A STUDY ON THE REGULATORY IMPACT OF NET METERING IN KENYA

On behalf of

Energy and Petroleum Regulatory Authority (EPRA)

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PROJECT INFORMATION

The study was undertaken by the Energy and Petroleum Regulatory Authority as part of the design of the net metering regulatory framework in Kenya.

Contact Details

Energy and Petroleum Regulatory Authority
Eagle Africa Centre,
Longonot Road, Upperhill
P.O. Box 42681-00100 Nairobi
Email: info@epra.go.ke/ renewableenergy@epra.go.ke
Tel: + 254 722 200947 | 020 2847000/200

Project Title

Consultancy Services for Study on the Regulatory Impact of Net Metering in Kenya

Authors

JKUAT Enterprise Limited
P.O.BOX 62000-00200
Nairobi-Kenya
Email: jkuates@jkuates.jkuat.ac.ke
Tel: +254-724256696/ 736524200
Contact Person: Dr. Keren K. Kaberere
Email: kkanuthu@eng.jkuat.ac.ke/ kkanuthu@gmail.com

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ABREVIATIONS AND NOTATIONS

AAA	All-aluminium alloy
ACSR	Aluminium conductor steel reinforced
AEPEA	Association of Energy Professionals Eastern Africa
BERC	Bangladesh Energy Regulatory Commission
CPUC	California Public Utilities Commission
CEB	Ceylon Electricity Board
DNO	Distribution Network Operator
ELCOS	Electricity Consumers Society of Kenya
EPC	Engineering, Procurement and Construction
EPRA	Energy and Petroleum Regulatory Authority
ESAK	Electricity Sector Association of Kenya
FiT	Feed-in-Tariff
GoMEn	Government Ministries and Entities
GIZ	German Agency for International Cooperation
GSK	GlaxoSmithKline
IRR	Internal Rate of Return
KAM	Kenya Association of Manufacturers
KEBS	Kenya Bureau of Standards
KEPSA	Kenya Private Sector Alliance
KEREA	Kenya Renewable Energy Association
KGBS	Kenya Green Building Society
KIPPRA	Kenya Institute for Public Policy Research and Analysis
KPLC	Kenya Power & Lighting Company
KTDA	Kenya Tea Development Agency
kV	Kilo volt
kVA	Kilo volt-ampere
kVAr	Kilo volt-ampere reactive
kW	Kilowatt
kWh	Kilowatt-hour
LCOE	Levelized Cost of Electricity
LCPDP	Least Cost Power Development Plan
LECO	Lanka Electricity Company
MASEN	Moroccan Agency for Sustainable Energy
MoE	Ministry of Energy
MTP	Medium-Term Plan
MW	Megawatt
NEM	Net Energy Metering
NEMA	National Environmental Management Authority
NERSA	National Energy Regulator of South Africa
NGO	Non-Governmental Organisation

NMD	Notified Maximum Demand
NPV	Net Present Value
PV	Photovoltaic
RE	Renewable Energy
REGS	Renewable energy generation system
REREC	Rural Electrification and Renewable Energy Corporation
RES	Renewable Energy System
RETs	Renewable Energy Technologies
RIA	Regulation Impact Assessment
ROI	Return on investment
SI	Statutory Instruments
SLSEA	Sri Lanka Sustainable Energy Authority
SSEG	Small-Scale Embedded Generation
SU	Strathmore University
TEMARIN	Technology, Markets and Investment
ToRs	Terms of Reference
UNIDO	United Nations Industrial Development Authority
USAID	United States Agency for International Development
V	Volts
W	Watt

CHAPTER ONE

INTRODUCTION

1.1 Background

Recently, there has been a growing interest among Kenyans to generate electricity for their own consumption as a supplement to the national grid supply. With plummeting prices of renewable energy technologies, a number of domestic, commercial, industrial and institutional facilities in Kenya are installing on site electricity plants to complement supply from the national grid. Such consumers connected to the national grid and with on-site generation are referred to as prosumers. This kind of generation installed at the point of use is known as distributed generation. The generation is mostly based on renewable energy technologies (RETs) such as solar photovoltaic (PV), hydropower, and biomass.

In Kenya, most prosumers have adopted solar photovoltaic technology with more than 100 MW estimated to have been installed. The electricity generated from this technology varies through the day depending on the available insolation. Similarly, the consumer load varies depending on the connected appliances at a particular time. Thus, it is difficult to precisely match the generation with demand which may sometimes lead to surplus or inadequate generation to meet the demand. Where there is generation inadequacy from the embedded generation, the deficit is met by the grid supply. However, where there is surplus the prosumers are required to install storage systems, or curtail generation. Storage systems are relatively expensive while curtailment results to underutilization of resources. Net energy metering (NEM) arrangement is a useful solution to problems related with storage of the excess energy.

A NEM arrangement allows prosumers to feed power into the national grid when they have excess, and draw the power when there is a deficit. The customers then offset their consumption from the grid by a fraction or whole of the energy banked. Alternatively, the energy banked in the grid may be charged at the same rate as the prosumer's applicable retail tariff or a different rate as may be guided by the regulator. The prosumer's net bill then is the difference between the energy import and export bill. A NEM arrangement enhances growth of RETs that would otherwise have problems with storage. The improved uptake of self generation from RE sources leads to an increase in distributed generation installations. Other benefits associated with net metering include:

i) Facilitation of economic development, technology innovation, local industry and job creation;
ii) Increased local ownership, and customer investment and participation in energy services;
iii) Enhanced energy security, diversification of energy sources, and self-sufficiency;
iv) Reduced greenhouse gas emissions.

In recognition of the aforementioned benefits, Section 162 of the Energy Act, 2019 (Act) provides a framework for prosumers to enter into a net metering arrangement with electricity distributors and/or retailers. It is in view of this that the Energy and Petroleum Regulatory Authority (Authority) is developing the draft Energy (Net Metering) Regulations (Draft Regulations), 2022 to actualize the section on net metering in the Act.t In addition, as part of the Draft Regulations development process, the Authority is required to undertake a Regulatory Impact Assessment to evaluate the possible social, environmental, and economic impacts of the regulatory instrument.

It is in view of this that the Authority proposed this consultancy. The work provides an assessment of the potential and possible impacts of net metering and the Draft Regulations in Kenya.

1.2 Study Objectives

The study was to identify the potential economic, environmental, and social impacts of the Draft Regulations in Kenya. To achieve this, the specific objectives included:

i) To conduct a desktop benchmarking exercise of policies, regulations, practices and incentives in other jurisdictions promoting adoption of the net metering system.
ii) To map the players to be affected directly by the net metering framework, consult them and analyse their inputs on the draft net metering regulations;
iii) To establish the current installed capacity of renewable energy-based projects installed in the country with the potential of entering into a net metering arrangement with the distribution licensee/retailer;
iv) To assess the potential in terms of installed capacity of the various renewable energy-based sources contributing to net metering in Kenya in the short, medium, and long-term based on the proposed minimum capacity in the Draft Regulations and the maximum capacity in the Energy Act, 2019;

v) To evaluate the impact of the proposed net metering capacity in the Draft Regulations on the cost of electricity based on the projected demand and generation capacity under the Least Cost Power Development Plan;

vi) To determine feeder and network conditions, and protection requirements to be considered before a prosumer is allowed to net meter with a distribution licensee/retailer;

vii) To determine the costs associated with the use of two-way communication meters (together with alternatives to the two-way communication meters) and associated infrastructure necessary for effective monitoring of the performance of plants under net metering and their real time impact on power system stability;

viii) To establish the financial, social, environmental, and economic benefits/impacts of net metering on Kenya's economy and the distribution licensee/retailer;

ix) To develop a techno-economic model for determining the Least Cost of Energy (LCOE) for the various renewable energy technologies to be adopted in the net metering system;

x) To conduct a sensitivity analysis of the LCOE for the various renewable energy technologies based on different installed capacities;

xi) To recommend a percentage energy credit to the prosumer by the distribution licensee/retailer for the banked energy based on the modelled LCOE for the various technologies with a reasonable rate of return, and the costs to the distribution licensee/retailer;

xii) To propose amendments to the Draft Regulations, based on the findings of the study;

xiii) To come up with a policy brief on net metering regime in Kenya, based on the study findings.

1.3 Scope of Work

The study focussed on review of recent net metering publication, techno-economic evaluation of NEM scheme in Kenya, review of net metering in other jurisdictions, and obtaining stakeholder inputs on the contents of the net metering framework. The reviewed net metering policies, regulations, practices, and incentives covered high-, upper middle- and lower middle-income countries. Further, the maximum on-site capacity considered was 1 MW as provided for in the Energy Act, 2019 and off-grid systems were not considered. The primary technology for consideration in net metering framework was solar photovoltaic. However, as part of the work, the potential of wind and small hydro power participating in net metering. The LCOE for the three RETs has been determined by the economic viability of the engagement based on

the cost of generation installation only i.e., does not include the utility's distribution cost since data on this component were not available. Secondary data on the growth trends of various RETs were used to project the RE installed capacities in the short, medium, and long term. For the purposes of this study, the short, medium, and long-term were considered to be 3, 5, and 10 years, respectively. The assessment of impacts of net metering on Kenya's economy were restricted to financial, social, environmental and economic impacts; political impacts were excluded.

CHAPTER TWO

STUDY METHODOLOGY

2.1. Introduction

The study involved both document analysis and data collection activities. To address the study objectives, the project team carried out the following activities:

- Document analysis of existing laws and policies
- Stakeholders' identification and mapping
- Sample design
- Development of data and information gathering tools
- Data and information collection
- Modelling and simulations
- Data analysis and reporting.

The methodology set out in the following sections was employed in delivering the services.

2.2. Desktop Study

2.2.1. Legal Requirements

The project team examined the Draft Regulations in light of the provisions of the Constitution of Kenya, the Energy Act 2019 and the Statutory Instruments Act 2013 to determine that:

a) The Authority has the power to make the regulations, and;
b) The regulations are not *ultra vires* of the functions and powers of the Authority as set forth in the Act.

The power to make regulations is granted under Article 94 (5) which provides that

> "*No person or body, other than Parliament, has the power to make provision having the force of law in Kenya except under authority conferred by this Constitution or by legislation*"

Additionally, clause (6) of Article 94 of the Constitution of Kenya provides that

> "*Act of Parliament, or legislation of a county, that confers on any State organ, State officer or person the authority to make provision having the force of law in Kenya, as contemplated in clause (5), shall expressly specify the purpose and objectives for which that authority is*

conferred, the limits of the authority, the nature and scope of the law that may be made, and the principles and standards applicable to the law made under the authority".

The project team reviewed the draft Energy (Net Metering) Regulations, 2020 in detail with a view to establishing:

a) Whether the Authority is possessed of the statutory authority to make the regulations under the enabling legislation i.e., the Energy Act, 2019.
b) Whether the specific rules made under the Draft Regulations have the effect of limiting or otherwise infringing upon the rights granted to persons under the Constitution of Kenya.
c) Whether the specific rules made under the Draft Regulations are each consistent with specific powers donated to the Authority under the Energy Act, 2019.
d) To the extent that the Draft Regulations interact and overlap with existing regulations under the Energy Act or any other law, the Draft Regulations are not in conflict or contradiction.
e) That the process employed in making the Draft Regulations is in compliance with the process laid down under the Statutory Instruments Act, 2013 taking into account pronouncements made by the courts expounding on the manner in which meaningful consultation ought to be conducted.
f) That the Draft Regulations meet the regulatory objectives established by the Authority while at the same time answering legitimate concerns raised by stakeholders during the engagement process.

2.2.2. Net Metering Benchmarking

The project team carried out a desktop benchmarking exercise of policies, regulations, practices and incentives in the main jurisdictions outside Kenya, promoting adoption of the net metering system. The countries/states that were benchmarked include Malaysia, California (United States of America), New Delhi (India), Bangladesh, Sri Lanka, Ghana, Tanzania, and Stellenbosch Municipality (South Africa) shown in Figure 2.1.

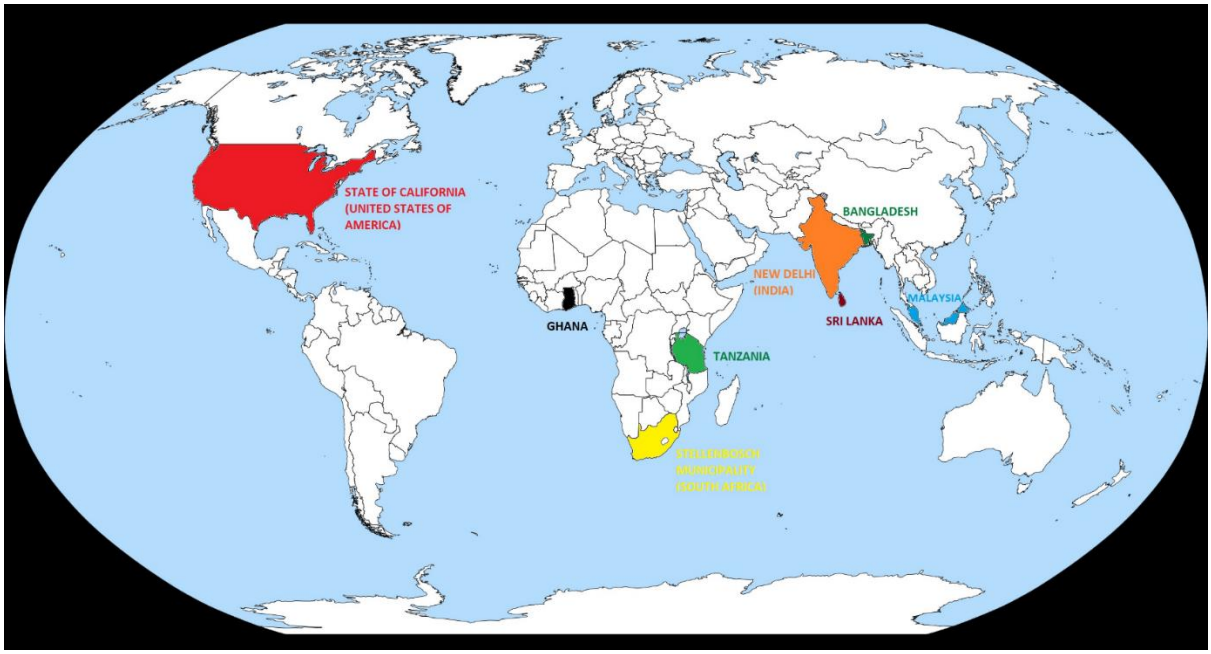

Figure 2.1: Distribution of benchmarked countries/states

For each jurisdiction, the team reviewed the legal framework; application of the net metering regulations; eligible consumer and RE sources; generation capacity limits; application to enter into a net metering agreement; installation, grid connection, maintenance and operation; costs, tariffs, and billing; and carbon credits.

2.2.3. Other Relevant Documents Reviewed

To gain deeper understanding of net metering, the team also review the following documents:

i) Report on the Assessment of a Net Metering Programme in Kenya Study (ECA & Carbon, 2014).

ii) UNEP DTU TEMARIN Kenya report on Clean Captive Power: Understanding the Uptake and Growth of Commercial and Industrial (C&I) Solar PV in Kenya (Bhamidipati & Gregersen, 2020)

iii) IEA PVPS Task 9, Subtask 4 Report on Net Metering and PV Self-consumption in Emerging Countries (Roux & Shanker, 2018)

iv) The Least Cost Power Development Plan (MoE, 2020) and Medium-Term Plan (MTP) (MoE, 2019).

2.3. Stakeholders Identification and Mapping

The major stakeholders were mapped and their respective stage of intervention identified. The stakeholders were categorized into national government agencies, County Governments, non-governmental organizations, donors and financiers, development partners, captive solar PV projects developers, engineering, procurement and construction (EPC) companies in the solar PV industry and sector associations. The list of stakeholders is provided in the appendix.

In the initial review, the team identified UNEP DTU TEMARIN Kenya report published in 2020 as a good source of baseline information on embedded grid-tie solar PV systems in Kenya, and the main developers and financiers in the space. The data from the report were complemented with information collected during the field work, and interviews with key informants. To identify the engineering, procurement and construction (EPC) companies, the database of solar PV contractors formed the primary source. This is considering players in the solar PV value chain have to be licensed by EPRA.

The team also mapped the stakeholders who would be directly affected by the net metering framework, consulted them and analysed their inputs on the draft net metering regulations.

2.4. The Population Size and Sampling Technique

2.4.1. Target Population

The target population consists of the stakeholders who will be affected by Energy (Net Metering) Regulations, 2020. The following stakeholders were considered for participation in the survey:

i) The consumers who have invested in self-generation of electricity through solar PV. The main sectors are industrial (including factories and processing units), commercial (office buildings, malls, hotels, petrol stations etc.), horticultural (flower farms, tea and coffee estates etc.) and institutional (learning institutions, religious buildings, courts, hospitals) facilities.

ii) Licensed Solar PV contractors made up of the following sub-classes:
   - Category C1 - Licensed to design and install solar PV systems
   - Category V1 - Licensed to design, install and sell solar PV systems.

iii) Financiers.

The classification and populations of the players are as captured in Table 2.1.

Table 2.1: Stakeholders population

Targeted stakeholder category	Category	Population
Consumers	Industrial	31
	Horticultural	30
	Commercial	67
	Institutional	29
	Sub-total	***184***
Licensed solar PV contractors	Class - C1	266
	Class - V1	309
	Sub-total	***575***
Financiers		***16***
TOTAL		**775**

Previous studies (EPRA, 2019) found that about 79% of the solar PV vendors have more than one license.

2.4.2. Sampling Methods

The team adopted both purposive and stratified sampling techniques. The decision to combine the two sampling methods was informed by the profile of the targeted respondents and the expected outcome of the survey. The rationale for each of the two sampling methods is presented in Table 2.2.

Table 2.2: Sampling methods

Sampling Method	Rationale
Stratified sampling	Based on the argument that the research targeted several respondent clusters who include consumers as is defined in the draft Energy (Net Metering) Regulations, 2020 and solar PV contractors.
Purposive sampling	Informed by the fact that the survey targeted respondents that are within a specific sub-sector i.e., energy, the survey employed the purposive sampling technique to identify key actors who may provide essential information to the survey. These mainly comprised of stakeholders in energy such as KPLC, KenGen, REREC, Ministry of Energy, KTDA, Council of Governors (CoG), UNIDO, GIZ, USAID, KAM, KEPSA, ESAK, ELCOS, KGBS, AEPEA, and KEREA.

2.4.3. The Sample Sizes

Since the stakeholders' population sizes involved in the study are finite, the study team used the following formula to determine the sample size for each stakeholder category.

$$N_s = \frac{qN}{q+(N-1)} \text{ and } q = \frac{Z^2 p(1-p)}{E^2}$$

where

N_s - Sample size

N - Stakeholder population size

Z - Obtained from standard normal distribution tables

p - Population proportion

E - Tolerance sampling error.

The values of the variables used for determining the sample sizes are given in Table 2.3.

Table 2.3: Variables used for determining sample size

Variable:	***Value:***	***Rationale:***
Confidence level	95%	Set at 95% because the survey is dealing with a finite population that is known and confirmed to be relevant to the study and thus, they represent a true population parameter.
Population proportion *(p)*	0.5	Sample of the population that is likely to have similar characteristics. Set to the conservative 0.5 the standard for finite populations.
Margin of Error (*E*)	0.05	A provision for the variance in results from a survey conducted using random sampling. Determined to be approximately 5% for a finite population and within a confidence level of 95%.
Alpha value (œ)	0.025	A statistical value used to determine the *Z*-score and is arrived at using the formulae œ = *(1 – Confidence level) x 0.5* œ = *(1-0.95) x 0.5* œ = *0.025*
Z-score *(Z)*	1.96	The number of standard deviations from the mean score associated with the population size. Obtained using the formulae:

Variable:	*Value:*	*Rationale:*
		Z= probability function[1] *(1 – Alpha value)* = 1.96
Sample size (*n*)	Varied	Based on the database lists for the various stakeholder categories
Population size *(N)*	Varied	This is differentiated by the various respondent clusters as was obtained from the databases. The specific distribution of the various respondent clusters is presented in Table 2.1

The sample sizes for this study for the finite respondent populations in their respective respondent clusters are given in Table 2.4.

Table 2.4: Respondent strata sample size

Targeted stakeholder category	**Population size (*N*)**	**Sample size (N_s)**	
		No.	% of *N*
Potential prosumers	157	112	71%
Licensed Solar PV contractors	288	165	57%
Financiers	16	16	100%
Agencies and associations	20	20	100%
TOTAL	**481**	**313**	**65%**[2]

To determine feeder and network conditions, and protection requirements to be considered before a prosumer is allowed to net-meter with a distribution licensee/retailer, the following four prosumers were selected and used for the study:

i) GlaxoSmithKline (GSK) – industrial
ii) Two Rivers Mall - commercial
iii) Black Petals Flower Farm in Limuru – Horticultural

[1] Probability function is a formula computed using weighted averages of the study variables and is used to validate the Z-score (z) value

[2] Sample population as a percentage of the total population

iv) Strathmore University – institutional.

2.5. Development of Data and Information Gathering Tools

The data and information gathering tools that were used are presented in Appendix A. The tools have open ended and close ended questions that cover both technical and legal aspects relating to the regulations. The tools were used during the study to gather the following data/information:

iv) The installed capacity of the RE systems and their average annual energy output
v) Cost of installing the RE based plants
vi) Peak load and the average energy requirement of the prosumers
vii) Share of the total energy demand provided by the installed RE plants
viii) Level of awareness of the facility of the net metering concept and the willingness to participate in the same
ix) To get the players input on the Draft Regulations on the eligible technologies, the generation capacity limits, the net metering agreement, grid interconnection requirements, and billing.

2.6. Data Collection

The project team sent out through email an introduction letter from the Authority together with the information gathering tool to the selected stakeholders prior to a face-to-face interview. This was followed by a visit by a team member who verified, validated, and where necessary sought clarification on the information provided.

Technical data for the feeders that supply the four prosumers selected for the study were obtained from KPLC. These included the feeder length, impedance, nominal operation voltage, the location of consumers connected to the feeder, measured operational data e.g., voltage, loading, among others. The RE plants' data (installed capacity, installation cost, annual energy output) and energy consumption were obtained from the consumers. Other data like the costs of two-way metering system components and other equivalents were obtained from literature and suppliers catalogues.

2.7. Modelling and simulation

2.7.1. Feeder and Network Analysis

The objective was to identify and analyse feeders supplying industrial, agricultural, commercial and institutional premises that were candidates for adopting a net metering system with a view to:

i) Establish the impact of various levels of power injection on the feeder voltage profile and the lines loadings based on their current carrying capacity.
ii) Identify feeder short circuit capacity with various generation levels to determine whether or not the output from the prosumers violates the Kenya National Distribution Code specifications.

Each of the four feeders supplying the four selected prosumers was modelled in a power system analysis tool. Simulations were then carried out to establish the impact of power injection into the grid on the feeder voltage profile. Hypothetical scenarios with more prosumers connected to the feeder and taking into consideration load growth were also explored. A worst-case scenario simulating the most unfavourable situation the grid may have to cope with (a day with very low load and high solar PV generation feed-in) was investigated.

Short circuit simulations for different sizes of generation plants from the prosumer were also run. The following assumptions were made:

1. All loads were modelled as static. Therefore, the contribution of motors to the short circuit current was neglected.
2. The maximum admissible temperature for minimum short circuit currents for all conductors -both underground and overhead- was taken to be 80°C.
3. Only balanced three-phase faults were considered because they are the most severe. Furthermore, zero sequence impedance data for the components in the network were not available.
4. No data was available on the maximum fault current contribution of the solar PV plants. Hence, it was assumed that the maximum fault current contribution of the inverters is between 1 to 1.5 times the inverter rating. Solar inverter watts rating is in most cases equal to the installed watt peak, give or take a small percentage. In this study, it was assumed inverters were oversized by a factor of 0.25 of the installed watt peak at unity power factor.

The IEC 60909, 2001 Short Circuit Analysis Calculation Method was used to calculate short circuit currents and expected fault levels. Two short circuit currents were calculated:

i) Maximum short circuit current - used for sizing circuit breakers.

ii) Minimum short circuit current - used for determining the required interrupting capacities of overcurrent protective devices. The trip current should be less than the minimum short circuit current.

The simulation results will inform the minimum technical specifications including protection system settings that will be required before a prosumer is allowed to enter into a net metering agreement with a licensee.

2.7.2. Techno-economic Model

The team developed a techno-economic model for determining the Least Cost of Energy (LCOE) for various RETs that may be adopted in the net metering system. The model was based on the installation cost of each RET, some of which were obtained from primary data collected from the field. Other cost estimates especially for other RETs that were not covered in the survey including the operation and maintenance (O&M) cost associated with various RETs were obtained from desktop studies. LCOE was computed using the formula below;

$$LCOE = \frac{NPV\ of\ total\ costs\ over\ the\ project\ lifetime}{NPV\ of\ electrical\ energy\ produced\ over\ the\ project\ lifetime}$$

$$LCOE = \frac{I + \sum_{t=1}^{N} \frac{OM_t}{(1+r)^t}}{\sum_{t=1}^{N} \frac{E_t}{(1+r)^t}}$$

where:

I - Initial cost of investment

OM - Operation and maintenance in year *t*

E - Energy produced by the prosumer in year *t*

r - Discount rate

N - Renewable Energy generation plant lifetime

The annual cost of operation and maintenance was assumed to be 1% of the initial cost for solar PV of the investment in the first year after installation and 2% for wind and hydroelectric power plants. Thereafter, the cost was escalated by 1% per annum. The annual energy produced by the generation plant was computed as follows.

$$E = C \times (1 - DR) \times 8760 \times CF$$

where:

C - Installed plant capacity in kW

DR - Degradation rate

CF - Plant capacity factor.

The system degradation rate was assumed to be 1%. The model was used to test the sensitivity of LCOE for the various RETs to the plant size, capacity factor, and the discount rate. Plausible assumptions were made based on available data on inflation rates, projected energy demand and other economic data that would predicate the future. In addition, the data for costs of installing and maintaining the RETs were obtained from the field survey and from literature.

Based on the modelled LCOE for the various RETs, the team has recommended the optimal energy credit to the prosumer by the distribution licensee / retailer for the banked energy considering a reasonable rate of return.

2.8. Data analysis

After collecting the data using the information gathering tools from the field constituting the stakeholders' inputs, the project team undertook a detailed review of the responses from the various players. The data were analysed both qualitatively and quantitatively. Descriptive statistical methods were used to examine features of the data. Regression and correlation analyses were used to study associations between impact variables. In addition, the modelling and simulation results were analysed and conclusions drawn.

2.8.1. Determination of the Current Installed Capacity and Future Development

The data collected on current installed capacities of various RETs based plants were analysed to establish the current installed capacity. The growth of the identified RETs in the last decade was analysed to determine installation trends. This information and that given by the consumers on their expansion plans in terms of the installed capacity and timeframe were used to project installation trends and potential in the short-, medium- and long-term periods. In addition, information on growth was sought from published economic, utility, and social projection reports like the LCPDP report, Vision 2030, and Ministry of Devolution and Planning reports. For the purposes of this study, these periods are defined to be 3, 5, and 10 years, respectively

considering the fact that the Statutory Instruments Act of 2013 provides that a statutory instrument shall expire ten (10) years after the day it was made.

2.8.2. Impact of Net Metering on Cost of Electricity

The impact of the net metering capacity on the cost of electricity based on the projected demand and generation capacity as stipulated in the LCPDP (MoE, 2020) was evaluated. This was achieved by estimating the total annual energy output of the RE plants and then projecting their expected output for different timeframes. Thereafter, the load consumption projections in the LCPDP were adjusted to accommodate the RE plants generation. The least cost of electricity (LCOE) for the system with the adjusted demand was then determined.

2.8.3. Two-way Communication Meters

The data obtained on the costs of the components and associated infrastructure necessary for two-way communication meters were analysed and compared with equivalent alternatives.

2.8.4. Impacts of Net Metering

The team obtained information on financial, social, environmental, and economic impacts of net metering from published literature that has been used as follows:

- To quantify financial impact, the team computed the consumption of the prosumers from data availed through questionnaires and desktop research. The energy consumption and power generation in the short, medium and long term has also been projected. The direct savings from self-generation have been determined and the IRR of the installed capacity computed.
- On social impact, the team identified direct social benefits such as employment created through the installation of the RE projects.
- In addition, on environmental impact the team identified the carbon credits that the installation of the RE projects would generate and the contribution of the projects to reduction of greenhouse emissions.
- Finally, on economic impact, by computing the energy consumption of the prosumers, the potential energy available to the market for use by other consumers has been determined.

2.8.5. Recommendations to the Draft Regulations

The desktop study, interviews with key informants and questionnaires administered to stakeholders form the basis of the recommendations to the Draft Regulations. Further, the team examined existing laws and regulations, and development in the sector when making recommendations.

2.8.6. Reporting

After analysing the simulation results and the field data, the team has drawn conclusions on:

i) The current installed capacity of RE based projects in the country with the potential of entering into a net metering agreement with the distribution licensee/retailer.
ii) The feeder and network conditions, and protection requirements to be considered before a prosumer is allowed to enter into a net metering agreement with a distribution licensee/retailer.
iii) The potential in terms of installed capacity of the various RE based sources contributing to net metering in Kenya.
iv) The costs associated with the use of two-way communication meters and their alternatives, and the associated infrastructure necessary for effective monitoring of the performance of plants under net metering.
v) The impact of the proposed net metering capacity in the Draft Regulations on the cost of electricity based on the projected demand and generation capacity under the LCPDP.
vi) The optimal range of energy credit to the prosumers by the licensee.
vii) The financial, social, environmental, and economic impacts of net metering on Kenya's economy and the distribution licensee/retailer.

Thus, the team has made proposals regarding improvements to the draft Energy (Net Metering) Regulations, 2020.

CHAPTER THREE

FIELD STUDY FINDINGS

The chapter addresses objectives ii), iii), vii) and viii) of the study. We start by presenting the findings of feedback obtained from the stakeholders. These include stakeholders as mapped out in section 2.4 and provided in the appendix (objective ii). The status of the current installed capacity of embedded systems in Kenya is also presented in this chapter (objective iii). The costs associated with introduction of two-way metering in this framework is also presented here (objective vii). The respondents also assisted in identifying the possible financial, social, environmental impacts that would arise from enacting the net metering framework in Kenya. The impacts focus on the participants in the net metering framework, Kenya's economy and the distribution licensee/retailer (objective viii).

3.1. Response Rate

A sample size of 313 respondents out of a population of 481 was targeted in this work. The details of the population are provided in the methodology. A total of 144 responses were received. Out of the received responses, 134 were complete while 8 were incomplete. Figure 3.1Figure 3.1: Summary of stakeholders' participation in the survey

details the level of participation in the survey by the targeted stakeholders.

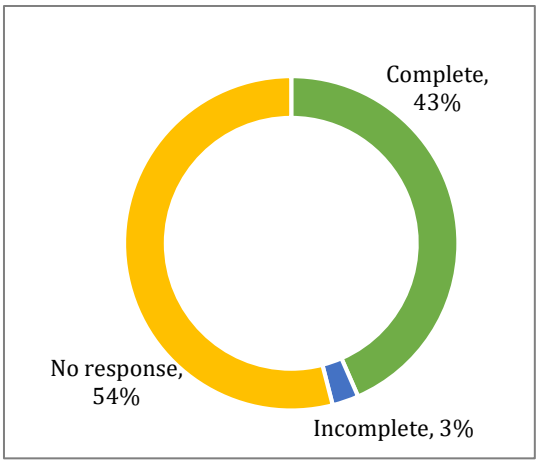

Figure 3.1: Summary of stakeholders' participation in the survey

The low response rate is associated with challenges of administering the questionnaire adopted due to the COVID-19 restriction. However, these rates are still above the average response rate

of 30% for email-based surveys (Fincham. E. J, 2008). It should be noted that the questionnaires that were analysed were complete to different levels.

Table 3.1 gives the breakdown of the number of respondents who participated in the survey for each category of stakeholders.

Table 3.1: Stakeholders participation in survey

Targeted stakeholder category	***Sample population***	***Actual no. of respondents***	***Respondents as percentage of sample population (%)***
Prosumers	112	39	35
Licensed Solar PV contractors	165	86	52
Financiers	16	3	19
Agencies and associations	20	16	80
TOTAL	**313**	**144**	**46[3]**

The prosumers response rate was also low at 35% as can be seen from Table 3.1. This may be due to the fact that some of the solar PV plants are not owned by the facility owners/operators; the plants sell electricity to the facilities but they are owned by a different entity. In such circumstances, the facility operators had very limited information on the power generation installations and thus, most shied away from participating in the survey. The questionnaires returned by 7 contractor and 1 prosumer were incomplete and were not included in the analysis.

The contractors often have multiple licenses; 48% of those who gave their license class had both C1 and V1 license whereas the remaining 52% had either of the two. In addition, about 69% of the contractors who participated in the survey had been in the solar PV business for over four years and are thus, well informed of the happenings in the industry. Only less than 3% of the respondents had been in the business for less than one year and the remaining about 28% had experience ranging between 1-4 years.

[3] Total respondents as a percentage of the sample population

It can be observed from Table 3.1 that the lowest participation rate was recorded for the financiers at 19%. The low participation by this category of stakeholders may be attributable to the fact that most of the identified financiers are not active in this market segment. Most of them have other revenue streams and not just the solar PV industry. Thus, they declined to participate in the survey.

3.2. Current Status of Embedded Generation in Kenya

3.2.1. Capacity of Installed Embedded Generation Systems

The Draft Regulations propose all renewable energy technologies to be eligible for net metering. However, all (100%) of the prosumers who participated in the survey had installed solar PV systems. It has previously been reported (BloombergNEF, 2019) that most of the solar PV installations in Kenya are in commercial and industrial (C&I) facilities. It has also been reported that their installation is chiefly motivated by the falling prices of solar PV systems which has made their cost competitive relative to the electricity tariffs charged by KPLC. Majority of the surveyed facilities (about 59%) were commercial, 36% industrial, and 5% residential as shown in Figure 3.2Figure 3.2: Surveyed facilities with embedded solar PV installation

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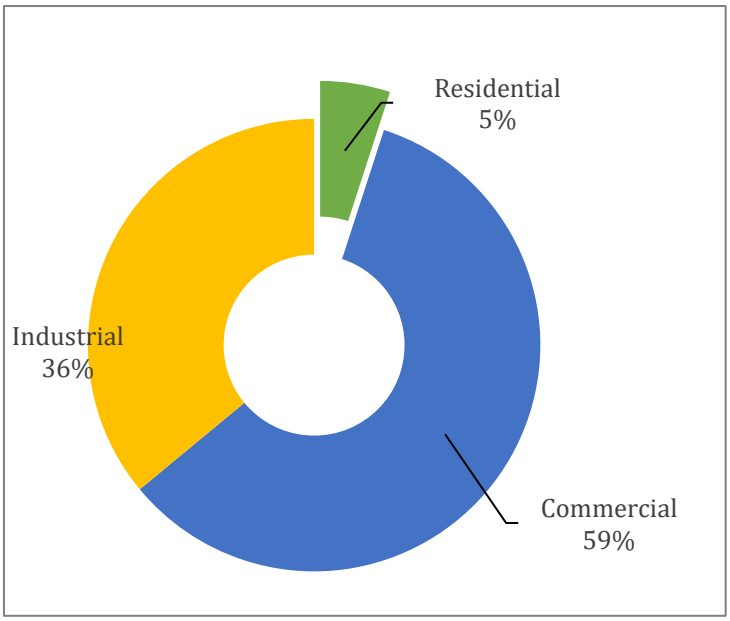


Figure 3.2: Surveyed facilities with embedded solar PV installation

The commercial facilities include diverse types of facilities like horticultural facilities, hotels, commercial buildings and malls, institutional facilities, places of worship, among others. The applicable tariffs for billing the prosumers are as shown in Figure 3.3.

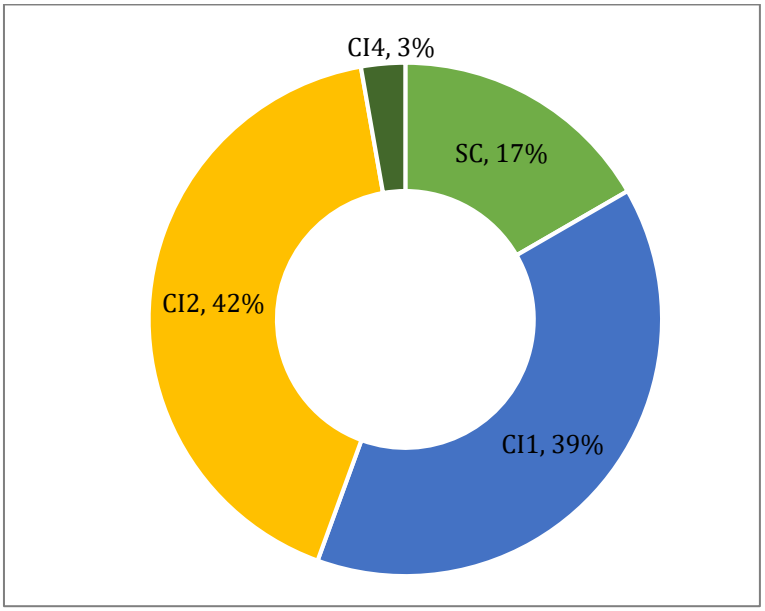


Figure 3.3: Applicable tariffs for billing facilities with own-generation

It can be seen from Figure 3.3 that most (42%) of the prosumers are billed under CI2 electricity tariff whereas those on CI1[4] follow at 39% and the facilities on non-domestic small commercial tariff account for 17%. It is worth noting that facilities charged on CI4 tariff (applicable to Commercial and Industrial prosumers who are supplied and metered at 66 kV) account for 3%. Those who are charged on the latter tariff are usually large electricity prosumers.

Most of the commercial and industrial embedded solar PV projects were commissioned in 2018 and 2019. The twos years accounted for 57% of all the installations surveyed as can be observed from Figure 3.4.

