	-	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coal	CEB	Lakvijiya 02	2	270	274.48	7.86	6,556,614	51,534,983	274.30	274.30	273.39	273.57	273.02	274.12	273.75	273.39	273.39	273.75	272.84	273.93	273.39	272.84	273.39	273.39
Coal	CEB	Lakvijiya 01	3	270	201.99	8.17	4,733,142	38,669,773	199.48	197.30	198.30	198.97	197.63	198.47	198.30	198.30	198.47	197.80	195.46	196.29	196.29	195.79	195.79	197.30
Thermal	CEB	Sapugaskanda B	4	72	63.70	20.80	1,412,778	29,385,788	62.41	62.71	49.20	48.66	48.85	48.76	49.21	48.59	49.38	48.77	49.33	49.20	49.28	49.09	49.13	49.59
Thermal	CEB	Barge	5	60	60.98	21.31	1,332,726	28,400,391	60.55	60.53	60.55	47.57	33.74	32.52	32.45	32.50	32.42	32.50	32.40	32.45	32.45	32.45	32.45	32.45
Thermal	CEB	KCCP (GT)	6	110	106.12	22.15	2,392,586	52,995,772	96.75	96.80	97.46	96.85	96.05	96.60	96.55	97.16	97.61	96.70	97.76	97.46	97.51	97.51	97.46	97.26
Thermal	CEB	KCCP (ST)	7	55	49.70	22.15	1,079,659	23,914,451	42.95	42.76	42.62	42.52	42.09	42.52	42.41	42.62	42.78	42.46	42.22	42.41	42.49	42.33	42.46	42.57
Thermal	IPP	Sapugaskanda A	8	72	34.57	22.21	694,008	15,413,917	34.57	34.08	22.12	22.14	22.02	22.09	22.23	22.10	21.92	21.90	22.01	22.23	21.86	22.24	22.02	22.05
Thermal	CEB	Uthuru Janani	9	24	22.57	22.41	409,735	9,182,154	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Thermal	CEB	Sojitz	10	163	133.70	22.83	3,061,354	69,890,717	133.10	132.53	132.67	132.78	125.21	124.98	125.34	119.05	105.45	105.40	105.54	95.65	95.33	95.22	95.54	95.47
Thermal	IPP	West Coast	11	270	137.59	24.43	3,159,717	77,191,876	136.18	136.65	136.36	136.03	118.34	118.81	118.56	118.81	118.01	118.52	118.63	118.52	118.52	118.45	118.81	118.52
Thermal	IPP	ACE Embilipitiya	12	90	86.92	24.84	1,473,877	36,611,107	86.92	64.06	44.26	44.70	44.21	12.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Thermal	IPP	KPS(GT7)	13	115	33.73	36.84	186,049	6,854,045	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Thermal	IPP	KPS (GTT)	14	51	114.45	48.10	1,816,448	87,371,146	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 2: Sample of displaced generation

Displacement Calculation																								
Solar Capacity	All	All	0				-		0.00	0.00	4.17	7.38	11.95	17.31	23.21	29.14	35.12	40.87	46.54	51.63	57.34	61.01	63.80	67.72
Coal	CEB	Lakvijiya 03	1	270	0.00	7.82	-	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coal	CEB	Lakvijiya 02	2	270	274.48	7.86	-	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coal	CEB	Lakvijiya 01	3	270	201.99	8.17	5,527	45,156	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Thermal	CEB	Sapugaskanda B	4	72	63.70	20.80	25,404	528,407	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Thermal	CEB	Barge	5	60	60.98	21.31	-	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Thermal	CEB	KCCP (GT)	6	110	106.12	22.15	48,775	1,080,377	0.00	0.00	4.17	7.38	10.08	8.62	9.67	9.67	9.12	8.46	8.52	8.41	9.02	9.27	9.12	8.97
Thermal	CEB	KCCP (ST)	7	55	49.70	22.15	29,706	657,996	0.00	0.00	0.00	0.00	1.87	7.32	7.50	7.40	7.02	6.57	6.75	6.51	6.19	5.95	6.08	5.95
Thermal	IPP	Sapugaskanda A	8	72	34.57	22.21	53,166	1,180,806	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Thermal	CEB	Uthuru Janani	9	24	22.57	22.41	-	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Thermal	CEB	Sojitz	10	163	133.70	22.83	5,226	119,318	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Thermal	IPP	West Coast	11	270	137.59	24.43	10,014	244,630	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Thermal	IPP	ACE Embilipitiya	12	90	86.92	24.84	81,211	2,017,277	0.00	0.00	0.00	0.00	0.00	1.38	6.03	8.72	7.52	7.12	7.85	7.61	7.65	7.82	7.73	8.00
Thermal	IPP	KPS(GT7)	13	115	33.73	36.84	59,170	2,179,830	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.36	11.46	18.72	23.43	16.31	0.00	0.00	0.00	0.00
Thermal	IPP	KPS (GTT)	14	51	114.45	48.10	-	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0	0	0	15	0	0.00	0.00	-	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0	0	0	16	0	0.00	0.00	-	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 3: Monthly summary

Monthly Summary

Month	January
Year	2019
Rooftop PV Capacity (MW)	60

Date	1	10	18	23	28	5	13	Monthly Estimate
Day	Tuesday	Thursday	Friday	Wednesday	Monday	Saturday	Sunday	
Energy (kWh)								
Hydro	6,803,552	12,894,653	11,163,372	12,948,624	12,149,531	11,522,547	8,339,636	334,011,185
Thermal	28,308,692	28,953,951	28,929,178	29,035,051	29,804,669	26,543,090	26,255,674	875,589,510
NCRE	1,019,443	888,930	763,318	677,788	598,003	785,871	843,564	24,697,775
Solar PV	182,713	158,788	161,069	189,632	170,174	173,808	124,018	5,138,039
Solar RT	365,425	317,576	322,138	379,264	340,348	347,617	248,037	10,276,077
Total	**36,679,825**	**43,213,898**	**41,339,075**	**43,230,359**	**43,062,725**	**39,372,933**	**35,810,928**	**1,249,712,586**
Generation Cost - Base Case Scenario (LKR)								
Hydro	13,607,103	25,789,306	22,326,744	25,897,248	24,299,063	23,045,094	16,679,271	668,022,370
Thermal	527,416,120	543,310,218	534,579,159	540,576,948	548,443,760	488,283,850	466,890,907	16,142,625,236
NCRE	15,935,748	13,887,999	11,917,139	10,582,441	9,323,351	12,272,611	13,176,195	386,216,796
Solar PV	3,445,959	2,994,739	3,037,762	189,632	3,209,480	3,278,025	2,338,988	81,468,353
Solar RT	8,039,352	6,986,666	7,087,037	8,343,816	7,487,652	7,647,566	5,456,811	224,830,220
Total	**568,444,282**	**592,968,929**	**578,947,840**	**585,590,084**	**592,763,305**	**534,527,145**	**504,542,172**	**17,503,162,976**
Generation Cost - No Solar Scenario (LKR)								
Hydro	24,315,590	32,578,013	32,517,256	26,017,309	32,699,166	39,223,330	17,685,728	897,082,232
Thermal	535,469,917	551,442,712	540,530,149	553,483,859	558,366,473	492,527,272	478,655,660	16,416,277,073
NCRE	15,935,748	13,887,999	11,917,139	10,582,441	9,323,351	12,272,611	13,176,195	386,216,796
Total	**575,721,255**	**597,908,724**	**584,964,545**	**590,083,608**	**600,388,989**	**544,023,213**	**509,517,584**	**17,699,576,101**
Impact for CEB								
Loss / (Benefit)								196,413,125

Total Days	31	
Sundays	4	5
Saturdays	4	4
Weekday holiday	1	
Saturday holiday	0	
Weekdays	23	22