[4] CI2 is applicable to Commercial and Industrial Consumers who are supplied and metered at 11 kV and CI1 tariff is for Commercial and Industrial Consumers who are supplied and metered at 415 V, 3-phase 4-wire, and whose consumption exceeds 15,000 units per billing period

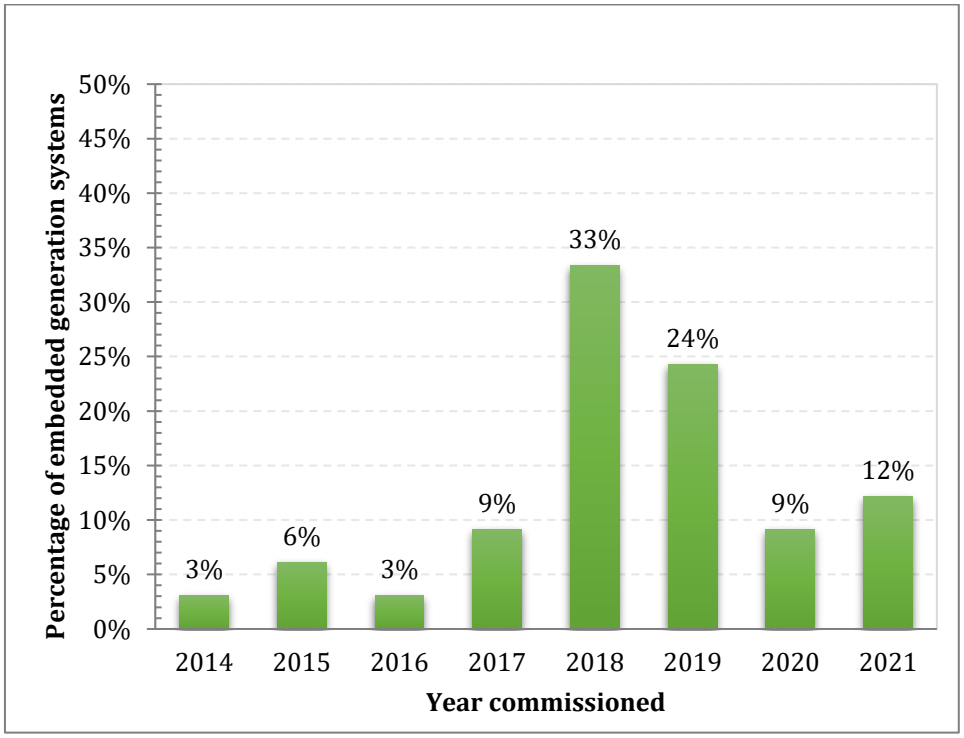


Figure 3.4: Own-generation systems commissioning date

It is worth noting that some of the facilities had phased commissioning where the overall installed capacity had been commissioned in phases. In such cases, the team considered the earlier of the two as the commissioning date. The peaking of prosumers around 2018-19 may be attributable to the steady fall in solar PV module prices globally since 2010, fiscal incentives and streamlining of the solar PV industry in Kenya following the enactment of the Energy (Solar Photovoltaic) Regulations, 2012.

In the study, we sought to understand the type of PV systems common in the market. Table 3.2 gives a summary of the proportion of contractors who had handled each type of PV system.

Table 3.2: Types of solar PV systems designed/installed by contractors

Type of solar PV system	***Proportion of contractors***
Grid-tied system	75%
Grid-tied-with-battery-backup	68%
Grid-tied Hybrid system	59%
Solar water pumping system	49%

It can be observed from Table 3.2 that 75% of the contractors had designed/installed grid-tied systems making this category the most commonly handled followed by grid-tied with battery

back-up systems at 68%. About 59% of the contractors alluded to handling grid-tied hybrid systems and 49% solar water pumping systems. It should be noted that the contractors had been asked to give the type of projects they had designed/installed. Thus, there is a possibility that some of the projects were designed but had not yet been implemented. The total installed capacity of grid-tied systems by C&I consumers as of December 2019 was about 24,647 kW and another 4,088 kW was under construction (Bhamidipati & Gregersen, 2020). No information was available on the installation status as at the time when the study was done.

The generation plants installed capacities and the average cost of installation are summarized in Table 3.3.**Error! Reference source not found.**

Table 3.3: Size and cost of own-generation systems

Installed generation capacity (kW)	***Proportion of installed systems***	***Average installation cost (USD/kW)***
≤ 50	32%	1,216
51 - 200	27%	1,128
201 – 500	14%	1,881
> 500	27%	1,876

The study focused on installations with rated capacity below 1,000 kW. It can be seen from Table 3.3 that systems below 50 kW were the most commonly installed accounting for 32% of the installations surveyed followed by those rated between 51 and 200 kW and the ones ranging between 501- 1,000 kW each at 27%.

Some respondents gave the total cost of installation instead of the cost per kW of installed capacity. Since the precise size of the plant was not given, the data were discarded. Thus, the installation costs given in Table 3.3 are the averages for the facilities that gave the installation cost per kW. The cost of installation alluded to for systems larger than 200 kW is high compared with that documented in (BloombergNEF, 2019) of 700 - 1400 USD/kW for C&I installations. Owing to economies of scale, the general expectation would be that the cost of these plants would be closer to the lower bracket. Figure 3.5 shows the total cost of different capacities of installed solar PV projects.

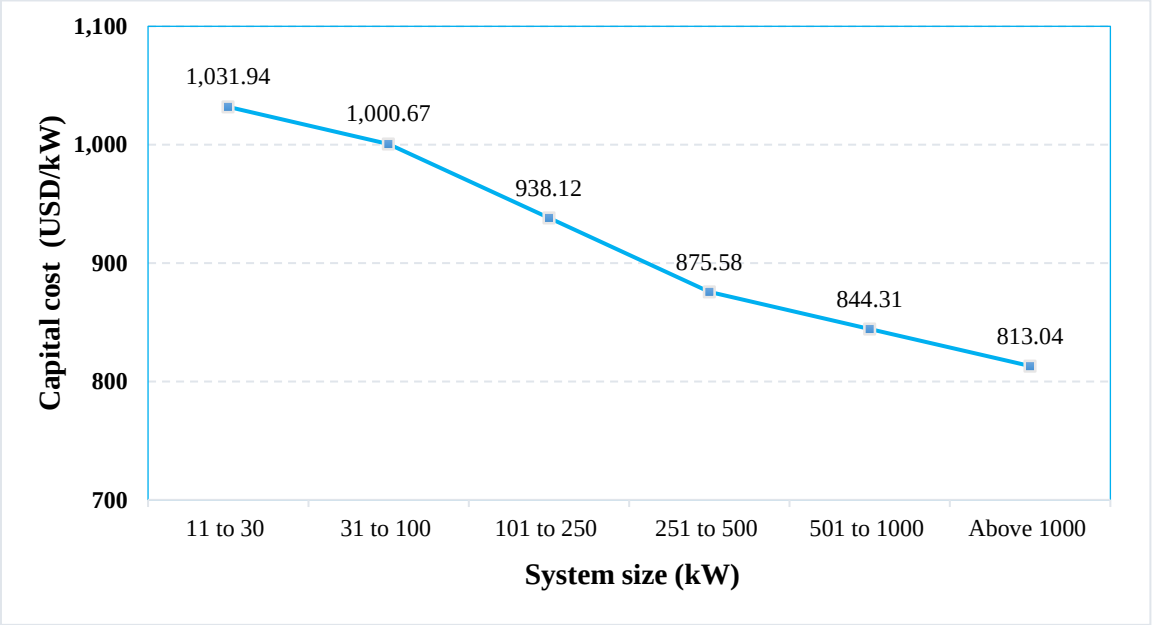
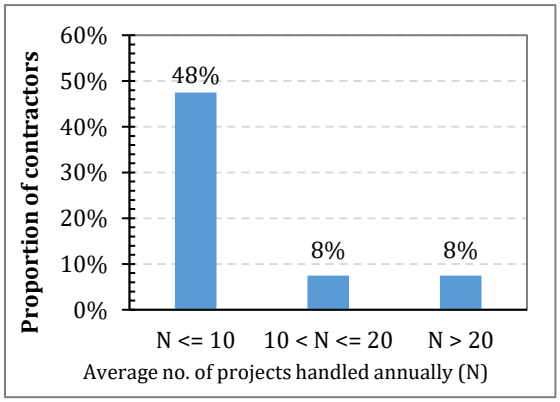
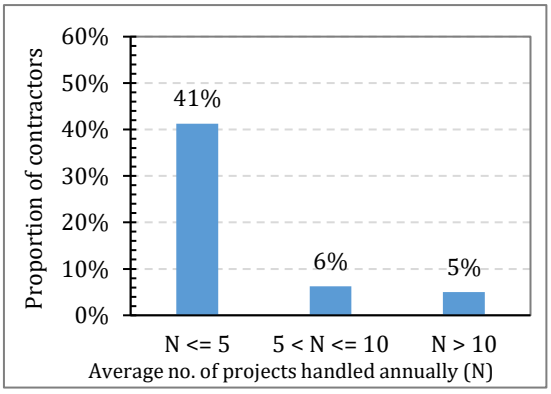


Figure 3.5: Average costs of solar PV installations

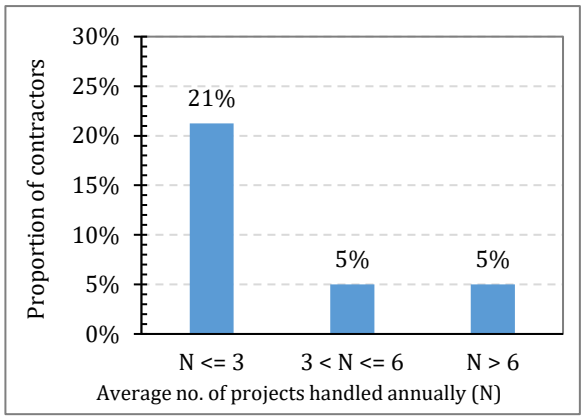
The study team also wanted to establish the size and average number of grid-tied projects designed/installed annually by the contractors. Again, some of the projects might not have been implemented and ended at design stage. Figure 3.6 shows the proportions of contractors who handle various sizes and numbers of solar PV projects.



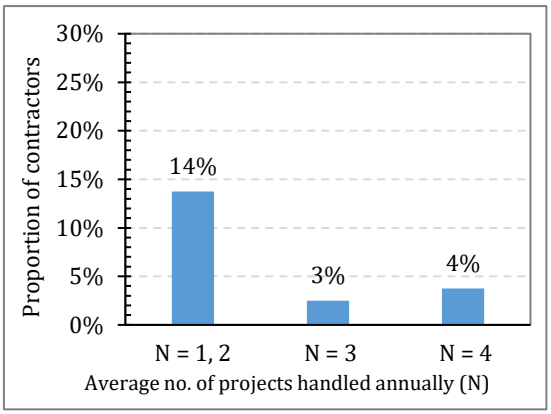
(a) Up to 50 kWp



(b) 51 - 200 kWp



(c) 201 - 500 kWp



(d) 501 - 1,000 kWp

Figure 3.6: Average annual number of grid-tied solar PV projects handled by contractors

It can be observed from Figure 3.6 that most contractors handle projects of capacity less than 50 kWp. Further, it can be seen from Figure 3.6 (a) that 48% of the contractors handle 10 or less projects of this capacity whereas another 8% each handle between 10-20 and over 20 projects annually. The proportions thin out as the project size increases with only 14%, 3%, and 4% of the contractors handling one or two, three, and four projects annually, respectively of capacity ranging from 501-1,000 kWp. This clearly shows that the larger projects are not very popular in the market. The most popular systems size is 200 kWp and below.

3.2.2. Facilities' Energy Consumption and Production

According to the designation of energy users[5] in Kenya, 46%, 43%, and 11% of the prosumers who participated in the survey and availed their annual energy consumption data are high, medium, and low consumers, respectively. However, it should be noted that the data on energy consumption were for electrical energy only whereas the designation is for all energy sources.

Only 8% of the responsive prosumers alluded to the installed plants meeting their facility's power demand with the remaining 92% indicating that their systems did not meet their demand. Further, of the prosumers who availed data for their facilities' annual energy consumption and self-generation supply, 17% had more than 50% of their annual energy demand supplied by

[5] High E > 1,200 MWh; medium 1,200 ≥ E > 180 MWh; low E ≤ 180 MWh

self-generation, 29% less than 10% of their demand whereas for the remaining 54%, their generation plants met between 10-50% of the facilities' annual energy demand. These results corroborate the fact that the prosumers' plants did not meet most of the facilities' demand. It is worth noting that only about 11% of the facilities had storage.

Majority (81%) of the prosumers who participated in the survey alluded to having installed a meter for recording the energy supplied by their generation plant. Of these installed meters, 87% are bi-directional and able to measure and record the peak power supplied whereas the remaining 13% are unidirectional and do not record the peak power supplied. In addition, 67% of the installed meters have time-of-use measurement capability. However, only 40% of the installed meters had been calibrated by the Kenya Bureau of Standards (KEBS). It should be noted that there are other bodies that are accredited to offer equipment calibration services and hence, the proportion may be higher. Additionally, 84% of the contractors indicated that the systems they install have ride-through capability to withstand distribution system disturbances like voltage and frequency spikes/excursions and safe shutdown. This is important for power system security. Based on the analysis, imbedded systems have been embraced in Kenya and majority of them already meet the criteria for net metering. The framework shall therefore serve to move the industry to the next level.

3.3. Prosumer Generation Expansion Plans and Net Metering Awareness

Most (67%) of the prosumers indicated that they have plans to install additional renewable energy generation system capacity. The distribution of the planned additional capacities is as shown in Table 3.4.

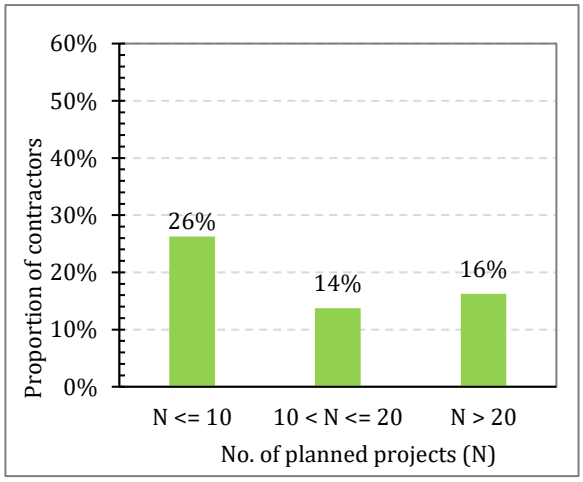
Table 3.4: Planned additional generation capacity

Additional Capacity (kW)	***Proportion of prosumers (%)***
≤ 50	8
51 - 500	42
501 – 950	0
> 950	17
Unknown	33

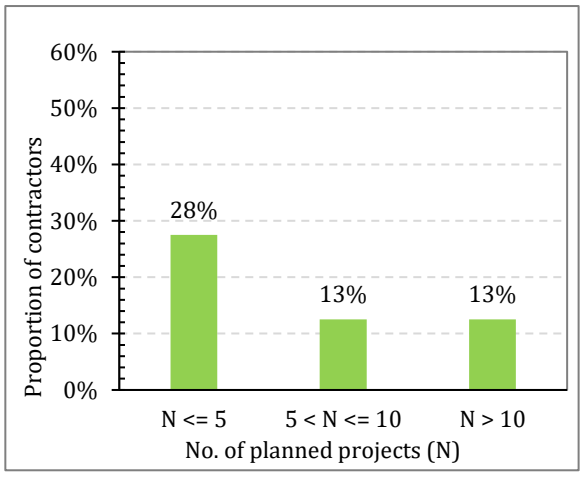
It can be observed from Table 3.4.that about 42% of the prosumers plan to increase their generation capacity by between 51-500 kW. Another 33% of the prosumers know they will be installing additional capacity in future but either they did not know how much additional capacity will be installed or they did not give the information. About 17% of the prosumers plan to install more than 950 kW additional capacity. This will automatically knock them out of the net metering arrangement which is capped by the Energy Act at 1,000 kW.

Most (54%) of the prosumers plan to install the additional generation capacity in less than three years from the time of the interview (2021) whereas for 33% of the prosumers, additional capacity will be installed in 3 – 5 years. A small proportion (4%) of the prosumers plan to increase their generation capacity in a timeframe longer than 5 years; the remaining (8%) did not give a timeline for installation of the additional capacity.

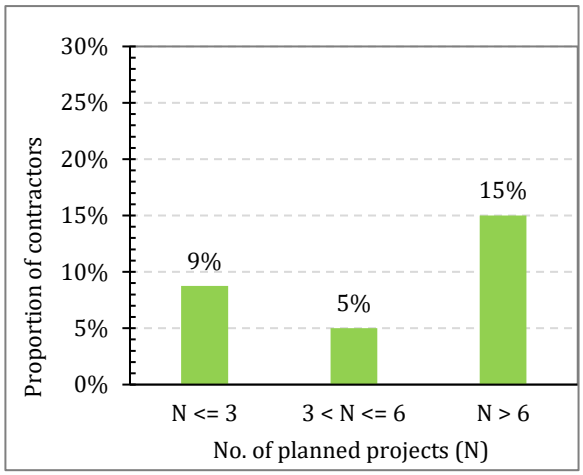
The team also sought the contractors' input on the size and number of grid-tied solar PV installations that are planned to be commissioned within three years' time. Figure 3.7 shows the proportions of contractors who have various sizes of solar PV projects that are planned for implementation.



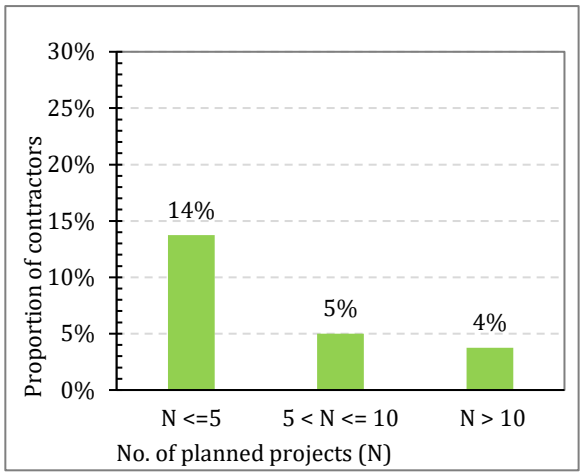
(a) Up to 50 kWp



(b) 51 - 200 kWp



(c) 201 - 500 kWp



(d) 501 - 1,000 kWp

Figure 3.7: Planned grid-tied solar PV projects to be implemented in 3 years' time

It can be seen from Figure 3.7 that systems under 200 kWp will continue being dominant for the next three years. However, there is also a notable increase in the planned number of systems of capacity between 501-1,000 kWp with 4% of the contractors expecting to commission more than 10 projects.

Majority (57%) of the prosumers who participated in the survey alluded to being aware of the net metering concept as provided for in the Act; the other 43% are not aware of the concept. The corresponding proportions for contractors are 86% and 14% for those who are aware and unaware of the concept, respectively. The lower awareness rate among consumers implies that there is need for deliberate effort to be put in to educate energy consumers on the provisions of the Act. Despite the fact that some prosumers indicated that they were not aware of the net metering concept, 97% of the respondents affirmed that they would consider entering into a net metering agreement with the distribution licensee. It is worth remembering that only 11% of the respondents have storage for excess energy and hence, net metering presents a good solution to most installations that may have excess generation from time to time. Implementation of net metering may also accelerate the expansion of own-generation in the short to medium term, if the terms are favourable to the consumers.

3.4. Net Metering Potential in Kenya

Globally, net metering is driven by the need to increase the share of renewable energy sources in electricity generation. The RES increase the generation capacity to meet increasing

electricity demand. Embedded generation in the distribution system also has benefits such as reduction of power losses and voltage support, among others. However, in Kenya, currently renewable sources already account for over 70% of the electricity produced and there is adequate generation both in terms of the installed generation capacity to meet the peak demand and energy. As such, CO_2 emission from the electricity sector is negligible in comparison with other countries and there is still great unexploited potential for power production mainly from geothermal to meet future energy demand. Thus, the motivation for net metering policy in Kenya has to deal with local issues, such as grid power reliability, optimizing the use of distribution networks, and affording consumers storage for their excess energy as an alternative to investing in storage systems.

Some power consumers have turned to self-generation through solar PV because of the cost competitiveness. The consumers with self-generation facilities are in manufacturing industry, the horticultural sector and commercial entities such as malls, warehouses, office buildings and public institutions (universities, hospitals). The government and non-governmental agencies that participated in the survey all concurred that solar PV installations are more likely to enter into a net metering arrangement. There were views that other RETs such as wind and small hydro power plants are not easily scalable and available and they have high investment cost thus, making them weak candidates for net metering.

Majority (94%) of the government and non-governmental agencies that participated in the survey were of the view that there is a strong market in Kenya for net metering. Further, the agencies gave the following as the objectives of net metering in Kenya:

i) To promote the uptake of renewable energy;
ii) To ensure the grid benefits from the embedded systems of up to 1 MW currently in the grid;
iii) To introduce an option of storing energy in the grid instead of using battery storage;
iv) Ensure excess energy generated does not get wasted;
v) It eliminates the need for exorbitant generators since the electricity grid also acts as a storage during the time they are generating more than their load requirements;
vi) To protect the interests of the prosumers and those of the off-taker (KPLC);
vii) To create jobs;
viii) Reduce the cost of electricity for consumers; and,

ix) Conserve the environment as consumers are encouraged to move towards renewable energy.

Majority (62%) of the government and non-governmental agencies are of the view that all categories of prosumers should be eligible to enter net metering; the eligibility criteria should be based on the facilities' capacity to generate excess power. The other respondents proposed starting with commercial and industrial consumers (31%) and residential and small commercial (8%). However, they also highlight that it will be necessary for studies to be done to establish the minimum installed capacity allowable to enter into a net-metering arrangement with the power off-taker. The simulations should consider the economics of storing power in the grid and getting it back for the various categories of consumers. A cost-benefit analysis on the considered RET should be done to establish the cut-off capacity below which the net metering arrangement would not be viable.

The agencies gave the following incentives and policy support mechanisms that may be considered for the success of net-metering:

i) Attractive compensation schemes for the excess power fed into the grid.
ii) Zero rate the import duty on products that are to be installed for purposes of entering into a net metering contract.
iii) Ensure net metering policies are detailed, transparent, and publicly available.
iv) The government should guarantee the distribution licensee/ retailer and power producers that their business will not be adversely affected.

Most of the agencies' respondents opined that implementation of net metering would result in several benefits as follows:

i) Economic impacts:
   - Job creation in the renewable energy industry.
   - Business opportunities through importation and sale of equipment to be used in generation of the renewable power and in net metering.
   - Reduced cost of power.
   - Increased revenue collection through taxes.
ii) Social impact: reduced disease burden due to environmental impacts related to improvements in air quality accruing from reduced air pollutants.
iii) Environmental impact: reduced carbon emission from displaced fossil fuel generation.

iv) Impacts on utility and power generating companies.

- Since consumption of power at source is encouraged by net metering, this shall result to reduced transmission losses and improved voltage profile that may reduce voltage regulation related costs.
- The distribution licensee/ retailer may experience some reduction in revenues at the start of the scheme, but once the concept kicks in they stand to benefit.

  Some respondent felt that net metering is likely to result in reduced profits and revenue.

3.5. Costs associated with bidirectional meters

Metering Options

The first option will utilize two energy meters one measuring energy import and the other energy exported to the grid. This option can be used for those prosumers that already have an existing meter installed by the distributor measuring energy importation. In such case another energy meter to record the amount of energy that is exported by the prosumer to the grid will have to be installed. For this arrangement to work effectively, post-paid meters should be applied. Prepaid meters will not be appropriate for this arrangement. This option will also require aggregation of both readings so as to arrive at the net value.

The second alternative can utilize a single bi-directional meter that can to measure both the energy imported and exported to the grid. At the end of the billing period the difference is computed and the deficit or surplus treated as per the contract.

Additional Infrastructure for Net metering

In both cases the prosumer will incur an additional cost of delivering the surplus energy to the grid. This will require an additional service cable, but since net metering is targeting individuals who are already connected to the grid, no additional poles are required. Before exporting to the grid, the power is supposed to adhere with grid code requirements which dictate the maximum voltage and frequency deviations allowable. This will require a grid-tied inverter which has anti-islanding capability to prevent feeding the grid during blackouts.

Costs of associated with meters and Infrastructure

The size of installations that can enter into a net metering will be up to 1 MW. The sizes of grid-tied inverters will therefore vary and hence the cost. The estimated cost of meters as per the current market prices are presented in Table 3.5.

Table 3.5: Types and prices of electricity meters

Type of electricity meter	***Estimated Price (Ksh.)***
Unidirectional post-paid meter - single phase	8,000
Unidirectional post-paid meter - three phase	15,000
Bi-directional meter - Single phase	10,000
Bi-directional meter - Three phase	17,000

All the meters are smart digital meters with an optional capability of sending real time data if communication infrastructure is availed. With the smart meters aggregation of the net values will be easy and the costs associated with meter readings will be eliminated. Other information such as time of use details can also be obtained through use of smart meters. They are therefore the most appropriate for net metering.

3.6. Stakeholders' Views on Draft Regulations

The study team sought the views of the industrial, commercial, and institutional consumers who had installed grid-tied solar PV systems, and solar PV contractors on some provisions in the draft Energy (Net Metering) Regulations, 2020. The results are presented in Table 3.6.

Table 3.6: Stakeholders' views on Draft Regulations

S. No.	*Provision in Draft Regulations*	*Agree with provision?*					
		Prosumers			*Solar PV contractors*		
		Yes	*No*	*Not sure*	*Yes*	*No*	*Not sure*
1	The Licensee shall offer the provision of net metering arrangement to prosumers, who intends to install grid connected renewable energy system, in its area of supply on non-discriminatory and first come first served basis, subject to operational constraints, provided that the consumer is eligible to install the grid connected renewable energy system of the rated capacity as specified under these Regulations	100%	0%	0%	93%	8%	0%
2	All renewable energy technologies are eligible for net metering	71%	29%	0%	92%	8%	0%
3	All residential, commercial and industrial customers supplied by a distribution Licensee or retailer are eligible to enter into net-metering agreement subject to these Regulations and other relevant laws	80%	20%	0%	92%	6%	1%
4	The onsite installed capacity for a renewable energy source for prosumers entering into a net meeting agreement shall be ***capped at the maximum demand in MW of the previous year*** for existing Prosumers	66%	34%	0%	65%	35%	0%
5	**New** consumers shall be eligible for net metering after **1 year of continuous operation**	70%	30%	0%	53%	47%	0%
6	A person shall not operate a net metering system unless he has a net metering system **agreement** with a Licensee	100%	0%	0%	86%	14%	0%
7	The maximum aggregate generation capacity of net metering systems shall be ***100 MW*** for the first 3 years from the date the Regulations come into force	59%	41%	0%	57%	43%	0%
8	A net meeting agreement applicant shall submit a ***feasibility study report*** including but not limited to demand forecasts and historical load profiles, among others	85%	15%	0%	79%	20%	1%
9	A Licensee shall communicate the decision on a prosumer's application in form of a written notice within ***60 days*** from the date of application for net metering agreement	88%	12%	0%	80%	20%	0%

S. No.	Provision in Draft Regulations	Agree with provision?					
		Prosumers			Solar PV contractors		
		Yes	No	Not sure	Yes	No	Not sure
10	The approval to enter into a net metering system agreement shall be specific to the Prosumer who sought the approval and that approval shall not be assigned or transferred to any other person	94%	6%	0%	85%	15%	0%
11	Any person who is aggrieved by the decision of the Licensee in rejecting an application for approval under the net metering system may, within 30 days of notification of decision, appeal to the Authority as provided for under the Energy (Complaints and Disputes Resolution) Regulations, 2020	97%	3%	0%	90%	10%	0%
	Meters for net metering systems shall:						
12	Measure and register electricity flow in ***both directions*** at the same rate	100%	0%	0%	97%	3%	0%
13	Measure and record ***peak*** supply in different periods	100%	0%	0%	94%	5%	1%
14	Provide for ***time-of-use*** metering	97%	3%	0%	88%	9%	3%
15	The eligible Prosumer shall bear all costs related to the meter and setting up the interconnection with the Licensee's network	85%	15%	0%	94%	5%	1%
16	A net metering facility shall have a visibly open, lockable, manual disconnect switch, which is accessible by a Licensee and clearly labelled **or**; (i) The generation system must be designed to shut down or disconnect and cannot be manually overridden by the customer upon loss of utility power; and (ii) The generation system must be warranted by the manufacturer to shut down or disconnect upon loss of utility power; and (iii) The generation system must be properly installed and operated, and inspected and/or tested by the distribution utility personnel.	97%	3%	0%	94%	6%	0%

S. No.	Provision in Draft Regulations	Agree with provision?					
		Prosumers			Solar PV contractors		
		Yes	No	Not sure	Yes	No	Not sure
17	The Prosumer shall inform and seek approval of the Licensee prior to the execution of any replacement or modifications to the net metering system or the connection point	97%	3%	0%	98%	3%	0%
18	Any net metering system causing interference or unacceptable parameters to the Licensee's system shall be disconnected until the issues are resolved	100%	0%	0%	91%	8%	0%
19	A Licensee shall provide to prosumers electricity services at non-discriminatory rates that are identical, with respect to rate structure, retail rate components, and any monthly charges, to rates approved by the Authority	97%	3%	0%	96%	1%	0%
20	Prosumers shall be obliged to pay the Licensee interconnection costs associated with their installation	76%	24%	0%	88%	9%	0%
21	Prosumers shall be compensated for electrical energy supplied to the Licensee with a credit for each unit exported in a billing period	100%	0%	0%	94%	6%	0%
22	Each exported unit shall grant the customer a net metering credit of 50% of the exported unit	46%	49%	6%	65%	35%	0%
23	A prosumer shall be billed for the difference between the discounted exported units and the energy supplied by the Licensee during a billing period in accordance with the applicable standard retail tariff schedule rates	97%	3%	0%	99%	1%	0%
24	If the Prosumer is, after the application of unit discount, a net exporter during the billing period, he shall not be billed for any energy supplied by the Licensee and shall carry forward any surplus credits to the next billing period	100%	0%	0%	96%	4%	0%
25	Any unused credits shall be forfeited at the end of the Licensee's financial year	26%	74%	0%	61%	39%	0%
26	Units generated and consumed on-site shall not attract any compensation or charge	100%	0%	0%	98%	3%	0%
27	Net metering Prosumers shall not be entitled to any monetary compensation for capacity, reactive power, voltage and frequency support or other benefits their systems may provide	86%	14%	0%	78%	22%	0%

S. No.	Provision in Draft Regulations	Agree with provision?					
		Prosumers			Solar PV contractors		
		Yes	No	Not sure	Yes	No	Not sure
28	The Licensee shall endeavour to avail the distribution system at all times. However, he shall not be liable for occurrences of network downtime as a result of faults and a net metering Prosumer shall not be compensated for any deemed generation during such time	80%	20%	0%	95%	5%	0%
29	For billing purposes, licensees shall not estimate the electricity consumed and generated by net-metered Prosumers during any billing period	97%	3%	0%	93%	8%	0%
30	Prosumers shall grant personnel of the Licensee access to their property for the purpose of maintaining and/or reading the meter	100%	0%	0%	96%	4%	0%
31	Where a Prosumer vacates the premises where a net-metering system is installed and terminates or transfers the corresponding net metering system agreement, he shall forfeit any remaining credits	80%	20%	0%	70%	30%	0%
32	Ownership of any carbon credits accruing to the Prosumer shall remain vested with him, unless otherwise specified by any other laws of Kenya	97%	3%	0%	97%	3%	0%

It can be seen from Table 3.6 that the majority (more than 50%) of both the prosumers and contractors who participated in the survey agree with about 94% and 100%, respectively of the provisions. However, we chose to use an acceptance rate of 70% to be acceptable and not a simple majority. Thus, we interrogated the proposals put forward by the stakeholders' who had a contrary view for provision numbers 4, 5, 7, 22, and 25. It can be observed that the acceptance rates for these provisions by both prosumers and contractors are below 70% except for number 5 for which about 70% of the prosumers agree with the provision and only 53% of the contractors. The agreement between these two groups of stakeholders is an indication of objectivity in their responses.

The proposals given by the stakeholders who disagreed with the five provisions are as follows.

i) ***Provision no. 4***: The onsite installed capacity for a renewable energy source for prosumers entering into a net meeting agreement shall be ***capped at the maximum demand in MW of the previous year*** for existing Prosumers.

Prosumers

- *No cap*
- *Commercial loads may grow drastically in 1 year, should be case by case*
- *Be left open because of intermittent nature of renewable energy*
- *A consideration should be given to the same prosumer but having decentralized generation country wide*
- *Cap based on the energy generated vs. energy consumed or energy consumed vs. fed to the grid*
- *No capping as this will limit small scale investors as well as industrial growth*

Solar PV Contractors

- *An allowance should be given to prosumers with more space or those planning for growth of their facilities*
- *There should be no cap in installed capacity*
- *Should be open to allow more production of energy and to the grid*
- *The system should auto adjust without capping the Prosumer since it is already metered*
- *What should be capped is how much of what is exported to the grid is eligible for net metering*
- *The cap could be 50% of maximum demand so that net metering benefits more people*
- *Capping will limit industries to potential growth in terms of energy consumption as it acts as deterrent to future expansion plans*
- *Capping will limit potential small-scale investors who may want to do net metering for commercial purpose*

- *The maximum export (Not capacity of the system) should be capped at rated capacity of the connection (as paid for by the client). This is a fixed, easily observable/ determined quantity*
- *KPLC should regulate quantity of inverters online using frequency controls if they want to reduce feed in capacity*

All the government and non-governmental agencies that participated in the survey were of the view that capping should be determined as a percentage of the facility's peak demand subject to the limit of 1 MW which is provided for in the Draft Regulations.

It should be understood that this restriction intends to ensure that the grid is optimally sized and utilized, as well as the distribution licensee/ retailer is properly remunerated for the network investments. Furthermore, the self-generation plants are supposed to meet the consumers own energy needs and should not be for commercial use since this is already taken care of by Feed-in-Tariff (FiT). Thus, limiting system capacity to the customer's load prevents oversized systems that may operate as net exporters and helps limit issues relating to settlement for excess generation from NEM systems. It also minimises the need for distribution network upgrades.

ii) ***Provision no. 5***: **New** consumers shall be eligible for net metering after **1 year of continuous operation**

Solar PV Contractors

- *6 months of continuous operation*
- *Should be eligible immediately once one qualifies to encourage investment*
- *Net metering should be applicable after installation of RE System*
- *Will be difficult to determine the 1-year period*
- *Should be eligible after 60 days so as to establish the prosumer's maximum demand*
- *Should start one month after commissioning*
- *Once the renewable system is commissioned and operational to optimise on the benefits*
- *Any potential investor with the ability to invest in a Solar Grid connect, should be given the opportunity to get into net metering as long as they can estimate the load capacity through energy data logging. This will be an incentive to start-up companies as it provides a cost saving from the onset*
- *If the maximum exported power (kW) is capped at the rated/ paid for connection power capacity and there is a sensible cap on the amount of net-metered/ off-set energy (e.g. no more than 100 % off-set of kWh in a year) then this 1 year delay is unnecessary*
- *Net metering capacity should be approved BEFORE the plant is built, though it can be authorized / validated thereafter. It is essential for anyone investing in a solar PV plant (for themselves or others) to know whether or not they can expect the benefit of net metering*

credits before going forward with the investment. This is especially important if caps are in place

The one-year operation period of the self-generation plants may be important for system observation to provide energy consumption and supply data for a 12-month cycle. The output of a REGS is weather dependent and the energy consumption for some consumers also changes with time of the year and hence, the need to observe the system for a whole cycle.

The proposed NEM scheme is a two-stage process; consumer applies and gets approval or otherwise decline notification. If the application is approved, the consumer embarks on installing the self-generation plant which meets all the technical, safety, inter-connection and other requirements. After all requirements are met, then the NEM agreement can be signed. However, in this two-stage process the one-year operation period prior to entering the NEM agreement may not be necessary since an approval to operate a net metering system is granted within 60 days after application. Further, the REGS has to meet all the requirements to be connected to the grid.

iii) ***Provision no. 7***: The maximum aggregate generation capacity of net metering systems shall be ***100 MW*** for the first 3 years from the date the Regulations come into force

Prosumers

- *Keep it open with no limit*
- *The agreement should be dependent on the energy generated as long as it is metered*
- *Provide room for review after 3 years*
- *Should be 200 MW*

Solar PV Contractors

- *It should not be limited; leave it open to attract investors*
- *50 MW*
- *500 MW for first 3 years from date of regulation coming into force*
- *200MW*
- *It can be capped with respect to the growing demand of energy in Kenya*
- *It should be 10% of the total installed capacity (280MW). 100MW is too small, a larger capacity may provide an adequate scale for the study period*
- *This depends on the absorption capacity of the current system. 100 MW sound very low compared with the estimated requirement of 3,000 Mwe*
- *A limit on the aggregate capacity will limit the number of producers-consumers systems on the grid. Not a benefit*
- *Maybe we should suggest a 10-20% of electricity consumed the previous year*

- *This should be determined based on an analysis of the impact of integrating this into the grid, in terms of what is feasible*
- *As generated and fed into grid.*

About 46% of the government and non-governmental agencies' who responded to the question on aggregated capacity capping were of the view that a study should be carried out to decide on appropriate cap. The other responses varied from no capping to 30% of the peak demand. If the maximum aggregate generation capacity is too large or unlimited, there may be a rapid increase in distributed generation capacity into the grid, which may create coordination problems between utility investments and distributed generators. The 100 MW (about 5% of the system peak demand) capping is proposed to be applicable for the first three years.

Majority (83%) of the agencies supported phased implementation of the net metering arrangement. The first three years would be pilot period used to test the concept before widening eligibility for the programme and increasing its sophistication. This phase ought to be reasonably conservative. After this trial period, the capping can be increased or declared to be unlimited depending on the lesson learnt and advancements in NEM schemes. It should be noted that as of December 2019, there was about 30.2 MW solar PV installed capacity and another 9.2 MW under construction (Bhamidipati & Gregersen, 2020). Given the economic slow down due to COVID-19 pandemic, the situation may not be very different at present.

iv) ***Provision no. 22***: Each exported unit shall grant the customer a net metering credit of 50% of the exported unit

Prosumers

- *NM credit of 75%*
- *No discounted unit, actual unit/ Units stored to be claimed in full*
- *Should be at gazetted tariffs*
- *The customer (prosumer) should be granted a net metering credit of 100% of the exported unit*
- *Should be 1 for 1for quick returns/payback*
- *Why not one for one since not really stored but sold to non - solar customers*
- *Export units attracts equal credit value*
- *70%*

Solar PV Contractors

- *Grant 100% credit because the prosumer also incurs costs such as inverters etc.*

- *50% applicable to industries only, for other customers, an average percentage should be calculated annually based on seasons/ demand*
- *It should be unit for unit*
- *Prosumer already caters for all the associated and metering installation costs. May be 75%*
- *This is very low compared to most of countries that have introduced net metering*
- *60%*
- *The consumer should get at least 70% credit of the consumption rate on each unit*
- *Should be 80% this is a storage service that's being offered, which is closer to the wheeling service*
- *The credit % should be roughly equivalent to the cost of power generation (including surcharges) of the licensee excluding transmission, distribution and grid maintenance expenses. This is likely closer to credit rate around 80%*

Two possible types of credits can be accumulated: (a) energy credits and (b) monetary credits. Energy credits compensate users for the generated energy surplus, measured in kWh. This credit can be a full compensation – 1 kWh of surplus equals 1 kWh of credit – or compensated at a different rate (greater-than or smaller-than 1). If Net Metering is accounted in energy credits, there is need to define if credits are personal and can be used only by the generator, or if they can be traded among users and virtually transferred.

In most of the jurisdictions that were reviewed, the energy surplus generated by consumers is injected in the grid in exchange for electricity credits (measured in kWh) that can be used later on in order to reduce their electricity expenses. However, there are differences in how the consumer bill is computed. For example, in Malaysia the cost of energy exported to the grid is computed based on the prevailing gazetted Energy rate whereas the cost of energy imported from the grid is computed based on the prevailing gazetted Energy rate and taxes and any pass-through charges. In Bangladesh, the prosumer pays for the net units and demand charge and other fixed charges; in Tanzania, net units are billed in accordance with the existing effective tariff schedule and other charges such as service and demand charges. In situations where customers earn a credit for each unit exported, this is conceptually equivalent to selling excess generation back to the grid at the retail rate that the utility would have charged them for that electricity (1:1). The handling of the banked energy was explored further in the techno-economic evaluation and the findings are presented in Chapter Four.

v) ***Provision no. 25***: Any unused credits shall be forfeited at the end of the Licensee's financial year

Prosumers

- *Carry forward to next financial year*
- *Keep them available for unlimited time*
- *Forfeited after 3 years*
- *No forfeiting*
- *Credits should be carried over without expiry*
- *Utility billing does not afford that provision. Billing should not be discriminatory.*

Solar PV Contractors

- *Unused credit should be carried forward to the next financial year*
- *Should not be forfeited*
- *Both the prosumer and the retailer/licensee need to be going concerns as the stored energy cannot be abstracted and used instantaneously simply because any of the parties financial year is closing*
- *The Licensee should compensate the customer with financial returns*
- *Credits are a profit; forfeiting in any circumstance does not serve prosumer*
- *It should have the same monthly billing cycle as post-paid supply. No need to forfeit*
- *The prosumer should be paid for all units exported as their units exported were consumed*
- *Any unused should be convertible to monetary value at the end of the year/or transferrable for use to a different consumer*
- *This lacks the motivation. The energy exported must have been consumed by another connected consumer on the grid who pays for it regardless. To forfeit the credit would be unfair to the prosumer. The values must be reconciled annually and either carried forward or compensated for in cash*
- *The unused credits should be used as a measure for net metering capacity for the next year - with some compensatory value*
- *A rolling 12 months basis would be a better approach as this allows for the balancing of seasonal variations in energy generation*
- *Let the prosumers have a chance to sell the unused credits to the licensee*
- Caried forward on renewal. 50% value back.

Figure 3.8 is a schematic representation of the credit accumulation rule decision process as presented in (Mejdalani, Chueca, Soto, Ji, & Hallack, 2018).

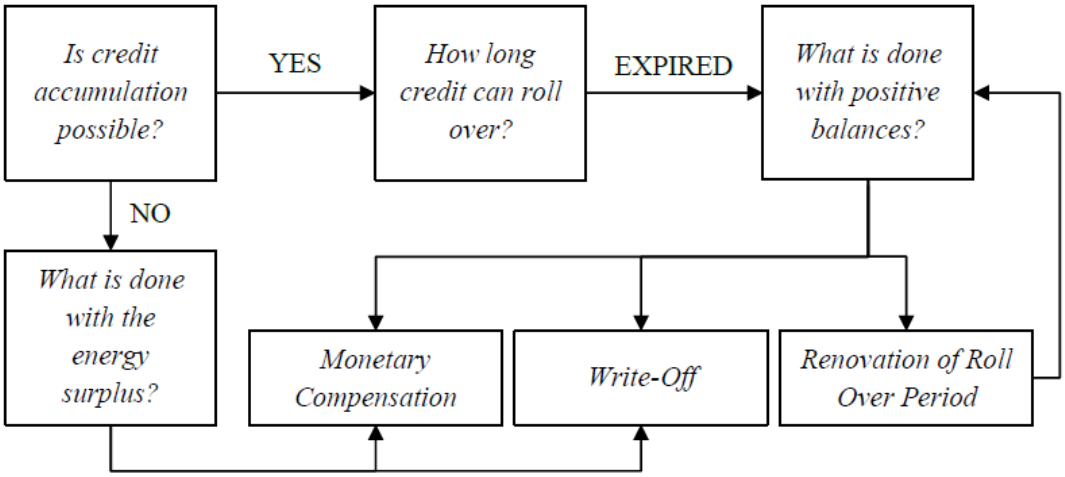


Figure 3.8: Credit accumulation rule decision process

Most of the benchmarked jurisdictions allow credit accumulation with roll over period of one year as proposed in the draft regulations. At the expiry of the period, some jurisdictions allow monetary compensation whereas others write off the credits. We further propose that the credits are written off at the expiry of the roll over period. This is considering that carrying forward the credits will become a liability to the distribution licensee which is not the intended objective of the net metering scheme.

3.7. Impacts of net metering

3.7.1. Financial/ Economic Impacts

- To prosumer - reduced investment in storage cost since at night grid power can be used instead of battery storage. The power that could have been stored is fed to the grid and be imported at night.
- Generally, the cost of own generation will be cut by more than 30% since storage cost alone accounts for about 30% for off grid projects
- Reduction of technical losses in the distribution system because the power generated by prosumers is consumed nearby. This consumption near the source reduces the amount of power required from the feeder sub-station during those times hence reducing the transmission losses. The distribution licensee loses a lot of revenues annually due to these technical losses that are bound to reduce.

- Net metering can also to result in reduced profits and revenue for the distribution licensee obtained from the sale of electricity. This might require it to change its way of operation at the beginning however in the long run that can be taken care by reduction in technical loses.
- Increased activities in the sale and installation of renewable energy systems will in addition to creating job opportunities provide an increased revenue stream through tax collection.

3.7.2. Environmental Impacts

- The power exported to the grid from RETs will assist in reducing the power required from fossil fuel powered generation technologies. This will in turn reduce the greenhouse gas emitted from the non-renewable sources. The country's carbon credits will increase as a result.
- This can further be reduced by advent of e-mobility, where the EVs can be charged from renewable energy sources reducing consumption of fuel.

3.7.3. Social Impacts

- With net metering, renewable energy installations will become attractive. As more investment is expected in this sector, employment will be created through installation of renewable energy projects.
- There will also be increased sales for vendors and new business opportunities for importation and sale of renewable energy systems due to increased demand. This will improve the quality of life for a number of people in the country.
- There will be a reduction in respiratory diseases due to reduced air pollutants.

CHAPTER FOUR

TECHNO-ECONOMIC EVALUATION OF NET METERING SCHEME

4.1. Technical Evaluation

Four feeders supplying facilities that may adopt the net metering arrangement were identified and studied. The selected facilities were GlaxoSmithKline (industrial), Black Petals Ltd. (agricultural), Strathmore University (institutional), and Two Rivers Mall (commercial). The feeders supplying these premises are; Nairobi South_2 11 kV feeder (GlaxoSmithKline), Red Hill 11 kV feeder (Black Petals Ltd.), Lower Hill 11 kV feeder (Strathmore University), and Two rivers 66 kV feeder (Two River Mall).

Power flow and short circuit simulations were carried out before and after the integration of these prosumers. The following are the parameters that were observed in the two simulations:

(i) Power flow simulations
- Total system loses (kW)
- Maximum line loading (percentage of the maximum rated)
- Bus voltages (in per unit)

(ii) Short circuit simulations
- Short circuit current / fault level (kA)

The above parameters indicate the stability of the system and therefore, it is important to observe them before and after inclusion of the prosumers output in the network.

4.1.1. GlaxoSmithKline

GlaxoSmithKline (GSK) is an industrial premises that has installed 1 MWp solar PV system. With a peak demand of 580 kW, this means much of the daytime load is offset by the solar PV system. GSK is supplied from New Industrial 66/11 kV, $2 \times 45\ MVA$ substation via the Nairobi South_2 11 kV feeder. The feeder is radial as shown in Figure 4.1.

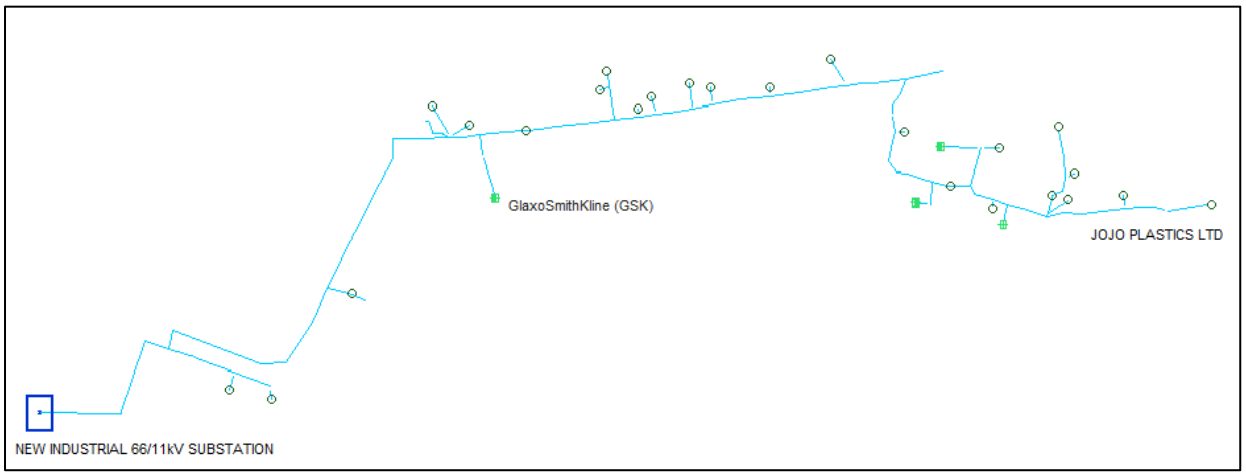


Figure 4.1: Nairobi South_2 11 kV Feeder as seen from Google Earth

The feeder is approximately 2.96 km long and consists of underground cables in some sections and aluminium conductor steel reinforced (ACSR) overhead bare conductors. The feeder has 24 transformers and four customers metered at 11 kV level; GSK, Nairobi Plastics, Cosmos Ltd and Sasio Road. Figure 4.2 show a typical daily load curve for the feeder.

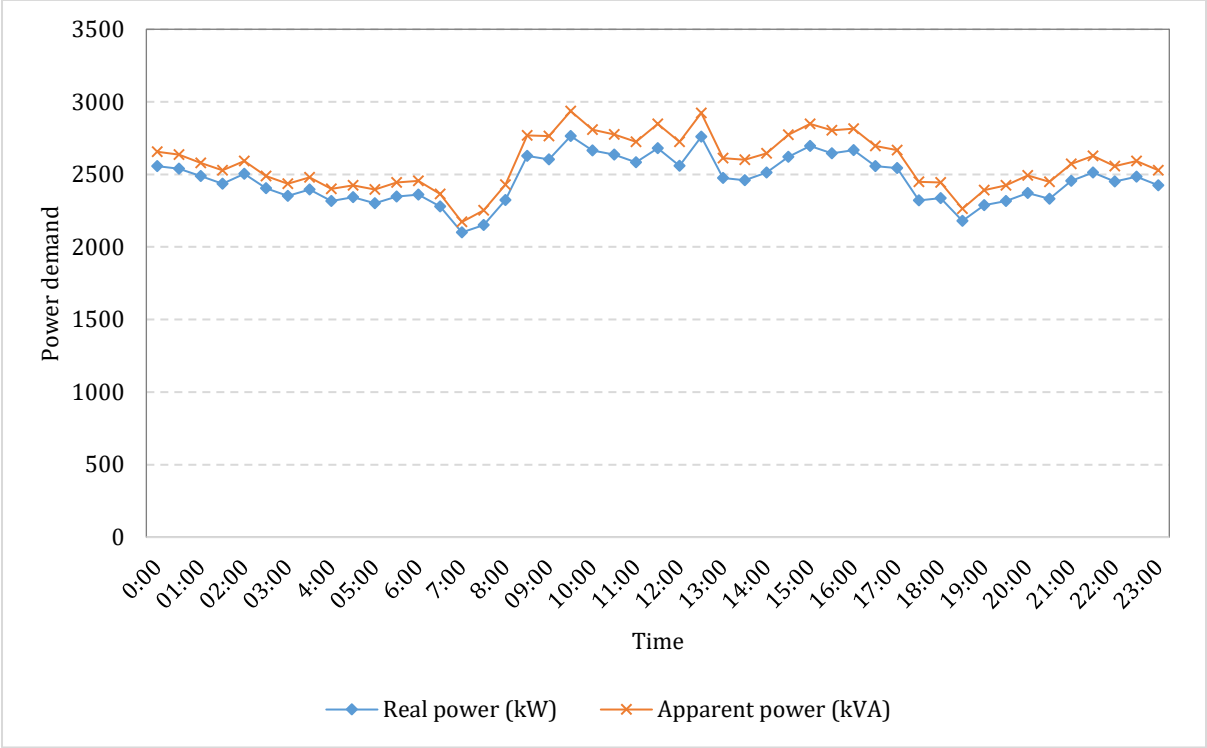


Figure 4.2: Nairobi South_2 11 kV Feeder typical daily load curve

It can be observed from Figure 4.2 that the feeder has two maximum loading times; 8.30 am to 1 pm and 2 to 5 pm. This is as expected since the feeder mainly supplies industries and thus, the peaks occur during working hours. The feeder's maximum load is about 2936 kVA and the

base load is about 2100 kVA with a daily load factor[6] of about 89%. Further, the power factor ranges from a low of 0.94 to a high of 0.97 lagging.

A typical daily load curve and the solar PV system generation output for GSK are given in Figure 4.3. However, it should be noted that the generation curve was for the 240 kWp system which has since been upgraded to 1000 kWp.

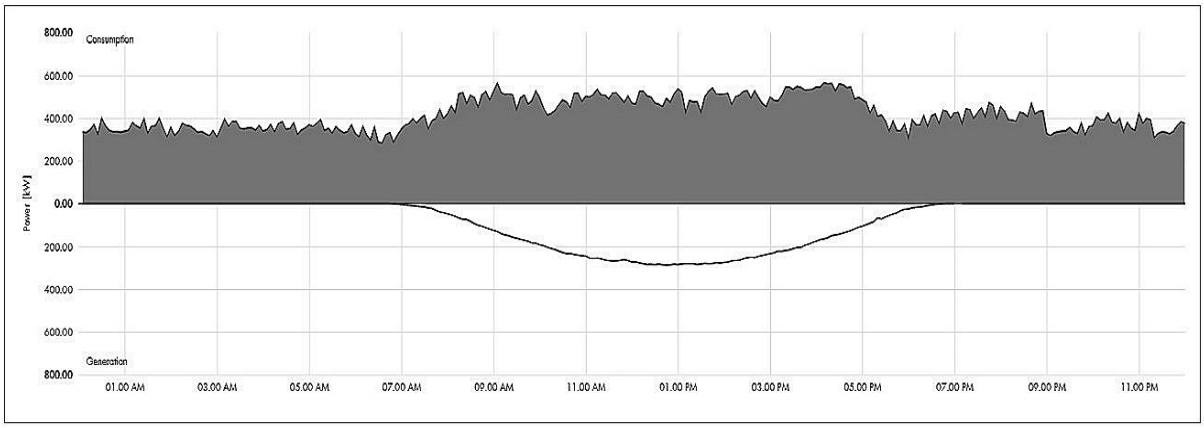


Figure 4.3: GSK typical daily load curve and generation output

It can be seen from Figure 4.3 that GSK has a maximum demand of about 580 kW that occurs at around 9 am and again between 3 and 5 pm. The facility's base load is about 300 kW. Further, the solar PV system gives maximum output of about 300 kW between 12 noon and 2 pm.

4.1.1.1. Feeder Network Steady-state Analysis with Maximum Solar PV Infeed

The solar PV generation at GSK is expected to meet some of the load demand during day time between 9.30 am to about 4.30 pm. The solar PV plant output is maximum between 12.00 - 1.00 pm. The PV output was assumed to be 1,000 kW, which is the installed capacity of the plant as at September 2021. GSK's load demand and the feeder loading at the time of maximum plant output were estimated from the facility's and feeder daily load curves, respectively. At

[6] Ratio of the average load to the peak load

around 11.00 am to 2.00 pm, GSK consumption ranges between 500 - 600 kW and the feeder load 2,700 - 2,950 kVA. The simulations were alternately run for feeder loads at 2790 kW and 917 kVAr and the load consumption at GSK pegged at 575 kW and 189 kVAr with and without solar PV infeed. The annual shutdown scenario was also considered whereby the load demand at GSK ranged between 60 – 110 kW and the solar PV output at maximum. Further, a hypothetical scenario was investigated where simulations were run with all the four consumers who are supplied and metered at 11 kV had solar PV installations. Load data for the three consumers were not availed and were assumed to be 296.4 kW and 97.4 kVAr each. Each prosumer's infeed was assumed to be 300 kW which is close to the maximum demand and would thus, be eligible for net metering.

The following four scenarios were simulated to determine the feeder network operating conditions for:

1. No solar PV generation
2. GSK maximum solar PV output (1MW) with local load
3. GSK maximum solar PV output (1MW) with minimum local load
4. Hypothetical case of four prosumers with maximum solar PV output (1.765 MW) with local loads.

The power flow results for the four scenarios are presented in Table 4.1.

Table 4.1: Power flow results for Nairobi South_2 11 kV Feeder with peak solar PV output

Scenario	***Feeder load***		***Grid supply***[7]		***Losses***[8]		***Max Loading (%)***
	P (kW)	***Q (kVAr)***	***P (kW)***	***Q (kVAr)***	***P (kW)***	***Q (kVAr)***	
1. No PV output with expected local load	2789	917	2808	949	30	58	34

[7] From 66 kV network

[8] Includes sub-station losses

2. PV Infeed 1 MW with expected local load	2789	917	1801	934	23	43	24
3. PV infeed 1 MW with projected minimum local load (Annual Shutdown)	2286	751	1296	763	17	27	24
4. PV infeed 1.765 MW	2928	962	1168	969	16	35	18

It can be observed from Table 4.1 that onsite generation infeed reduces grid power supply which in turn reduces the line loading and the feeder losses. It can also be seen that when the GSK load is at minimum e.g., during maintenance, and the generation infeed maintained at maximum (Scenario 3), the grid supply, line loading, and losses are further decreased compared with Scenario 2 due to the reduction in the total feeder load. The voltages remained between 0.99 and 1.00 per unit for all the analysed operating conditions.

4.1.1.2. Impact of Peak PV Generation on the Feeder Fault Levels

Short circuit simulations were run for the following scenarios:

1. Without solar PV generation.
2. With 1 MW solar PV generation output.
3. With 1.75 MW solar PV generation output (hypothetical).

The short circuit simulation results are given in Table 4.2.

Table 4.2: Fault currents at select buses in Nairobi South_2 11 kV Feeder

Bus name	***SC current (kA)***	***No PV Generation***	***With 1 MW infeed at GSK***	***With 1.75 MW infeed***
New Ind. 11 kV Primary Substation Busbars	Maximum	34.9	34.9	34.9
	TX 1 Bus	19.2	19.2	19.2
	Minimum	32.3	32.3	32.3
	TX 2 Bus	17.6	17.6	17.6
GSK	Maximum	13.5	13.5	13.5
	Minimum	11.7	11.7	11.7
Nairobi Plastics	Maximum	6.70	6.70	6.68
	Minimum	5.65	5.65	5.65

Sasio Rd.	Maximum	6.32	6.32	6.32
	Minimum	5.31	5.31	5.31
Jojo Plastics	Maximum	5.47	5.47	5.47
	Minimum	4.55	4.55	4.55

It can be observed from Table 4.2 that the self-generation has no impact on the system fault level at all the buses. In Kenya, the minimum design short circuit rating is 31.5 kA CB rating for both transmission and distribution networks, the bulk power supply point at the feeder was set to operate at 31.5 kA short circuit current for both maximum and minimum values although for the minimum value it should lower. It can be seen from Table 4.2*: Fault currents at select buses in Nairobi South_2 11 kV Feeder*

that the maximum short circuit currents at all buses except the secondary bus bar at the primary substation are below the minimum design short circuit rating of 31.5 kA. At the primary substation, two transformers were modelled in parallel connected to the same bus. If a single transformer is used, the maximum short circuit current and thus, CB rating would be based on the calculated value of 19.2 kA.

4.1.2. Strathmore University

Strathmore University (SU) is an academic institution supplied from the Nairobi West 66/11kV, 2 x 45 MVA substation via the Lower Hill 11 kV feeder. The Lower Hill 11 kV feeder is predominantly constructed using 75 mm^2 ACSR overhead bare conductors and underground cables in some sections. Figure 4.4 presents the Lower Hill 11 kV feeder as seen from google earth.

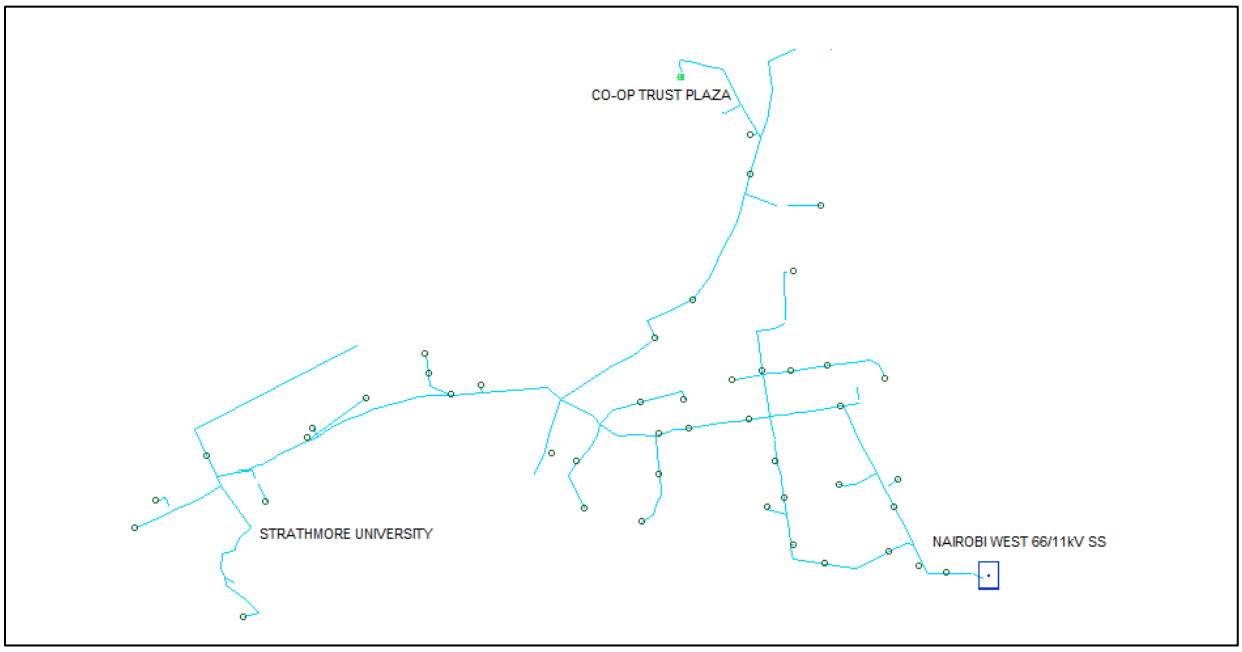


Figure 4.4: Lower Hill 11 kV Feeder as seen from Google Earth

A typical daily load curve for the feeder is presented in Figure 4.5.

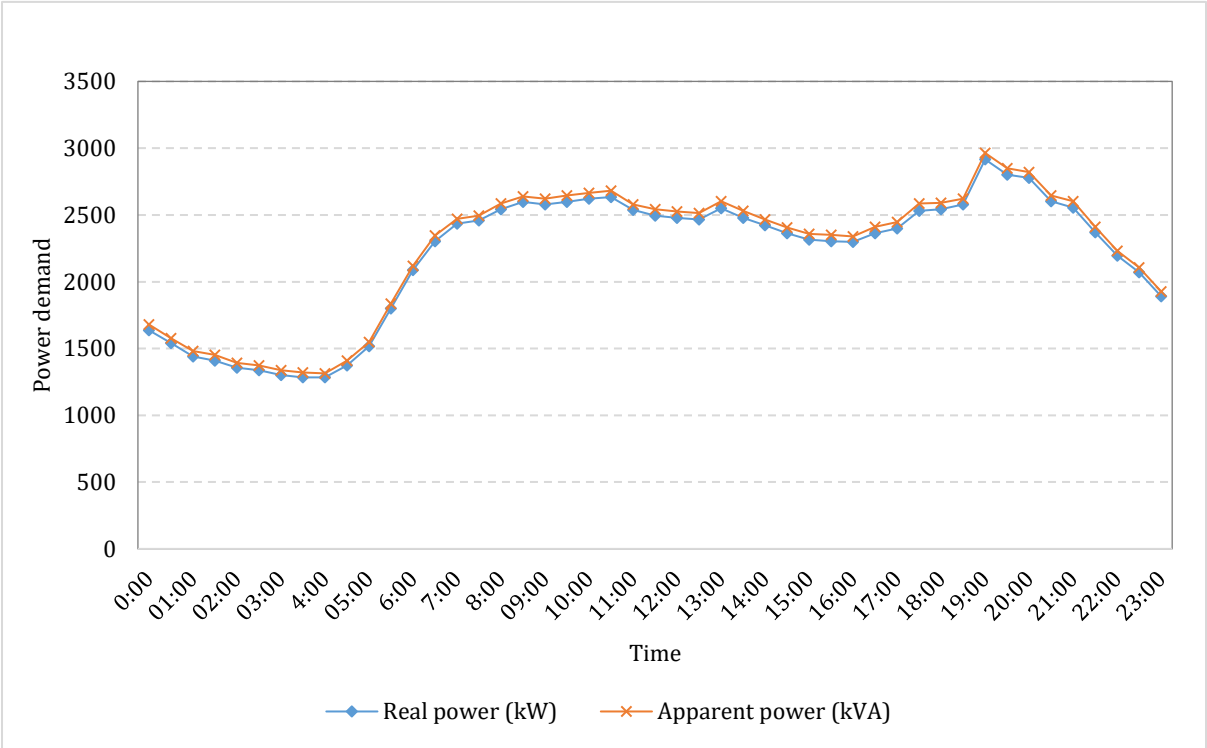


Figure 4.5: Lower Hill 11 kV Feeder typical daily load curve

It can be seen from Figure 4.5 that the feeder has one peak that occurs from around 6.30 to 8.30 pm and a dip between midnight and 5 am. The feeder's maximum load is about 2970 kVA and the base load is about 1300 kVA with a daily load factor of about 75%. Further, the power

factor ranges between 0.97 to a high of 0.99 lagging. The feeder supplies a mix of commercial, institutional, and residential consumers.

4.1.2.1. Feeder Network Steady-state Analysis with Maximum Solar PV Infeed

Strathmore University has a 600 kWp solar PV system; the prosumer's load and generation curves were not availed. Simulations were done taking an estimate of feeder load demand (including losses) of 2600 kVA at 0.98 power factor lagging at around 1 pm when solar PV infeed is expected to be maximum. Simulations were run with and without solar PV system infeed. The load flow results are shown in Table 4.3.

Table 4.3: Power flow results for Lower Hill 11 kV Feeder with peak solar PV output

Scenario	***Grid supply***[9]		***Losses***[10]		***Max Loading (%)***
	P (kW)	***Q (kVAr)***	***P (kW)***	***Q (kVAr)***	
1. No PV output with projected local load	2503	524	26	36	55
2. PV Infeed 600 kW with projected local load	1895	515	18	26	42

It can be observed from Table 4.3 by comparing the results for scenarios 1 with those for 2 that generation from the REGSs reduces grid power supply which in turn reduces the line loading and losses as expected.

Lower Hill feeder supplies residential estates and some commercial facilities that are not large consumers. Hence, it was difficult to identify a potential future prosumer. Further, the installed capacity at Strathmore University is higher than the peak load. In addition, the facility has a PPA with the off taker and is thus, unlikely to participate in net metering scheme. Therefore, no analysis was done with additional generation infeed.

[9] From 66 kV network

[10] Includes sub-station losses

4.1.2.2. Impact of PV Generation on the Feeder Fault Levels

The following three scenarios were investigated:

1. Short circuit analysis of the feeder without solar PV generation infeed
2. Short circuit analysis of the feeder with 600 kW solar PV infeed

The expected maximum and minimum short circuit currents are presented in Table 4.4.

Table 4.4: Fault currents at select buses in Lower Hill 11 kV Feeder

Bus name	***SC current (kA)***	***No PV Generation***	***With 600 kW infeed at SU***
Nairobi West Primary Substation Busbars	Maximum	34.9	34.9
	TX 1 Bus	19.2	19.2
	Minimum	32.3	32.3
	TX 2 Bus	17.6	17.6
Muthaiti Avenue Bus 2	Maximum	16.0	16.0
	Minimum	13.6	13.6
Nyayo Stadium	Maximum	11.3	11.3
	Minimum	9.30	9.30
Aerodrome Rd.	Maximum	8.75	8.75
	Minimum	7.16	7.16
Strathmore University	Maximum	8.07	8.07
	Minimum	6.58	6.58
Kentrack Agencies	Maximum	6.46	6.46
	Minimum	5.23	5.23

The primary substation secondary bus short circuit currents are higher than the minimum design short circuit rating of 31.5 kA as can be seen from Table 4.4. As earlier noted for the GSK case, this is due to the fact that two transformers are connected in parallel to this bus. For a single transformer the maximum short circuit current is 19.2 kA. The results indicate that the maximum short circuit currents are well below the minimum design short circuit rating for transmission networks in Kenya at all the buses. It is also observable that the PV infeed does not have any impact on the maximum short circuit currents.

4.1.3. Black Petals Ltd.

The Black Petals (BP) Ltd.is an agricultural premises that is supplied from Cianda 66/11 kV, 2 x 23 MVA substation via the Red Hill 11 kV feeder. This is a radial feeder primarily constructed of 150 mm^2 ACSR conductor. The feeder layout as seen from google earth is shown in Figure 4.6.

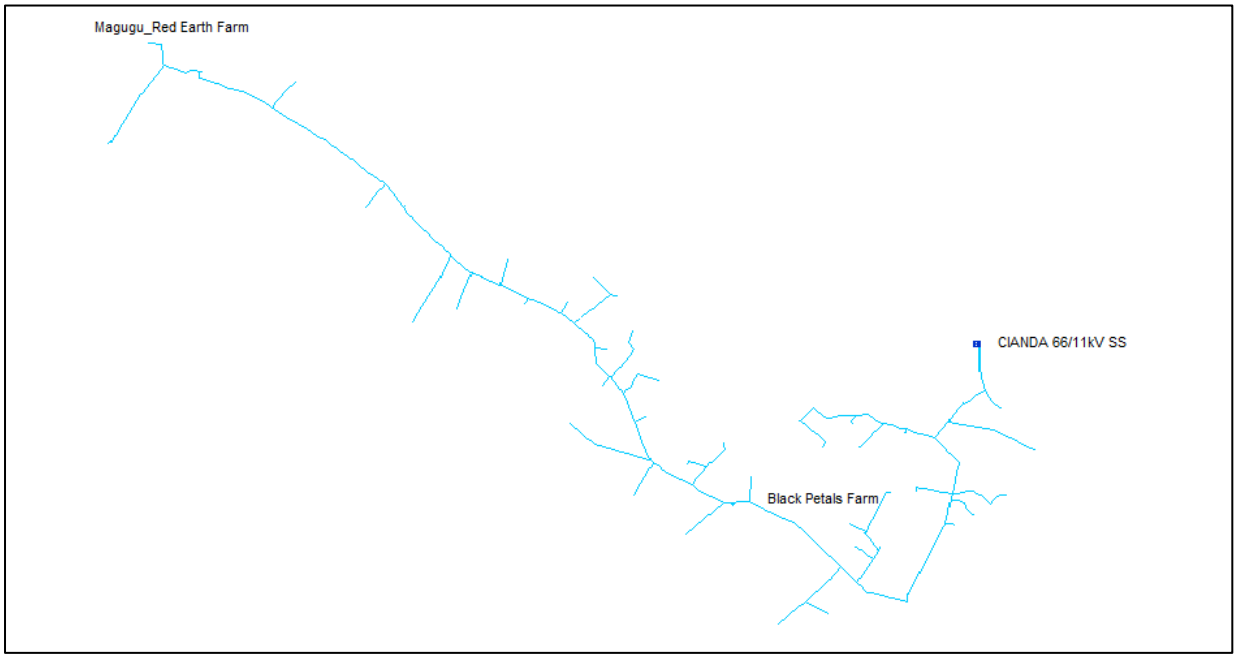


Figure 4.6: Red Hill 11 kV Feeder as seen from Google Earth

The feeder has 62 secondary transformers. In addition, BP has a 175 kWp solar PV power plant. Figure 4.7 shows a typical daily load curve for the feeder.

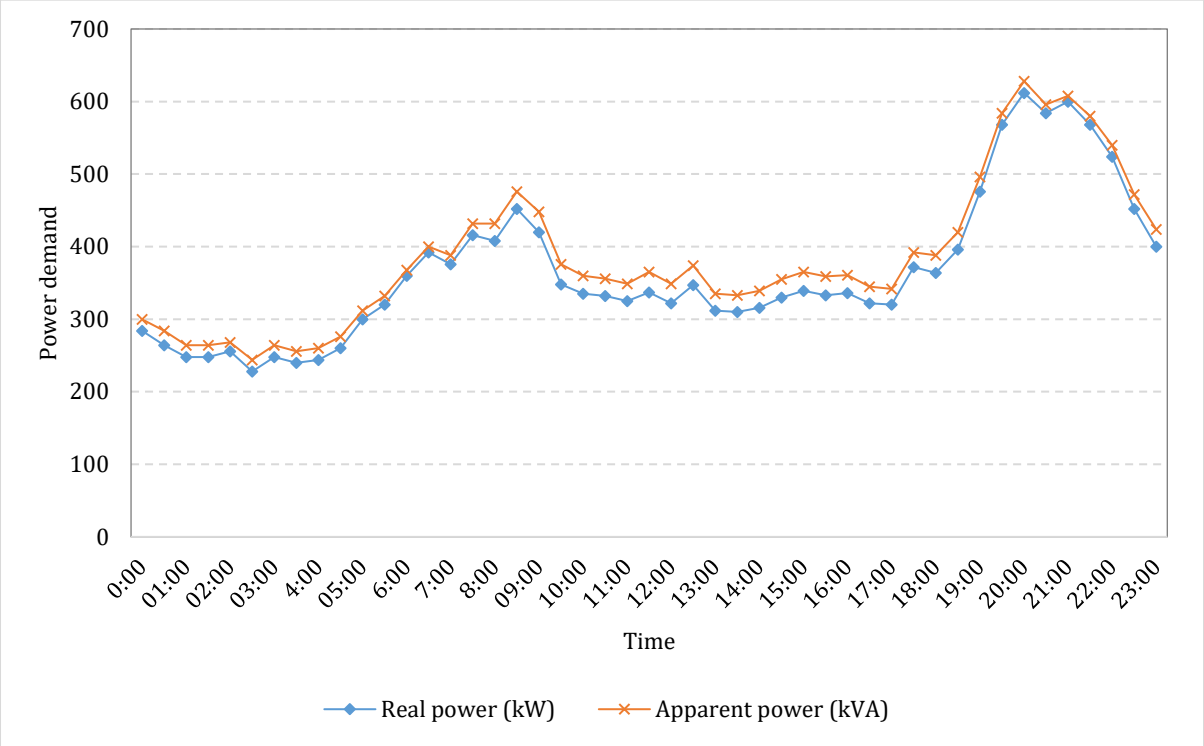


Figure 4.7: Red Hill 11 kV Feeder typical daily load curve

It can be seen from Figure 4.7 that the feeder has two maximum loading times; 6 am to 9.30 am and 6.30 to 11 pm. The feeder's maximum load is about 630 kVA and the base load is about 240 kVA with a daily load factor of about 60%. Further, the power factor ranges between 0.92 to a high of 0.99 lagging.