Table 4: Annual summary

Annual Summary													
Month	January	February	March	April	May	June	July	August	September	October	November	December	Total
Energy Estimate (kWh)													
Hydro	334,011,185	318,303,014	212,054,232	153,112,160	198,159,667	165,208,187	191,507,753	311,443,590	314,667,960	611,447,560	522,155,341	587,221,412	3,919,292,062
Thermal	875,589,510	811,448,221	1,117,464,152	1,034,976,018	1,121,855,129	1,015,919,718	1,070,553,361	870,038,232	785,960,475	502,497,666	547,605,122	544,936,745	10,298,844,348
NCRE	24,697,775	20,597,740	15,995,283	15,199,362	42,312,218	50,336,256	45,501,531	77,275,338	71,753,645	77,938,714	53,893,808	54,669,352	550,171,021
Solar PV	5,138,039	4,170,386	5,711,005	4,927,455	5,445,696	4,019,014	5,060,819	3,778,215	3,602,493	2,722,818	4,052,118	4,105,739	52,733,796
Solar RT	10,276,077	9,035,835	11,640,336	14,782,364	18,152,320	14,736,384	20,243,277	16,372,267	16,811,632	13,614,088	22,286,650	23,265,852	191,217,084
Total	**1,249,712,586**	**1,163,555,196**	**1,362,865,007**	**1,222,997,359**	**1,385,925,030**	**1,250,219,558**	**1,332,866,742**	**1,278,907,643**	**1,192,796,205**	**1,208,220,846**	**1,149,993,039**	**1,214,199,099**	**15,012,258,311**
Generation Cost - Base Case Scenario (LKR)													
Hydro	668,022,370	636,606,028	424,108,463	306,224,320	396,319,334	330,416,375	383,015,506	622,887,181	629,335,920	1,222,895,120	1,044,310,682	1,174,442,825	7,838,584,123
Thermal	16,142,625,236	12,255,915,747	18,141,462,820	16,696,521,686	17,830,223,440	15,645,799,962	17,863,935,865	13,863,243,069	11,474,151,745	5,747,180,059	7,015,830,327	6,956,634,206	159,633,524,163
NCRE	386,216,796	310,733,912	260,622,246	237,502,699	649,406,928	786,987,344	709,058,189	1,190,179,392	1,123,473,250	1,206,834,516	857,711,167	886,859,497	8,605,585,935
Solar PV	81,468,353	67,515,659	80,822,881	77,327,716	88,920,199	64,120,128	82,764,834	63,250,845	56,347,848	43,387,795	64,412,453	73,115,416	843,454,127
Solar RT	224,830,220	202,195,826	253,445,957	318,156,477	398,351,402	326,262,417	448,477,063	368,345,697	348,829,039	306,380,173	488,740,400	510,200,348	4,194,215,020
Total	**17,503,162,976**	**13,472,967,173**	**19,160,462,367**	**17,635,732,899**	**19,363,221,303**	**17,153,586,227**	**19,487,251,457**	**16,107,906,183**	**13,632,137,801**	**8,526,677,664**	**9,471,005,028**	**9,601,252,292**	**181,115,363,368**
Generation Cost - No Solar Scenario (LKR)													
Hydro	897,082,232	652,653,937	659,604,664	471,115,494	548,755,857	348,221,449	602,754,055	740,455,960	669,019,308	1,252,593,001	1,044,672,566	1,303,886,417	9,190,814,941
Thermal	16,416,277,073	12,542,314,259	18,415,362,009	17,049,344,865	18,246,159,903	16,009,552,728	18,258,295,089	14,155,842,942	11,853,848,175	6,060,964,778	7,553,589,227	7,360,533,437	163,922,084,484
NCRE	386,216,796	310,733,912	260,622,246	237,502,699	649,406,928	786,987,344	709,058,189	1,190,179,392	1,123,473,250	1,206,834,516	857,711,167	886,859,497	8,605,585,935
Total	**17,699,576,101**	**13,505,702,108**	**19,335,588,919**	**17,757,963,059**	**19,444,322,688**	**17,144,761,521**	**19,570,107,333**	**16,086,478,293**	**13,646,340,732**	**8,520,392,296**	**9,455,972,959**	**9,551,279,352**	**181,718,485,360**
Revenue Loss													
From Solar PV	217,030,752	190,836,843	245,843,892	312,203,529	383,377,008	311,232,428	427,538,020	345,782,275	355,061,672	287,529,546	470,694,057	491,374,792	4,038,504,815
Impact for CEB													
Generation (Profit/(Loss	196,413,125	32,734,935	175,126,551	122,230,160	81,101,385	(8,824,705)	82,855,876	(21,427,890)	14,202,931	(6,285,368)	(15,032,069)	(49,972,941)	603,121,992
Revenue Loss	(217,030,752)	(190,836,843)	(245,843,892)	(312,203,529)	(383,377,008)	(311,232,428)	(427,538,020)	(345,782,275)	(355,061,672)	(287,529,546)	(470,694,057)	(491,374,792)	(4,038,504,815)
Total Benefit/(Loss)	(20,617,627)	(158,101,908)	(70,717,341)	(189,973,369)	(302,275,623)	(320,057,133)	(344,682,144)	(367,210,165)	(340,858,740)	(293,814,914)	(485,726,125)	(541,347,733)	(3,435,382,823)

4.2 Sensitivity analysis

A sensitivity analysis was carried out to analyze the capacity variation, cost variation net plus ratio variation and the distribution loss variation.

4.2.1 Sensitivity analysis for solar capacity changes

Sensitivity analysis was conducted to observe the impact if the solar rooftop capacities are changed. An additional 25% and 50% of solar rooftop capacities were considered, but a negative change is not considered for obvious reasons. Additional solar rooftop capacities result an increase in the profit from the generation, but also increases the revenue loss from the solar rooftop customers. The net negative impact (loss) increases when the solar rooftop capacity increases. The specific impact is presented in the table 5 and figure 12.

Table 5: Sensitivity analysis for solar capacity

	Base Case	Solar RT Capacity (+25%)	Solar RT Capacity (+50%)
Generation Profit/(Loss)	603,121,992	907,666,664	1,241,837,434
Revenue Loss	(4,038,504,815)	(5,048,131,018)	(6,057,757,222)
Total Benefit/(Loss)	(3,435,382,823)	(4,140,464,354)	(4,815,919,788)

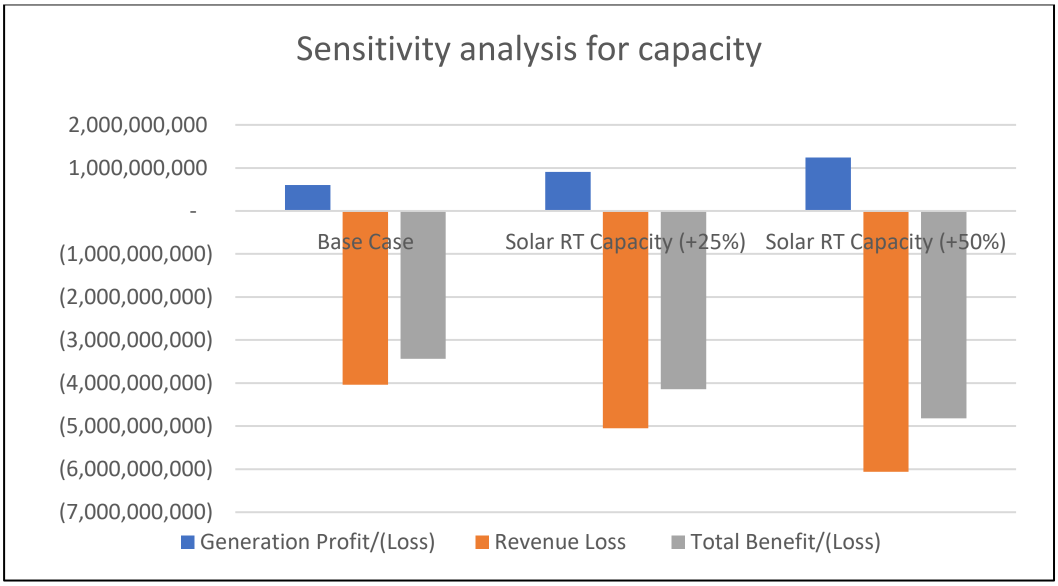

Figure 12:Sensitivity analysis for capacity

4.2.2 Sensitivity analysis for costs

Sensitivity analysis was conducted to observe the impact if the solar rooftop costs are changed. Cost increase of 10% and 20% and cost decrease of 10% and 20% from the base case were considered. Decrease of unit cost decreases the generation cost and overall loss to the utility has reduces. The specific impact is presented in the table 6 and figure 13.