4.1.3.1. Feeder Network Steady-state Analysis with Maximum Solar PV Infeed

The load consumption data for BP were not availed. The PV infeed is expected to be maximum at around 1300 hrs. Thus, the feeder load at the time of maximum infeed was estimated from the feeder load curve to be 345 kVA. Simulations were run with an infeed to the grid from Black Petals of 175 kW at unity power factor. The network load flow results are presented in Table 4.5.

Table 4.5: Power flow results for Red Hill 11 kV Feeder with peak solar PV output

Scenario	***Grid supply***		***Losses***		***Max loading (%)***
	P (kW)	***Q (kVAr)***	***P (kW)***	***Q (kVAr)***	
1. No PV infeed with projected feeder demand	328	107	1.2	1.6	4.0

2. PV infeed - 175 kW with peak feeder demand	153	107	0.75	1.1	2.2

It can be observed from Table 4.5 by comparing the results for scenarios 1 with those for 2 that generation from the REGSs reduces grid power supply which in turn reduces the line loading and losses as expected.

4.1.3.2. Impact of PV Generation on the Feeder Fault Levels

The following three scenarios were investigated:

1. Short circuit analysis of the feeder without solar PV generation infeed
2. Short circuit analysis of the feeder with 175 kW solar PV infeed

The expected maximum and minimum short circuit currents are presented in Table 4.6.

Table 4.6: Fault currents at select buses in Red Hill 11 kV Feeder

Bus name	***SC current (kA)***	***No PV Generation***	***With 175 kW infeed at Black Petal***
Cianda Primary Substation Busbars	Maximum	23.5	23.5
	Minimum	21.6	21.6
Rima Estate 1	Maximum	5.50	5.50
	Minimum	4.72	4.72
PEFA Bloomfield	Maximum	5.25	5.25
	Minimum	4.50	4.50
Black Petals	Maximum	3.38	3.38
	Minimum	2.87	2.87
Riara Ridge	Maximum	2.11	2.11
	Minimum	1.78	1.78
Magugu Red Earth Farm	Maximum	1.16	1.16
	Minimum	0.970	0.970

The results of Table 4.6 show that the maximum short circuit currents are well below the minimum design short circuit rating for transmission networks in Kenya at all the buses. It is

also observable that the PV infeed does not have any impact on the maximum short circuit currents.

4.1.4. Two Rivers Mall

Two Rivers Mall is a commercial premises supplied from Ruaraka 132/66 kV, 2 x 60 MVA substation via the Two Rivers 66 kV feeder. The feeder has no other customers connected to it and has an approximate length of 12.6 km. It is constructed with a 300 mm^2 all-aluminium alloy (AAA) conductor.

The loading profile for Two Rivers Mall was not availed. The mall has a 1280 kWp solar PV system and the peak load was estimated to be 1990 kVA at 0.90 power factor lagging.

4.1.4.1. Feeder Network Steady-state Analysis with Maximum Solar PV Infeed

The feeder network conditions were investigated without and with solar PV infeed at peak load. The load flow results are given in Table 4.7.

Table 4.7: Power flow results for Two-Rivers 66 kV Feeder

Scenario	***Grid supply***		***Losses***		***Max loading (%)***
	P (kW)	***Q (kVAr)***	***P (kW)***	***Q (kVAr)***	
1. No PV infeed with peak load	1802	873	0.63	9.0	4.4
2. PV infeed - 1280 kW with peak load	522	854	0.16	2.3	1.2

It can be observed from Table 4.7 that the solar PV infeed reduces the line loading and the losses as expected. The losses are very low owing to the fact that this is a 66 kV feeder that is very lightly loaded.

4.1.4.2. Impact of PV Generation on the Feeder Short Circuit Capacity

The fault levels at the Ruaraka substation and Two Rivers Mall 11 kV bus are presented in Table 4.8.

Table 4.8: Fault Levels at the sending and receiving ends of the Two Rivers feeder

Bus name	*SC current (kA)*	*No PV Generation*	*With 1280 kW infeed at Two Rivers*
Ruaraka 66 kV Primary S/S	Maximum Values	2.29	2.29
	Minimum Values	2.09	2.09
Two Rivers 11 kV	Maximum Values	5.50	5.50
	Minimum Values	4.72	4.72

The introduction of the PV plant has no effect on the fault levels of the buses in the network.

From the results of simulations done on the four feeders, it can be concluded that;

1. The feeder operating conditions are not violated and it is highly unlikely they would be violated with the evolution of net metering occasioned by increased participation of prosumers in the future. Based on the load data available, the feeders are loaded within the prescribed limits in terms of their current carrying capacity under most operating conditions. The overall effect of the prosumer injection on the feeder loading is reduction in the loading of the feeders.

   The utility (Kenya Power) may therefore assess the need of uprating overloaded feeders to higher cross-sectional area or make the cross-sectional area uniform over the entire feeder length, as generation injection from prosumers evolves.

2. Voltage regulation of the feeders is improved. Under the various loading scenarios analysed, the voltage profile of the feeders was between 0.99 and 1.0 per unit. It has been found that introduction of prosumers under Net metering Schemes will generally improve the voltage profile of the feeders and should aid in voltage regulation thus, enhancing operation of the distribution system within the limits as specified in the Distribution Grid Code.

3. Short circuit capacity of the feeders is largely unaffected with the injection from Net Metering prosumers, even with the consideration of future prosumers. The fault contribution of the prosumers is almost negligible, and would unlikely contribute to raising fault levels above the minimum design short circuit ratings of the feeders.

   The utility (Kenya Power) will however need to be conducting continuous studies on the feeders as more prosumers are approved. This will ensure that short circuit capacity of equipment is not violated. It should however be a condition for all prosumers to study their protection systems and conduct protection grading as they interface with the grid for proper

fault sensing. These include proper fuse selection and setting of overcurrent/overload sensing devices considering that there will be instances where the current flowing on the feeders will be reduced but protection sensing should not be compromised. On occasions that the feeders will be uprated and more prosumers will be getting connected, the utility substation distance protection relays will have to be adjusted for proper zone reach. Further, it should be a condition for all prosumers to demonstrate that voltage sensing interlocks are in place at their point of connection to isolate their systems from the grid upon detection of grid loss/loss of incoming voltage. This is to prevent the prosumer facilities from back feeding a dead utility network or feeding faults. This will ensure proper functioning of the prosumer equipment, reduction of outage durations and for general operational safety of the distribution system in accordance with the specifications of the Distribution Grid Code.

4.2. Economic Evaluation

This section looks at the economics of net metering by computing the lifetime costs associated with installation of renewable energy systems that can participate in net metering. This has been done by computing LCOE for different sizes among other variables considering likely scenarios and costs that prosumers will incur in setting up the plants.

4.2.1. Computation of LCOE and Sensitivity Analysis

In this section the LCOE of the three technologies was evaluated responding to objective (ix) of the study. Further we conducted a sensitivity analysis of the LCOE with varying solar PV installed capacity, capacity factor and discount rate.

For sensitivity analysis, the capacity factor and the discount rates were as it in Table 4.9.

Table 4.9: Parameter values used in LCOE computation

Parameter	***Solar PV***	***Wind***	***HEP***
Discount rate	7-15 %		
Capacity Factor	15 – 20 %	30 – 40 %	40 – 60 %

Wind and HEP have higher capacity factors as compared to solar PV and therefore yield more annual energy for the same installed capacity.

For solar PV systems, the capital expenditure for different capacities was calculated using their corresponding costs per kW as given in Figure 3.5. The values of LCOE evaluated for different installed capacities at 18% capacity factor are given in Table 4.10.

Table 4.10: LCOE for solar PV systems at 18% capacity factor

Installed capacity (kW)	***LCOE (USD cents/ kWh)***
20	8.20
100	7.95
200	7.45
400	6.95
600	6.71
1,000	6.46

It can be observed from Table 4.10 that as expected, the LCOE decreases as the installed system capacity increases. The largest allowable system size under the net metering arrangement is 1,000kW and the LCOE at 18% capacity factor was found to be 6.46 USD cents.

The sensitivity analysis results for LCOE to capacity factor are shown in Figure 4.8. Here the discount rate was kept constant at 10%.

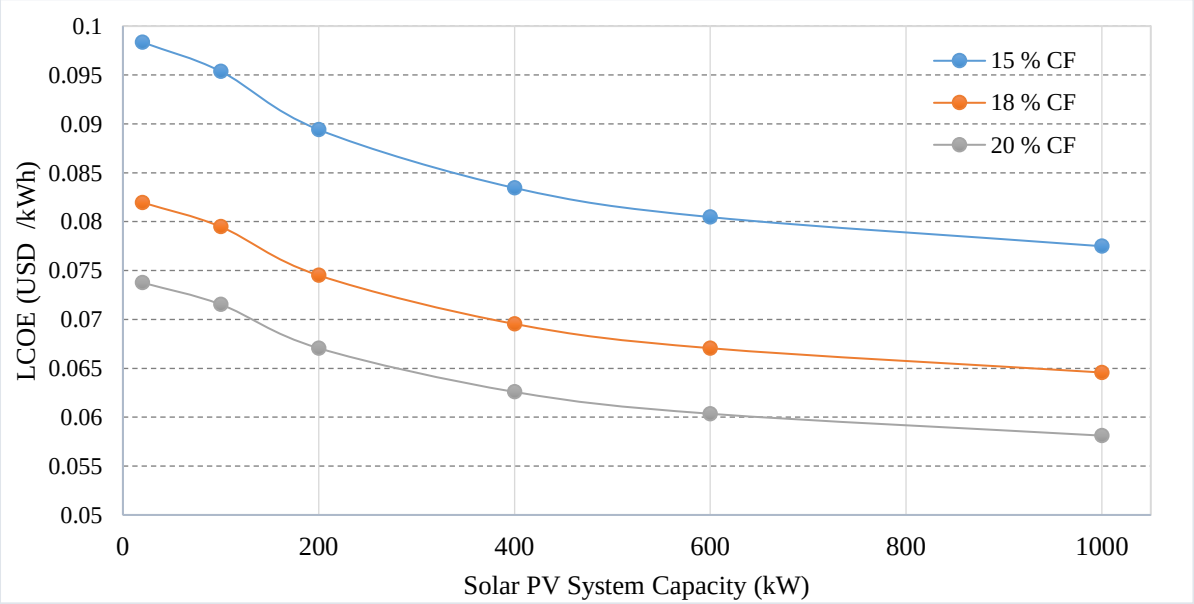


Figure 4.8: LCOE of solar PV for different capacity factors and sizes

From Figure 4.8, one of the observations is that the LCOE decreases as the system size increases. This is because larger plants enjoy economies of scale. Another observation is on

the capacity factor effect whereby, its increase reduces the LCOE for all the sizes considered. A higher capacity factor implies that, the plant generates energy at the rated kW capacity for longer time when in operation. At the lowest capacity factor of 15 % the value of LCOE for the lowest capacity considered of 20 kW is 0.098 $/kWh. This is the highest value computed LCOE. This in a solar PV system represent the most pessimistic scenario with an annual average of 3.6 peak sun hours (PSH). On the other hand, the most optimistic scenario is a capacity factor of 20 % equivalent to an annual average of 4.8 PSH. This case gives an LCOE of as low as 0.058 for large systems 1 MW and above.

Figure 4.9 shows the how the LCOE varies with change in the discount rate between 7 % and 15 %. In these different sizes of solar PV systems was taken while a constant capacity factor of 18 % was assumed.

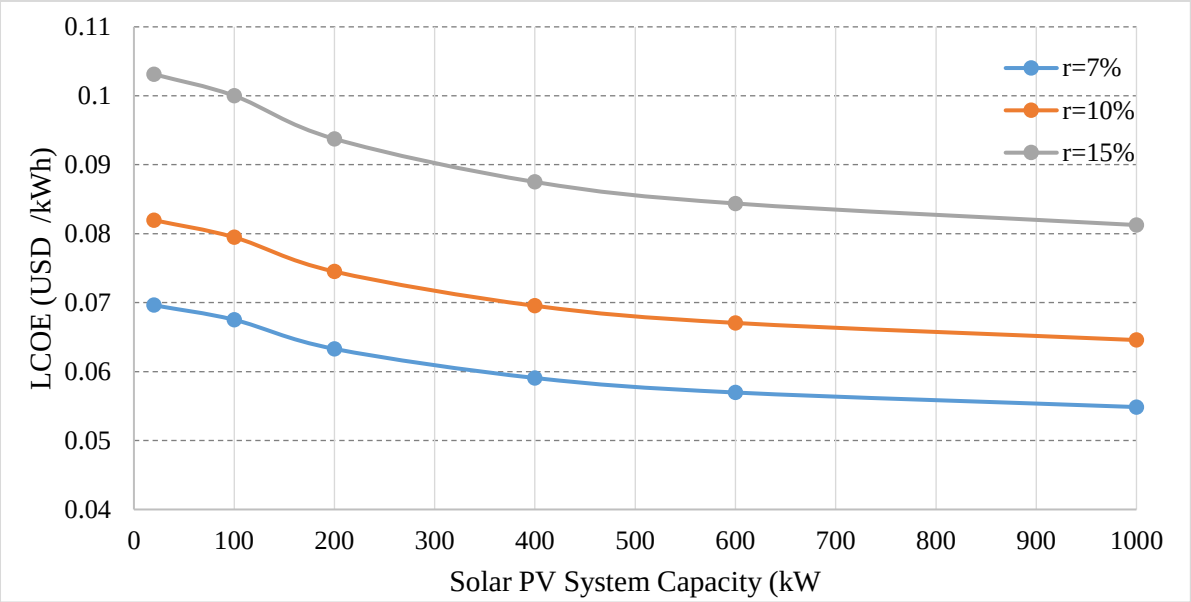


Figure 4.9: LCOE of different solar PV sizes and discount rates

From the figure, it can be seen that the LCOE increases as the discount rate is increased. The worst-case scenario is the lowest installed capacity of 20 kW with a discount of 15% which yield an LCOE of 0.103 $/kWh. The best-case scenario is highest size of 1 MW with the lowest discount rate of 7% which yield an LCOE of 0.0548 $/kWh.

The capital costs associated with wind power plants are however higher as compared to solar PV plants. Hydroelectric power (HEP) plants have the highest capacity factor of the three of between 40% to 60% and this can be even higher depending on the area's hydrology. These two plants also enjoy the economies of scale therefore large plants will have less capital

investment per kW compared to small ones. Unlike solar PV, wind and HEP plants are more site specific and may not be installed anywhere. They require more studies to assess their viability. This explains why solar PV is the most exploited captive technology in Kenya.

Table 4.11 gives the LCOE of wind and HEP power plants with an installed capacity of about 1 MW.

Table 4.11:LCOE for Wind and HEP systems at different capacity factors

Wind (Estimated for 1MW capacity)			
Capacity factor	**30%**	**35%**	**40%**
LCOE (USD cents)	8.32	7.13	6.24
HEP (Estimated capacity of 1MW)			
Capacity factor	**40 %**	**50%**	**60%**
LCOE	8.22	6.58	5.48

From Table 4.11 it can be seen that HEP has the lowest LCOE at its highest capacity factor. Another factor that explains this is the longer economic life and compared to both wind and solar PV technologies.

4.2.2. Optimal Credit for Energy Banked

The motivation behind net metering for the prosumer is to ensure that the extra energy generated from the installed system during low consumption period does not go to waste. However, the grid operator also incurred expenses in putting the infrastructure in place in addition to regular maintenance costs. For cases where someone will need to make money their other schemes such as feed in tariff that can be sought for. To ensure that the prosumer gets a value for exported, the worst-case scenario of LCOE as computed above was picked.

Worst – case scenario of LCOE (Maximum cost incurred by the prosumer to export 1 kWh=\$0.103(≈ Kshs 11.34)
Estimated tariff charged = Kshs 20

$\therefore$ Exported unit equivalent based on the tarrif charged$= \frac{11.34}{20} = 0.567$

Based on the above calculation the team would like to proposed a credit of 0.6. This means that for one unit (kWh) exported by the prosumer, a fraction of 0.6 kWh. This will give a reasonable return on investment to the prosumer and also ensure that the distribution licensee is able to meet the costs associated with maintaining the system. This is because the credit awarded to the prosumer will be nearly equal to the tariff they could have charged.

CHAPTER FIVE

NET METERING IN OTHER JURISDICTIONS

5.1. Introduction

Net Metering has been practised in different jurisdictions over the years. This chapter presents a series of case studies on net metering in these jurisdictions addressing objective (i). The parameters reviewed in the jurisdictions include:

a) Reason for the net metering framework
b) Legal framework
c) Application
d) Eligible renewable energy sources and consumers
e) Generation capacity limits
f) Application to enter into a net metering system agreement
g) Installation, grid interconnection, maintenance and operations
h) Costs, tariffs, and billing
i) Monitoring and control
j) Carbon credits.

The findings in the case studies will be used as key lessons in the proposals to be captured in the draft Energy (Net Metering) Regulations, 2022. These studies are based on desk-top review of the documents available on the internet.

The jurisdictions reviewed include Malaysia, California, New Delhi, Bangladesh, Sri Lanka, Ghana, Tanzania, and Stellenbosch Municipality.

5.2. Malaysia

5.2.1. Legal Framework

The legal framework for net metering in Malaysia was established in 2021 and is governed through guidelines. The guidelines were issued by the Suruhanjaya Tenaga Energy

Commission (the Energy Commission). The Energy Commission is the energy regulator established under Section 50C with powers to regulate the energy supply activities in Malaysia.

Section 50C (1) of the Electricity Supply Act allows the Energy Commission to issue guidelines or directions on any matter under the Electricity Supply Act to any licensee, non-domestic electrical installation owner or operator, registered manufacturer or importer, competent person or any person. According to section 50 (c)(4), these guidelines are binding.

The "Guidelines for Solar Photovoltaic Installation under The Programme of NEM Rakyat and NEM GoMEn In Peninsular Malaysia" (Suruhanjaya Tenaga Energy Commission, 2021) were issued by the Energy Commission on 30th January 2021 (the "Guidelines"). The Guidelines were established to promote renewable energy through installation of solar systems on residential and government premises primarily for self-consumption and any excess energy to be exported under the NEM Rakyat and NEM GoMEn programmes.

5.2.2. Application

The Guidelines are applicable to parties participating in the NEM Rakyat or NEM GoMen programmes. The NEM Rakyat and NEM GoMen programmes are initiatives under the net-metering programme in Malaysia. The participants in the NEM Rakyat and NEM GoMen programmes are consumers occupying private dwelling premises not used as a hotel, boarding house or used for the purpose of carrying out any form of business, trade, professional activities or services (the "Domestic Consumers") who have not participated in any prior solar programmes. While NEM GoMen programme is applicable to government ministries and entities ("Government Agency"). The Guidelines are applicable to:

a) any Domestic Consumer or Government Agency participating in the NEM Rakyat and NEM GoMEn in Peninsular Malaysia;
b) the relevant Distribution Licensee, whose Distribution System is connected to the NEM Consumer; and
c) the Sustainable Energy Development Authority (SEDA) which is the implementing agency (the "Implementing Agency") for the NEM Rakyat and NEM GoMEn programmes.

The NEM programme in Malaysia is applicable to solar PV installations with PV panels mounted on the rooftop of the building within the same Premise.[11]

5.2.3. Generation capacity limits

The maximum capacity of the solar PV installation is as follows:

a) Domestic consumers;
   i) single phase consumer - not more than 4 kW
   ii) three phase consumer - not more than 10 kW.
b) Government agencies – not more than 1,000 kW and subject to the following conditions:
   i) For medium voltage (50,000 V ≥ V ≥ 1,000 V) consumers, not exceeding 75% of Maximum Demand[12] based on:
      - the average of the recorded Maximum Demand of the past one (1) year; or
      - the declared Maximum Demand for Consumers with less than one (1) year record; and
   ii) For low voltage (V ≤ 1,000 V AC or V ≤ 1,500 V DC line-line) consumers, not exceeding 60% of fuse rating (for direct meter) or 60% of the current transformer (CT) rating of the metering current transformers.

The total capacities eligible for application under the NEM 3.0 Programme in Peninsular Malaysia are as follows:

a) For Domestic Consumer – up to 100,000 kW; and
b) For Government Agency – up to 100,000 kW.

5.2.4. Application to enter into a net metering system agreement

a) General

- Application for NEM is on a first-come-first-served basis up to the allocated capacity for each category or up to 31 December 2023, whichever comes first.

[11] means a building together with its land, outbuildings and any structures within the same compound occupied or used by the NEM Consumer

[12] means twice the largest number of kWh used during any consecutive thirty (30) minutes in a month

- The application to enter into net metering is submitted to the Implementing Agency, , with supporting documents. The application is accompanied by an application fee of 10 Malaysian Ringgit (approximately KES. 267.00) The application form contains the consumer's address, identification details, site location, energy source supply and installation information, equipment cost, installation costs and annual operational expenditure and a proposed work plan on commencement of operation.
- The Implementing Agency processes and verifies the application, notifies the Applicant whether its application is accepted, advice the Applicant to proceed with net energy metering assessment study (NEMAS) for installations above 72 kW, and provide the detail of the application to the Distribution Licensee within ten (10) days from the date of complete submission of application.
- Upon being notified by the Implementing Agency on approval of the application, the Applicant commences to install the solar PV installation within three (3) months from the date of the notification (date of notification inclusive), failing which, the application is deemed withdrawn and cancelled.
- The NEM Consumer signs a NEM Contract with the Distribution Licensee before the commencement of operation.

b) Parties to the net metering agreement

- The consumer is required to sign an agreement which is annexed to the Guidelines. The agreement is deemed to commence once the distribution licensee accepts the testing and commission report submitted by the consumer and installation of the meter by the distribution licensee. The agreement is between the consumer and the distribution licensee who is the holder of a licence to distribute electricity issued by the Energy Commission.
- If the consumer sells the Premise, then the new owner may apply to continue with the programme for the remaining duration of the period of operation.
- The consumer is prohibited from transferring any credit amount to any accounts of other consumers or third-party accounts.

c) Net energy metering assessment study

The net energy metering assessment study (NEMAS), which is pre-requisite for approval of the NEM application, determines the technical impact of the solar PV installation to the

distribution system and establish technical and safety requirements that may be necessary for the Installation. The costs of NEMAS is borne by the Consumer.

NEMAS in only applicable for installations above 72kW. Installations below 72kW do not require any analysis by the Distribution Licensee and the Consumer is supposed to ensure that the exported power is less than the existing capacity of the Distribution Licensee and Consumer's equipment.

Each NEMAS is valid for one (1) year commencing from the date of the Distribution Licensee's approval of the study.

d) Licensing requirement

- A licence is required for any person to use, work or operate (or permits to be used, worked or operated) a solar PV installation above 72 kWp, 3-phase system, and above 24 kWp for single-phase system.
- The consumer or the owner of the PV system asset should apply for a licence from the Energy Commission after the approval of NEM application.

5.2.5. Installation, grid interconnection, maintenance and operations

- The equipment, design, installation, testing and commissioning, and the operation and maintenance of the solar PV installation should comply with the Energy Laws and any other relevant legal and regulatory frameworks.
- The design, calculation, drawings, Installation, testing and commissioning of the PV installation and the interconnection to the Distribution System should be certified by qualified and competent persons.
- The Distribution Licensee has the right to disconnect supply at the Point of Interconnection in the event of any danger or risk to the safety, reliability or security of the Distribution System or the safety of the Consumer's installation which the solar PV installation may cause.
- Battery energy storage system for the PV installation is allowed.
- The PV installation should be equipped with smart inverter features among them anti-islanding protection, voltage and frequency ride-through capability, ramp rate control, reactive power control functions, active power control functions, frequency-watt (droop

curve) and volt-watt, data log/memory card for event logs, remote monitoring and configurability.

- Use of a single-phase inverter should not cause unbalance conditions to Distribution Licensee's system. If such a condition is violated, requirement of a three-phase inverter is automatically enforced.
- The Consumer is responsible for safe operation and maintenance of the solar PV installation in its Premise up to the Point of Interconnection of the Distribution Licensee's supply line.
- The supply line and equipment beyond the Point of Interconnection and the metering facilities for measurement of energy supplied by and exported to the Distribution System is the responsibility of the Distribution Licensee.
- The meter should have bi-directional capability to measure and record energy exported by the Consumer to the Distribution Licensee and energy supplied by the Distribution Licensee to the Consumer.
- The meter shall be supplied and installed by the Distribution Licensee.
- Cost of the import-export meter is borne by the consumer.
- LV (400 V and 230 V) indirect solar PV power generation system should be capable of operating within the steady state voltage range +10% and -6%.
- MV (6.6 – 33 kV) indirect solar PV power generation system should be capable of operating within the steady state voltage limits ±5%.

5.2.6. Costs, tariffs and billing

- The consumer receives credit for excess energy exported to the distribution system and the credits may be used to offset part of the electricity bill for energy provided by the Distribution Licensee during the applicable billing period as follows:

  Net charge amount (RM) = (Energy imported from Distribution Licensee[13] x prevailing gazetted Energy rate) – (Energy exported to Distribution Licensee x prevailing gazetted Energy rate)

[13] Energy imported is subjected to Sale and Service Tax, Imbalanced Cost Pass Through

During the first ten (10) years of operation under the NEM Contract:

- The credit received by the consumer for excess energy may be used to offset part of the electricity bill for energy provided by the Distribution Licensee during the applicable billing period.
- Net credit is allowed to roll over for a maximum of twelve (12) months within the Settlement Period. Any available energy after the period is forfeited.
- After the ten (10) years period, the solar PV installation should be strictly for self-consumption in the Premise where the solar PV system is installed, and no offset and roll-over will be allowed nor for any excess energy to be exported.

5.2.7. Carbon credits

The consumer is entitled to the value of any credits or financial benefits which are available or may become available for reductions of "greenhouse gas" emission earned from the generation of solar energy by solar PV installation.

5.3. California

5.3.1. Legal Framework

California adopted the net metering framework in 1995 through Senate Bill 656 Stats. 1995, ch. 369. Net Metering in California is regulated by the California Public Utilities Commission (CPUC). The CPUC regulates privately owned electric, natural gas, telecommunications, water, railroad, rail transit, and passenger transportation companies. The current substantive law in respect to net metering in the State of California is the Public Utility Code 2827 of 2018 (the "Code") (California Legislative Information, 2022).

The Code is intended to encourage substantial private investment in renewable energy resources, stimulate in-state economic growth, reduce demand for electricity during peak consumption periods, help stabilize California's energy supply infrastructure, enhance the continued diversification of California's energy resource mix, reduce interconnection and administrative costs for electricity suppliers, and encourage conservation and efficiency.

5.3.2. Eligible Technologies and consumers

The California net metering framework focusses on renewable energy technologies. According to the Code, renewable electrical generation facility is defined as a facility that uses:

a) biomass;

b) solar thermal;
c) photovoltaic;
d) wind energy (greater than 50 kW but less than 1 MW);
e) geothermal;
f) fuel cells using renewable fuels;
g) small hydroelectric generation of 30 MW or less (that does not cause an adverse impact on instream beneficial uses or cause a change in the volume or timing of streamflow);
h) digester gas;
i) municipal solid waste conversion;
j) landfill gas;
k) ocean wave, ocean thermal, or tidal current; and
l) any additions or enhancements to the facility using that technology.

The eligible consumers include; residential, small commercial, industrial, or agricultural, Department of Corrections and Rehabilitation, United States Armed Forces base or facility.

5.3.3. Application

Net energy metering is applicable to customer-generators who are either:

a) *Electric Utility*: an electrical corporation, a local publicly owned electric utility, or an electrical cooperative, or any other entity, except an electric service provider, that offers electrical service. An electric service provider is a non-utility entity that offers electrical service to customers within the service territory of an electrical corporation. The Code does not apply to a local publicly owned electric utility that serves more than 750,000 customers and that also conveys water to its customers.

b) *Consumer*: a residential customer, small commercial customer that has a maximum peak demand of less than 20 kW, or commercial, industrial, or agricultural customer of an electric utility, who uses a renewable electrical generation facility, or a combination of those facilities, with a total capacity of not more than 1 MW, that is located on the customer's owned, leased, or rented premises, and is interconnected and operates in parallel with the electrical grid, and is intended primarily to offset part or all of the customer's own electrical requirements; or

c) *The Department of Corrections and Rehabilitation* using a renewable electrical generation technology, or a combination of renewable electrical generation technologies, with a total capacity of not more than 8 MW, located on the department's owned, leased, or rented premises, and is interconnected and operates in parallel with the electrical grid, and is intended primarily to offset part or all of the facility's own electrical requirements. The

amount of any wind generation exported to the electrical grid should not exceed 1.35 MW at any time.

d) *The United States Armed Forces base or facility* using a renewable electrical generation facility, or a combination of those facilities and the renewable electrical generation facility. The renewable electrical generation facility should be located on premises owned, leased, or rented by the United States Armed Forces base or facility and should be interconnected and operates in parallel with the electrical grid. Further, the renewable electrical generation facility should be primarily intended to offset part or all of the base or facility's own electrical requirements, and the renewable electrical generation facility has a generating capacity that does not exceed the lesser of 12 MW or one MW greater than the minimum load of the base or facility over the prior 36 months. However, the United States Armed Forces base or facility that is an eligible customer generator *shall not receive compensation for exported generation*.

5.3.4. Generation capacity limits

- Prior to July 1, 2017, the NEM capacity limit was 5% of the aggregate customer peak demand of all electricity used by eligible customer-generators served by all the electric utilities in the large electrical corporation's service area. For purposes of calculating a large electrical corporation's program limit, "aggregate customer peak demand" meant the highest sum of the noncoincident peak demands of all of the large electrical corporation's customers that occurs in any calendar year.
- After July 1, 2017, there is no limitation on the amount of generating capacity or number of new eligible customer-generators entitled to receive service pursuant to the standard contract or tariff.

5.3.5. Application to enter into a net metering system agreement

- The Code requires that the electric utility provider processes NEM or net surplus electricity compensation in no more than 30 working days from the date of receipt of the completed application form and accompanying documents for an interconnection agreement from an eligible customer-generator.
- The Code does not provide a template or standard for the net-metering contract. Instead, it requires the electric utility providers to develop a standard contract or tariff providing for net energy metering and shall make this standard contract or tariff available to eligible customer-generators, upon request, on a first-come-first-served basis until the time that the

total rated generating capacity used by eligible customer-generators exceeds 5% of the electric utility provider's aggregate customer peak demand.

- The Code prohibits charging consumers an additional charge that would increase a consumer's costs beyond those of other consumers who are not eligible customer-generators in the rate class to which the eligible prosumer would otherwise be assigned if the customer did operate a renewable electrical generation facility.
- NEM assessment studies are done for interconnection of a renewable electrical generation facility with a capacity greater than 1 MW within 60 working days of an application by a customer-generator.
- If the study reveals the need for upgrades to the transmission or distribution system arising solely from the interconnection, the Code required the electrical corporation upgrades the system before the interconnection.
- The costs of the upgrades are borne by the eligible customer-generator.

5.3.6. Installation, grid interconnection, maintenance and operations

- The consumer is responsible for procuring and installing a bi-directional meter.
- All meters are required to provide “time-of-use” measurements of electricity flow.
- A consumer with multiple meters may choose to aggregate the electrical load of the meters located on the property where the renewable electrical generation facility is located and, on all property, adjacent or contiguous to the property on which the renewable electrical generation facility is located, if those properties are solely owned, leased, or rented by the consumer. A consumer may only elect to aggregate the electrical load of multiple meters if the renewable electrical generation facility, or a combination of those facilities, has a total generating capacity of not more than 1 MW.
- If the consumer chooses to aggregate the electric load, the electric utility uses the aggregated load for the purpose of determining whether a consumer is a net consumer or a net surplus prosumer during a 12-month period.

5.3.7. Monitoring and control

On an annual basis, every electric utility is required to avail certain information to the ratemaking authority. The ratemaking authority is a body responsible for setting the rates of electricity utility which is either the CPUC in the case of an electrical corporation or a body

selected by shareholders or members in the case of an electrical cooperative or a local elected body in the case of a local publicly owned utility. The information which is availed is in respect to:

- The total rated generating capacity used by eligible customer-generators that are customers of that provider in the provider's service area
- The net surplus electricity purchased by the electric utility.

5.3.8. Costs, tariffs and billing

- The net energy metering calculation is made by measuring the difference between the electricity supplied to the consumer and the electricity generated by the consumer and fed back to the electrical grid over a period of 12 months.
- Any net monthly consumption of electricity is calculated according to the terms of the contract or tariff to which the same customer would be eligible for if the customer was not an eligible prosumer.
- If the same customer-generators are net generators over a billing period, the net kWh generated is valued at the same price per kWh as the electric utility would charge for the baseline quantity of electricity during that billing period, and if the number of kWh generated exceeds the baseline quantity, the excess is valued at the same price per kWh as the electric utility would charge for electricity over the baseline quantity during that billing period.
- For all eligible residential and small commercial prosumers and for each billing period, the net balance of moneys owed to the electric utility for net consumption of electricity or credits owed to the prosumer for net generation of electricity are carried forward as a monetary value until the end of each 12-month period.
- For all eligible commercial, industrial, and agricultural prosumers, the net balance of moneys owed are paid in accordance with the electric utility's normal billing cycle, except that if the eligible prosumer is a net electricity producer over a normal billing cycle, any excess kWh generated during the billing cycle is carried over to the following billing period as a monetary value, and appear as a credit on the prosumer's account, until the end of the annual period.
- At the end of each 12-month period, for a net surplus prosumer, the electric utility upon an affirmative election by the net surplus prosumer, shall either (a) provide net surplus electricity compensation for any net surplus electricity generated during the prior 12-month

period, or (b) allow the net surplus prosumer to apply the net surplus electricity as a credit for kWh subsequently supplied by the electric utility to the net surplus prosumer. For an eligible prosumer that does not affirmatively elect to receive service pursuant to net surplus electricity compensation, the electric utility shall retain any excess kWh generated during the prior 12-month period. The eligible prosumer not affirmatively electing to receive service pursuant to net surplus electricity compensation shall not be owed any compensation for the net surplus electricity unless the electric utility enters into a purchase agreement with the eligible prosumer for those excess kWh.

- A prosumer who chooses to aggregate their load are ineligible to receive net surplus electricity compensation.
- If an eligible prosumer with multiple meters elects to aggregate the electrical load of those meters and different rate schedules are applicable to service at any of those meters, the electricity generated by the renewable electrical generation facility is allocated to each of the meters in proportion to the electrical load served by those meters.
- An eligible prosumer who chooses to aggregate the electrical load of multiple meters should remit service charges to the electric utility that provides service to the meters, for the cost of providing billing services.
- The ratemaking authority is responsible for establishing the net surplus electricity compensation valuation to compensate the net surplus customer-generator for the value of net surplus electricity generated by the consumer. In determining the valuation amount, the ratemaking authority will consider:
  (a) the value of the electricity itself;
  (b) the value of the renewable attributes of the electricity; and
  (c) the ratemaking authority shall ensure that the rate does not result in a shifting of costs between the consumer and other bundled service consumers.

5.3.9. Carbon credits

The consumer is entitled to the value of any credits or financial benefits which are available or may become available for reductions of "greenhouse gas" emission earned from the generation of energy by any renewable energy source.

5.4. New Delhi

5.4.1. Legal Framework

The foundation of net metering in India was based on the need to increase energy generation capacity from renewable sources. The implementation of the net metering initiatives was initiated in 2005 when the Ministry of Energy formulated the National Electricity Policy aimed at adding new generation capacity and enhancing availability of electricity. Subsequently, in the 2016 Tariff Policy, the Ministry of Power recommended the fixing of a minimum percentage of the total consumption of electricity in the area of a distribution licensee for purchase of energy from renewable energy sources, taking into account availability of such resources and its impact on retail tariffs. The Tariff Policy further recommended that all State Electricity Regulatory Commissions should purchase a minimum of 8% of the total consumption energy from renewable sources, excluding hydro power.

Section 181 read with Sections 61 and 86(1) (e) of the Electricity Act, 2003 (Act 36 of 2003) and all other powers enabling it in this behalf, the Delhi Electricity Regulatory Commission made the Delhi Electricity Regulatory Commission (Net Metering for Renewable Energy) Regulations, 2014 which regulate Net Metering and grid connectivity for Renewable Energy Generator (Delhi Electricity Regulatory Commission, 2014).

At national level, on the other hand, section 176 of the Electricity Act (Act 36 of 2003) allows the Central Government of India to make rules for carrying out the provisions of the Electricity Act. In line with this power, the Central Government of India subsequently passed the Electricity (Rights of Consumers) Rules 2020 (Central Government of India, 2020). In April 2021, the Rules 2020 were amended to include provisions regulating net metering (Ministry of Power, 2021).

5.4.2. Application

- The Regulations apply to consumers who are buyers of energy/electricity from the distribution licensee in its area of supply and the distribution licensee.

5.4.3. Eligible RE sources

- The Delhi Electricity Regulatory Commission (Net Metering for Renewable Energy) Regulations, 2014 do not specify the type of renewable energy sources which are eligible for net metering. The renewable energy sources are limited to the renewable Energy sources which are recognized by Ministry of New and Renewable Energy (MNRE) including solar energy, wind, and hydro power among others, or any other agency as may be notified by Government of India/Commission are eligible.

5.4.4. Generation capacity limits

The capacity of Renewable Energy system to be installed at any premises is subject to:

i) the feasibility of interconnection with the grid;

ii) the available capacity of the service line connection of the consumers of the premises; and

iii) the sanctioned load of the consumer of the premises.

5.4.5. Application to enter into a net metering system agreement

- The prosumer is required to submit the application to connect the Renewable Energy system to the distribution system to the concerned Distribution Licensee.

5.4.6. Installation, grid interconnection, maintenance and operations

- The requirement for the Net Meter is defined as either one bi-directional meter or two meters, one each for recording the net import and net export of electricity.
- The Renewable Energy Meter[14] and the Net Meter at the premises of the consumer are procured and installed by the Distribution Licensee. Alternatively, the consumer of the premises may procure the Net Meter and present it to the distribution licensee for testing and installation.
- The cost of Renewable Energy Meter is borne by the distribution licensee and the cost of Net Meter is borne by the consumer of the premises.
- The Renewable Energy Generator may install grid interactive Renewable Energy system with or without battery backup.

5.4.7. Costs, tariffs and billing

- If during any billing period, the exported units exceed the imported units, such surplus units injected by the consumer is carried forward to the next billing period as energy credit and is shown as energy exported by the consumer for adjustment against the energy consumed in subsequent billing periods within the settlement period.

[14] Unidirectional energy meter, used solely to record the renewable energy generation from the Renewable Energy System

- During any billing cycle, the distribution licensee raises invoice for the net electricity consumption, as per applicable tariff, only after adjusting/ netting off of the unadjusted energy credits of the previous billing cycle(s). The surplus energy measured in kWh is utilized to offset the consumption measured in kWh only unless otherwise allowed by the Commission from time to time.
- At the end of each Financial Year, any net energy credits, which remain unadjusted, are paid for by the distribution licensee to the consumers as per the rates notified by the Commission from time to time.
- There are no deemed generation charges payable to the Renewable Energy Generator or consumer of the premises.

5.5. Bangladesh

The Government of Bangladesh pledged to bring all the citizens within the reach of electricity access. Thus, to ensure universal electricity access and energy security, the Power Division took fuel diversification to be one of its major strategies. The Renewable Energy Policy of Bangladesh had targeted to generate 10% of the total electricity i.e., 2,000 MWh from renewable sources by the year 2020.

To encourage distributed generation based on renewable energies, steps were taken to introduce net metering system. To avail the net metering facility to the on-grid consumers and encourage them to install renewable energy generation systems, the Power Division took steps to develop and launch Net Metering Guideline - 2018 (Sustainable and Renewable Energy Development Authority, 2018).

5.5.1. Legal Framework

The guideline was launched on an experimental basis and is not anchored in law. The guideline was prepared to promote renewable energy through installation of rooftop solar systems and to utilize the electricity generated at the consumer premise through net metering arrangement.

5.5.2. Application

The Net Energy Metering Agreement is between Utility Company and Consumer.

5.5.3. Eligible RE sources and consumers

- All renewable energy sources are eligible.

- Any three-phase consumer who is either a residential, commercial or industrial consumer is considered eligible for the net metering system.
- A consumer is considered eligible if they are current customer of the Utility that is responsible for the supply of electricity in the area.
- The applicant should not have any outstanding arrears prior to making the application
- The applicant must either be the legal owner or have the legal permission from the owner(s) or their legal representative(s) for installing the proposed renewable energy system in the premise.

5.5.4. Generation capacity limit

- The maximum permissible generator size is 70% of the customer's sanctioned load.
- The maximum output AC capacity of the installed RE system for NEM cannot be more than 3 MW.
- In case of a medium-voltage[15] (MV) consumer, the installed capacity of the renewable energy system cannot be more than 70% of the rated capacity of the distribution transformer or cumulative capacity of the distribution transformers.

5.5.5. Application to enter into a net metering system agreement

- The eligible consumer applies in writing for a net metering agreement to the Utility.
- The Utility is required to issue the NEM approval within ten (10) working days, starting from the submission date of the application.

5.5.6. Installation, grid interconnection, maintenance and operations

- The NEM consumer is required to complete all the tasks installing the renewable energy system including the NEM system within eight (8) months of receiving the NEM approval.
- If the distribution Utility's system has to undergo any modification (e.g., up rating cable, fuse, switchgear, and transformer and protection scheme) to install the consumer's renewable energy system, the NEM applicant bears all incurred costs.

[15] 1 kV < V ≤ 33 kV

- A single three-phase bidirectional smart meter is required for net metering.
- In case of eligible consumers who fall under the different tariff metering scheme, smart meter capable of recording electricity consumption and generation during peak and off-peak hours separately need to be installed.
- The Utility is responsible for procuring, testing, installing, maintaining and reading the net meters.
- The cost of the meters and other relevant costs are borne by the consumer.
- The renewable energy system is required to operate within the steady state voltage limits ±10%.
- The maximum voltage fluctuation range allowed for LV and MV due to varying renewable energy sources is 6%.
- The consumer is obliged to use a smart inverter.

5.5.7. Costs, tariffs and billing

- If the amount of imported and exported electricity is equal, then the prosumer pays the demand charge and other fixed charges only.
- If during any billing period the prosumer is a net importer, the utility bills for the net electricity consumption by the prosumer after adjusting the carry over units (if any) from the previous billing cycle of the same settlement period along with the demand charges and other fixed charges.
- If during any billing period the prosumer is a net exporter, after adjusting the carry over units (if any) from the previous billing cycle of the same settlement period, the excess kWh are carried over to the next billing period. The prosumer should pay for the demand charge and other fixed charges.
- Any credited electricity units are carried over to the next billing period for a maximum period of 12 months (settlement period).
- The settlement period is the end of each fiscal year and all the credits should be adjusted or compensated in the last month (June) of the settlement period.
- At the end of settlement period, if the prosumer is a net exporter of electricity, then the Utility pays the prosumer for the net exported amount of electricity at bulk purchase rate (tariff) for 33 kV lines set by Bangladesh Energy Regulatory Commission (BERC).
- For prosumers whose electricity consumption during peak and off-peak hours are separately recorded, the off-peak units are adjusted first and then the peak hour consumption are adjusted later.

5.6. Sri Lanka

The Soorya Bala Sangramaya Project was formulated to promote installation of small solar power plants on the rooftops of households, religious places, hotels, commercial establishments, and industries with a target to add 1,000 MW of solar electricity to the national grid by 2025 and 1,500 MW by 2030.

Ceylon Electricity Board (CEB) offers the Energy Banking Facility for microscale generating facilities. The scheme allows any electricity consumer whose contract demand is not more than 1,000 kVA and connected to CEB LV distribution network to install a renewable energy-based electricity generating facility and connect it to the CEB's electricity network.

5.6.1. Legal Framework

The "Soorya Bala Sangramaya" (A Sinhala term meaning "Battle for solar energy") is a community based solar electricity generation programme launched on 6 September 2016 by the Ministry of Power and State Minister of Solar, Wind and Hydro Power Generation Projects Development in collaboration with Sri Lanka Sustainable Energy Authority (SLSEA), Ceylon Electricity Board (CEB) and Lanka Electricity Company (Private) Limited (LECO). CEB is the sole company in charge of electricity generation, transmission, distribution, and retailing in Sri Lanka.

Although the "Soorya Bala Sangramaya" a collaborating effort through the public bodies to promote the popularity of solar energy is a government project, there is no legislation or rules setting out the framework. However, there is a net energy metering manual that guides the arrangement (Ceylon Electricity Board, 2014).

5.6.2. Application

The Net Energy Metering Agreement is between CEB and a Producer.

5.6.3. Eligible RE sources

- The eligible RE sources include micro hydro, wind, solar PV, biomass, agricultural and municipal waste.

- The entire generating capacity must be located within the Producer's premises and shall be owned by the Producer.

5.6.4. Generation capacity limit

There is no set capacity for the generating facilities. However, the capacity of the generating facility should not exceed the allocated capacity set out in the electricity agreement between the consumer and CEB.

5.6.5. Application to enter into a net metering system agreement

- The agreement for net metering, net accounting, and net plus is between CEB and a consumer who owns a valid account receiving electricity from CEB distribution network.
- The agreement is valid for 20 years.

5.6.6. Installation, grid interconnection, maintenance and operations

- A voltage and frequency sensing and time delay function to prevent the generating facility from energizing a de-energized distribution system circuit and to prevent the generating facility from reconnecting with CEB distribution system unless CEB distribution system service voltage is within ±6% of the nominal supply voltage and frequency is within 47 Hz to 52 Hz and are stable for at least 3 minutes.
- The generating facility shall cease to energize CEB distribution system for faults on CEB distribution system circuit to which it is connected.
- The generating facility shall be automatically disconnected from the CEB distribution network within 0.5 second when the CEB supply is intentionally or automatically switched off.
- The producer shall furnish and install a ganged manually operated isolating switch near the point of common coupling (PCC) to isolate the generating facility from CEB distribution system.
- Net metering is via bi-directional meter.
- CEB installs the meters and metering equipment to implement Net Energy Metering.
- Initial metering cost is borne by the Producer.

5.6.7. Costs, tariffs and billing

- If the electrical energy supplied by CEB exceeds the electricity exported by the Consumer plus any energy credits carried-over from the previous Billing Period, the charges for the net energy (kWh) consumed are calculated using the Producer's applicable tariff. The fixed charge and/or the minimum charge applicable for the installation are also applicable.
- If the electricity exported by the Producer plus any energy credits carried-over from the previous Billing Period exceeds the electrical energy supplied by CEB, the Producer is billed only for the applicable fixed charge and/or the minimum charge. The balance of the electricity generated is carried over to the next Billing Period and appear as an *energy credit, stated in kilowatt hours*.
- Energy credits may be carried over from one Billing Period to another, for so long as the Consumer has a legal contract for the supply of electricity by CEB, and during the Term of the Agreement.
- In case the Producer's electricity account and/or premises contract is terminated for whatever reason, any accumulated energy credits on the last day of such termination are granted to the CEB with no financial compensation to the Producer.
- Energy credits are not transferable.
- No rebate or credit is given for maximum Demand.

5.7. Ghana

5.7.1. Legal Framework

The Net Metering Sub-Code (Energy Commission, 2015) in accordance with provisions of the Renewable Energy Act 2011, Act 832 which provides for the development, management, utilisation, sustainability and adequate supply of renewable energy generation of heat and power and for related matters.

The objective of net metering in Ghana was premised on encouraging electricity consumers to supplement their purchase of electricity with grid-connected renewable energy self-generation.

Under the net metering billing mechanism, renewable energy generation facility owners are credited for electricity the facility supplies to the grid, and this credit is set off against electricity purchased from the Distribution Utility.

Although the Net Metering Sub-Code states that net metering is not designed to be an income generating mechanism for the renewable energy generation facility owner, the incentive of the renewable energy generation facility owner in net metering is generally power cost reduction or climate change mitigation.

5.7.2. Application

A Customer-generator and the Distribution Utility are required to enter into a Connection Agreement that is consistent with the net metering Sub-Code.

5.7.3. Eligible RE sources

- The eligible RE sources include Solar, wind, hydro, biomass, bio-fuel, landfill gas, sewage gas, geothermal energy, ocean energy.

5.7.4. Generation capacity limit

The total generating capacity of a net-metered facility is limited to 200 kW per installation.

5.7.5. Installation, grid interconnection, maintenance and operations

- The Prosumer is responsible for protecting its equipment in such a manner that faults or other disturbances in the Supplier's distribution network does not cause damage to Customer-generator's equipment.
- The Prosumer should ensure the automatic disconnection of the generation facility from the Supplier's distribution network, in the event of a power outage in the Supplier's distribution network or any abnormal operation of the Supplier's distribution network.
- Inverters of solar PV systems larger than 13.8 kVA should be of balanced three-phase type and inverters up to 13.8 kVA can be of single-phase type.
- A customer with a multiphase connection is required to split the Net-Metered Generating Unit in a balanced manner over all phases if the Net-Metered Generating Unit is larger than 4.6 kVA.
- The continuous voltage range of operation of a Net-Metered Generating Unit should be within ±10% of the rated voltage.
- The Net-Metered Generating Unit should operate at unity power factor or at least at a power factor of greater than 0.98.
- Bi-directional meters are to be used for metering.

- Distribution Utility provides, installs, and maintains the bi-directional meter and metering equipment.
- The initial metering cost is borne by the Producer.
- The prosumer submits net metering application to the Distribution Utility.

5.7.6. Costs, tariffs and billing

- A Prosumer receives a credit of 1 kWh in the billing period for every kWh exported in excess of its consumption.
- Any excess kWh credits earned by a Prosumer are carried over and applied to subsequent billing periods to offset the Customer-generator's consumption in those billing periods until the end of the Calendar year after which they lapse.
- All taxes, levies and charges approved by the Public Utilities Regulatory Commission are paid by the Prosumer based on its total electricity consumption from the Distribution Utility; the excess kWh credits cannot be used to defray any fixed monthly Customer charges or levies or taxes.

5.7.7. Monitoring and control

- The Distribution Utility is required to submit an annual Net Metering report to the Energy Commission by 31st March of each year, that includes the following information for the previous calendar year:
  i) Total number of Net-Metered Prosumer facilities, by resource type
  ii) Total rated generating capacity of Net-Metered Prosumer facilities, by resource type
  iii) Total number of kWh received from Net-Metered Prosumers.
  iv) Total estimated amount of kWh produced by Net-Metered Prosumers.

5.8. Tanzania

5.8.1. Legal Framework

The legal framework for net metering in Tanzania is governed by the Electricity (Net-Metering) Rules, 2018 made under sections 45 and 46 of the Electricity Act (CAP.131).

5.8.2. Application

The Rules apply to activities in relation to net-metering of electricity in Tanzania Mainland. The interconnection agreement for net-metering for generating facilities less than 1 MW is between a Customer and the Distribution Network Operator (DNO).

5.8.3. Eligible RE sources

Any facility that generates electricity using a fuel source derived from renewable resources.

5.8.4. Generation capacity limit

- A nominal generating capacity of less than 1,000 kW.
- Total rated generating capacity owned and operated by net-metering customers within a utility's service area should not exceed 5% of the highest peak load during the previous calendar year. However, the utility may offer net-metering beyond this limit if it deems it necessary.

5.8.5. Application to enter into a net metering system agreement

- The Net-Metering Facility may be owned or leased by the Customer and the Customer is not precluded from contracting for the lease, operation or maintenance of a Net-Metering Facility with a third party.
- Agreement remains in effect for twenty (20) years.
- The Customer is required to procure and maintain an insurance cover for personal injury and property damage arising from operations of the Net Metering facility and the insurance cover forms part to the Agreement.

5.8.6. Installation, grid interconnection, maintenance and operations

- The Prosumer is responsible for protecting its equipment.
- Bi-directional meter for net metering.
- The DNO installs, owns, and maintains at its sole expense all kilowatt hour meter(s) and associated equipment; the Customer provides at its own expense adequate facilities necessary for the installation of the meter(s) and associated equipment.

5.8.7. Costs, tariffs and billing

- The net-metering customer shall receive kWh credits, or fraction thereof, for the energy that it exports to the DNO.
- Depending on the customer tariff category, the net-metering customer is billed the net energy and other charges such as service and demand charges during the applicable billing period.
- If the prosumer is a net energy importer during the billing period, the net-metering customer is billed for the net kWh supplied by the DNO in accordance with the existing effective tariff schedule approved by the Authority.
- If the prosumer is a net energy exporter during the applicable billing period, the DNO credits the net-metering customer with any accumulated net excess generation in the next applicable billing period.
- Any excess kWh credits earned by a customer are carried over and applied to subsequent billing periods to offset the customer's consumption in those billing periods
- The credits expire after 3 years or in the event that the customer terminates service with the network operator.
- Subject to approval by the Authority, the network operator is allowed to prescribe a fixed monthly service charge to be paid by each net-metering customer for each customer's tariff category.
- There is no monetary payment made from the network operator to the customer.

5.8.8. Monitoring and control

A DNO is required to submit records and reports on quarterly basis to the Authority by the 15th day of each quarter. The report should contain the following information:

i) Total number of net-metering customers served by a DNO;
ii) Type and capacity of each net-metering facility by the net-metering customers;
iii) Energy recorded by the import and export registers of each bi-directional meter.

5.8.9. Carbon credits

Any renewable energy credit created as a result of electricity supplied by a net-metering facility is the property of the net-metering customer that generated the renewable credit.

5.9. Stellenbosch Municipality

5.9.1. Legal Framework

The Electricity Regulation Act Number 4 of 2006 was enacted to, among other objectives, achieve the efficient, effective, sustainable, and orderly development and operation of electricity supply infrastructure in South Africa. The Electricity Regulation Act established the National Energy Regulator of South Africa (NERSA) which is mandated to issue rules designed to implement the national government's electricity policy framework. In line with its mandate, NESRA issued the "Standard Conditions for Small Scale (less than 100kW) Embedded Generation with Municipal Boundaries" on 22 September 2011. The Standard Conditions for Small Scale (less than 100kW) Embedded Generation with Municipal Boundaries requiring municipalities to register and maintain a database of all small-scale embedded generation of less than 100 kW within their area. Various municipalities have developed their own guidelines and regulations for Small-Scale Embedded Generation (SSEG).

Section 3(3) of Stellenbosch Municipality's Electricity Supply By-Law, PN 8497 of 28 September 2021 states that no person may generate electricity by way of a fixed installation and into a municipal network unless an agreement has been concluded with the municipality, and such agreement together with the provisions of the guidelines, as well as any other legislation governing the licensing of generators, shall govern such generation of electricity.

5.9.2. Application

The guidelines apply to all customers who wish to install SSEG systems with a generation capacity less than 1 MW and connect to the municipal electrical grid including the Stellenbosch Municipality.

5.9.3. Eligible RE sources and consumers

- Renewable energy and cogeneration
- Residential, commercial, and industrial customers.

5.9.4. Generation capacity limit

- SSEG system with generation capacity smaller than 1 MW.
- Customers are allowed to generate to the maximum of their service circuit breaker or Notified Maximum Demand (NMD) and the rated loading of the service cable.

5.9.5. Application to enter into a net metering system agreement

- SSEG who are net importers are classified as generators “for own use” and do not require a generating license from the NERSA.

5.9.6. Installation, grid interconnection, maintenance and operations

- The customer pays for any changes required to the municipal electrical grid upstream of the connection point as a result of the SSEG installation
- Bi-directional meter for net metering.
- The Municipality provides and installs the requisite meters at the customer’s cost.

5.9.7. Costs, tariffs and billing

- All SSEG installations are required to consume more energy than they produce on a consecutive 12-month period.
- Residential customers who have excess generation to regularly require the facility to feed excess power back onto the municipal electrical grid qualify for the SSEG tariff. The tariff comprises of a daily service, network and meter reading charge, electricity consumption charges for kWh consumed, and a rate per kWh at which the Municipality shall purchase residential excess generation.

The salient features of the net metering programmes in other jurisdictions are presented in Table 5.1.

Table 5.1:Summary of salient features of NEM programmes in other jurisdictions

Jurisdiction	***Eligibility***	***Capacity Limits***	***Costs and Tariffs***	***Metering***
Malaysia	▪ Solar PV ▪ Domestic consumer & government agencies	▪ Domestic *(1-phase ≤4kW, 3-phase ≤10 kW)* ▪ Government agencies *(≤1 MW) and subject to* a. LV: ≤60% of fuse rating b. MV: 75% of Maximum Demand ▪ Total capacities *(Up to 100MW for each of the 2 categories)*	▪ Energy exported offsets part of electricity bill ▪ Cost of exported and imported energy is based on prevailing gazetted Energy rate. Imported energy attracts Sale and Service Tax and pass-through charges ▪ Credit roll-over for up to 1 year, forfeited if lasts more than that ▪ NEM contract is 10 years thereafter, no energy export.	▪ Bi-directional meter and cost borne by the consumer ▪ Meter supplied and installed by Distribution Licensee
California	▪ Biomass, solar thermal, PV, wind ▪ Residential, small commercial, industrial, agricultural, Department of Corrections and	▪ Less than 1 MW[16] ▪ Prior to 01/07/2017, the capacity limited 5% of the aggregate customer peak demand ▪ After 01/07/2017, no limitation	▪ The customer pays for net electricity consumed at the rate that could have been applied before. ▪ Surplus generation calculated using the consumers	▪ Bi-directional meter procured and installed by consumer ▪ Must provide "time-of-use" measurements ▪ Load aggregation for meters on the property with REGS

[16] Residential, commercial, industrial, or agricultural

Jurisdiction	*Eligibility*	*Capacity Limits*	*Costs and Tariffs*	*Metering*
	Rehabilitation, US Armed Forces base or facility		applicable tariff at the end of billing cycle. ▪ Credit roll-over as a monetary value to next billing cycle allowed up to 1 year	and adjacent or contiguous ones solely owned/ leased/ rented by the consumer allowed
New Delhi	Renewable Energy sources recognized by MNRE	Subject to: ▪ the feasibility of interconnection with the grid ▪ Available service line capacity ▪ consumer sanctioned load	▪ Customer pays for net consumption as per applicable tariff ▪ Energy credit roll-over to next billing cycle allowed up to 1 year ▪ At the end of the FY, distribution licensee pays consumer for any net energy credits at rates notified by the Commission	▪ One bi-directional meter or two meters *(for export and import)* ▪ Net meter installed by distribution licensee ▪ Cost of net meter met by consumer
Bangladesh	▪ All renewable energy sources ▪ 3-phase residential, commercial or industrial consumer	▪ 70% of the customer's sanctioned load and not more than 3 MW ▪ MV consumer – not more than 70% of the rated capacity of the distribution transformer	▪ Customer pays for extra consumption as per applicable tariff. ▪ Credit roll-over to next billing cycle allowed up to 1 year ▪ The consumer must pay the demand charge and other fixed charges when the net is zero or net export ▪ If at the end of a financial year a prosumer is a net exporter, the Utility pays the prosumer for the net exported amount of electricity at bulk purchase rate	▪ Three-phase bi-directional smart meter is required for net metering ▪ Utility responsible for procurement, installation, and maintenance of net meter ▪ Consumer meets cost of net meter and other relevant costs.

Jurisdiction	*Eligibility*	*Capacity Limits*	*Costs and Tariffs*	*Metering*
Sri Lanka	▪ Most Renewable energy resources ▪ Total generating capacity must be located within the Producer's premises ▪ Generating system must be owned by the Producer	▪ No set capacity for the generating facilities ▪ Not to exceed the allocated capacity set out in the electricity agreement between the consumer and utility	▪ Net energy consumed charged using the Producer's applicable tariff ▪ Fixed charge and/or the minimum charges are applicable even when net export ▪ Energy credits may be rolled over to next Billing Period so long as the Consumer has a legal electricity supply contract ▪ Energy credits are not transferable	▪ A bi-directional meter for net metering ▪ Meter installed by the utility ▪ Initial metering costs paid for by the Producer.
Ghana	Most RE sources	Limited to 200 kW per installation	▪ A Prosumer receives a credit of 1 kWh for every kWh exported ▪ Credit roll-over to next billing cycle ▪ Any accumulated credits lapse at the end of calendar year ▪ All taxes, levies and charges approved by the Regulator are applicable to total electricity consumed from utility	▪ Bi-directional net meter ▪ Utility install and maintain meter ▪ Initial metering cost paid for by the producer.
Tanzania	Generation from renewable resources	▪ Less than 1 MW ▪ Net-metering customers within a utility's service area should not exceed 5% of the	▪ Customer shall receive kWh credits, or fraction thereof, for the energy exported	▪ Bi-directional net meter ▪ Utility installs, owns, and maintains net meter

Jurisdiction	*Eligibility*	*Capacity Limits*	*Costs and Tariffs*	*Metering*
		highest peak load subject to utility's judgement	▪ Prosumer billed for net energy consumed using existing effective tariff schedule ▪ Credit roll-over to next billing cycle allowed, expiry period is 3 years ▪ Demand and other fixed charges are applicable ▪ Subject to approval by the Authority, the network operator may prescribe a fixed monthly service charge to be paid by each net-metering customer ▪ No monetary payment made from the network operator to the customer	▪ Customer provides all associated equipment at their own cost
Stellenbosch Municipality	▪ RE and cogeneration ▪ Residential, commercial, and industrial customers	▪ Less than 1 MW ▪ Limited to service CB or NMD and the rated loading of the service cable	▪ Installations are required to consume more energy than they produce in 12 consecutive months ▪ Surplus exports are compensated after service and other charges at an SSEG approved rate.	▪ Bi-directional net meter ▪ Municipality provides and installs the meters at the customer's cost

From the comparative review, the policy justification for net-metering is based on a number of factors these include provision of additional generating capacity, increasing electricity access, increasing energy security, reducing dependence on non-renewable energy sources, reducing greenhouse gases emissions from power generation, increasing the share of renewable energy sources in the electricity mix, encouraging and supporting the development of renewable or clean distributed generation, and to enhancing power reliability. The drivers behind the development of net metering policies include specification in legislation, initiatives of the electricity regulator in response to a government order, regional government/ municipalities, and utilities.

The main renewable energy sources that are used for electricity generation are solar energy, wind energy, hydro, biogas, biomass, geothermal, wave and tidal energy. However, in most countries, most of the net-metering systems are solar PV installations. Ideally, the renewable energy system should just meet the consumer's energy needs. However, due to variability in load demand and/or the renewable energy resource, there may be excess energy generation which is banked in the grid through a net-metering scheme.

From the comparative review, the following salient points emerge:

a) Legislative framework

The enacted frameworks, target to promote the update of renewable energy technologies. Initially, countries would start with ambitious targets anchored in their policies to use renewable energy. However, failure to meet these targets based on short-term milestones, pushed the countries to resort to innovative ways of popularizing renewable energy such as net metering.

The net metering frameworks were either based on an elaborate codified system with binding provisions or guidelines that allow parties the freedom to contract. Where elaborate laws exist, the laws regulate the relationship between the prosumer and the distributor. This is similar to what is being proposed in Kenya.

Guidelines were common in jurisdictions where a decentralized system of distribution of power with numerous distributors. An illustration of this was in such as South Africa and India which utilize a legislative framework that acts as guidelines to allow the distributor the freedom to contract since there may be different licensing requirements for the different distributors.

In Kenya, we recommend the adoption of regulations that provide requirements guiding the relationship between prosumers and the distribution/retail licensees.

b) Eligibility

i) Prosumer

The eligibility of consumers who participate in net metering programmes differ from one jurisdiction to another. The participants range from domestic, commercial, industrial, institutional and government premises. However, it is unanimous the individual persons being consumers of electricity are allowed to participate in the net metering schemes as long as they meet the requirements set out in the legal framework. In the net metering regulations for Kenya for Kenya, we recommend that the framework covers residential, commercial and industrial customer supplied by a distribution licensee is eligible.

ii) Renewable energy sources

In the reviewed case studies, the net metering frameworks applied to RETs including solar PV, wind, biomass, and hydro power. However, in the Malaysia case study, net metering was only for solar PV. Stellenbosch unlike the other case studies included cogeneration. The choice of eligible RE sources was influenced by renewable energy resource availability. In the Kenya's case, we propose recognition of biomass, geothermal, small hydropower, solar, wind, solid urban waste and biogas in the net metering system. This is considering the resources are available in most parts of the country.

c) Power generation capacity

Malaysia, Stellenbosch Municipality, California, and Tanzania allow consumer generation systems with installed capacity not exceeding 1 MW to enter into net metering agreements. Further, the limit in Ghana is 200 kW whereas in Bangladesh it is 3 MW. California and Sri Lanka have no set limit whereas in New Delhi, the capacity is dependent on the available service line capacity and the consumer sanctioned load. In Kenya, we recommend two tier capacity control. First, the capacity be limited to the prosumer consumption and secondly, with an upper limit of 1MW set in of the Act.

d) Net metering agreement

All the benchmarked jurisdictions require the prosumer and utility to sign an agreement setting out the terms of the net metering arrangement. Some have a standard form of the agreement as part of the framework. The other jurisdiction afford the parties the freedom to draft their own contracts. However, to reduce the time of roll out from when a party experience interest and when the contract is signed, we have provided a standardized template for net-metering agreement as part of the proposed regulations.

e) Metering

For all the benchmarked jurisdictions except New Delhi, a bi-directional meter is required; in New Delhi two meters option is acceptable. Some jurisdictions have smart bidirectional meters. In addition, the cost of the meter and the installation are borne by the prosumer in all the benchmarked jurisdictions except Tanzania where the utility owns the meter. The meters are often provided by the Distribution Licensee/retailer but paid for by the prosumer. The regulator may approve the costs charged for the meter as prudent. In the net metering regulations for Kenya for Kenya, we recommend use of bidirectional meters.

f) Costs and tariffs

The nature of net metering in most of the benchmarked jurisdictions allows compensation of surplus energy through either offsetting the energy or the bill. For example, in Malaysia, the cost of imported energy is based on the prevailing gazetted energy rate and also attracts taxes and pass-through charges whereas the cost of exported energy is only based on the energy rate. In New Delhi, Bangladesh, Sri Lanka, and California, the customer pays for the net consumption as per the applicable tariff. In some jurisdictions, the consumer must pay demand charge and other fixed charges even when there is net zero or energy export. Energy credit roll over to the next billing cycle is allowed in all the benchmarked jurisdictions with maximum roll-over duration of 1 year. It is only Tanzania where the roll-over duration was 3 years while in Sri Lanka, the credits can be rolled over for the life of the supply contract. In California, the credit is rolled over as a monetary value. In Malaysia and Ghana, the energy credits are forfeited at the end of the roll-over period; in New Delhi, Bangladesh, and Stellenbosch Municipality, the utility pays the prosumer for net exported energy.

g) Incentives

Compensation for the surplus energy produced by a prosumer is one of the key incentives for considering net metering. However, there are other non-monetary incentives offered in some jurisdictions such as exempting self-generating facilities from the bureaucratic licensing and registration requirements in South Africa, and entitlement of prosumers to carbon credits or similar benefits for greenhouse gas emissions in California. Exempting licence requirements and allocating ownership of carbon rights to the prosumer is a welcome non-monetary incentive which Kenya seeks to adopt.

h) Novel concepts

Net metering laws in some jurisdictions contain some additional novel concepts. We have recommended Kenya to adopt the following novel concepts the Draft Regulations:

i) *Load aggregation*: California has extended net metering to prosumers with multiple meters within the same premises such as apartment blocks. This may be beneficial in the Kenyan situation as it would encourage residential and commercial developers to include net metering systems in large scale developments as incentive to purchasers and tenants.

CHAPTER SIX

LEGAL REQUIREMENTS AND REVIEW OF DRAFT REGULATIONS

6.1. Compliance of the Regulations with the Kenya Constitution and Energy Act

The proposed Regulations were examined in light of the provisions of the Constitution of Kenya (GOK, 2010), the Statutory Instruments Act (Number 23 of 2013), and the Energy Act (Number 1 of 2019) (GOK, 2019) to determine: -

a) whether the Authority has the power to make the regulations, and;
b) whether the Draft Regulations are not *ultra vires* of the functions and powers of the Authority as set forth in the Energy Act; and
c) the process employed in making the proposed regulations as laid down under the Statutory Instruments Act.

6.1.1. Powers of the Authority to Make the Regulations

The Constitution of Kenya (the "Constitution") limits the power to make any provision having the force of law to Parliament or an authority conferred such power under the Constitution or by legislation. Article 94 (5) of the Constitution provides as follows:

"*No person or body, other than Parliament, has the power to make provision having the force of law in Kenya except under authority conferred by this Constitution or by legislation*."

Additionally, Article 94 (6) of the Constitution provides that "*Act of Parliament, or legislation of a county, that confers on any State organ, State officer or person the authority to make provision having the force of law in Kenya, as contemplated in clause (5), shall expressly specify the purpose and objectives for which that authority is conferred, the limits of the authority, the nature and*

scope of the law that may be made, and the principles and standards applicable to the law made under the authority."

Accordingly, therefore any entity purporting to promulgate a regulatory instrument can only do so on the basis of explicit authority granted under the Constitution or an act of parliament. In this instance, the statutory underpinning for the making of the Regulations can be found in the Energy Act, 2019.

Section 162 (3) of the Energy Act makes provision for net metering and defines net-metering as: "*a system that operates in parallel with the distribution system of a licensee and that measures, by means of one or more meters, the amount of electrical energy that is supplied:*

a) by the distribution licensee or retailer to a consumer who owns the renewable energy generator; and

b) *by the consumer who owns the renewable energy generator to the distribution licensee or retailer.*"

Section 162 (2) envisions the making of regulations for net-metering which prescribe the modalities putting into effect the requirement that "*each distribution licensee or retailer shall upon application, make available net metering service to any electricity consumer that the licensee serves".*

Section 162 (1) allows for net-metering under the following parameters:

a) *Capacity*: the consumer must own an electric power generator of a capacity not exceeding one megawatt (1 MW);

b) *Agreement*: the consumer and a distribution licensee or retailer, who serves the consumer, will enter into a net-metering system agreement to operate a net-metering system; and

c) *Location*: the consumer must have a generation facility located in the area of supply of the distribution licensee or retailer.

Section 198 of the Energy Act allows the Cabinet Secretary to make regulations for carrying out the provisions of the Energy Act, by notification in the Kenya Gazette, upon the recommendation of the Authority.

Section 208 of the Energy Act outlines the general power of the Cabinet Secretary to make regulations. According to the Section:

a) The Authority Recommendation: *The Cabinet Secretary may, on the recommendation of the Authority and subject to section 167, make regulations for or with respect to any matter that by this Act is required or permitted to be prescribed, or that is necessary or expedient to be prescribed for carrying out or giving effect to this Act.*

b) Formulation: *The regulations to be made under this Act may be formulated by the Authority on its own motion or may be proposed to the Authority by any licensee or person.*

c) Public participation: *Before making recommendation of any regulations to the Cabinet Secretary under this Act, the Authority shall publish the proposed regulations for purposes of inviting proposals from the public, in such manner as it may deem fit, at least thirty days before the regulations are submitted to the Cabinet Secretary.*

d) Conditions: *The regulations made by the Cabinet Secretary in accordance with this section may, impose conditions, requiring acts or things to be performed or done to the satisfaction of the Authority, prohibiting acts or things from being performed or done and may prescribe periods or dates upon, within or before which such acts or things shall be performed or done or within which such conditions shall be fulfilled.*

e) Time frame: *The regulations made under this Act may be made for a limited period or without limit of period and may be made subject to such conditions as the Cabinet Secretary deems fit, and may contain such supplemental and consequential provisions as the Cabinet Secretary considers necessary for giving full effect to the regulations.*

6.1.2. The Proposed Regulations are not *Ultra Vires*

Article 94 (6) of the Constitution which is quoted in sub-section 6.1.1 provides that an Act of Parliament empowering an entity to make subsidiary legislation shall expressly specify: -

1. *the purpose and objectives for which that authority is conferred;*
2. *the limits of the authority;*
3. *the nature and scope of the law that may be made; and*
4. *the principles and standards applicable to the law made under the authority.*

Where subsidiary legislation is made that does not conform to Article 94 (6), it is liable to be struck down by a court either wholly or in part.

We have reviewed the Draft Regulations to ensure that any powers proposed to be exercised by the Authority thereunder are specifically provided under the Act. We have identified the powers to be exercised by the Authority and identified their specific underpinning in the Act as presented in Table 3.1.

Table 3.1: Powers to be exercised by the Authority

Power	***Empowering Section of the Energy Act 2019***
Regulation 6(2): The Authority shall review the maximum aggregate generation capacity limit as may be appropriate.	**Section 10** allows the Authority to regulate the generation, importation, exportation, transmission, distribution, supply, and use of electrical energy with the exception of licensing of nuclear facilities.
Regulation 7(3): Approval of fees payable under the net-metering agreement	**Section 11(c)** gives the Authority power to set, review and adjust electric power tariffs and tariff structures and investigate tariff charges, whether or not a specific application has been made for a tariff adjustment. Section 2 defines tariff as a set of prices, rates, charges, and any cost associated with capacity, supply and delivery of energy which may vary by category of consumers, service voltage or time of use, and may include any adjustments, as approved by the Authority.
Regulation 8(5): Review appeals for rejection of applications for net-metering system.	**Section 11 (i)**, the Authority has the power to investigate and determine complaints or disputes between parties over any matter relating to licences and licence conditions under the Energy Act.
Regulation 9(5): Issue guidelines for supply of electricity.	The Energy Act does not provide any no express power to the Authority to develop or issue guidelines for the supply of electricity.
Regulations 10(1): Approve rates for the tariff control period applicable prosumers.	**Section 11(c)** gives the Authority power to set, review and adjust electric power tariffs and tariff structures and investigate tariff charges, whether or not a specific application has been made for a tariff adjustment.
Resolution of disputes	**Section 11 (i)** investigate and determine complaints or disputes between parties over any matter relating to licences and licence conditions under the Energy Act.

6.2. The Regulation Making Process Under the Statutory Instruments Act

6.2.1. Introduction

The purpose of the Statutory Instruments (SI) Act is *"... to provide for the making, scrutiny, publication and operation of statutory instruments and matters connected therewith ...*" Section 3 of the SI Act states that it applies to *"... every statutory instrument made directly or indirectly under any Act of Parliament or other written legislation"*.

Section 198 (1) of the Energy Act[17] (the 'Act') avails the Cabinet Secretary in charge of Energy the power to " *.... upon recommendation by the Authority may, make regulations for carrying out the provisions of this Act by notification, in the Gazette*."

We note that the current practice is for the Authority to undertake the entire process of making regulations and doing all things that appertain thereto save for signing into law and for the Cabinet Secretary to sign processed regulations into force. Accordingly, therefore, the Cabinet Secretary, and by extension, the Authority are 'regulation-making authorities'[18] within the meaning of the SI Act and their activities in this regard are subject to the said Act.

The SI Act establishes the role of the legislature particularly the Committee on Delegated Legislation (the Committee) in the scrutiny of legislature to ensure their legality and lays down the various steps that are to be taken by a regulation-making body when making regulations. At the heart of the SI Act is an emphasis on very detailed public consultation and subsequent review of legislation by parliament.

6.2.2. Regulation Making Process under the SI Act

1. Public Consultation

[17] No. 1 of 2019

[18] Section 2 of the SI Act defines regulation-making authority as "any authority authorized by an Act of Parliament to make statutory instruments."

A regulation-making authority shall make appropriate consultations with persons who are likely to be affected by the proposed instrument prior to making regulations which is likely to have a direct, or a substantial indirect effect on business or restrict competition[19].

In determining whether a consultation is appropriate, the regulation making authority shall consider the extent to which the consultation drew on the knowledge of persons having expertise in fields relevant to the proposed regulations and ensured that persons likely to be affected by the proposed regulations had an adequate opportunity to comment on its proposed content.