Table 6: Sensitivity analysis for solar costs

	Base Case	Cost -20%	Cost -10%	Cost +10%	Cost +20%
Generation (Profit/Loss)	603,121,992	1,441,964,996	1,022,543,494	183,700,490	(235,721,012)
Total (Benefit/Loss)	(3,435,382,823)	(2,596,539,819)	(3,015,961,321)	(3,854,804,325)	(4,274,225,827)

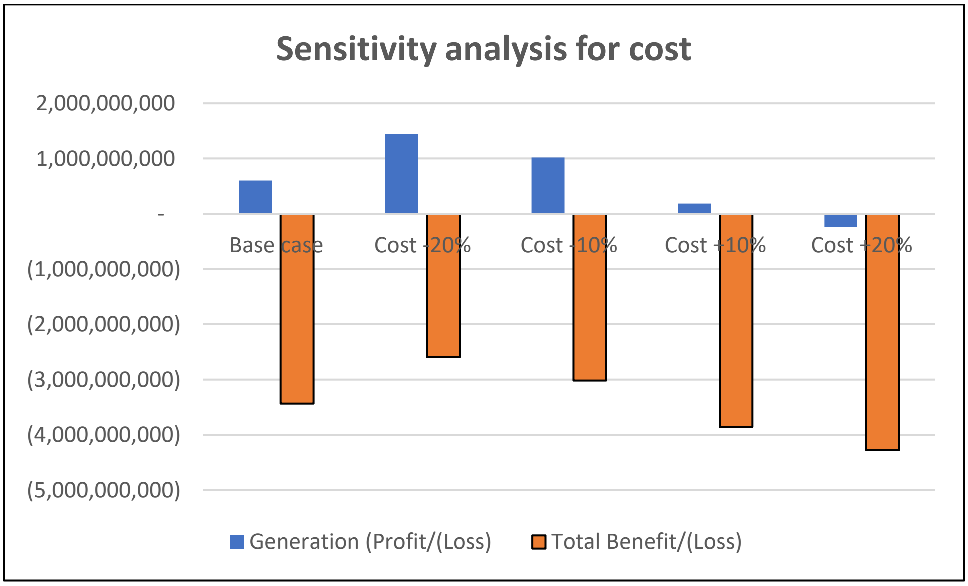

Figure 13: Sensitivity analysis for costs

4.2.3 Sensitivity analysis for Net plus scenario

A sensitivity analysis was conducted to see the impact of Net plus capacity ratio. For the base case considered 40% as the Net plus customers from the total rooftop generation (based on the given data). Then conducted the sensitivity analysis for 20% to 80%. It was observed that increasing net plus ratio minimized the overall loss to the utility and the impact is presented in table 7 and figure 14.

Table 7: Sensitivity analysis for Net plus ratio

	Net plus 20%	Base case Net plus 40%	Net plus 60%	Net plus 80%
Revenue Loss	(5,384,673,086)	(4,038,504,815)	(2,692,336,543)	(1,346,168,272)
Total Benefit/(Loss)	(4,672,570,497)	(3,326,402,225)	(1,980,233,954)	(634,065,682)

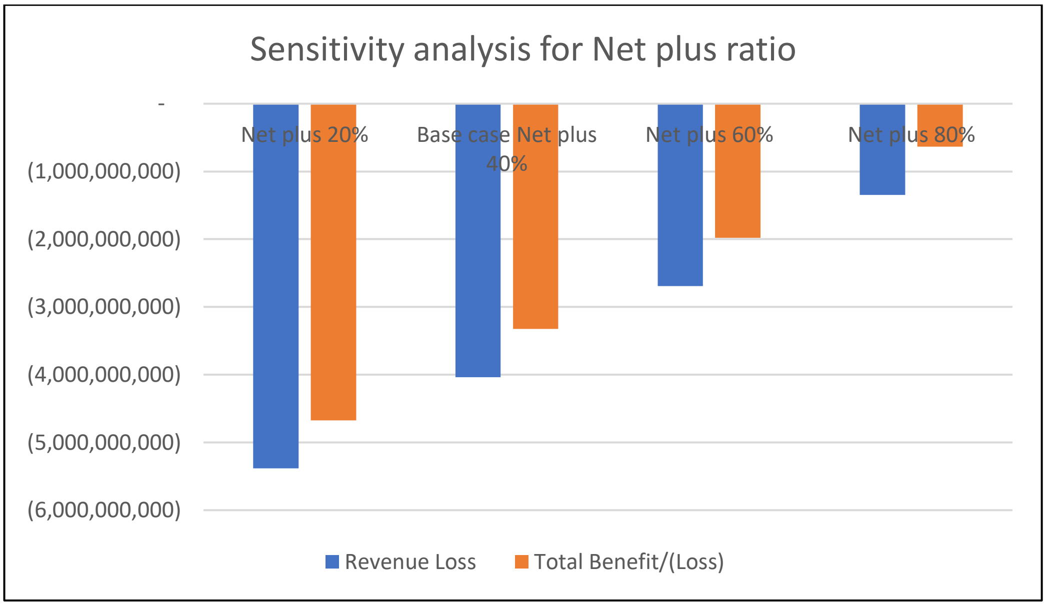

Figure 14: Sensitivity analysis for Net plus ratio

4.2.4 Sensitivity analysis for Network loss

Finally, a sensitivity analysis was conducted to observe the impact from the possible network losses. It was assumed that the network losses would be 2% in the base case scenario and varied the network loss up to 6% and calculated the total benefit or loss to the utility. The result presents in table 8 and figure 15 below.

Table 8: Sensitivity analysis for network loss

	Base case (2%)	Network loss 4%	Network loss 6%
Generation (Profit/(Loss)	603,121,992	494,257,479	385,700,341
Total Benefit/(Loss)	(3,435,382,823)	(3,544,247,335)	(3,652,804,474)

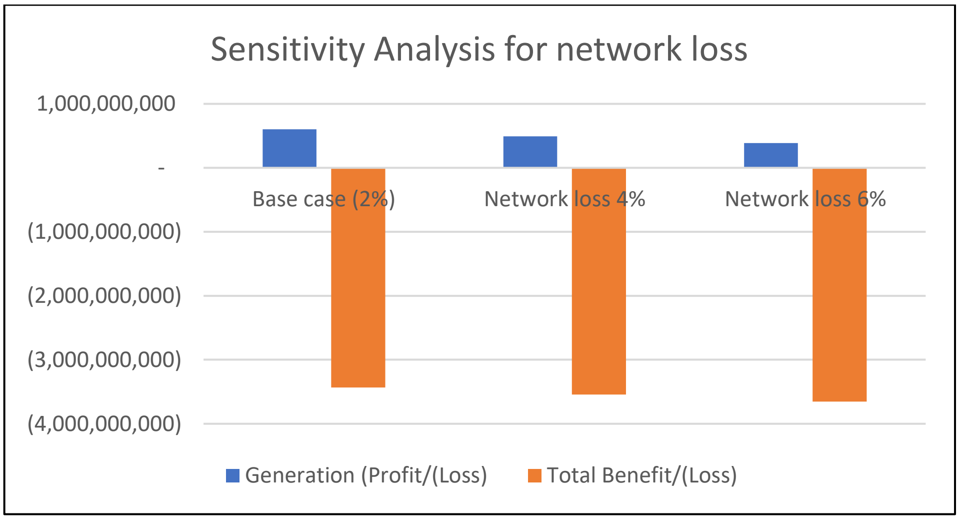

Figure 15: Sensitivity analysis for network loss

All the calculation for sensitivity analysis is attached as Appendices.