The form of consultation shall:

a) involve notification, either directly or by advertisement, of bodies that, or of organizations representative of persons who, are likely to be affected by the proposed regulations; or
b) invite submissions to be made by a specified date or might invite participation in public hearings to be held concerning the proposed regulations.

2. Explanatory Memorandum

The Statutory Instrument Act requires the proposed regulations to be accompanied by an explanatory memorandum. The explanatory memorandum is a statement, prepared by the regulation-making authority that explains the purpose and operation of the proposed regulations. It includes any documents incorporated in the proposed regulations by reference and indicates how they may be obtained. The explanatory memorandum shall contain:

a) a statement on the proof and demonstration that sufficient public consultation was conducted as required under Articles 10 and 118 of the Constitution;
b) a brief statement of all the consultations undertaken before the proposed regulations were made;
c) a brief statement of the way the consultation was carried out;
d) an outline of the results of the consultation;
e) a brief explanation of any changes made to the legislation as a result of the consultation.

[19] Section 5 (1) of the SI Act

3. *Preparation of a Regulatory Impact Statement*

A regulation making authority is required to prepare a regulatory impact statement if proposed regulations are likely to impose significant costs on the community or a part of the community.

The SI Act[20] stipulates that the regulatory impact statement shall include the following information:

a) A statement of the objectives of the proposed regulations and the reasons for them;
b) A statement explaining the effect of the proposed regulations;
c) Statement of other practicable means of achieving those objectives, including other regulatory as well as non-regulatory options;
d) Cost-benefit analysis of the proposed statutory instrument and of any other practicable means of achieving the same objectives including an assessment of the economic, environmental, and social impact and the likely administration and compliance costs including resource allocation costs;
e) Reasons why the other means of achieving the same objectives are not preferable;
f) Draft copy of the proposed regulations.

The responsible Cabinet Secretary has a duty to:

a) Ensure that independent advice as to the adequacy of the regulatory impact statement and of the assessment included in the regulatory impact statement is obtained and considered in accordance with the guidelines;
b) Issue a certificate in writing confirming compliance with the Statutory Instruments Act and the guidelines and that in their opinion the regulatory impact statement adequately assesses the likely impact of the proposed regulations; and
c) Enclose a copy of the regulatory impact statement and the compliance certificate is tabled in Parliament with the proposed regulations.

[20] Section 7 (1) *ibid*

Notification of the regulatory impact statement: A regulatory impact statement shall be notified in the Kenya Gazette and in a newspaper in a manner that ensures that those most likely to be affected by the proposed statutory instrument are able to read it. The notice must inform the public of the time and manner for giving comments; all comments must be considered and should be produced before the Committee when the statutory instrument is tabled. The notice shall:

a) include a brief statement of the policy objectives sought to be achieved by the proposed regulations; and
b) state where copies of the regulatory impact statement may be obtained or inspected;
c) if a draft of the proposed regulations may be obtained or inspected, state that the draft may be obtained or inspected and where;
d) state that anyone may comment on the proposed regulations;
e) state how and when comments may be made;
f) state how consultation about the proposed regulations will take place; and
g) allow at least fourteen days from publication of the notice for the making of comments.

The responsible Cabinet Secretary shall ensure that all comments and submissions are considered before the statutory rule is made and a copy of all comments and submissions is given to the relevant Parliamentary or Senate committee as soon as practicable after the statutory rule is tabled.

4. Laying of the Statutory Instruments before the Committee

Every Cabinet Secretary responsible for a regulation-making authority shall within seven (7) sitting days after the publication of the proposed regulations, ensure that a copy of the proposed regulations is transmitted to the responsible Clerk for tabling before the relevant House of Parliament.

Once tabled, the proposed regulations shall be referred to a committee established under the Standing Orders of the National Assembly or the Senate for the purpose of reviewing and scrutinizing statutory instruments (the "Committee").

The Committee has up to twenty-eight (28) sitting days after the date of referral of the statutory instrument to the Committee to make a report to Parliament containing only a resolution that the statutory instruments that stands permanently revoked failure of which the House may, by resolution approve the proposed regulations which shall be deemed to have fully met the relevant considerations for scrutiny by the Committee.

The Committee has the power to summon the regulation-making authority for which the draft legislation has been made for scrutiny, before tabling the report to Parliament for their information and modification where necessary.

5. Publication and Commencement

The Draft Regulations shall be published in the Kenya Gazette. The draft regulations shall come into effect either on the date specified on the draft regulations or on the date of publication when no date is specified.

It is important to ensure that all steps required under the SI Act are followed keenly to avoid the resultant regulations being challenged and potentially invalidated by the courts.

The SI Act further provides that a statutory instrument shall expire ten (10) years after the day it was made unless it is sooner repealed or it is extended for a period not exceeding twelve (12) months. Only one extension of a statutory instrument is permitted.

6.3. Review of the Draft Energy (Net-Metering) Regulations, 2020

This section reviews the Energy (Net-Metering) Regulations, 2020 (the *"Draft Regulations*") together with its schedules including the Net-metering Application form and the template Net-metering System Agreement. It highlights identified errors, referencing issues and conflicts with other laws and proposes amendments and considerations that may assist in rectifying the issues this legal and regulatory review has identified.

6.3.1. References

i) *Title:* The Draft Regulations are referred to as The Energy (Net Metering) Regulations, 2020. Noting that the Draft Regulations will likely be reviewed and published this year, the title should be amended to *The Energy (Net-Metering) Regulations, 2022*.

ii) *Definition of Act:* The definition of Act should be amended to include the statute number and read *The Energy Act Number 1 of 2019*.

iii) *Net metering:* The Energy Act refers to "net-metering" which includes a hyphen between the words "net" and "metering". However the Draft Regulations refer to "net metering" which is

missing the hyphen. For uniformity with the Energy Act, the Draft Regulations should be amended to refer to *net-metering*".

iv) *Distribution licensee:* The Draft Regulations define Distribution licensee as a *licensee authorized under the Energy (Electricity Licensing) Regulations 2012 and subsequent revisions to operate and maintain a distribution system for supplying electrical energy to its consumers in its area of supply*. With the risk of repeal of the Energy (Electricity Licensing) Regulations, 2012 in the future, and to avoid interpretation challenges, the definition of distribution licensee should be amended to *a holder of a distribution licence under the Act*. There are numerous references to licensee which is not a defined term under the Draft Regulations. The term *the licensee* should be replaced with *the Distribution Licensee*.

v) *Code Participants:* The definition of Code Participants in Regulation 3 refers to the generation, transmission, distribution, and supply of electrical energy or any other operation for which a license is required pursuant to the Act. The reference to a *license* should be amended to refer to a *licence*.

vi) *Retailer:* There are numerous references to a retailer in the Draft Regulations specifically in association with a distribution licensee. However, retailer has not been defined. The definition of retailer should be amended to *holder of a retail supply licence as defined in the Act*.

vii) *Grid:* The definition of *Export* refers to *the local distribution grid*. This is the only reference to *the local distribution grid*. The reference to *the local distribution grid* should be replaced with *the grid* as this is the reference that has been used in the Draft Regulations.

viii) *Kenyan Standard:* The definition of Kenyan Standard refers to the Standards Act. The reference to the Standards Act should be complete and refer to statute number. This will assist in ease of reference to the statute in case the current Standards Act is repealed and replaced.

ix) *Definition of parallel operation* or *operates in parallel:* Although *parallel operation* or *operates in parallel* has been defined, the words are not used in the Draft Regulations. The reference to *parallel operation* or *operates in parallel* should thus, be deleted.

The definition of *parallel operation* or *operates in parallel* seems to erroneously also include the definition of *phase one of the net metering programme*; the latter definition should be

separated from the former definition. However, the term *phase one of the net metering programme* has also not been used in the Draft Regulations.

6.3.2. Review of the Draft Regulation

i) Regulation 6(1) states that the onsite capacity for a renewable energy source for prosumers entering into a net metering agreement shall be capped at the maximum demand in MW for the previous year for existing consumers and new consumers shall be eligible for net metering after one (1) year of continuous operation. Regulation 6(1) should be amended to clarify:
   a. The nature of the capping: The reference to maximum demand is quite general and it is not clear if this is referring to existing consumers in the net metering scheme or existing consumers who generate electricity.
   b. The nature of continuous operation by the new consumers is ambiguous and the regulation should be amended to refer to one (1) year continuous operation of the renewable energy generation system.

ii) Regulation 6(2) states that the maximum aggregate generation capacity of net metering systems shall be one hundred megawatts (100 MW) for the first three (3) years from the date these Regulations come into force. The first three (3) years from the date these Regulations come into force has been defined in Regulation 3 as *Phase One of the Net-Metering Programme*. The Regulation should therefore be amended to refer to the defined term.

iii) Regulation 6(4) states that a licensee shall allow non-discriminatory net-metering arrangement on first-come-first serve basis for prosumers, self-owned and third party owned, on-site renewable energy generators as long as the total capacity (in MW) complies with limits stipulated in Regulation 6(1) and Regulation 6(2). Practically, the net-metering arrangement is implemented through a net-metering agreement. The sub-rule should be amended to refer to the net-metering agreement.

iv) Regulation 8(1) requires the licensee to examine applications in Regulation 7 within sixty (60). The period should refer to days and should be amended to clarify this.

v) Regulation 8(5) refers to the Energy (Complaints and Disputes Resolution) Regulations, 2020. This regulation should refer to the Energy (Complaints and Disputes Resolution) Regulations, 2012 instead.

vi) Regulation 9(1) refers to the Energy (Electricity Supply) Regulations, 2020. The Energy (Electricity Supply) Regulations, 2020 are not yet in force and the current version of the Energy

(Electricity Supply) Regulations, 2020 is referred to as the Energy (Electricity Supply) Regulations, 2021. The cross reference should be updated to the year when the Energy (Electricity Supply) Regulations, 2020 came into force.

vii) Regulation 11(1) should include the word *day* after 15th.

6.3.3. First Schedule: Net Metering Application Form

The Net Metering Application Form requires the applicant to declare that the information provided in the application is true and accurate and that they understand that it is an offence, under the Energy Act 2019. This is not correct. Section 210 of the Energy Act, 2019 only criminalizes making of a false statement or a statement which the person has reason to believe is untrue, to the Cabinet Secretary, or to the Authority, committee, agent or an officer acting on behalf of the Authority. The duty to provide accurate information does not extend to licensees or distribution licensees.

6.3.4. Second Schedule: Net Metering Agreement

5.3.4.1.Agreement Template Review

The template agreement is simple and easy to read making it easy to review and understand by the consumer. However, this could be diluted as the template agreement is highly reliant on the provisions of the Draft Regulations and assumes the consumer is well versed with the provisions of the Draft Regulations. This creates an onerous task of cross referencing to the Draft Regulations in the interpretation of the template agreement and the risk of ambiguity if the Draft Regulations are repealed or amended during the term of a net-metering system agreement. The template agreement should balance between the statutory requirements, transparency, and freedom of parties to contract. The following amendments meet this threshold:

i) Clause 1 - *Eligibility*: this clause states that the System meets the applicable norms for being integrated into the Distribution Network, and that the Consumer shall maintain the System accordingly for the duration of this Agreement. The clause should include a cross reference to the inter-connection requirements in clause 2.

ii) Clause 4 - *Other Clearances and Approvals*: the approvals should extend to any approval under the terms of the occupation of the premises such as approvals from the registered proprietor of the premises where the system is situated.

iii) Clause 5 - *Period of Agreement and Termination*:

a. *Term of contract*: clause 5 provides that the agreement shall be for a period of 10 years. It is not clear when the 10 years commence. This clause should be amended to include the date of commissioning of the System by the Licensee.

b. *Service of Notice*: the clause refers to termination of the agreement through the service of a notice. The clause should clarify how notice is served under the agreement such as service of notice by hand delivery to the consumer's premises or by registered post.

iv) Clause 6 - *Access and Disconnection*: clause 6 provides the terms of access and disconnection to the metering equipment and disconnecting devices of the system. The following amendments should be included:

a. *Licensee*: the access to the Licensee should extend to the Licensee's authorised employees, servants, agents as there is a likelihood that the Licensee may outsource these services to third parties; and

b. *Costs*: the clause should clarify who shall bear the costs of disconnecting the System.

v) Clause 8 - *Commercial Settlement*: the agreement should consider the commercial settlement upon termination of the agreement. Specifically, the agreement should consider billing of any credit amount subsisting upon the termination of the agreement.

5.3.4.2.Additional clauses to the template agreement

We propose addition of the following clauses to the template agreement:

i) *Exceptions to accepting the exported energy*: the agreement should anticipate circumstances that would exclude the licensee from accepting the electricity from the consumer such as adverse effect to the public or other consumers, interrupting the supply of electricity to conduct maintenance of the system, the System delivers the exported energy which does not conform to the electrical characteristics consistent with prudent utility practices or upon termination of the agreement.

ii) *Maintenance of System*: The agreement should contain an undertaking by the Consumer to take steps to ensure that no damage is caused to the meters and to maintain any electrical installation within the premises at any time for safety purposes and also make good the defects to the meters and the System.

iii) *Ownership of the meters*: the agreement should clarify who owns the equipment connected to the Licensee's distribution system including the unidirectional or bi-directional meters.

iv) *Consumer covenants*: Duty to ensure the system complies with the requirements of the Draft Regulations and statutory compliance.

v) *Representation and warranties*: the Consumer should provide representation and warranties that:

   a. *Proprietary interest:* the Consumer should warrant that they are either the owners or tenants of the premises where the system is situated and have full control and possession of the premises;

   b. *Capacity:* the consumer should provide a warranty that the capacity of the system shall not exceed the limit of 1 MW.

vi) *Events of default:* the agreement should include events of default which may also lead to termination of the agreement such as:

   a. the Consumer is liquidated or wound up or passes a resolution for voluntary winding up (otherwise than for a bona fide reconstruction or amalgamation) or if similar or analogous proceedings are instituted against or taken by that party; or

   b. the Consumer has a receiver or an administrative receiver appointed in respect of all or any part of their assets or if similar or analogous proceedings are instituted against the assets of that party; or

   c. the Consumer enters into an arrangement for the benefit of their creditors; or

   d. the Consumer stops commits an act of insolvency; or

   e. the Consumer dies; or

   f. any warranty, representation or covenant made by the Consumer in the agreement is false or inaccurate in any material respect; or

   g. the electricity supply contract by the Licensee is terminated; or

   h. the Consumer vacates the premises and is no longer in control or possession of the premises.

vii) *Service of Notices*: the agreement refers to notices served upon parties for termination of the agreement. However, there is no reference to the process of service of notices.

viii) *Right to disconnect*: the Licensee should have a right to temporarily disconnect the System from its distribution network without prior notice, as a remedy in addition to termination of

the agreement where operation of the System will jeopardize the safety, reliability or security of Licensee's system or presents an imminent physical threat or endanger the safety, life or health of any person or property during maintenance of the System or the Consumer does not comply with its obligations under the agreement.

ix) *Miscellaneous Provisions*: the following general provisions should be included:

a. *Waiver*: No failure or delay to exercise any power, right or remedy by either party shall operate as a waiver of that right, power or remedy and no single or partial exercise by that party of any right, power or remedy shall preclude its further exercise or the exercise of any other right, power or remedy.

b. *Variations to be in Writing*: No addition to or variation, deletion, or agreed cancellation of all or any clauses or provisions of the agreement will be of any force or effect unless in writing and signed by the parties.

c. *Severability of provisions*: Each of the provisions of the agreement is severable and distinct from the others and, if at any time one or more of these provisions is or becomes invalid, illegal or unenforceable, the validity, legality and enforceability of the remaining provisions shall not in any way be affected or impaired.

d. *Taxes*: The Consumer shall be responsible for all present and future taxes, duties, levies and other similar charges including any related interest and penalties, however designated, arising out or imposed by law in connection with the operation of the System.

6.3.5. Potential conflict with other laws

Consumer vs Prosumer: We support the amendment to change the reference from Consumer to Prosumer in order to exclude the application of the Consumer Protection Act Number 46 of 2012.

The Energy Act defines a consumer as *any person supplied or entitled to be supplied with electrical energy or petroleum*. This definition is similar to the definition of consumer under the Consumer Protection Act which defines a consumer as *a person to whom particular goods or services are marketed in the ordinary course of the supplier's business*. The Consumer Protection Act affords consumers the following rights which may be contrary to the spirit of the net-metering arrangement:

i) *Interpretation of the net-metering agreement in the consumer's favour*: section 7 of the Consumer Protection Act provides that any ambiguity that allows for more than one reasonable

interpretation of a consumer agreement provided by the supplier to the consumer or of any information that must be disclosed under the Consumer Protection Act shall be interpreted to the benefit of the consumer.

ii) *Unfair practice*:

a. Section 13 of the Consumer Protection Act defines an unfair practice as making an unconscionable representation. An unconscionable representation includes Without limiting the generality of what may be taken into account in determining whether a representation is unconscionable, there may be taken into account that the person making the representation or the person's employer or principal knows or ought to know that the price grossly exceeds the price at which similar goods or services are readily available to like consumers.

b. An unfair practice allows any agreement, whether written, oral or implied, entered into by a consumer after or while a person has engaged in an unfair practice may be rescinded by the consumer and the consumer is entitled to any remedy that is available in law, including damages.

c. Section 16 of the Consumer Protection Act entitles a consumer to recover the amount by which the consumer's payment under the agreement exceeds the value that the goods or services have to the consumer or to recover damages, or both.

A summary of the proposed amendments to the Draft Regulations are given in Annexure 1.

CHAPTER SEVEN

CONCLUSIONS AND RECOMMENDATIONS

7.1. Conclusions

It is important to have the right regulatory framework for net metering in the country from the onset especially since it a new introduction in Kenya's electricity sector. This study carried out a desktop benchmarking exercise on policies, regulations, practices and incentives in other jurisdictions promoting adoption of the net metering system. Whereas most jurisdictions are motivated by the need to increase the footprint of renewable energy in their electricity generation or generation inadequacy, Kenya currently has more than 70% of the generation coming from RE sources and there is adequate generation capacity. Thus, the net metering has to be motivated by other factors. These have been found to be the need to provide storage for the REGSs that continue to be installed by electricity consumers. The study benchmarked net metering practices in eight jurisdictions in the world. The study identified some areas other jurisdictions policies and regulations that can form a basis of establishing the same in Kenya. The specific provisions have been highlighted and recommended for inclusion in the draft regulations.

The study also mapped out the stakeholders that will be affected directly by the net metering framework. This was followed by a consultation exercise with a sample of them to get their inputs on the framework. The stakeholders considered in the survey have been highlighted in the report together with an analysis of their inputs. Some of these inputs were also considered in drafting the net metering framework which is also an output of this work.

A technical study on the impact of having customers with captive solar PV plants connecting to the grid through the net metering framework was also carried out. The aim was to determine if the existing network around those customers could be affected by their inclusion into the grid. The result show that there is no impact on the existing protection scheme that can cause any problem to the network even when all the energy generated is fed to the grid. However, in some instances the feeding lines could be overloaded by power flows from this plant especially during shutdowns when there is no local consumption. This differs from place to place depending on the lines carrying capacity and if there are other prosumers already connected to the same network. It is therefore recommended that before connection a feasibility study be carried out to establish this.

This is especially important in instances where the installed captive systems are large and there are existing prosumers already on net metering framework.

From most of the benchmarked jurisdictions the net metering framework is enabled using bi-directional meters capable of reading both energy import and export. There are also other aspects in net metering such as time of use information that are important. For this purpose, some jurisdictions are using smart meters. It is therefore recommended that for net metering to be implemented efficiently in Kenya, smart bi-directional meters be used for this purpose.

This work also conducted technoeconomic analysis for determining the LCOE for solar PV, wind and HEP technologies considered to be the possible beneficiaries of this framework. Further, sensitivity of LCOE to different installed capacities of solar PV systems was conducted. The LCOE varies with different sizes and technologies as seen in this report.

7.2. Recommendations

The following are the recommendations that have been made throughout the document.

- To ensure that the connection of additional systems to the grid do not violate its operating limits, it is recommended that before connection a comprehensive power flow study be carried. The output of the studies should include but not limited to showing the line loading and voltage profile and both should be within the allowable limits after inclusion of the captive source.
- The net metering framework will require information on the time of consumption from the prosumers among other details. It is therefore recommended that for net metering to be implemented efficiently in Kenya, smart bi-directional meters be used for this purpose.
- Since there are facilities that might have more than one meter in the same premises it is recommended that load aggregation be done to determine net importation or exportation at the end of a billing period.
- To ensure that both parties engaged in the net metering framework, the prosumer and the distribution licensee are considered it is recommended that the prosumer be awarded 0.6 credit for all the energy exported at any given time.

The recommendations of the team based on the study outputs informed the proposed documents in the annexures.

ANNEXURES

ANNEXURE 1

Proposed Amendments Schedule

Clause	***Current clause***	***Proposed amendment***
Title	Energy (Net-Metering) Regulations, 2020	Energy (Net-Metering) Regulations, 2020 2022
3 (definition of Act)	Act means the Energy Act 2019	"Act" means the Energy Act *Number 1 of* 2019"
Whole document	Net metering	Net-metering
Whole document	licensee	Distribution ~~l~~Licensee
3 (definition of Distribution licensee)	"Distribution licensee" means a licensee authorized under the Energy (Electricity Licensing) Regulations 2012 and subsequent revisions to operate and maintain a distribution system for supplying electrical energy to its consumers in its area of supply	"Distribution ~~l~~Licensee means ~~a licensee authorized under the Energy (Electricity Licensing) Regulations 2012 and subsequent revisions to operate and maintain a distribution system for supplying electrical energy to its consumers in its area of supply~~ a holder of a distribution licence under the Act
3 (definition of Code participants)	"***Code Participants***" means the system operator, the Authority, large consumers and persons who carry out or who intend to carry out the generation, transmission, distribution and supply of electrical energy or any other operation for which a license is required pursuant to the Act	"***Code Participants***" means the system operator, the Authority, large consumers and persons who carry out or who intend to carry out the generation, transmission, distribution and supply of electrical energy or any other operation for which a ~~license~~ licence is required pursuant to the Act;
Definition of retail	None.	"***Retaile***r" means the holder of a retail supply licence as defined in the Act;
3 (definition of Export)	"***Export***" means, with regard to meter readings, the number of units of electricity (measured in kwh) that a prosumer has supplied to the	"***Export***" means, with regard to meter readings, the number of units of electricity (measured in kwh) that a prosumer has supplied to the ~~local distribution~~ grid within a billing period;

	local distribution grid within a billing period;	
3 (Definition of Kenyan Standard)	"***Kenyan Standard***" means the specification or code of practice declared by the National Standards Council under rule 9 of the Standards Act;	"***Kenyan Standard***" means the specification or code of practice declared by the National Standards Council under rule 9 of the Standards Act (Cap 486 of the Laws of Kenya);
3 (definition of parallel operation or operates in parallel)	"***Parallel operation***" or "***Operates in parallel***" means the operation of on-site generation by a customer while the customer is connected to the distribution system of the licensee phase one of the net metering programme" means the first three years of implementation of net metering in Kenya from the date of coming into force of these regulations;	"***Parallel operation***" or "***Operates in parallel***" means the operation of on-site generation by a customer while the customer is connected to the distribution system of the licensee; "***Phase one of the net metering programme***" means the first three (3) years of implementation of net metering in Kenya from the date of coming into force of these regulations;
6 (1)	The onsite installed capacity for a renewable energy source for prosumers entering into a net meeting agreement shall (i) not exceed 1 MW and; (ii) be capped at the maximum demand in MW of the previous year for existing consumers. New consumers shall be eligible for net metering after one (1) year of continuous operation.	The onsite installed capacity for a renewable energy source for prosumers entering into a net meeting agreement shall: (i) not exceed 1 MW and; (ii) be capped at the maximum demand in MW of the previous year for existing consumers in the net-metering scheme. New prosumers ~~consumers~~ shall be eligible for net metering after one (1) year of continuous operation of a source of renewable energy.
6(2)	The maximum aggregate generation capacity of net metering systems shall be one hundred megawatts (100MW) for the first three (3) years from the date these Regulations come into force.	The maximum aggregate generation capacity of net metering systems shall be one hundred megawatts (100MW) for Phase One of the Net-Metering Programme ~~the first three (3) years from the date these Regulations come into force~~.

6(4)	A licensee shall allow non-discriminatory net-metering arrangement on first-come-first serve basis for prosumers, self-owned and third party owned, on-site renewable energy generators as long as the total capacity (in MW) complies with limits stipulated in Regulation 6(1) and Regulation 6(2)	A licensee shall enter into a net-metering system agreement with a prosumer on a ~~allow~~ non-discriminatory, ~~net-metering arrangement on~~ first-come-first serve basis for prosumers, self-owned and third party owned, on-site renewable energy generators as long as the total capacity (in MW) complies with limits stipulated in Regulation 6(1) and Regulation 6(2)
8(1)	The licensee shall examine all applications in Regulation 7 within sixty (60) and in a non-discriminatory basis, taking into account;	The licensee shall examine all applications in Regulation 7 within sixty (60) days and in a non-discriminatory basis, taking into account;
8(5)	Any person who is aggrieved by the decision of the licensee in rejecting an application for approval under the net metering system may, within thirty (30) days of notification of decision, appeal to the Authority as provided for under the Energy (Complaints and Disputes Resolution) Regulations, 2020	Any person who is aggrieved by the decision of the licensee in rejecting an application for approval under the net metering system may, within thirty (30) days of notification of decision, appeal to the Authority as provided for under the Energy (Complaints and Disputes Resolution) Regulations, ~~2020~~ 2012.
9(1)	The installation, interconnection maintenance and, where applicable, operations of net metering systems in a licensee's area of supply shall only be performed by competent personnel approved by the licensee in that area of supply in accordance with the Energy (Electricity Supply) Regulations 2020 and using such equipment and system	To be updated once the Energy (Electricity Supply) Regulations 2020 came into force.

	configuration so as to meet relevant requirements of the Kenya Electricity Grid Code, and any relevant Kenya Standards.	
11(1)	Licensees shall develop and maintain a register on their website, as specified in the Fourth Schedule, of net-metered Consumers in their areas of supply. The register shall be continuous updated and submitted quarterly to the Authority by the 15th of each fourth month.	Licensees shall develop and maintain a register on their website, as specified in the Fourth Schedule, of net-metered prosumers ~~Consumers~~ in their areas of supply. The register shall be continuous updated and submitted quarterly to the Authority by the 15th day of each fourth month.
First Schedule: Net Metering Application Form		
2(a)	Income Tax Personal Identification Number	Kenya Revenue Authority Personal ~~Income Tax~~ Identification Number
Declaration	I/We hereby, declare that the information provided in this application is true and accurate. I/We understand that it is an offence, under the Energy Act 2019.	I/We hereby, declare that the information provided in this application is true and accurate. ~~I/We understand that it is an offence, under the Energy Act 2019.~~
Second Schedule: Net Metering Agreement		
Clause 1 Eligibility	The System meets the applicable norms for being integrated into the Distribution Network, and that the Consumer shall maintain the System accordingly for the duration of this Agreement.	The System meets the applicable norms as required in clause 2 of this agreement for being integrated into the Distribution Network, and that the ~~Consumer~~ Prosumer shall maintain the System accordingly for the duration of this Agreement.
Clause 4 Other Clearances and Approvals	The Prosumer shall obtain any statutory approvals and clearances that may be required, such as from the Authority and all other relevant statutory agencies,	(a) The ~~Consumer~~ Prosumer shall obtain any statutory approvals and clearances that may be required, such as from the Authority and all other relevant statutory agencies, before connecting the System to the distribution Network.

	before connecting the System to the distribution Network.	(b) If the Prosumer ~~Consumer~~ is occupying the premises where the System is situate under the terms of a lease, sub-lease or a licence, then the Prosumer ~~Consumer~~ shall obtain the prior written consent of the registered proprietor of the premises or any other person as required by the terms of the lease, sub-lease or licence for the installation and commissioning of the System.
Clause 5 Period of Agreement and Termination	This Agreement shall be for a period for 10 years, but may be terminated prematurely:	This Agreement shall be for a period for 10 years from the date when the System is commissioned by the Licensee, but may be terminated prematurely:
		d. Upon the occurrence of an event of default. For purposes of this agreement, an event of default shall occur upon the following: i the Prosumer is liquidated or wound up or passes a resolution for voluntary winding up (otherwise than for a bona fide reconstruction or amalgamation) or if similar or analogous proceedings are instituted against or taken by that party; or ii the Prosumer shall have a receiver or an administrative receiver appointed in respect of all or any part of their assets or if similar or analogous proceedings are instituted against the assets of that party; or iii the Prosumer enters into an arrangement for the benefit of their creditors; or iv the Prosumer stops commits an act of insolvency; or v the Prosumer dies; or vi any warranty, representation or covenant made by the Prosumer in this agreement is false or inaccurate in any material respect; or

		vii the electricity supply contract by the Licensee is terminated; or viii the Prosumer vacates the premises and is no longer in control or possession of the premises.
Clause 6 Access and Disconnection	The Consumer shall provide access to the Licensee to the metering equipment and disconnecting devices of the System, both automatic and manual.	The ~~Consumer~~ Prosumer shall provide access to the Licensee or the Licensee's authorised employees, servants, agents to the metering equipment and disconnecting devices of the System, both automatic and manual.
Exceptions to accepting the exported energy		Without prejudice to any other provision in this agreement, the Licensee shall not be obligated to accept the exported energy if any of the following circumstances occurs: (a) for such periods and under such circumstances as the Licensee thinks fit having regard to public safety and private safety; (b) any emergency condition occurs; (c) the System delivers the exported energy which does not conform to the electrical characteristics consistent with prudent utility practices; (d) maintenance of the System or the meters; (e) the disconnection of the System from Licensee's Distribution Network due to the failure of the Prosumer to pay the any amount payable under this agreement; or (f) the Prosumer is in breach of the provisions of the Energy Act or the Energy (Net-Metering) Regulations or any statutory modification or re-enactment thereof or any other statutory provision relating to the production, supply and use of electricity.
Maintenance of System		a. The Prosumer shall maintain at their own expense the System in good and substantial repair in order to keep it in good an operating condition (subject to

		fair wear and tear only) including replacement of worn, damaged and lost parts, and shall make good any damage or destruction to the System; b. The Prosumer shall not make any alteration to the System and shall not remove any existing component (or components) from the System without the prior written consent of the Licensee unless to comply with any mandatory modifications required by law or any regulatory authority.
Consumer covenants		The Prosumer shall ensure that the System complies the provisions of the Energy Act or the Energy (Net-Metering) Regulations or any statutory modification or re-enactment thereof or any other statutory provision relating to the production, supply and use of electricity.
Representations and warranties		The Prosumer warrants and represents that: a. the System shall substantially conform to its specification (as made available by the Licensee), be of satisfactory quality and fit for purpose and the System's generation capacity shall not exceed 1MW; and b. they are in possession and control of the premises where the System is situate.
Services of notices		All notices to be given in terms of this agreement will be given in writing and will be delivered by hand or registered post to their postal address in first page of this agreement.

		if delivered by hand during business hours, be presumed to have been received on the date of delivery. Any notice delivered after business hours or on a day which is not a business day will be presumed to have been received on the following business day. If sent by registered post, be presumed to have been received five (5) days after posting. Notwithstanding the above, any notice given in writing, and actually received by the Party to whom the notice is addressed, will be deemed to have been properly given and received, notwithstanding that such notice has not been given in accordance with this clause.
Miscellaneous clauses		a. Waiver: No failure or delay to exercise any power, right or remedy by either party shall operate as a waiver of that right, power or remedy and no single or partial exercise by that party of any right, power or remedy shall preclude its further exercise or the exercise of any other right, power or remedy. b. Variations to be in Writing: No addition to or variation, deletion, or agreed cancellation of all or any clauses or provisions of the agreement will be of any force or effect unless in writing and signed by the parties. c. Severability of provisions: Each of the provisions of the agreement is severable and distinct from the others and, if at any time one or more of these provisions is or becomes invalid, illegal or unenforceable, the validity, legality and enforceability of the remaining

		provisions shall not in any way be affected or impaired. d. Taxes: The Consumer shall be responsible for all present and future taxes, duties, levies and other similar charges including any related interest and penalties, however designated, arising out or imposed by law in connection with the operation of the System.

ANNEXURE 2

PROPOSED REGULATIONS

APPENDICES

Table A2: Nairobi South_2 Feeder Bus Voltages with no Generation

Bus	Low Consumption no PV Infeed		Peak Consumption no PV Infeed	
	Voltage Magnitude, kV	Voltage Magnitude, p.u.	Voltage Magnitude, kV	Voltage Magnitude p.u.
N. IND AREA 66KV	66.	1.	66.	1.
N. IND AREA 11KV	10.98843	0.9989486	10.98625	0.9987502
LE	10.97832	0.9980295	10.97425	0.9976588
ORBIT SPORTS	10.97824	0.9980221	10.97415	0.99765
M.V. INSPECTION	10.96424	0.9967494	10.9576	0.9961456
HoM 2	10.94344	0.9948585	10.933	0.993909
HoM 1	10.94327	0.9948424	10.93279	0.9938897
GSK	10.93983	0.9945296	10.92883	0.9935297
IND. AREA 1	10.93817	0.9943792	10.92672	0.993338
NAIROBI TIMBER	10.93161	0.993783	10.91883	0.9926212
102588	10.93158	0.9937798	10.91879	0.9926175
SANYO_ARMCO 1	10.93094	0.993722	10.91803	0.9925479
SANYO_ARMCO 2	10.93002	0.9936385	10.91692	0.9924474
MIMASA	10.92844	0.9934945	10.91502	0.9922743
GALAXY	10.92695	0.9933593	10.91323	0.9921118
IND. AREA 2	10.91967	0.992697	10.90447	0.9913155
LUNGALUNGA RD	10.91668	0.9924259	10.90088	0.9909895
PATCO IND.	10.91011	0.9918281	10.89298	0.9902708
RANGWE RD	10.90542	0.9914022	10.88735	0.9897588
IND AREA 3	10.904	0.9912724	10.88563	0.9896028
STAINLESS STEEL	10.90058	0.9909619	10.88153	0.9892296
IND. AREA 4	10.90049	0.9909537	10.88142	0.9892197
IND. AREA 5	10.9001	0.9909186	10.88095	0.9891775
IND. AREA 6	10.90008	0.9909165	10.88092	0.989175
PAPER HOUSE	10.89967	0.9908795	10.88044	0.9891305
JOJO PLASTICS	10.89936	0.9908509	10.88006	0.9890961
15063	0.	0.	0.	0.
COSMOS LTD	0.	0.	0.	0.
NAIROBI PLASTICS	0.	0.	0.	0.
SASIO RD	0.	0.	0.	0.

Table A3: Nairobi South_2 11kV Feeder Branch Section Percentage Loading with no Generation

Branch Section	% Loading Low Consumption no Generation	% Loading Peak Consumption no Generation
IS2LS001	25.93154	30.73805
IS2LS005.1	22.39944	26.49787
IS2LS002.1	20.92761	24.75674
IS2LS005.3	20.92761	24.75674
IS2LS005.4-5	20.28899	23.98993
IS2LS005.6	17.73009	20.91622
IS2LS046.3	13.93502	16.75076
IS2LS005.7	13.83003	16.62173
IS2L019	13.42359	16.13349
IS2LS036.1-2	11.35916	13.65477
IS2LS020.1	11.09554	13.33651
IS2LS021.1	10.815	12.99945
IS2LS046.1	9.534095	11.46045
IS2LS022	9.39984	11.29984
IS2LS024	9.399839	11.29984
IS2LS025	8.777486	10.55178
ISLS046.5	8.722477	10.48489
IS2LS046.7	8.081375	9.714468
IS2LS028.1	7.797694	9.373933
IS2LS028.2	7.797694	9.373933
IS2LS028.4	7.797693	9.373933
IS2LS001.1	7.440601	8.944297
IS2LS021	7.440601	8.944297
IS2LS017.1	5.954008	6.556182
IS2LS016	5.443847	5.994257
IS2LS003	4.024746	4.83149
IS2LS019.1	3.554113	4.269994
IS2LS002.2	3.300026	3.961577
IS2LS028.10	2.942199	3.536885
IS2LS028.5	2.895075	3.48025
IS2LS028.8	2.553783	3.069931
IS2LS028.9	2.553671	3.06977
IS2LS021.2	2.546794	3.059819
IS2LS019.2	2.546424	3.059284
IS2LS015	2.543671	3.055321
IS2LS028.6	2.27244	2.731779
IS2LS028.11	1.961447	2.357896
IS2LS014.2	1.953635	2.346609
PATCO IND. MV	1.791127	2.152731
IS2LS019.3	1.598726	1.920718
IS2LS033	1.365328	1.639005
0054	1.276436	1.534306

IS2LS005.2	1.275614	1.53216
IS2LS046.8	1.274953	1.531656
IS2LS046.6	1.274605	1.531308
IS2SL028.012	0.9807517	1.178989
IS2LS026	0.9797929	1.177844
IS2LS008	0.9749489	1.170648
IS2LS046.2	0.8086233	0.9715408
IS2LS020.2	0.5578224	0.6701785
IS2L046.4	0.441291	0.5302149
IS2LS028.7	0.3113293	0.3742526

Table A4: Nairobi South_2 11kv Feeder Bus Voltages

Bus	Voltage Magnitude, p.u. No Generation	Voltage Magnitude, p.u. With Generation
N. IND AREA 66KV	1.	1.
N. IND AREA 11KV	0.9985904	0.9986392
LE	0.9973697	0.9977366
ORBIT SPORTS	0.9973603	0.9977273
M.V. INSPECTION	0.9956438	0.9966087
HoM 2	0.9930993	0.9948429
HoM 1	0.9930787	0.9948223
GSK	0.9926262	0.9947592
IND. AREA 1	0.9924674	0.9943217
NAIROBI TIMBER	0.991702	0.9935576
102588	0.9916979	0.9935536
SANYO_ARMCO 1	0.9916236	0.9934794
SANYO_ARMCO 2	0.9915163	0.9933723
MIMASA	0.9913315	0.9931878
GALAXY	0.9911579	0.9930146
IND. AREA 2	0.9903074	0.9921657
LUNGALUNGA RD	0.9899593	0.9918182
PATCO IND.	0.9891918	0.9910522
RANGWE RD	0.988645	0.9905064
IND AREA 3	0.9884784	0.9903401
STAINLESS STEEL	0.9880798	0.9899423
IND. AREA 4	0.9880692	0.9899318
IND. AREA 5	0.9880242	0.9898868
IND. AREA 6	0.9880215	0.9898841
PAPER HOUSE	0.987974	0.9898367
JOJO PLASTICS	0.9879372	0.9898
15063	0.	0.
COSMOS LTD	0.	0.
NAIROBI PLASTICS	0.	0.
SASIO RD	0.	0.

Table A5: Nairobi South_2 11kv Feeder Branch Section Percentage Loading

Branch Section	% Loading No Generation	% Loading With Generation
IS2LS001	34.60188	23.2391
IS2LS005.1	30.0777	18.79442
IS2LS002.1	28.10134	17.85431
IS2LS005.3	28.10134	17.71562
IS2LS005.4-5	27.283	17.55947
IS2LS005.6	24.00167	17.55947
IS2LS046.3	17.88792	17.19535
IS2LS005.7	17.74891	16.76011
IS2L019	17.22766	14.55455
IS2LS036.1-2	14.58196	14.21471
IS2LS020.1	14.24144	13.8555
IS2LS021.1	13.88157	13.57883
IS2LS046.1	12.23841	12.21541
IS2LS022	12.06727	12.04458
IS2LS024	12.06727	12.04458
IS2LS025	11.26844	11.24725
ISLS046.5	11.19667	11.17563
IS2LS046.7	10.37404	10.35455
IS2LS028.1	10.01061	9.99178
IS2LS028.2	10.01061	9.99178
IS2LS028.4	10.01061	9.99178
IS2LS001.1	9.551631	9.533676
IS2LS021	9.551631	9.533676
IS2LS017.1	9.545762	8.908395
IS2LS016	8.726852	8.144391
IS2LS003	5.155083	5.153187
IS2LS019.1	4.558904	4.550391
IS2LS002.2	4.226932	4.225377
IS2LS028.10	3.777094	3.769991
IS2LS028.5	3.716613	3.709623
IS2LS028.8	3.278413	3.272249
IS2LS028.9	3.278229	3.272065
IS2LS021.2	3.266871	3.26077
IS2LS019.2	3.26626	3.260162
IS2LS015	3.261665	3.255951
IS2LS028.6	2.917314	2.911828
IS2LS028.11	2.518032	2.513296
IS2LS014.2	2.505093	2.500703
PATCO IND.	2.29875	2.294437
IS2LS019.3	2.050664	2.046836
IS2LS033	1.748779	1.748136
0054	1.638454	1.635376
IS2LS046.8	1.636004	1.633269

IS2LS046.6	1.635429	1.632939
IS2LS005.2	1.63387	1.632367
IS2SL028.012	1.259063	1.256695
IS2LS026	1.257833	1.255468
IS2LS008	1.24932	1.248111
IS2LS046.2	1.037295	1.035357
IS2LS020.2	0.7155231	0.714187
IS2L046.4	0.5661067	0.5650486
IS2LS028.7	0.3996685	0.398917

Table A6: Lower Hill Feeder Bus Voltage Comparison

Bus	**Low Consumption no Generation**		**Peak Consumption no Generation**	
	Voltage Magnitude KV	**Voltage Magnitude pu**	**Voltage Magnitude KV**	**Voltage Magnitude pu**
NAIROBI BUCKLEYS66KV	66.	1.	66.	1.
NAIROBI BUCKLEYS 11KV	10.99155	0.9992315	10.97856	0.9980508
110889	10.98644	0.9987672	10.96614	0.9969218
MSUFI RD 2	10.98268	0.9984256	10.957	0.9960905
SUMBA RD 1	10.97842	0.9980381	10.94662	0.9951473
MSUFI RD 1	10.97698	0.9979072	10.94312	0.9948287
SUMBA RD 2	10.9755	0.9977728	10.93951	0.9945012
TYSON ESTATE	10.97515	0.9977406	10.93866	0.9944232
LENNA HOMES LTD.	10.9741	0.9976454	10.9361	0.9941913
N. WEST HOSP.	10.96909	0.9971899	10.9239	0.9930817
12919B	10.9689	0.9971726	10.92344	0.9930398
MUTHAITI AVENUE 1	10.96813	0.9971025	10.92156	0.9928691
MUTHAITI AVENUE 2	10.9664	0.9969458	10.91736	0.9924874
GHANDI AVENUE 1	10.9641	0.9967361	10.91174	0.9919765
MUTHAITI AVENUE 3	10.96378	0.9967075	10.91098	0.9919073
SOUTH C 1	10.96373	0.9967023	10.91084	0.9918947
MUTHAITI AVENUE N.WEST	10.96359	0.9966902	10.91052	0.9918652
ALAMA IQBAL	10.96344	0.9966768	10.91016	0.9918327
NAMREEF LTD	10.9634	0.996673	10.91006	0.9918236
NYAYO STADIUM	10.96305	0.9966412	10.90921	0.9917462
GHANDI AVENUE N.WEST	10.95867	0.996243	10.89852	0.9907745
GHANDI AVENUE 2	10.95561	0.9959649	10.89106	0.9900967
KODI RD 1	10.95551	0.9959551	10.8908	0.990073
KODI RD 2	10.95539	0.9959448	10.89053	0.990048
SOUTH C 2	10.95098	0.9955434	10.87976	0.9890693
KODI RD 3	10.95079	0.9955267	10.87931	0.9890286

KODI RD 4	10.9507	0.9955183	10.87909	0.9890084
KODI RD 5	10.94748	0.9952254	10.87123	0.9882941
AERODROME RD	10.94618	0.9951071	10.86806	0.9880056
MADARAKA ESTATE 1	10.94542	0.9950378	10.86621	0.9878369
MADARAKA ESTATE 2	10.94537	0.9950337	10.8661	0.9878269
SYS. REINFORCEMENT	10.94507	0.9950063	10.86536	0.9877599
KENYA RAILWAYS	10.94351	0.9948641	10.86154	0.9874128
MADARAKA ESTATE 3_4	10.94346	0.9948604	10.86145	0.9874043
MADARAKA ESTATE 5	10.94344	0.9948583	10.86139	0.9873992
A. BUSINESS CENTER	10.94342	0.9948562	10.86133	0.9873936
NYAYO STADIUM S. POOL	10.9432	0.994836	10.86079	0.9873445
SYS. REINFORCEMENT 2	10.94286	0.9948057	10.85998	0.987271
STRATHMORE	10.9427	0.9947906	10.85957	0.987234
SIWAKA ESTATE 2	10.94194	0.9947214	10.85772	0.9870654
SIWAKA ESTATE 1	10.94179	0.9947086	10.85738	0.9870342
KENTRACK AGENCIES	10.94151	0.9946825	10.85668	0.9869706

Table A7: Lower Hill 11kV Feeder Branch Section Percentage Loading

Branch	**% Loading**	**% Loading**
	Low Consumption no Generation	**Peak Consumption no Generation**
NLHLS001	27.17888	65.91462
NLHLS002.1	20.87406	50.62408
NLHLS002.2	20.56556	49.88139
NLHLS003	20.07967	48.71068
NLHLS016	14.05894	34.15558
NLHLS017.1	13.57305	32.98001
NLHLS017.2	13.26455	32.23272
NLHLS019	12.3159	29.93314
NLHLS004.1	11.59559	28.12871
NLHLS021	11.36726	27.63115
NLHLS004.2	11.28708	27.38446
NLHLS219.1	10.31531	25.03912
NLHLS219.2	10.16105	24.66676
NLHLS018	10.16105	24.66676
NLHLS135	9.852923	23.92157
NLHLS024	8.730595	21.22173
NLHLS006	8.484085	20.58197
NLHLS007.1	8.175584	19.83796
NLHLS0072	7.867082	19.09346
NLHLS171.1	7.867082	19.09346
NLHLS171.3	7.867082	19.09346
NLHLS170	7.867081	19.09346

NLHLS008	7.381988	17.91996
NLHLS010	7.381988	17.91996
NLHLS011	6.896098	16.74545
NLHLS015.1	6.896098	16.74545
NLHLS015	6.741847	16.37245
NLHLS025	6.12101	14.87853
NLHLS026	4.758383	11.56795
NLHLS031	2.82279	6.863786
NLHLS027	2.714441	6.59993
NLHLS012	2.535839	6.138465
NLHSLS034	2.482419	6.034843
NLHLS146	2.405293	5.847495
NLHLS147	1.919405	4.666914
NLHLS195	1.85101	4.500735
NLHLS032	1.542508	3.750632
NLHLS035.2	1.265283	3.075624
NLHLS014	1.265277	3.061981
NLHLS131	1.102893	2.668704
NLHLS196-199	0.97178	2.363051
NLHLS029	0.97178	2.36305
NLHLS 201-203	0.9717799	2.36242
NLHLS005	0.9717799	2.361139
NLHLS035	0.9707681	2.350095
NLHLS013	0.970213	2.345349
NLHLS020.1	0.7943917	1.927698
54642	0.7943917	1.92567
NLHLS030	0.6813138	1.65629
NLHLS028	0.6813138	1.656013
NLHLS219	0.6813138	1.655297
NLHLS020.2	0.6813138	1.65528
NLHLS037	0.6213903	1.510355
NLHLS132.1	0.6170034	1.493006
NLHLS038.1	0.4627526	1.124781
NLHLS043	0.4627524	1.12478
NLHLS009	0.4441161	1.073365
NLHLS218.2	0.4016773	0.9707508
NLHLS180	0.3085017	0.7501029
NLHLS132.2	0.3085017	0.7486302
54643-54646	0.3085017	0.7478445
NLHLS018.3	0.3085017	0.7465063
NLHLS232	0.3085017	0.7464529
NLHLS218.1	0.308135	0.7451916
NLHLS160	0.3031173	0.7367661
NLHLS022	0.1542511	0.3745857
NLHLS132	0.1542509	0.3742921
54648-54638-54639	0.1542509	0.3723647

NLHLS023	0.1081452	0.2626215
NLHLS033	0.07712555	0.1874868

Table A8: Lower Hill 11kV Feeder Bus Voltage at Expected Feeder Loading Conditions

Bus	**Voltage Magnitude, p.u. with no PV Infeed**	**Voltage Magnitude, p.u. with 600kW PV Infeed**
NAIROBI BUCKLEYS 66KV	1.	1.
NAIROBI BUCKLEYS 11KV	0.9983884	0.998452
110889	0.9974494	0.9977172
MSUFI RD 2	0.9967581	0.9971748
SUMBA RD 1	0.9959737	0.9965635
MSUFI RD 1	0.9957088	0.9963566
SUMBA RD 2	0.9954364	0.9961494
TYSON ESTATE	0.9953716	0.9960927
LENNA HOMES LTD.	0.9951787	0.9959488
N. WEST HOSP.	0.9942561	0.9952571
12919B	0.9942212	0.9952222
MUTHAITI AVENUE 1	0.9940793	0.9951176
MUTHAITI AVENUE 2	0.9937619	0.9948863
GHANDI AVENUE 1	0.9933371	0.9945819
MUTHAITI AVENUE 3	0.9932794	0.9945014
SOUTH C 1	0.9932689	0.9944909
MUTHAITI AVENUE N. WEST	0.9932444	0.9944664
ALAMA IQBAL	0.9932174	0.9944394
NAMREEF LTD	0.9932098	0.9944318
NYAYO STADIUM	0.9931454	0.9943675
GHANDI AVENUE N. WEST	0.9923377	0.9939071
GHANDI AVENUE 2	0.9917741	0.9935307
KODI RD 1	0.9917544	0.993511
KODI RD 2	0.9917335	0.9934902
SOUTH C 2	0.9909198	0.9929787
KODI RD 3	0.9908859	0.9929449
KODI RD 4	0.9908691	0.9929281
KODI RD 5	0.9902752	0.9925824
AERODROME RD	0.9900354	0.992402
MADARAKA ESTATE 1	0.989895	0.9923973
MADARAKA ESTATE 2	0.9898868	0.992389
SYS. REINFORCEMENT	0.9898311	0.9923431
KENYA RAILWAYS	0.9895425	0.9922767
MADARAKA ESTATE 3_4	0.9895354	0.9922682
MADARAKA ESTATE 5	0.9895311	0.992264
A. BUSINESS CENTER	0.9895266	0.9921393
NYAYO STADIUM S. POOL	0.9894857	0.9921062

SYS. REINFORCEMENT 2	0.9894245	0.9920803
STRATHMORE	0.9893938	0.9920277
SIWAKA ESTATE 2	0.9892536	0.9918515
SIWAKA ESTATE 1	0.9892276	0.9918355
KENTRACK AGENCIES	0.9891748	0.9917948

Table A9: Lower Hill 11kV Feeder Branch Section at Expected Feeder Loading Conditions

Bus	% Loading	% Loading
	No PV Infeed	600kW PV Infeed
NLHLS001	54.83144	42.10631
NLHLS002.1	42.11192	32.3387
NLHLS002.2	41.49334	31.72151
NLHLS003	40.5184	30.74898
NLHLS016	28.40404	18.68949
NLHLS004.1	27.42575	17.76671
NLHLS017.1	26.80398	17.71826
NLHLS004.2	24.89092	17.1488
NLHLS017.2	23.39805	17.10152
NLHLS019	22.97619	15.20632
NLHLS219.1	22.77839	15.20254
NLHLS219.2	20.8258	14.89369
NLHLS018	20.5158	14.89369
NLHLS135	20.5158	14.27617
NLHLS021	19.89561	13.31413
NLHLS006	17.64656	12.98227
NLHLS007.1	17.12035	12.36451
NLHLS0072	16.50085	11.74664
NLHLS171.1	15.88102	11.74664
NLHLS171.3	15.88102	11.74664
NLHLS170	15.88102	11.74664
NLHLS008	15.88102	10.77401
NLHLS010	14.9044	10.77401
NLHLS011	14.9044	9.80075
NLHLS015.1	13.92683	9.80075
NLHLS015	13.92683	9.491844
NLHLS024	13.6164	8.095383
NLHLS029	12.37199	8.037806
NLHLS031	9.618905	5.690729
NLHLS025	5.707131	5.675664
NLHLS030	5.487796	5.635297
NLHLS012	5.107978	5.101699
NLHSLS034	5.018096	5.006417
NLHLS146	4.862293	4.850976
NLHLS147	3.880532	3.871498
NLHLS195	3.742307	3.731552
NLHLS032	3.118602	3.10964

NLHLS026	2.557478	3.087042
NLHLS035.2	2.548057	2.551527
NLHLS014	2.220825	2.544927
NLHLS131	1.964825	2.218097
NLHLS196-199	1.964824	1.959177
NLHLS 201-203	1.96439	1.959177
NLHLS035	1.963189	1.958616
NLHLS013	1.955389	1.952983
NLHLS005	1.952596	1.951183
NLHLS027	1.603404	1.945796
NLHLS020.1	1.602003	1.600081
54642	1.377231	1.599172
NLHLS028	1.37704	1.37325
NLHLS219	1.376546	1.373077
NLHLS020.2	1.376534	1.373065
NLHLS037	1.255921	1.252999
NLHLS132.1	1.242437	1.240911
NLHLS038.1	0.9352984	0.9331223
NLHLS043	0.9352983	0.9331222
NLHLS009	0.893408	0.8925098
NLHLS218.2	0.8080039	0.8071915
NLHLS232	0.6237043	0.6219119
NLHLS018.3	0.6226878	0.6213972
54643-54646	0.6221452	0.6210457
NLHLS132.2	0.6212208	0.6204577
NLHLS180	0.6211839	0.6204209
NLHLS218.1	0.6201979	0.6195736
NLHLS160	0.6126494	0.611224
NLHLS022	0.3115308	0.310807
54648-54638-54639	0.3113281	0.3106829
NLHLS132	0.3099961	0.3097565
NLHLS023	0.2184138	0.2179063
NLHLS033	0.1558993	0.1554514

Table A10: Red Hill Feeder Bus Voltage

Bus	**Low Consumption no Generation**		**Peak Consumption no Generation**	
	Voltage Magnitude KV	**Voltage Magnitude pu**	**Voltage Magnitude KV**	**Voltage Magnitude pu**
CIANDA 66	66.	1.	66.	1.
CIANDA 11	10.99767	0.9997878	10.9944	0.9994913
YARA ESTATE 1	10.99532	0.9995747	10.98878	0.9989799
YARA ESTATE 2	10.99313	0.9993753	10.98352	0.9985016

CIANDA COFFEE RESEARCH INSTITUTE	10.99122	0.9992015	10.97893	0.9980849
BENEDICTINE NUNS	10.98942	0.9990386	10.97464	0.9976943
KIMORORI VILLAGE	10.98934	0.9990306	10.97443	0.9976753
GATATHA POLICE POST	10.98928	0.9990255	10.97429	0.997663
RIMA ESTATE 1	10.98923	0.9990206	10.97416	0.9976512
RIMA ESTATE 2	10.9892	0.9990179	10.97409	0.9976447
KAWAIDA ROAD 1	10.98572	0.9987021	10.96577	0.9968877
KAWAIDA ROAD 2	10.9845	0.9985908	10.96283	0.9966209
KAWAIDA VILLAGE 1	10.98435	0.9985769	10.96247	0.9965878
KAWAIDA VILLAGE 2	10.98423	0.9985662	10.96218	0.9965619
SYS. REIN. to S/S 01010	10.98413	0.9985576	10.96196	0.9965414
KAWAIDA KIAMBAA	10.98351	0.9985011	10.96047	0.996406
KAWAIDA SHOP	10.98253	0.9984122	10.95812	0.9961929
SYS. REIN. to S/S 16165	10.98253	0.9984117	10.95811	0.9961918
KAWAIDA VILLAGE 3	10.98052	0.9982289	10.95329	0.9957539
PEFA BLOOMFIELD	10.97943	0.9981298	10.95068	0.9955162
KAWAIDA JUNCTION	10.97844	0.99804	10.94831	0.9953012
KENTMERE ESTATE HOUSE	10.97531	0.9977554	10.94081	0.9946193
KARUGA KOINANGE 1	10.9742	0.9976545	10.93815	0.9943777
KARUGA KOINANGE 2	10.97419	0.9976536	10.93813	0.9943756
RIMA ESTATE 3	10.97407	0.9976426	10.93784	0.9943492
BLACK PETALS (KARIA FARM)	10.97402	0.9976382	10.93772	0.9943386
VALENTINE GROWERS W/PUMP	10.97321	0.9975648	10.93579	0.9941631
GATHAIKA VILLAGE	10.9682	0.9971093	10.9238	0.9930723
TAKATAKA SOLUTIONS	10.96762	0.9970559	10.92239	0.9929445
EHOTHIA FARM	10.96714	0.9970128	10.92126	0.9928414
NAZARETH TEL. EXCHANGE	10.96614	0.9969216	10.91885	0.992623
GATONO ESTATE 1	10.96579	0.9968896	10.91801	0.9925463
GATONO VILLAGE 2	10.96577	0.9968878	10.91796	0.9925422
NAZARETH	10.96574	0.9968854	10.9179	0.9925364

NAZARETH HOSPITAL	10.96485	0.9968043	10.91577	0.9923424
KAMIANO ESTATE - RIARA RIDGE	10.96442	0.9967653	10.91474	0.9922488
KAWAMWAKI FARM	10.9642	0.9967456	10.91422	0.9922017
A.C.K NAZARETH	10.96387	0.9967155	10.91343	0.9921297
C.P.K RIARA	10.96317	0.9966519	10.91175	0.9919775
RIARA RIDGE	10.96237	0.9965787	10.90983	0.9918025
DUNCAN NDEGWA 1	10.96184	0.996531	10.90857	0.9916882
DUNCAN NDEGWA 2	10.96183	0.9965302	10.90855	0.9916863
DUNCAN NDEGWA 3	10.96095	0.9964498	10.90643	0.9914939
HON. MATIBA	10.96052	0.9964113	10.90542	0.9914019
SKN MATIBA	10.96005	0.996368	10.90428	0.9912982
GORDON	10.96002	0.9963658	10.90422	0.991293
STRAGOLLEN TEA FACTORY	10.95979	0.9963446	10.90366	0.9912423
MARGARET NJAMBI	10.95923	0.9962938	10.90233	0.9911207
MUTIGA	10.95879	0.9962539	10.90128	0.9910253
UTTE FARM	10.95835	0.9962132	10.90021	0.9909279
SN KIMUCHU	10.95825	0.9962042	10.89997	0.9909063
ELDO FARM	10.95807	0.9961881	10.89955	0.9908678
KARAI FARMERS COMPANY	10.95799	0.9961808	10.89935	0.9908504
LIMURU HILL LTD	10.9578	0.9961639	10.89891	0.9908101
MUHURI MUCHIRI	10.95766	0.9961512	10.89857	0.9907795
KARIA AREA	10.9576	0.9961452	10.89842	0.9907653
KARITHI KIARIE	10.95744	0.9961305	10.89803	0.9907302
RIARA RIDGE RD	10.95743	0.99613	10.89802	0.990729
KIARA FARM	10.9572	0.9961095	10.89748	0.9906797
KIAWAROGA PUMP	10.95686	0.996078	10.89665	0.9906045
KIRUGU FARM	10.95681	0.996074	10.89654	0.9905949
ITUNGI VILLAGE	10.95676	0.9960688	10.89641	0.9905824
MAGUGU RED EARTH FARM	10.95665	0.9960589	10.89615	0.9905588

Table A11: Lower Hill 11kV Feeder Branch Section Percentage Loading

Branch	% Loading	% Loading
	Low Consumption no Generation	Peak Consumption no Generation
CRHLS001.2	3.059944	7.343849
CRHLS001.1	2.85888	6.861297
CRHLS002	2.778049	6.667302
CRHLS004	2.737633	6.570304
CRHLS006	2.727529	6.546055
CRHLS007	2.545658	6.109566

CRHLS025.1	2.545658	6.109566
CRHLS025.2	2.464827	5.915572
CRHLS008.1	2.216271	5.319038
CRHLS008.2-076.1	2.13544	5.125044
CRHLS076.3	2.054609	4.931049
CRHLS009	1.993985	4.785553
CRHLS022.1	1.95357	4.688556
CRHLS022.2	1.933362	4.640057
CRHLS022.3-010-012	1.892946	4.54306
CRHLS013	1.882842	4.518811
CRHLS018	1.614079	3.87378
CRHLS022-026	1.533248	3.679785
CRHLS029.1	1.523143	3.655536
CRHLS029.3	1.268527	3.044456
CRHLS031	1.228111	2.947459
CRHLS032	1.187696	2.850462
CRHLS035	1.086657	2.607971
CRHLS036	1.005827	2.413978
CRHLS038	0.9856191	2.36548
CRHLS040-041	0.9452039	2.268483
CRHLS042	0.9047888	2.171487
CRHLS044	0.8643736	2.074491
CRHLS046	0.854762	2.051424
CRHLS051	0.8345539	2.002925
CRHLS053	0.8345538	2.002925
CRHLS055	0.8143459	1.954426
CRHLS056	0.7335148	1.760431
CRHLS061	0.6526835	1.566437
CRHLS063	0.5718524	1.372443
CRHLS065	0.4910215	1.178449
CRHLS067-LMTLS064	0.484959	1.163899
CRHLS029.2	0.3887122	0.9329088
LMTLS056-062	0.3232982	0.7759135
TKTK UG	0.2725256	0.6540612
CRHLS072	0.2687645	0.6450337
LMTLS061	0.2646965	0.6352698
LMTLS053	0.2343856	0.5625238
CRHLS023	0.2081406	0.499537
LMTLS410.1	0.1939714	0.46553
CRHLS014	0.1879331	0.4510386
CRHLS071-069.1	0.1818711	0.4364894
LMTLS410.2	0.1737645	0.4170337
LMTLS050	0.161663	0.3879903
CRHLS016	0.1475173	0.354041
LMTLS049	0.141455	0.3394915

CRHLS074	0.1273092	0.305542
CRHLS068	0.1273092	0.305542
CRHLS069.2	0.1010397	0.2424943
CRHLS033.1	0.1010393	0.2424939
CRHLS069.3	0.08083165	0.1939953
CRHLS057-058	0.08083153	0.1939952
CRHLS019	0.08083142	0.1939951
CRHLS024	0.08083131	0.193995
B. NUNS	0.08083131	0.193995
27067-27075	0.08083131	0.193995
CRHLS073	0.08083131	0.193995
CRHLS020	0.08083131	0.193995
CRHLS062	0.08083131	0.193995
CRHLS064	0.08083131	0.193995
LMTLS063	0.08083131	0.193995
NAZARETH O/H	0.06170047	0.1480809
LMTLS047	0.06062362	0.1454964
LMTLS054	0.05860284	0.1406465
CRHLS069.4	0.04041582	0.09699766
CRHLS003	0.04041571	0.09699755
CRHLS070	0.04041571	0.09699755
27055-27066	0.04041571	0.09699755
CRHLS015	0.04041571	0.09699755
CRHLS030	0.04041571	0.09699755
CRHLS039	0.04041571	0.09699755
CRHLS043	0.04041571	0.09699755
CRHLS059	0.04041571	0.09699755
CRHLS060	0.04041571	0.09699755
LMTLS055	0.04041571	0.09699755
LMTLS048	0.04041571	0.09699755
LMTLS046-411	0.03085032	0.07404053
CRHLS048	0.02020802	0.04849894
CRHLS069.22	0.02020791	0.04849883
CRHLS069.5	0.02020791	0.04849883
CRHLS078	0.02020791	0.04849883
CRHLS017	0.02020791	0.04849883
CRHLS033.2-034	0.02020791	0.04849883
CRHLS037	0.02020791	0.04849883
CRHLS054	0.02020791	0.04849883
LMTLS413	0.02020791	0.04849883
CRHLS045	0.01010402	0.02424948
CRHLS005-068-079	0.01010401	0.02424947
CRHLS027	0.01010401	0.02424947
CRHLS049-059	0.01010401	0.02424947
LMTLS051	0.00633189	0.01519637
CRHLS066	0.00606245	0.01454973

Table A12: Red Hill 11kV Feeder Bus Voltage at Expected Feeder Loading Conditions

Bus	Voltage Magnitude, p.u. with no PV Infeed	Voltage Magnitude, p.u. with 175kW PV Infeed
CIANDA 66	1.	1.
CIANDA 11	0.9997242	0.9997471
YARA ESTATE 1	0.9994472	0.9995828
YARA ESTATE 2	0.999188	0.999424
CIANDA COFFEE RESEARCH INSTITUTE	0.9989621	0.9992837
BENEDICTINE NUNS	0.9987504	0.9991468
KIMORORI VILLAGE	0.99874	0.9991365
GATATHA POLICE POST	0.9987334	0.9991298
RIMA ESTATE 1	0.998727	0.9991234
RIMA ESTATE 2	0.9987234	0.9991199
KAWAIDA ROAD 1	0.998313	0.9988982
KAWAIDA ROAD 2	0.9981684	0.9988128
KAWAIDA VILLAGE 1	0.9981504	0.9987947
KAWAIDA VILLAGE 2	0.9981364	0.9987885
SYS. REIN. to S/S 01010	0.9981252	0.9987807
KAWAIDA KIAMBAA	0.9980518	0.9987555
KAWAIDA SHOP	0.9979363	0.998699
SYS. REIN. to S/S 16165	0.9979357	0.9986984
KAWAIDA VILLAGE 3	0.9976981	0.9985862
PEFA BLOOMFIELD	0.9975693	0.9985266
KAWAIDA JUNCTION	0.9974526	0.9985127
KENTMERE ESTATE HOUSE	0.9970827	0.9984733
KARUGA KOINANGE 1	0.9969516	0.9984407
KARUGA KOINANGE 2	0.9969505	0.9983748
RIMA ESTATE 3	0.9969362	0.9983391
BLACK PETALS (KARIA FARM)	0.9969304	0.9983085
VALENTINE GROWERS W/PUMP	0.9968352	0.9981151
GATHAIKA VILLAGE	0.9962432	0.9975223
TAKATAKA SOLUTIONS	0.9961739	0.9974528
EHOTHIA FARM	0.9961179	0.9973967
NAZARETH TEL. EXCHANGE	0.9959994	0.997278
GATONO ESTATE 1	0.9959577	0.9972363
GATONO VILLAGE 2	0.9959555	0.9972341
NAZARETH	0.9959524	0.997231
NAZARETH HOSPITAL	0.995847	0.9971254
KAMIANO ESTATE - RIARA RIDGE	0.9957962	0.9970746

KAWAMWAKI FARM	0.9957707	0.9970489
A.C.K NAZARETH	0.9957316	0.9970098
C.P.K RIARA	0.995649	0.9969271
RIARA RIDGE	0.9955539	0.9968319
DUNCAN NDEGWA 1	0.9954919	0.9967697
DUNCAN NDEGWA 2	0.9954908	0.9967687
DUNCAN NDEGWA 3	0.9953864	0.9966641
HON. MATIBA	0.9953364	0.996614
SKN MATIBA	0.9952801	0.9965576
GORDON	0.9952773	0.9965548
STRAGOLLEN TEA FACTORY	0.9952497	0.9965272
MARGARET NJAMBI	0.9951837	0.9964611
MUTIGA	0.9951319	0.9964092
UTTE FARM	0.995079	0.9963563
SN KIMUCHU	0.9950673	0.9963445
ELDO FARM	0.9950464	0.9963236
KARAI FARMERS COMPANY	0.995037	0.9963141
LIMURU HILL LTD	0.995015	0.9962922
MUHURI MUCHIRI	0.9949985	0.9962756
KARIA AREA	0.9949907	0.9962678
KARITHI KIARIE	0.9949717	0.9962487
RIARA RIDGE RD	0.994971	0.9962481
KIARA FARM	0.9949443	0.9962213
KIAWAROGA PUMP	0.9949034	0.9961804
KIRUGU FARM	0.9948982	0.9961752
ITUNGI VILLAGE	0.9948914	0.9961684
MAGUGU RED EARTH FARM	0.9948786	0.9961555

Table A13: Red Hill 11kV Feeder Branch Section Percentage Loadings

Bus Section	% Loading	% Loading
	No PV Infeed	175kW PV Infeed
CRHLS001.2	3.977924	2.152375
CRHLS001.1	3.716541	2.0983
CRHLS002	3.61146	2.010946
CRHLS004	3.55892	1.99322
CRHLS006	3.545784	1.980085
CRHLS007	3.309353	1.910611
CRHLS025.1	3.309352	1.860639
CRHLS025.2	3.204272	1.848168
CRHLS008.1	2.88115	1.729606
CRHLS008.2-076.1	2.776069	1.704929
CRHLS076.3	2.670989	1.655722

CRHLS009	2.592178	1.649083
CRHLS022.1	2.539638	1.625489
CRHLS022.2	2.513368	1.625488
CRHLS022.3-010-012	2.460828	1.596543
CRHLS013	2.447693	1.557962
CRHLS018	2.0983	1.544003
CRHLS022-026	1.99322	1.527847
CRHLS029.1	1.980085	1.412653
CRHLS029.3	1.649083	1.307574
CRHLS031	1.596543	1.281304
CRHLS032	1.544003	1.235272
CRHLS035	1.412653	1.228764
CRHLS036	1.307574	1.176224
CRHLS038	1.281304	1.143675
CRHLS040-041	1.228764	1.123685
CRHLS042	1.176224	1.11119
CRHLS044	1.123685	1.084919
CRHLS046	1.11119	1.084919
CRHLS051	1.084919	1.058649
CRHLS053	1.084919	1.054596
CRHLS055	1.058649	0.9898483
CRHLS056	0.9535684	0.9535684
CRHLS061	0.8484877	0.9478672
CRHLS063	0.7434075	0.9272804
CRHLS065	0.6383274	0.8870079
CRHLS067-LMTLS064	0.6304462	0.8771426
CRHLS029.2	0.5053258	0.8484877
LMTLS056-062	0.4202872	0.7434075
TKTK UG	0.3542832	0.6383274
CRHLS072	0.3493936	0.6304462
LMTLS061	0.3441051	0.5053258
LMTLS053	0.3047009	0.4202872
CRHLS023	0.2705827	0.3542832
LMTLS410.1	0.2521626	0.3441051
CRHLS014	0.2443128	0.3047009
CRHLS071-069.1	0.2364322	0.2705827
LMTLS410.2	0.2258936	0.2521626
LMTLS050	0.2101617	0.2364322
CRHLS016	0.1917723	0.2258936
LMTLS049	0.1838914	0.2101617
CRHLS074	0.165502	0.1838914
CRHLS068	0.165502	0.165502
CRHLS069.2	0.1313514	0.1313514
CRHLS033.1	0.131351	0.131351
CRHLS069.3	0.105081	0.105081

CRHLS057-058	0.1050809	0.1050809
CRHLS019	0.1050808	0.1050808
CRHLS024	0.1050807	0.1050807
B. NUNS	0.1050807	0.1050807
27067-27075	0.1050807	0.1050807
CRHLS073	0.1050807	0.1050807
CRHLS020	0.1050807	0.1050807
CRHLS062	0.1050807	0.1050807
CRHLS064	0.1050807	0.1050807
LMTLS063	0.1050807	0.1050807
NAZARETH O/H	0.08021056	0.08021056
LMTLS047	0.07881064	0.07881064
LMTLS054	0.07618363	0.07618363
CRHLS069.4	0.0525405	0.0525405
CRHLS003	0.05254039	0.05254039
CRHLS070	0.05254039	0.05254039
27055-27066	0.05254039	0.05254039
CRHLS015	0.05254039	0.05254039
CRHLS030	0.05254039	0.05254039
CRHLS039	0.05254039	0.05254039
CRHLS043	0.05254039	0.05254039
CRHLS059	0.05254039	0.05254039
CRHLS060	0.05254039	0.05254039
LMTLS055	0.05254039	0.05254039
LMTLS048	0.05254039	0.05254039
LMTLS046-411	0.04010537	0.04010537
CRHLS048	0.02627036	0.02627036
CRHLS069.22	0.02627025	0.02627025
CRHLS069.5	0.02627025	0.02627025
CRHLS078	0.02627025	0.02627025
CRHLS017	0.02627025	0.02627025
CRHLS033.2-034	0.02627025	0.02627025
CRHLS037	0.02627025	0.02627025
CRHLS054	0.02627025	0.02627025
LMTLS413	0.02627025	0.02627025
CRHLS045	0.01313519	0.01313519
CRHLS005-068-079	0.01313518	0.01313518
CRHLS027	0.01313518	0.01313518
CRHLS049-059	0.01313518	0.01313518
LMTLS051	0.00823142	0.00823142
CRHLS066	0.00788115	0.00788115

APPENDIX B: INFORMATION GATHERING TOOLS

A.1. QUESTIONNAIRE

STUDY ON THE REGULATORY IMPACT OF NET METERING IN KENYA

A. BACKGROUND

Recently, there has been a growing interest among Kenyans to generate electricity for their own consumption as a supplement to the national grid supply referred to as distributed generation. Consequently, a number of them have become both electricity producers and consumers (prosumers). This distributed generation is mostly based on renewable energy technologies such as solar photovoltaic (PV) systems, hydropower and biomass. As of now, more than 30 MW embedded solar generation plants have been installed in the country. To solve problems that might come with storage of the power generated by prosumers, a net metering arrangement is useful. The arrangement allows prosumers to "bank" or "store" their electricity on the grid when there is over-production. They then offset their consumption from the grid by a fraction or whole of the energy they banked there. This arrangement enhances growth of renewable energy technologies that would without the net metering have problems with storage. Other benefits associated with net metering include: facilitation of economic development, technology innovation, local industry and job creation; increased local ownership, customer investment and participation in energy services; enhanced energy security, diversification and self-sufficiency; reduced greenhouse gas emissions.

In recognition of the net metering benefits, Section 162 of the Energy Act, 2019 allows prosumers with electric generators of capacity not exceeding 1 MW to enter into a net metering agreement with their respective electricity retailer. It is in view of this that the Energy and Petroleum Regulatory Authority (EPRA) has developed draft Energy (Net Metering) Regulations (Draft Regulations), 2020 as an instrument of implementing the Section of the Act. Under the Statutory Instruments Act, 2013 the Authority is required to conduct a Regulatory Impact Assessment before any Regulation is gazetted. It is in view of this that the Authority proposes to evaluate the impacts of the net metering regulatory framework in Kenya.

Your organisation has been identified to participate in the survey as a stakeholder to be affected by the Energy (Net Metering) Regulations, 2020. Your participation in this survey is of paramount importance. *JKUATES* has been contracted by EPRA to undertake the survey.

The data and information provided shall be treated as STRICTLY CONFIDENTIAL and shall only be used for the purposes of the study. Further, it shall not be disclosed to any other parties other than EPRA.