CHAPTER 05

CONCLUSION AND RECOMMENDATIONS

Main objective of this study is to analyze the financial impact to the utility by absorbing solar generation and replacing existing high-cost generation technologies. The study also analyzed the impact due to loss of revenue from forgoing high tariff paying customers by absorbing rooftop solar under net metering and net accounting schemes. Two approaches were used to build the financial model to study the financial impact.

- Financial impact due to the cost of generation.
- Financial impact due to the loss of revenue from solar rooftop customers.

The conclusion from the study mainly highlights that solar penetration is beneficial to the utility to displace the existing high-cost generation. However, CEB loses revenue from the existing consumers once they move on to solar rooftop with net-metering or net-accounting schemes. As a summary of the study, CEB would have spent additional Rs. 603 million for generation in year 2019, if solar was not available in the system. The revenue loss to the CEB is Rs. 4 billion and the net loss for CEB is Rs. 3.4 billion in year 2019.

From the sensitivity analysis for changes in the installed solar capacity, the results confirm higher penetration of rooftop solar benefits CEB in reducing the generation cost. However due to the prevailing tariff regime, CEB loses revenue from solar Prosumers.

From the results, it can be recommended to allow solar rooftop with Net plus scheme, as it does not alter revenue from the consumption. The Net plus scheme contributes to the generation capacity without a revenue loss to the utility.

The sensitivity analysis of changing solar unit cost confirms the requirement for a solar rooftop tariff revision. The utility pays customer for generation during the daytime, at the same time provide high-cost generation at night. Also, consumers can use the grid electricity if the generation is not sufficient during the day. However, consumers do not pay any service charge or capacity fee for maintaining such reserves from the utility to provide uninterrupted supply. It can be recommended to impose a service charge and impose mandatory Time of Day tariff for net metering and net accounting consumers to overcome the negative impact to the utility.

The current net accounting scheme facilitates offsetting energy imports against exports rather than the monetary value of imports and exports. In order to create a win-win for both the utility and prosumers, this scheme can be amended to offset just the actual consumption within the facility and generate revenue for the total exported energy to the grid at the present net plus rates. Accordingly, the imports will be charged at the standard electricity tariff applicable to the facility. At the end of the billing cycle the net value of cost of imports and income from exports will be the payment pending to/from the utility.

However, with the present economic situation of the country, there are all the reasons to promote distributed roof top solar generation, however the tariff regime needs to carefully consider the impact to the utility and to minimize the revenue loss to the utility and also to consider the escalations of capital expenditure.

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APPENDICES

Appendix 1 - Monthly Summary - 2019

Month	January
Year	2019
Rooftop PV Capacity (MW)	60

	Actual days	Effective days
Total Days	31	
Sundays	4	5
Saturdays	4	4
Weekday holidays	1	
Saturday holidays	0	
Weekdays	23	22

Date	1	10	18	23	28	5	13	Monthly Estimate
Day	Tuesday	Thursday	Friday	Wednesday	Monday	Saturday	Sunday	
Energy (kWh)								
Hydro	6,803,552	12,894,653	11,163,372	12,948,624	12,149,531	11,522,547	8,339,636	334,011,185
Thermal	28,308,692	28,953,951	28,929,178	29,035,051	29,804,669	26,543,090	26,255,674	875,589,510
NCRE	1,019,443	888,930	763,318	677,788	598,003	785,871	843,564	24,697,775
Solar PV	182,713	158,788	161,069	189,632	170,174	173,808	124,018	5,138,039
Solar RT	365,425	317,576	322,138	379,264	340,348	347,617	248,037	10,276,077
Total	**36,679,825**	**43,213,898**	**41,339,075**	**43,230,359**	**43,062,725**	**39,372,933**	**35,810,928**	**1,249,712,586**
Generation Cost - Base Case Scenario (LKR)								
Hydro	13,607,103	25,789,306	22,326,744	25,897,248	24,299,063	23,045,094	16,679,271	668,022,370
Thermal	527,416,120	543,310,218	534,579,159	540,576,948	548,443,760	488,283,850	466,890,907	16,142,625,236
NCRE	15,935,748	13,887,999	11,917,139	10,582,441	9,323,351	12,272,611	13,176,195	386,216,796
Solar PV	3,445,959	2,994,739	3,037,762	189,632	3,209,480	3,278,025	2,338,988	81,468,353
Solar RT	8,039,352	6,986,666	7,087,037	8,343,816	7,487,652	7,647,566	5,456,811	224,830,220
Total	**568,444,282**	**592,968,929**	**578,947,840**	**585,590,084**	**592,763,305**	**534,527,145**	**504,542,172**	**17,503,162,976**
Generation Cost - No Solar Scenario (LKR)								
Hydro	24,315,590	32,578,013	32,517,256	26,017,309	32,699,166	39,223,330	17,685,728	897,082,232
Thermal	535,469,917	551,442,712	540,530,149	553,483,859	558,366,473	492,527,272	478,655,660	16,416,277,073
NCRE	15,935,748	13,887,999	11,917,139	10,582,441	9,323,351	12,272,611	13,176,195	386,216,796
Total	**575,721,255**	**597,908,724**	**584,964,545**	**590,083,608**	**600,388,989**	**544,023,213**	**509,517,584**	**17,699,576,101**
Impact for CEB								
Loss / (Benefit)								196,413,125

Month	February
Year	2019
Rooftop PV Capacity (MW)	65

	Actual days	Effective days
Total Days	28	
Sundays	4	6
Saturdays	4	4
Weekday holidays	2	
Saturday holidays	0	
Weekdays	20	18

Date	1	5	13	21	25	16	10	Monthly Estimate
Day	Friday	Tuesday	Wednesday	Thursday	Monday	Saturday	Sunday	
Energy (kWh)								
Hydro	15,080,598	13,306,588	10,151,060	11,840,167	11,056,054	8,946,861	10,225,248	318,303,014
Thermal	27,902,294	26,604,257	33,165,442	32,203,051	33,595,532	30,492,655	22,830,589	811,448,221
NCRE	835,945	612,103	1,268,968	866,057	496,259	594,170	475,933	20,597,740
Solar PV	65,625	137,283	171,884	194,196	162,429	129,153	182,026	4,170,386
Solar RT	142,187	297,448	372,415	420,758	351,930	279,832	394,390	9,035,835
Total	44,026,648	40,957,679	45,129,769	45,524,229	45,662,205	40,442,670	34,108,185	1,163,555,196
Generation Cost - Base Case Scenario (LKR)								
Hydro	30,161,197	26,613,176	20,302,120	23,680,334	22,112,109	17,893,722	20,450,495	636,606,028
Thermal	484,236,856	450,111,795	508,941,657	484,987,331	516,522,124	441,155,895	281,668,837	12,255,915,747
NCRE	13,065,539	9,544,580	19,850,787	13,529,118	7,726,987	9,226,066	7,408,068	310,733,912
Solar PV	1,237,682	2,589,166	3,241,730	194,196	3,063,418	2,435,828	3,433,009	67,515,659
Solar RT	3,128,111	6,543,846	8,193,132	9,256,670	7,742,467	6,156,299	8,676,569	202,195,826
Total	531,829,385	495,402,563	560,529,427	531,647,648	557,167,106	476,867,809	321,636,979	13,472,967,173
Generation Cost - No Solar Scenario (LKR)								
Hydro	30,161,197	26,613,176	20,786,620	23,680,334	24,452,558	18,996,218	20,695,180	652,653,937
Thermal	489,563,225	460,506,715	519,640,486	498,929,485	527,328,685	449,721,591	292,990,158	12,542,314,259
NCRE	13,065,539	9,544,580	19,850,787	13,529,118	7,726,987	9,226,066	7,408,068	310,733,912
Total	532,789,961	496,664,470	560,277,894	536,138,937	559,508,230	477,943,875	321,093,406	13,505,702,108
Impact for CEB								
Loss / (Benefit)								32,734,935

Month	March
Year	2019
Rooftop PV Capacity (MW)	70

	Actual days	Effective days
Total Days	31	
Sundays	5	7
Saturdays	5	5
Weekday holidays	2	
Saturday holidays	0	
Weekdays	21	19

Date	13	12	22	25	28	16	3	Monthly Estimate
Day	Wednesday	Tuesday	Friday	Monday	Thursday	Saturday	Sunday	
Energy (kWh)								
Hydro	9,575,586	9,968,347	5,040,678	5,042,105	5,182,708	7,247,592	6,220,066	212,054,232
Thermal	37,223,011	35,089,598	37,476,100	37,636,295	38,842,667	37,595,268	31,667,237	1,117,464,152
NCRE	423,452	576,308	484,768	290,201	392,451	819,283	625,375	15,995,283
Solar PV	99,740	173,686	202,750	181,143	362,645	103,078	166,539	5,711,005
Solar RT	232,727	405,267	473,084	422,667	465,610	240,516	388,591	11,640,336
Total	47,554,516	46,213,205	43,677,381	43,572,412	45,246,082	46,005,737	39,067,808	1,362,865,007
Generation Cost - Base Case Scenario (LKR)								
Hydro	19,151,173	19,936,693	10,081,355	10,084,211	10,365,416	14,495,183	12,440,132	424,108,463
Thermal	617,437,050	574,358,556	619,034,079	620,468,819	649,508,691	623,205,069	474,052,876	18,141,462,820
NCRE	6,611,293	8,982,960	7,546,689	4,518,162	6,098,240	12,795,230	9,766,884	260,622,246
Solar PV	1,881,098	3,275,712	3,823,873	181,143	3,763,460	1,944,059	3,140,928	80,822,881
Solar RT	5,119,992	8,915,866	10,407,855	9,298,680	10,243,423	5,291,360	8,549,008	253,445,957
Total	650,200,606	615,469,787	650,893,852	644,551,016	679,979,230	657,730,902	507,949,827	19,160,462,367
Generation Cost - No Solar Scenario (LKR)								
Hydro	19,347,208	35,460,382	22,475,156	27,386,248	23,184,132	14,687,014	14,332,530	659,604,664
Thermal	624,157,099	579,392,369	627,984,106	624,611,945	658,196,443	629,778,989	490,281,087	18,415,362,009
NCRE	6,611,293	8,982,960	7,546,689	4,518,162	6,098,240	12,795,230	9,766,884	260,622,246
Total	650,115,601	623,835,712	658,005,951	656,516,355	687,478,814	657,261,233	514,380,501	19,335,588,919
Impact for CEB								
Loss / (Benefit)								175,126,551

Month	April
Year	2019
Rooftop PV Capacity (MW)	90

	Actual days	Effective days
Total Days	30	
Sundays	4	6
Saturdays	4	3
Weekday holidays	1	
Saturday holidays	1	
Weekdays	22	21

Date	2	5	11	17	29	20	28	Monthly Estimate
Day	Tuesday	Friday	Thursday	Wednesday	Monday	Saturday	Sunday	
Energy (kWh)								
Hydro	4,263,629	4,627,620	5,156,038	4,905,103	6,840,050	4,551,319	5,188,326	153,112,160
Thermal	37,590,445	38,426,852	40,046,580	28,057,680	35,080,406	30,063,950	32,022,654	1,034,976,018
NCRE	296,209	308,241	418,166	609,666	770,221	565,986	578,029	15,199,362
Solar PV	203,276	173,466	161,800	181,143	110,069	194,776	125,210	4,927,455
Solar RT	609,828	520,397	485,399	543,429	330,206	584,328	375,631	14,782,364
Total	42,963,387	44,056,576	46,267,982	34,297,022	43,130,952	35,960,360	38,289,849	1,222,997,359
Generation Cost - Base Case Scenario (LKR)								
Hydro	8,527,257	9,255,240	10,312,076	9,810,206	13,680,099	9,102,639	10,376,652	306,224,320
Thermal	619,349,789	646,803,278	680,193,105	468,858,804	558,217,222	430,244,460	486,235,846	16,696,521,686
NCRE	4,615,650	4,803,632	6,501,708	9,506,343	11,999,611	8,800,009	8,984,918	237,502,699
Solar PV	3,833,787	3,271,565	3,051,539	181,143	2,075,893	3,673,477	2,361,465	77,327,716
Solar RT	13,416,220	11,448,743	10,678,769	11,955,446	7,264,526	12,855,223	8,263,875	318,156,477
Total	649,742,703	675,582,459	710,737,197	500,311,942	593,237,351	464,675,807	516,222,756	17,635,732,899
Generation Cost - No Solar Scenario (LKR)								
Hydro	22,497,863	14,713,575	18,377,292	15,992,510	19,263,443	9,102,639	10,376,652	471,115,494
Thermal	630,404,676	660,287,777	693,116,710	480,170,398	566,456,654	446,904,598	496,799,828	17,049,344,865
NCRE	4,615,650	4,803,632	6,501,708	9,506,343	11,999,611	8,800,009	8,984,918	237,502,699
Total	657,518,189	679,804,984	717,995,710	505,669,250	597,719,707	464,807,246	516,161,398	17,757,963,059
Impact for CEB								
Benefit / (Loss)								122,230,160

Month	May
Year	2019
Rooftop PV Capacity (MW)	100

	Actual days	Effective days
Total Days	31	
Sundays	4	7
Saturdays	4	3
Weekday holidays	2	
Saturday holidays	1	
Weekdays	23	21

Date	3	8	9	14	27	25	12	Monthly Estimate
Day	Friday	Wednesday	Thursday	Tuesday	Monday	Saturday	Sunday	
Energy (kWh)								
Hydro	5,279,549	6,236,104	6,141,983	6,356,445	8,978,968	5,530,958	6,142,285	198,159,667
Thermal	37,779,041	36,399,745	39,139,358	36,959,782	36,965,741	35,756,481	32,594,613	1,121,855,129
NCRE	1,644,218	1,649,835	1,213,826	1,476,816	1,124,124	1,373,506	1,072,047	42,312,218
Solar PV	121,015	195,677	196,937	180,352	179,064	182,782	173,848	5,445,696
Solar RT	403,382	652,256	656,455	601,172	596,879	609,273	579,494	18,152,320
Total	45,227,204	45,133,617	47,348,558	45,574,566	47,844,774	43,453,000	40,562,286	1,385,925,030
Generation Cost - Base Case Scenario (LKR)								
Hydro	10,559,097	12,472,208	12,283,966	12,712,889	17,957,935	11,061,916	12,284,569	396,319,334
Thermal	616,567,791	562,028,710	650,875,539	579,114,178	615,724,601	593,084,171	478,409,355	17,830,223,440
NCRE	25,738,464	25,845,171	19,004,186	23,112,892	17,599,791	21,505,319	16,775,551	649,406,928
Solar PV	2,282,336	3,690,465	3,714,223	180,352	3,377,139	3,447,267	3,278,777	88,920,199
Solar RT	8,874,407	14,349,634	14,442,011	13,225,788	13,131,330	13,404,007	12,748,867	398,351,402
Total	664,022,096	618,386,187	700,319,924	628,346,098	667,790,796	642,502,680	523,497,119	19,363,221,303
Generation Cost - No Solar Scenario (LKR)								
Hydro	18,761,392	21,208,366	24,680,410	14,591,710	22,947,084	11,190,078	12,284,569	548,755,857
Thermal	623,100,032	574,352,759	662,679,855	594,869,421	629,674,723	610,508,043	494,141,894	18,246,159,903
NCRE	25,738,464	25,845,171	19,004,186	23,112,892	17,599,791	21,505,319	16,775,551	649,406,928
Total	667,599,888	621,406,296	706,364,451	632,574,022	670,221,598	643,203,439	523,202,014	19,444,322,688
Impact for CEB								
Loss / (Benefit)								81,101,385

Month	June
Year	2019
Rooftop PV Capacity (MW)	110

	Actual days	Effective days
Total Days	30	
Sundays	5	6
Saturdays	5	5
Weekday holidays	1	
Saturday holidays	0	
Weekdays	20	19

Date	6	12	14	18	24	8	9	Monthly Estimate
Day	Thursday	Wednesday	Friday	Tuesday	Monday	Saturday	Sunday	
Energy (kWh)								
Hydro	6,100,697	5,672,838	5,307,617	4,885,367	5,676,681	5,465,819	5,472,489	165,208,187
Thermal	37,228,150	33,833,774	35,481,527	39,150,803	35,230,186	32,247,886	27,861,236	1,015,919,718
NCRE	1,347,471	1,939,819	1,643,955	1,632,485	1,840,836	1,672,411	1,668,151	50,336,256
Solar PV	19,830	147,124	146,136	179,180	180,443	102,077	162,981	4,019,014
Solar RT	72,710	539,455	535,832	656,992	661,623	374,282	597,596	14,736,384
Total	44,768,859	42,133,009	43,115,066	46,504,827	43,589,768	39,862,475	35,762,452	1,250,219,558
Generation Cost - Base Case Scenario (LKR)								
Hydro	12,201,395	11,345,676	10,615,235	9,770,733	11,353,361	10,931,638	10,944,977	330,416,375
Thermal	604,405,471	522,957,492	552,463,339	654,207,684	534,785,504	502,576,813	371,900,305	15,645,799,962
NCRE	21,050,806	30,357,663	25,715,556	25,566,285	28,770,704	26,166,076	26,100,852	786,987,344
Solar PV	373,995	2,774,761	2,756,123	179,180	3,403,146	1,925,172	3,073,815	64,120,128
Solar RT	1,599,625	11,868,011	11,788,294	14,453,825	14,555,698	8,234,211	13,147,107	326,262,417
Total	639,631,292	579,303,602	603,338,547	704,177,706	592,868,414	549,833,911	425,167,057	17,153,586,227
Generation Cost - No Solar Scenario (LKR)								
Hydro	12,201,395	11,345,676	11,967,841	12,706,646	11,750,388	10,931,638	10,944,977	348,221,449
Thermal	606,343,008	535,608,290	567,826,190	671,427,212	554,316,405	507,314,450	386,333,380	16,009,552,728
NCRE	21,050,806	30,357,663	25,715,556	25,566,285	28,770,704	26,166,076	26,100,852	786,987,344
Total	639,595,209	577,311,628	605,509,587	709,700,143	594,837,497	544,412,164	423,379,209	17,144,761,521
Impact for CEB								
Loss / (Benefit)								(8,824,705)

Month	July
Year	2019
Rooftop PV Capacity (MW)	120

	Actual days	Effective days
Total Days	31	
Sundays	4	5
Saturdays	4	4
Weekday holidays	1	
Saturday holidays	0	
Weekdays	23	22

Date	2	11	15	26	31	20	7	**Monthly Estimate**
Day	Tuesday	Thursday	Monday	Friday	Wednesday	Saturday	Sunday	
Energy (kWh)								
Hydro	5,915,290	5,922,052	3,990,354	5,588,648	6,953,947	11,184,455	4,388,131	191,507,753
Thermal	37,553,877	37,763,846	36,023,227	35,691,865	37,811,495	23,577,137	32,585,970	1,070,553,361
NCRE	1,808,406	681,778	1,503,699	1,483,034	1,302,619	2,001,850	1,493,155	45,501,531
Solar PV	139,746	176,332	183,181	169,907	185,284	104,829	183,488	5,060,819
Solar RT	558,984	705,327	732,724	679,627	741,135	419,314	733,952	20,243,277
Total	45,976,302	45,249,335	42,433,185	43,613,081	46,994,478	37,287,585	39,384,695	1,332,866,742
Generation Cost - Base Case Scenario (LKR)								
Hydro	11,830,579	11,844,105	7,980,709	11,177,296	13,907,894	22,368,910	8,776,261	383,015,506
Thermal	642,127,683	645,127,202	593,099,084	613,823,704	683,709,680	279,668,269	552,511,687	17,863,935,865
NCRE	28,334,458	10,660,086	23,541,500	23,186,581	20,382,509	31,306,613	23,393,829	709,058,189
Solar PV	2,635,607	3,325,619	3,454,793	169,907	3,494,451	1,977,066	3,460,582	82,764,834
Solar RT	12,297,637	15,517,204	16,119,926	14,951,797	16,304,966	9,224,911	16,146,938	448,477,063
Total	697,225,964	686,474,215	644,196,011	663,309,285	737,799,499	344,545,769	604,289,298	19,487,251,457
Generation Cost - No Solar Scenario (LKR)								
Hydro	19,548,242	22,069,488	15,938,286	26,976,298	22,148,848	22,368,910	8,776,261	602,754,055
Thermal	656,442,173	642,188,236	610,195,037	626,030,646	700,592,593	290,015,272	572,451,958	18,258,295,089
NCRE	28,334,458	10,660,086	23,541,500	23,186,581	20,382,509	31,306,613	23,393,829	709,058,189
Total	704,324,873	674,917,811	649,674,823	676,193,525	743,123,950	343,690,794	604,622,048	19,570,107,333
Impact for CEB								
Loss / (Benefit)								82,855,876

Month	August
Year	2019
Rooftop PV Capacity (MW)	130

	Actual days	Effective days
Total Days	31	
Sundays	4	6
Saturdays	5	5
Weekday holidays	2	
Saturday holidays	0	
Weekdays	22	20

Date	2	7	13	22	26	31	18	Monthly Estimate
Day	Friday	Wednesday	Tuesday	Thursday	Monday	Saturday	Sunday	
Energy (kWh)								
Hydro	5,870,336	7,873,769	12,494,689	10,049,589	11,614,524	12,485,939	9,567,044	311,443,590
Thermal	36,845,437	36,265,476	26,413,463	29,077,917	24,630,315	22,967,057	23,712,086	870,038,232
NCRE	1,789,625	1,537,453	1,928,870	3,368,313	3,689,683	3,799,465	1,335,862	77,275,338
Solar PV	113,307	176,332	18,281	134,655	116,607	136,741	157,222	3,778,215
Solar RT	490,999	764,105	79,220	583,507	505,295	592,545	681,294	16,372,267
Total	45,109,704	46,617,134	40,934,523	43,213,983	40,556,422	39,981,747	35,453,507	1,278,907,643
Generation Cost - Base Case Scenario (LKR)								
Hydro	11,740,672	15,747,538	24,989,378	20,099,179	23,229,047	24,971,879	19,134,088	622,887,181
Thermal	655,208,273	654,191,282	443,902,628	413,411,704	410,758,313	364,798,326	288,227,106	13,863,243,069
NCRE	28,025,260	24,070,289	30,125,223	52,523,962	57,491,660	59,228,714	20,848,374	1,190,179,392
Solar PV	2,136,978	3,325,619	344,789	134,655	2,199,199	2,578,938	2,965,200	63,250,845
Solar RT	10,801,972	16,810,304	1,742,833	12,837,150	11,116,488	13,035,988	14,988,461	368,345,697
Total	707,913,156	714,145,031	501,104,851	499,006,649	504,794,707	464,613,845	346,163,230	16,107,906,183
Generation Cost - No Solar Scenario (LKR)								
Hydro	22,741,230	29,357,582	24,989,378	24,880,772	23,229,047	24,971,879	19,134,088	740,455,960
Thermal	664,252,175	642,823,006	446,008,503	424,456,269	425,296,386	381,864,232	305,862,738	14,155,842,942
NCRE	28,025,260	24,070,289	30,125,223	52,523,962	57,491,660	59,228,714	20,848,374	1,190,179,392
Total	715,018,665	696,250,877	501,123,104	501,861,003	506,017,093	466,064,825	345,845,201	16,086,478,293
Impact for CEB								
Loss / (Benefit)								(21,427,890)

Month	September
Year	2019
Rooftop PV Capacity (MW)	140

	Actual days	Effective days
Total Days	30	
Sundays	5	6
Saturdays	4	4
Weekday holidays	1	
Saturday holidays	0	
Weekdays	21	20

Date	3	11	26	27	30	21	15	Monthly Estimate
Day	Tuesday	Wednesday	Thursday	Friday	Monday	Saturday	Sunday	
Energy (kWh)								
Hydro	9,348,952	6,795,303	14,459,924	14,325,649	13,458,574	9,282,887	7,330,467	314,667,960
Thermal	29,832,928	34,689,355	21,673,398	24,174,246	23,774,108	27,038,533	23,538,366	785,960,475
NCRE	3,053,828	2,102,295	2,539,343	1,794,091	2,113,222	2,514,610	2,625,129	71,753,645
Solar PV	133,656	152,495	136,635	108,238	146,140	145,738	17,680	3,602,493
Solar RT	623,728	711,646	637,630	505,109	681,987	680,110	82,504	16,811,632
Total	42,993,092	44,451,094	39,446,930	40,907,333	40,174,032	39,661,879	33,594,146	1,192,796,205
Generation Cost - Base Case Scenario (LKR)								
Hydro	18,697,904	13,590,606	28,919,848	28,651,297	26,917,149	18,565,774	14,660,934	629,335,920
Thermal	504,143,543	584,796,160	261,312,845	317,882,903	305,442,891	364,325,434	353,756,106	11,474,151,745
NCRE	47,626,619	32,784,448	39,395,913	27,816,633	32,762,131	39,123,101	40,906,311	1,123,473,250
Solar PV	2,520,751	2,876,065	2,576,935	108,238	2,756,203	2,748,618	333,435	56,347,848
Solar RT	13,722,008	15,656,203	14,027,853	11,112,402	15,003,721	14,962,430	1,815,096	348,829,039
Total	586,710,826	649,703,481	346,233,394	385,571,473	382,882,095	439,725,356	411,471,883	13,632,137,801
Generation Cost - No Solar Scenario (LKR)								
Hydro	25,420,804	13,590,606	29,661,747	28,706,247	29,318,247	18,565,774	14,660,934	669,019,308
Thermal	514,612,289	599,745,432	279,092,541	329,891,214	323,223,508	383,038,513	355,905,698	11,853,848,175
NCRE	47,626,619	32,784,448	39,395,913	27,816,633	32,762,131	39,123,101	40,906,311	1,123,473,250
Total	587,659,712	646,120,486	348,150,201	386,414,094	385,303,887	440,727,388	411,472,943	13,646,340,732
Impact for CEB								
Loss / (Benefit)								14,202,931

Month	October
Year	2019
Rooftop PV Capacity (MW)	150

	Actual days	Effective days
Total Days	31	
Sundays	4	4
Saturdays	4	4
Weekday holidays	0	
Saturday holidays	0	
Weekdays	23	23

Date	3	11	15	23	28	26	20	**Monthly Estimate**
Day	Thursday	Friday	Tuesday	Wednesday	Monday	Saturday	Sunday	
Energy (kWh)								
Hydro	13,045,072	18,784,604	19,993,651	21,901,899	22,006,635	22,676,472	20,093,778	611,447,560
Thermal	25,895,300	19,616,821	17,956,348	15,295,896	11,381,777	11,357,347	10,599,005	502,497,666
NCRE	1,943,214	2,274,317	2,567,819	2,890,671	2,665,549	2,479,010	2,778,484	77,938,714
Solar PV	148,753	99,555	135,151	111,282	48,518	40,968	30,603	2,722,818
Solar RT	743,763	497,776	675,754	556,410	242,589	204,842	153,015	13,614,088
Total	41,776,102	41,273,073	41,328,724	40,756,158	36,345,068	36,758,638	33,654,885	1,208,220,846
Generation Cost - Base Case Scenario (LKR)								
Hydro	26,090,144	37,569,208	39,987,303	43,803,798	44,013,270	45,352,943	40,187,556	1,222,895,120
Thermal	347,222,730	213,369,375	184,139,504	200,227,408	115,305,966	112,911,896	104,578,387	5,747,180,059
NCRE	30,135,453	35,259,332	39,816,108	44,883,363	41,375,032	38,444,877	43,074,070	1,206,834,516
Solar PV	2,805,475	1,877,612	2,548,945	111,282	915,047	772,663	577,171	43,387,795
Solar RT	16,362,793	10,951,075	14,866,594	12,241,012	5,336,965	4,506,516	3,366,323	306,380,173
Total	422,616,595	299,026,601	281,358,455	301,266,863	206,946,280	201,988,896	191,783,506	8,526,677,664
Generation Cost - No Solar Scenario (LKR)								
Hydro	31,179,289	37,673,481	41,249,946	43,803,798	44,013,270	45,352,943	40,187,556	1,252,593,001
Thermal	365,628,044	226,912,219	195,576,862	215,334,408	121,956,845	114,920,532	106,101,027	6,060,964,778
NCRE	30,135,453	35,259,332	39,816,108	44,883,363	41,375,032	38,444,877	43,074,070	1,206,834,516
Total	426,942,786	299,845,032	276,642,917	304,021,568	207,345,147	198,718,353	189,362,652	8,520,392,296
Impact for CEB								
Loss / (Benefit)								(6,285,368)

Month	November
Year	2019
Rooftop PV Capacity (MW)	165

	Actual days	Effective days
Total Days	30	
Sundays	4	6
Saturdays	5	5
Weekday holidays	2	
Saturday holidays	0	
Weekdays	21	19

Date	1	6	19	21	25	16	3	Monthly Estimate
Day	Friday	Wednesday	Tuesday	Thursday	Monday	Saturday	Sunday	
Energy (kWh)								
Hydro	22,011,586	17,561,370	18,202,255	15,060,735	14,564,770	12,753,553	21,044,142	522,155,341
Thermal	16,812,867	22,911,431	19,915,457	24,455,457	24,076,660	16,679,322	8,859,233	547,605,122
NCRE	1,778,061	1,604,024	1,867,461	1,689,300	1,499,552	1,589,611	2,547,212	53,893,808
Solar PV	147,727	144,860	130,369	173,372	65,083	178,684	105,399	4,052,118
Solar RT	812,500	796,729	717,031	953,547	357,954	982,764	579,693	22,286,650
Total	41,562,741	43,018,414	40,832,574	42,332,411	40,564,019	32,183,935	33,135,680	1,149,993,039
Generation Cost - Base Case Scenario (LKR)								
Hydro	44,023,173	35,122,740	36,404,511	30,121,470	29,129,539	25,507,106	42,088,285	1,044,310,682
Thermal	219,451,275	320,510,868	250,594,441	358,570,333	352,389,083	177,931,765	70,068,450	7,015,830,327
NCRE	27,563,063	24,873,008	28,954,962	26,243,116	23,291,048	24,647,640	39,492,869	857,711,167
Solar PV	2,786,137	2,732,055	2,458,765	173,372	1,227,457	3,369,988	1,987,821	64,412,453
Solar RT	17,875,001	17,528,028	15,774,685	20,978,033	7,874,987	21,620,815	12,753,255	488,740,400
Total	311,698,649	400,766,700	334,187,364	436,086,325	413,912,115	253,077,314	166,390,680	9,471,005,028
Generation Cost - No Solar Scenario (LKR)								
Hydro	44,023,173	35,122,740	36,404,511	30,174,183	29,129,539	25,539,420	42,088,285	1,044,672,566
Thermal	236,556,813	343,191,618	271,076,596	385,830,037	362,041,312	201,654,293	78,378,589	7,553,589,227
NCRE	27,563,063	24,873,008	28,954,962	26,243,116	23,291,048	24,647,640	39,492,869	857,711,167
Total	308,143,048	403,187,367	336,436,069	442,247,336	414,461,900	251,841,353	159,959,743	9,455,972,959
Impact for CEB								
Loss / (Benefit)								(15,032,069)

Month	December
Year	2019
Rooftop PV Capacity (MW)	170

	Actual days	Effective days
Total Days	31	
Sundays	5	7
Saturdays	4	4
Weekday holidays	2	
Saturday holidays	0	
Weekdays	22	20

Date	5	10	13	18	30	21	1	**Monthly Estimate**
Day	Thursday	Tuesdya	Friday	Wednesday	Monday	Saturday	Sunday	
Energy (kWh)								
Hydro	20,852,670	21,157,982	16,356,423	12,525,047	18,454,364	23,069,122	19,651,283	587,221,412
Thermal	16,378,946	17,569,213	22,715,446	27,484,940	22,074,096	12,178,745	10,190,172	544,936,745
NCRE	2,022,154	1,999,768	1,564,348	1,414,886	779,736	2,001,329	2,562,471	54,669,352
Solar PV	88,849	139,745	160,718	56,963	189,167	163,624	128,036	4,105,739
Solar RT	503,478	791,888	910,735	322,790	1,071,948	927,205	725,536	23,265,852
Total	39,846,096	41,658,596	41,707,670	41,804,626	42,569,312	38,340,025	33,257,497	1,214,199,099
Generation Cost - Base Case Scenario (LKR)								
Hydro	41,705,341	42,315,965	32,712,846	25,050,093	36,908,728	46,138,244	39,302,566	1,174,442,825
Thermal	183,738,916	203,500,512	316,576,204	413,179,681	406,080,679	104,602,376	63,702,962	6,956,634,206
NCRE	31,439,650	31,089,952	24,289,992	22,041,623	12,115,419	31,117,389	39,783,343	886,859,497
Solar PV	1,675,692	2,635,591	3,031,140	56,963	3,567,695	3,085,955	2,414,753	73,115,416
Solar RT	11,076,507	17,421,543	20,036,168	7,101,390	23,582,855	20,398,499	15,961,785	510,200,348
Total	269,636,106	296,963,562	396,646,350	467,429,750	482,255,376	205,342,463	161,165,409	9,601,252,292
Generation Cost - No Solar Scenario (LKR)								
Hydro	44,411,755	49,015,741	32,712,846	26,199,345	58,714,183	46,138,244	39,302,566	1,303,886,417
Thermal	194,171,286	217,959,934	341,009,842	420,124,593	417,371,093	128,686,520	69,034,338	7,360,533,437
NCRE	31,439,650	31,089,952	24,289,992	22,041,623	12,115,419	31,117,389	39,783,343	886,859,497
Total	270,022,691	298,065,626	398,012,680	468,365,561	488,200,695	205,942,153	148,120,247	9,551,279,352
Impact for CEB								
Loss / (Benefit)								(49,972,941)

Appendix 2 - Sensitivity Analysis for Network loss

Network loss		Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
	Generation (Profit/(Loss)	204,727,501	37,638,025	183,940,657	131,589,409	91,446,941	(1,475,758)	97,833,293	(11,562,624)	22,036,653	431,191	(4,284,140)	(40,079,449)	712,241,699
	Revenue Loss	(217,030,752)	(190,836,843)	(245,843,892)	(312,203,529)	(383,377,008)	(311,232,428)	(427,538,020)	(345,782,275)	(355,061,672)	(287,529,546)	(470,694,057)	(491,374,792)	(4,038,504,815)
0%	Total Benefit/(Loss)	(12,303,251)	(153,198,819)	(61,903,235)	(180,614,120)	(291,930,067)	(312,708,185)	(329,704,727)	(357,344,899)	(333,025,019)	(287,098,354)	(474,978,196)	(531,454,242)	(3,326,402,225)
	Generation (Profit/(Loss)	196,413,125	32,734,935	175,126,551	122,230,160	81,101,385	(8,824,705)	82,855,876	(21,427,890)	14,202,931	(6,285,368)	(15,032,069)	(49,972,941)	603,121,992
	Revenue Loss	(217,030,752)	(190,836,843)	(245,843,892)	(312,203,529)	(383,377,008)	(311,232,428)	(427,538,020)	(345,782,275)	(355,061,672)	(287,529,546)	(470,694,057)	(491,374,792)	(4,038,504,815)
2%	Total Benefit/(Loss)	(20,617,627)	(158,101,908)	(70,717,341)	(189,973,369)	(302,275,623)	(320,057,133)	(344,682,144)	(367,210,165)	(340,858,740)	(293,814,914)	(485,726,125)	(541,347,733)	(3,435,382,823)
	Generation (Profit/(Loss)	188,118,532	27,830,261	166,336,160	112,874,501	70,796,047	(16,136,515)	67,914,610	(31,286,422)	6,378,503	(12,990,358)	(25,757,860)	(59,819,981)	494,257,479
	Revenue Loss	(217,030,752)	(190,836,843)	(245,843,892)	(312,203,529)	(383,377,008)	(311,232,428)	(427,538,020)	(345,782,275)	(355,061,672)	(287,529,546)	(470,694,057)	(491,374,792)	(4,038,504,815)
4%	Total Benefit/(Loss)	(28,912,220)	(163,006,583)	(79,507,732)	(199,329,029)	(312,580,961)	(327,368,942)	(359,623,410)	(377,068,696)	(348,683,169)	(300,519,903)	(496,451,917)	(551,194,773)	(3,544,247,335)
	Generation (Profit/(Loss)	179,862,447	22,928,787	157,562,730	103,524,445	60,511,783	(23,417,017)	53,002,092	(41,142,095)	(1,401,295)	(19,677,107)	(36,441,038)	(69,613,392)	385,700,341
	Revenue Loss	(217,030,752)	(190,836,843)	(245,843,892)	(312,203,529)	(383,377,008)	(311,232,428)	(427,538,020)	(345,782,275)	(355,061,672)	(287,529,546)	(470,694,057)	(491,374,792)	(4,038,504,815)
6%	Total Benefit/(Loss)	(37,168,305)	(167,908,056)	(88,281,162)	(208,679,084)	(322,865,225)	(334,649,445)	(374,535,928)	(386,924,370)	(356,462,966)	(307,206,653)	(507,135,095)	(560,988,184)	(3,652,804,474)
	Generation (Profit/(Loss)	171,643,870	18,035,233	148,797,377	94,177,265	50,256,236	(30,660,215)	38,109,091	(50,982,379)	(9,161,695)	(26,344,936)	(47,048,823)	(79,372,629)	277,448,395
	Revenue Loss	(217,030,752)	(190,836,843)	(245,843,892)	(312,203,529)	(383,377,008)	(311,232,428)	(427,538,020)	(345,782,275)	(355,061,672)	(287,529,546)	(470,694,057)	(491,374,792)	(4,038,504,815)
8%	Total Benefit/(Loss)	(45,386,882)	(172,801,611)	(97,046,516)	(218,026,264)	(333,120,772)	(341,892,643)	(389,428,929)	(396,764,654)	(364,223,367)	(313,874,482)	(517,742,880)	(570,747,422)	(3,761,056,420)