PROSUMERS/ OWNERS OF INSTALLED RENEWABLE ENERGY SYSTEMS

SECTION A

Please tick (☐) as appropriate

1. Type of facility

1. Residential ☐	2. Commercial ☐	3. Industrial ☐

2. Electricity billing method/tariff applicable to your facility

1. SC1 (0-100 kWh) ☐	2. SC2 (101 - 15,000 kWh) ☐	3 CI1 ☐
4. CI2 ☐	5. Other (Please specify)	

3. Type of renewable energy system(s) installed at your facility

1. Solar PV ☐	2. Small hydropower ☐	3. Wind ☐	4. Solid urban waste ☐
5. Biomass ☐	6. Biogas ☐	7. Geothermal ☐	8. Other (Please specify

4. Year when the renewable energy system was **commissioned**

   ……

5. Total **installed generation capacity** of the renewable energy system

1) ≤ 50 kW ☐	2) 51 - 200 kW ☐	3) 201 – 500 kW ☐	4) > 500 kW ☐

6. **Total cost** of installation …… (USD/kW)

7. Is the energy supply from the renewable energy system metered?

1. Yes ☐	2. No ☐

8. If your answer to (7) is **Yes**, does the meter have the following capabilities?

a) Measure the flow of electricity in both directions at the same rate	1. Yes ☐	2. No ☐
b) Measure and record peak supply in different periods	1. Yes ☐	2. No ☐
c) Provide for time-of-use metering	1. Yes ☐	2. No ☐
d) Calibrated by KEBS	1. Yes ☐	2. No ☐

9. Average **annual energy output** of the installed system? ……..…….. kWh

10. What is the annual average **monthly peak demand** of your facility? ……Kw

11. In which month does your facility record the highest peak demand? ……

12. What is the average **annual electrical energy consumption** of your facility? …… kWh

13. Does the installed renewable energy system meet your whole facility's power demand?

1. Yes ☐	2. No ☐

14. Do you have storage for excess energy?

1. Yes ☐	2. No ☐

15. If your answer in (14) is **Yes**, what is the size of the storage? ……..…… (kWh/Ah)

16. If your answer in (14) is **Yes**, what was the cost of storage? ……..……

17. Are there plans to install additional renewable energy system generation capacity?

1. Yes ☐	2. No ☐

18. If your answer in (17) is **Yes**, what is the planned additional generation capacity? ……..…… kW

19. If your answer in (17) is ***Yes***, what is the estimated timeline for installation of the additional generation capacity?

1) Less than 3 years ☐	2) 3 – 5 years ☐	3) Over 5 years ☐

20. Are you aware of the net metering concept as provided for in the Energy Act, 2019?

1. Yes ☐	2. No ☐

21. Would you consider entering into a net metering agreement with an electricity distribution Licensee or retailer?

1. Yes ☐	2. No ☐

22. If your answer in (21) is ***No***, please explain why you would not be interested in net metering.

……
……

……
……

……
……

SOLAR PV CONTRACTORS/MANUFACTURERS/ IMPORTERS

SECTION A

Please tick (☐) as appropriate

1. What class of licence does your firm hold?

1. C1 ☐	2. V1 ☐

2. For how long have you been in this business?

1) Less than 1 year ☐	(2) 1-4 years ☐	3) Over 4 years ☐

3. What types of solar PV systems do you design/ install? Please give the average total installation costs for each system

Type of system	*Average total installation costs (USD/Wp)*
Grid-tied system ☐	
Grid-tied-with-battery-backup ☐	
Grid-tied Hybrid system ☐	
Solar water pumping system ☐	

4. What is the *average number* of grid-tied solar PV projects you handle in a year?

System size	*Average No. of projects*
≤ 50 kWp	
51 – 200 kWp	
201 – 500 kWp	
501 – 1,000 kWp	

5. Give the number of grid-tied solar PV projects in the pipeline to be *commissioned within the* ***next three years***

System size	*No. of projects*
≤ 50 kWp	
51 – 200 kWp	
201 – 500 kWp	

501 – 1,000 kWp	

6. What is the additional cost of storage in a solar PV system? ……..

7. Do the systems that you instal have ride-through capability to withstand distribution system disturbances like voltage and frequency spikes/excursions and safe shutdown?

1. Yes ☐	2. No ☐

8. What is the bandwidth? ……

9. Are you aware of the net metering concept as provided for in the Energy Act, 2019?

1. Yes ☐	2. No ☐

SECTION B: DRAFT ENERGY (NET METERING) REGULATIONS, 2020

TO BE COMPLETED BY BOTH PROSUMERS AND CONTRACTORS

This section presents the provisions made in the Draft Regulations. Please indicate whether or not you agree with each provision. Where you DO NOT agree, please propose an alternative. In case your response can not fit in the space provide, write at the end of the table and indicate the respective question number

	Provision in Draft Regulations	Agree with provision?			If NO, Proposal?
1.	The Licensee shall offer the provision of net metering arrangement to prosumers, who intends to install grid connected renewable energy system, in its area of supply on non-discriminatory and first come first served basis, subject to operational constraints, provided that the consumer is eligible to install the grid connected renewable energy system of the rated capacity as specified under these Regulations	Yes ☐	No ☐	Not sure ☐	
2.	All renewable energy technologies are eligible for net metering	Yes ☐	No ☐	Not sure ☐	
3.	All residential, commercial and industrial customers supplied by a distribution Licensee or retailer are eligible to enter into net-metering agreement subject to these Regulations and other relevant laws	Yes ☐	No ☐	Not sure ☐	
4.	The onsite installed capacity for a renewable energy source for prosumers entering into a net meeting agreement shall be ***capped at the maximum demand in MW of the previous year*** for existing Prosumers	Yes ☐	No ☐	Not sure ☐	
5.	**New** consumers shall be eligible for net metering after **1 year of continuous operation**	Yes ☐	No ☐	Not sure ☐	

6.	A person shall not operate a net metering system unless he has a net metering system **agreement** with a Licensee	Yes ☐	No ☐	Not sure ☐	
7.	The maximum aggregate generation capacity of net metering systems shall be ***100 MW*** for the first 3 years from the date the Regulations come into force	Yes ☐	No ☐	Not sure ☐	
8.	A net meeting agreement applicant shall submit a ***feasibility study report*** including but not limited to demand forecasts and historical load profiles, among others	Yes ☐	No ☐	Not sure ☐	
9.	A Licensee shall communicate the decision on a prosumer's application in form of a written notice within ***60 days*** from the date of application for net metering agreement	Yes ☐	No ☐	Not sure ☐	
10.	The approval to enter into a net metering system agreement shall be specific to the Prosumer who sought the approval and that approval shall not be assigned or transferred to any other person	Yes ☐	No ☐	Not sure ☐	
11.	Any person who is aggrieved by the decision of the Licensee in rejecting an application for approval under the net metering system may, within 30 days of notification of decision, appeal to the Authority as provided for under the Energy (Complaints and Disputes Resolution) Regulations, 2020	Yes ☐	No ☐	Not sure ☐	
	Meters for net metering systems shall:	Yes ☐	No ☐	Not sure ☐	
12.	Measure and register electricity flow in ***both directions*** at the same rate	Yes ☐	No ☐	Not sure ☐	

13.	Measure and record ***peak*** supply in different periods	Yes ☐	No ☐	Not sure ☐	
14.	Provide for ***time-of-use*** metering	Yes ☐	No ☐	Not sure ☐	
15.	The eligible Prosumer shall bear all costs related to the meter and setting up the interconnection with the Licensee's network	Yes ☐	No ☐	Not sure ☐	
16.	A net metering facility shall have a visibly open, lockable, manual disconnect switch, which is accessible by a Licensee and clearly labelled **or**; (i) The generation system must be designed to shut down or disconnect and cannot be manually overridden by the customer upon loss of utility power; and (ii) The generation system must be warranted by the manufacturer to shut down or disconnect upon loss of utility power; and (iii) The generation system must be properly installed and operated, and inspected and/or tested by the distribution utility personnel.	Yes ☐	No ☐	Not sure ☐	
17.	The Prosumer shall inform and seek approval of the Licensee prior to the execution of any replacement or modifications to the net metering system or the connection point	Yes ☐	No ☐	Not sure ☐	
18.	Any net metering system causing interference or unacceptable parameters to the Licensee's system shall be disconnected until the issues are resolved	Yes ☐	No ☐	Not sure ☐	
19.	A Licensee shall provide to prosumers electricity services at non-discriminatory rates that are identical, with respect to rate structure, retail rate components, and any monthly charges, to rates approved by the Authority	Yes ☐	No ☐	Not sure ☐	

20.	Prosumers shall be obliged to pay the Licensee interconnection costs associated with their installation	Yes ☐	No ☐	Not sure ☐	
21.	Prosumers shall be compensated for electrical energy supplied to the Licensee with a credit for each unit exported in a billing period	Yes ☐	No ☐	Not sure ☐	
22.	Each exported unit shall grant the customer a net metering credit of 50% of the exported unit	Yes ☐	No ☐	Not sure ☐	
23.	A prosumer shall be billed for the difference between the discounted exported units and the energy supplied by the Licensee during a billing period in accordance with the applicable standard retail tariff schedule rates	Yes ☐	No ☐	Not sure ☐	
24.	If the Prosumer is, after the application of unit discount, a net exporter during the billing period, he shall not be billed for any energy supplied by the Licensee and shall carry forward any surplus credits to the next billing period	Yes ☐	No ☐	Not sure ☐	
25.	Any unused credits shall be forfeited at the end of the Licensee's financial year	Yes ☐	No ☐	Not sure ☐	
26.	Units generated and consumed on-site shall not attract any compensation or charge	Yes ☐	No ☐	Not sure ☐	
27.	Net metering Prosumers shall not be entitled to any monetary compensation for capacity, reactive power, voltage and frequency support or other benefits their systems may provide	Yes ☐	No ☐	Not sure ☐	
28.	The Licensee shall endeavour to avail the distribution system at all times. However, he shall not be liable for occurrences of network downtime as a result of	Yes ☐	No ☐	Not sure ☐	

	faults and a net metering Prosumer shall not be compensated for any deemed generation during such time				
29.	For billing purposes, licensees shall not estimate the electricity consumed and generated by net-metered Prosumers during any billing period	Yes ☐	No ☐	Not sure ☐	
30.	Prosumers shall grant personnel of the Licensee access to their property for the purpose of maintaining and/or reading the meter	Yes ☐	No ☐	Not sure ☐	
31.	Where a Prosumer vacates the premises where a net-metering system is installed and terminates or transfers the corresponding net metering system agreement, he shall forfeit any remaining credits	Yes ☐	No ☐	Not sure ☐	
32.	Ownership of any carbon credits accruing to the Prosumer shall remain vested with him, unless otherwise specified by any other laws of Kenya	Yes ☐	No ☐	Not sure ☐	

Question no.	Additional Comments

33. Who should own the electricity meter used for net-metering measurements?

1) Distribution Licensee/retailer	☐	(2) Prosumer	☐

34. Please give reasons for your answer in (33).

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35. Which financial/ social/ environmental/ economic impacts on Kenya's economy and the distribution licensee/retailer are likely to result from net metering?

a) Kenya's economy

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b) Distribution licensee/ retailer

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THANK YOU FOR YOUR COOPERATION IN COMPLETING THIS QUESTIONNAIRE

A.2. INTERVIEW GUIDE

QUESTIONS TO GOVERNMENT AND NON-GOVERNMENTAL ORGANISATIONS' OFFICERS

1. What would be the objectives of net metering in Kenya?
2. In your opinion, is there a strong market for net metering in Kenya? Discuss.
3. Which type of consumers (residential, commercial, institutional, by electricity tariff category) should be eligible for net metering and why?
4. Who are the potential players to be affected directly by the net metering framework?
5. Which RETs (solar PV, wind, small hydro, biomass/biogas, geothermal) are more likely to enter into a net metering arrangement with a licensee?
6. Currently, about 30 MW embedded solar generation plants have been installed in the country. What should be the initial maximum aggregate generation capacity of the net metering systems and why?
7. To prevent oversized systems that may operate as net exporters, how should the capping of the onsite installed capacity be determined? (kW or percentage)
8. It is necessary to implement the net metering program in phases, with the first phase being the pilot phase. How long do you think this should take?
9. Would there be need to recalculate the value of net metering credits/compensation after the first phase? Explain
10. Is there need to spell out the duration of net metering contract?
11. It is important to carry out studies on the feeder supplying a prospective net metering prosumer. Do you think such feasibility studies should be carried out by all prosumers or should they be done for certain sizes of installed capacity plants?
12. Who should own the electricity meter used for net-metering measurements? Why?
13. What are the current total installation costs of different RETs in Kenya (USD/kW)?
14. What incentives and policy support are necessary for the success of net metering?
15. Which financial, social, environmental, and economic impacts on Kenya's economy and the distribution licensee/retailer are likely to result from net metering?

Appendix A: System Modelling Data

Table A1: Typical Feeder Loading Data

Feeder	***Red Hill 11 kV Feeder***			***Nairobi South_2 11 kV Feeder***			***Lower Hill 11 kV Feeder***		
Time	***P(kW)***	***S(kVA)***	***pf***	***P(kW)***	***S(kVA)***	***pf***	***P(kW)***	***S(kVA)***	***pf***
0:00	284	300	0.9467	2556	2656	0.9623	1638	1680	0.9750
00:15	264	284	0.9296	2536	2624	0.9665	1542	1572	0.9809
00:30	264	284	0.9296	2540	2636	0.9636	1542	1578	0.9772
00:45	260	276	0.9420	2536	2628	0.9650	1464	1500	0.9760
01:00	248	264	0.9394	2488	2580	0.9643	1440	1482	0.9717
01:15	236	248	0.9516	2484	2576	0.9643	1434	1476	0.9715
01:30	248	264	0.9394	2436	2528	0.9636	1410	1452	0.9711
01:45	240	256	0.9375	2460	2548	0.9655	1344	1380	0.9739
02:00	256	268	0.9552	2504	2592	0.9660	1356	1392	0.9741
02:15	224	236	0.9492	2500	2592	0.9645	1332	1368	0.9737
02:30	228	244	0.9344	2404	2488	0.9662	1338	1374	0.9738
02:45	224	240	0.9333	2344	2428	0.9654	1332	1374	0.9694
03:00	248	264	0.9394	2352	2436	0.9655	1302	1338	0.9731
03:15	248	264	0.9394	2380	2468	0.9643	1314	1350	0.9733
03:30	240	256	0.9375	2396	2480	0.9661	1284	1320	0.9727
03:45	220	232	0.9483	2352	2440	0.9639	1284	1320	0.9727
04:00	244	260	0.9385	2316	2400	0.9650	1284	1314	0.9772
04:15	256	268	0.9552	2352	2440	0.9639	1356	1392	0.9741
04:30	260	276	0.9420	2344	2424	0.9670	1374	1410	0.9745
04:45	264	280	0.9429	2340	2428	0.9638	1422	1452	0.9793
05:00	300	312	0.9615	2300	2396	0.9599	1518	1548	0.9806
05:15	304	316	0.9620	2296	2392	0.9599	1692	1722	0.9826
05:30	320	332	0.9639	2348	2444	0.9607	1800	1836	0.9804
05:45	340	352	0.9659	2328	2420	0.9620	1908	1944	0.9815
06:00	360	368	0.9783	2360	2456	0.9609	2088	2118	0.9858
06:15	372	380	0.9789	2304	2392	0.9632	2244	2280	0.9842
06:30	392	400	0.9800	2280	2364	0.9645	2304	2346	0.9821
06:45	368	380	0.9684	2272	2352	0.9660	2364	2394	0.9875
07:00	376	388	0.9691	2100	2172	0.9669	2436	2472	0.9854
07:15	392	408	0.9608	1980	2056	0.9630	2424	2460	0.9854
07:30	416	432	0.9630	2152	2252	0.9556	2460	2496	0.9856
07:45	432	452	0.9558	2236	2348	0.9523	2490	2532	0.9834
08:00	408	432	0.9444	2324	2428	0.9572	2544	2586	0.9838
08:15	420	440	0.9545	2508	2632	0.9529	2460	2502	0.9832
08:30	452	476	0.9496	2628	2768	0.9494	2598	2640	0.9841
08:45	436	460	0.9478	2672	2824	0.9462	2592	2634	0.9841
09:00	420	448	0.9375	2604	2764	0.9421	2580	2622	0.9840
09:15	432	464	0.9310	2700	2864	0.9427	2562	2610	0.9816
09:30	348	376	0.9255	2764	2936	0.9414	2598	2646	0.9819
09:45	425	455	0.9341	2660	2808	0.9473	2604	2652	0.9819
10:00	335	360	0.9306	2664	2808	0.9487	2622	2664	0.9842
10:15	428	455	0.9407	2672	2808	0.9516	2592	2634	0.9841
10:30	332	356	0.9326	2636	2776	0.9496	2634	2682	0.9821
10:45	415	443	0.9368	2592	2732	0.9488	2562	2604	0.9839
11:00	325	349	0.9312	2584	2724	0.9486	2538	2580	0.9837
11:15	420	448	0.9375	2628	2768	0.9494	2472	2514	0.9833

11:30	337	365	0.9233	2680	2848	0.9410	2496	2544	0.9811
11:45	444	478	0.9289	2772	2948	0.9403	2514	2568	0.9790
12:00	322	349	0.9226	2560	2724	0.9398	2478	2526	0.9810
12:15	433	466	0.9292	2704	2876	0.9402	2550	2604	0.9793
12:30	347	374	0.9278	2760	2924	0.9439	2466	2514	0.9809
12:45	406	435	0.9333	2536	2684	0.9449	2514	2562	0.9813
13:00	312	335	0.9313	2476	2612	0.9479	2550	2604	0.9793
13:15	393	421	0.9335	2456	2596	0.9461	2556	2604	0.9816
13:30	310	333	0.9309	2460	2600	0.9462	2478	2532	0.9787
13:45	398	425	0.9365	2488	2624	0.9482	2526	2568	0.9836
14:00	316	339	0.9322	2512	2644	0.9501	2424	2466	0.9830
14:15	417	444	0.9392	2604	2740	0.9504	2394	2442	0.9803
14:30	330	355	0.9296	2620	2772	0.9452	2364	2406	0.9825
14:45	424	455	0.9319	2648	2808	0.9430	2346	2388	0.9824
15:00	339	365	0.9288	2696	2848	0.9466	2316	2358	0.9822
15:15	431	461	0.9349	2692	2848	0.9452	2328	2376	0.9798
15:30	333	359	0.9276	2644	2804	0.9429	2304	2352	0.9796
15:45	409	439	0.9317	2556	2712	0.9425	2256	2304	0.9792
16:00	336	361	0.9307	2668	2816	0.9474	2298	2340	0.9821
16:15	414	444	0.9324	2588	2740	0.9445	2358	2400	0.9825
16:30	322	345	0.9333	2556	2696	0.9481	2364	2412	0.9801
16:45	398	423	0.9409	2488	2612	0.9525	2400	2448	0.9804
17:00	320	342	0.9357	2544	2668	0.9535	2400	2448	0.9804
17:15	336	360	0.9333	2400	2532	0.9479	2442	2490	0.9807
17:30	372	392	0.9490	2320	2448	0.9477	2532	2586	0.9791
17:45	384	408	0.9412	2308	2424	0.9521	2532	2586	0.9791
18:00	364	388	0.9381	2336	2444	0.9558	2544	2592	0.9815
18:15	356	384	0.9271	2204	2288	0.9633	2562	2604	0.9839
18:30	396	420	0.9429	2180	2264	0.9629	2580	2622	0.9840
18:45	420	440	0.9545	2200	2292	0.9599	2784	2826	0.9851
19:00	476	496	0.9597	2288	2392	0.9565	2916	2964	0.9838
19:15	532	548	0.9708	2332	2440	0.9557	2838	2880	0.9854
19:30	568	584	0.9726	2316	2424	0.9554	2802	2850	0.9832
19:45	596	608	0.9803	2312	2420	0.9554	2766	2802	0.9872
20:00	612	628	0.9745	2372	2492	0.9518	2778	2820	0.9851
20:15	600	616	0.9740	2380	2504	0.9505	2652	2700	0.9822
20:30	584	596	0.9799	2332	2448	0.9526	2604	2646	0.9841
20:45	592	604	0.9801	2428	2540	0.9559	2562	2604	0.9839
21:00	600	608	0.9868	2456	2572	0.9549	2556	2604	0.9816
21:15	568	576	0.9861	2476	2592	0.9552	2466	2508	0.9833
21:30	568	580	0.9793	2512	2628	0.9559	2370	2412	0.9826
21:45	540	556	0.9712	2444	2560	0.9547	2376	2412	0.9851
22:00	524	540	0.9704	2452	2556	0.9593	2196	2232	0.9839
22:15	476	492	0.9675	2496	2600	0.9600	2112	2148	0.9832
22:30	452	472	0.9576	2484	2592	0.9583	2070	2106	0.9829
22:45	428	452	0.9469	2428	2528	0.9604	1980	2010	0.9851
23:00	400	424	0.9434	2424	2528	0.9589	1890	1926	0.9813

APPENDIX B1: SOLAR PV CONTRACTORS/MANUFACTURERS/ IMPORTERS

B. BACKGROUND

Recently, there has been a growing interest among Kenyans to generate electricity for their own consumption as a supplement to the national grid supply referred to as distributed generation. Consequently, a number of them have become both electricity producers and consumers (prosumers). This distributed generation is mostly based on renewable energy technologies such as solar photovoltaic (PV) systems, hydropower and biomass. As of now, more than 30 MW embedded solar generation plants have been installed in the country. To solve problems that might come with storage of the power generated by prosumers, a net metering arrangement is useful. The arrangement allows prosumers to "bank" or "store" their electricity on the grid when there is over-production. They then offset their consumption from the grid by a fraction or whole of the energy they banked there. This arrangement enhances growth of renewable energy technologies that would without the net metering have problems with storage. Other benefits associated with net metering include: facilitation of economic development, technology innovation, local industry and job creation; increased local ownership, customer investment and participation in energy services; enhanced energy security, diversification and self-sufficiency; reduced greenhouse gas emissions.

In recognition of the net metering benefits, Section 162 of the Energy Act, 2019 allows prosumers with electric generators of capacity not exceeding 1 MW to enter into a net metering agreement with their respective electricity retailer. It is in view of this that the Energy and Petroleum Regulatory Authority (EPRA) has developed draft Energy (Net Metering) Regulations (Draft Regulations), 2020 as an instrument of implementing the Section of the Act. Under the Statutory Instruments Act, 2013 the Authority is required to conduct a Regulatory Impact Assessment before any Regulation is gazetted. It is in view of this that the Authority proposes to evaluate the impacts of the net metering regulatory framework in Kenya.

Your organisation has been identified to participate in the survey as a stakeholder to be affected by the Energy (Net Metering) Regulations, 2020. Your participation in this survey is of paramount importance. *JKUATES* has been contracted by EPRA to undertake the survey.

The data and information provided shall be treated as STRICTLY CONFIDENTIAL and shall only be used for the purposes of the study. Further, it shall not be disclosed to any other parties other than EPRA.

Please send the completed questionnaire to roy.orenge@jkuat.ac.ke

SOLAR PV CONTRACTORS/MANUFACTURERS/ IMPORTERS

SECTION A

Please tick (☐) as appropriate

10. What class of licence does your firm hold?

1. C1 ☐	2. V1 ☐

11. For how long have you been in this business?

1) Less than 1 year ☐	(2) 1-4 years ☐	3) Over 4 years ☐

12. What types of solar PV systems do you design/ install? Please give the average total installation costs for each system

Type of system	*Average total installation costs (USD/Wp)*
Grid-tied system ☐	
Grid-tied-with-battery-backup ☐	
Grid-tied Hybrid system ☐	
Solar water pumping system ☐	

13. What is the *average number* of grid-tied solar PV projects you handle in a year?

System size	*Average No. of projects*
≤ 50 kWp	
51 – 200 kWp	
201 – 500 kWp	
501 – 1,000 kWp	

14. Give the number of grid-tied solar PV projects in the pipeline to be *commissioned within the **next three years***

System size	*No. of projects*
≤ 50 kWp	
51 – 200 kWp	
201 – 500 kWp	
501 – 1,000 kWp	

15. What is the additional cost of storage in a solar PV system? ……...

16. Do the systems that you install have ride-through capability to withstand distribution system disturbances like voltage and frequency spikes/excursions and safe shutdown?

1. Yes ☐	2. No ☐

17. Please give the systems' frequency and voltage bandwidths under disturbance conditions

1. Frequency ± …….%	……..% 2. Voltage ±

18. Are you aware of the net metering concept as provided for in the Energy Act, 2019?

1. Yes ☐	2. No ☐

SECTION B: DRAFT ENERGY (NET METERING) REGULATIONS, 2020

This section presents the provisions made in the Draft Regulations. Please indicate whether or not you agree with each provision. Where you DO NOT agree, please propose an alternative. In case your response can not fit in the space provide, write at the end of the table and indicate the respective question number

*A **licensee** means an entity authorized to operate and maintain a distribution system for supplying electrical energy to its consumers in its area of supply.*

	Provision in Draft Regulations	Agree with provision?			If NO, Proposal?
	The Licensee shall offer the provision of net metering arrangement to prosumers, who intends to install grid connected renewable energy system, in its area of supply on non-discriminatory and first come first served basis, subject to operational constraints, provided that the consumer is eligible to install the grid connected renewable energy system of the rated capacity as specified under these Regulations	Yes ☐	No ☐	Not sure ☐	
	All renewable energy technologies are eligible for net metering	Yes ☐	No ☐	Not sure ☐	
	All residential, commercial and industrial customers supplied by a distribution Licensee or retailer are eligible to enter into net-metering agreement subject to these Regulations and other relevant laws	Yes ☐	No ☐	Not sure ☐	
	The onsite installed capacity for a renewable energy source for prosumers entering into a net metering agreement shall be ***capped at the maximum demand in MW of the previous year*** for existing Prosumers	Yes ☐	No ☐	Not sure ☐	
	New consumers shall be eligible for net metering after **1 year of continuous operation**	Yes ☐	No ☐	Not sure ☐	

	A person shall not operate a net metering system unless he has a net metering system **agreement** with a Licensee	Yes ☐	No ☐	Not sure ☐	
	The maximum aggregate generation capacity of net metering systems shall be ***100 MW*** for the first 3 years from the date the Regulations come into force	Yes ☐	No ☐	Not sure ☐	
	A net metering agreement applicant shall submit a ***feasibility study report*** including but not limited to demand forecasts and historical load profiles, among others	Yes ☐	No ☐	Not sure ☐	
	A Licensee shall communicate the decision on a prosumer's application in form of a written notice within ***60 days*** from the date of application for net metering agreement	Yes ☐	No ☐	Not sure ☐	
	The approval to enter into a net metering system agreement shall be specific to the Prosumer who sought the approval and that approval shall not be assigned or transferred to any other person	Yes ☐	No ☐	Not sure ☐	
	Any person who is aggrieved by the decision of the Licensee in rejecting an application for approval under the net metering system may, within 30 days of notification of decision, appeal to the Authority as provided for under the Energy (Complaints and Disputes Resolution) Regulations, 2020	Yes ☐	No ☐	Not sure ☐	
	Meters for net metering systems shall:				
	Measure and register electricity flow in ***both directions*** at the same rate	Yes ☐	No ☐	Not sure ☐	
	Measure and record ***peak*** supply in different periods	Yes ☐	No ☐	Not sure ☐	
	Provide for ***time-of-use*** metering	Yes ☐	No ☐	Not sure ☐	

	The eligible Prosumer shall bear all costs related to the meter and setting up the interconnection with the Licensee's network	Yes ☐	No ☐	Not sure ☐	
	A net metering facility shall have a visibly open, lockable, manual disconnect switch, which is accessible by a Licensee and clearly labelled **or**; (iv) The generation system must be designed to shut down or disconnect and cannot be manually overridden by the customer upon loss of utility power; and (v) The generation system must be warranted by the manufacturer to shut down or disconnect upon loss of utility power; and (vi) The generation system must be properly installed and operated, and inspected and/or tested by the distribution utility personnel.	Yes ☐	No ☐	Not sure ☐	
	The Prosumer shall inform and seek approval of the Licensee prior to the execution of any replacement or modifications to the net metering system or the connection point	Yes ☐	No ☐	Not sure ☐	
	Any net metering system causing interference or unacceptable parameters to the Licensee's system shall be disconnected until the issues are resolved	Yes ☐	No ☐	Not sure ☐	
	A Licensee shall provide to prosumers electricity services at non-discriminatory rates that are identical, with respect to rate structure, retail rate components, and any monthly charges, to rates approved by the Authority	Yes ☐	No ☐	Not sure ☐	
	Prosumers shall be obliged to pay the Licensee interconnection costs associated with their installation	Yes ☐	No ☐	Not sure ☐	
	Prosumers shall be compensated for electrical energy supplied to the	Yes ☐	No ☐	Not sure ☐	

	Licensee with a credit for each unit exported in a billing period				
	Each exported unit shall grant the customer a net metering credit of 50% of the exported unit	Yes ☐	No ☐	Not sure ☐	
	A prosumer shall be billed for the difference between the discounted exported units and the energy supplied by the Licensee during a billing period in accordance with the applicable standard retail tariff schedule rates	Yes ☐	No ☐	Not sure ☐	
	If the Prosumer is, after the application of unit discount, a net exporter during the billing period, he shall not be billed for any energy supplied by the Licensee and shall carry forward any surplus credits to the next billing period	Yes ☐	No ☐	Not sure ☐	
	Any unused credits shall be forfeited at the end of the Licensee's financial year	Yes ☐	No ☐	Not sure ☐	
	Units generated and consumed on-site shall not attract any compensation or charge	Yes ☐	No ☐	Not sure ☐	
	Net metering Prosumers shall not be entitled to any monetary compensation for capacity, reactive power, voltage and frequency support or other benefits their systems may provide	Yes ☐	No ☐	Not sure ☐	
	The Licensee shall endeavour to avail the distribution system at all times. However, he shall not be liable for occurrences of network downtime as a result of faults and a net metering Prosumer shall not be compensated for any deemed generation during such time	Yes ☐	No ☐	Not sure ☐	
	For billing purposes, licensees shall not estimate the electricity consumed and generated by net-metered Prosumers during any billing period	Yes ☐	No ☐	Not sure ☐	
	Prosumers shall grant personnel of the Licensee access to their property	Yes ☐	No ☐	Not sure ☐	

	for the purpose of maintaining and/or reading the meter				
	Where a Prosumer vacates the premises where a net-metering system is installed and terminates or transfers the corresponding net metering system agreement, he shall forfeit any remaining credits	Yes ☐	No ☐	Not sure ☐	
	Ownership of any carbon credits accruing to the Prosumer shall remain vested with him, unless otherwise specified by any other laws of Kenya	Yes ☐	No ☐	Not sure ☐	

Please give any additional comments to questions 10 - 41 in the following table

Question no.	Additional Comments

51. Who should own the electricity meter used for net-metering measurements?

1) Distribution Licensee/retailer ☐	(2) Prosumer ☐

52. Please give reasons for your answer in (42).

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53. Which financial/ social/ environmental/ economic impacts on Kenya's economy and the distribution licensee/retailer are likely to result from net metering?

a) Kenya's economy

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b) Distribution licensee/ retailer

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THANK YOU FOR YOUR COOPERATION IN COMPLETING THIS QUESTIONNAIRE

APPENDIX B2: PROSUMERS/ OWNERS OF INSTALLED RENEWABLE ENERGY SYSTEMS

C. BACKGROUND

Recently, there has been a growing interest among Kenyans to generate electricity for their own consumption as a supplement to the national grid supply referred to as distributed generation. Consequently, a number of them have become both electricity producers and consumers (prosumers). This distributed generation is mostly based on renewable energy technologies such as solar photovoltaic (PV) systems, hydropower and biomass. As of now, more than 30 MW embedded solar generation plants have been installed in the country. To solve problems that might come with storage of the power generated by prosumers, a net metering arrangement is useful. The arrangement allows prosumers to "bank" or "store" their electricity on the grid when there is over-production. They then offset their consumption from the grid by a fraction or whole of the energy they banked there. This arrangement enhances growth of renewable energy technologies that would without the net metering have problems with storage. Other benefits associated with net metering include: facilitation of economic development, technology innovation, local industry and job creation; increased local ownership, customer investment and participation in energy services; enhanced energy security, diversification and self-sufficiency; reduced greenhouse gas emissions.

In recognition of the net metering benefits, Section 162 of the Energy Act, 2019 allows prosumers with electric generators of capacity not exceeding 1 MW to enter into a net metering agreement with their respective electricity retailer. It is in view of this that the Energy and Petroleum Regulatory Authority (EPRA) has developed draft Energy (Net Metering) Regulations (Draft Regulations), 2020 as an instrument of implementing the Section of the Act. Under the Statutory Instruments Act, 2013 the Authority is required to conduct a Regulatory Impact Assessment before any Regulation is gazetted. It is in view of this that the Authority proposes to evaluate the impacts of the net metering regulatory framework in Kenya.

Your organisation has been identified to participate in the survey as a stakeholder to be affected by the Energy (Net Metering) Regulations, 2020. Your participation in this survey is of paramount importance. *JKUATES* has been contracted by EPRA to undertake the survey.

The data and information provided shall be treated as STRICTLY CONFIDENTIAL and shall only be used for the purposes of the study. Further, it shall not be disclosed to any other parties other than EPRA.

Please send the completed questionnaire to roy.orenge@jkuat.ac.ke

Please tick (☐) as appropriate

23. Type of facility

1. Residential ☐	2. Commercial ☐	3. Industrial ☐

24. Electricity billing method/tariff applicable to your facility

1. SC1 (0-100 kWh) ☐	2. SC2 (101 - 15,000 kWh) ☐	3 CI1 ☐
4. CI2 ☐	5. Other (Please specify)	

25. Type of renewable energy system(s) installed at your facility

1. Solar PV ☐	2. Small hydropower ☐	3. Wind ☐	4. Solid urban waste ☐
5. Biomass ☐	6. Biogas ☐	7. Geothermal ☐	8. Other (Please specify

26. Year when the renewable energy system was **commissioned**

……

27. Total **installed generation capacity** of the renewable energy system

1) ≤ 50 kW ☐	2) 51 - 200 kW ☐	3) 201 – 500 kW ☐	4) > 500 kW ☐

28. **Total cost** of installation …… (USD/kW)

29. Is the energy supply from the renewable energy system metered?

1. Yes ☐	2. No ☐

30. If your answer to (7) is **Yes**, does the meter have the following capabilities?

a) Measure the flow of electricity in both directions at the same rate	1. Yes ☐	2. No ☐
b) Measure and record peak supply in different periods	1. Yes ☐	2. No ☐

c) Provide for time-of-use metering	1. Yes ☐	2. No ☐
d) Calibrated by KEBS	1. Yes ☐	2. No ☐

31. Average **annual energy output** of the installed system? …….....……....….. kWh

32. What is the annual average **monthly peak demand** of your facility (consumption)? ……kVA

33. In which month does your facility record the highest peak demand? ……

34. What is the average **annual electrical energy consumption** of your facility? ……..… kWh

35. Does the installed renewable energy system meet your whole facility's power demand?

1. Yes ☐	2. No ☐

36. Do you have storage for excess energy?

1. Yes ☐	2. No ☐

37. If your answer in (14) is **Yes**, what is the size of the storage? ……...…… (kWh/Ah)

38. If your answer in (14) is **Yes**, what was the cost of storage? ……...…….

39. Are there plans to install additional renewable energy system generation capacity?

1. Yes ☐	2. No ☐

40. If your answer in (17) is **Yes**, what is the planned additional generation capacity? ……... kW

41. If your answer in (17) is ***Yes***, what is the estimated timeline for installation of the additional generation capacity?

1) Less than 3 years ☐	2) 3 – 5 years ☐	3) Over 5 years ☐

42. Are you aware of the net metering concept as provided for in the Energy Act, 2019?

1. Yes ☐	2. No ☐

43. Would you consider entering into a net metering agreement with an electricity distribution Licensee or retailer?

1. Yes ☐	2. No ☐

44. If your answer in (21) is ***No***, please explain why you would not be interested in net metering.

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SECTION B: DRAFT ENERGY (NET METERING) REGULATIONS, 2020

This section presents the provisions made in the Draft Regulations. Please indicate whether or not you agree with each provision. Where you DO NOT agree, please propose an alternative. In case your response can not fit in the space provide, write at the end of the table and indicate the respective question number.

*A **licensee** means an entity authorized to operate and maintain a distribution system for supplying electrical energy to its consumers in its area of supply.*

	Provision in Draft Regulations	Agree with provision?			If NO, Proposal?
	The Licensee shall offer the provision of net metering arrangement to prosumers, who intends to install grid connected renewable energy system, in its area of supply on non-discriminatory and first come first served basis, subject to operational constraints, provided that the consumer is eligible to install the grid connected renewable energy system of the rated capacity as specified under these Regulations	Yes ☐	No ☐	Not sure ☐	
	All renewable energy technologies are eligible for net metering	Yes ☐	No ☐	Not sure ☐	
	All residential, commercial and industrial customers supplied by a distribution Licensee or retailer are eligible to enter into net-metering agreement subject to these Regulations and other relevant laws	Yes ☐	No ☐	Not sure ☐	
	The onsite installed capacity for a renewable energy source for prosumers entering into a net metering agreement	Yes ☐	No ☐	Not sure ☐	

	shall be ***capped at the maximum demand in MW of the previous year*** for existing Prosumers				
	New consumers shall be eligible for net metering after **1 year of continuous operation**	Yes ☐	No ☐	Not sure ☐	
	A person shall not operate a net metering system unless he has a net metering system **agreement** with a Licensee	Yes ☐	No ☐	Not sure ☐	
	The maximum aggregate generation capacity of net metering systems shall be ***100 MW*** for the first 3 years from the date the Regulations come into force	Yes ☐	No ☐	Not sure ☐	
	A net metering agreement applicant shall submit a ***feasibility study report*** including but not limited to demand forecasts and historical load profiles, among others	Yes ☐	No ☐	Not sure ☐	
	A Licensee shall communicate the decision on a prosumer's application in form of a written notice within ***60 days*** from the date of application for net metering agreement	Yes ☐	No ☐	Not sure ☐	
	The approval to enter into a net metering system agreement shall be specific to the Prosumer who sought the approval and that approval shall not be assigned or transferred to any other person	Yes ☐	No ☐	Not sure ☐	
	Any person who is aggrieved by the decision of the Licensee in rejecting an application for approval under the net metering system may, within 30 days of notification of decision, appeal to the Authority as provided for under the	Yes ☐	No ☐	Not sure ☐	

	Energy (Complaints and Disputes Resolution) Regulations, 2020				
	Meters for net metering systems shall:				
	Measure and register electricity flow in ***both directions*** at the same rate	Yes ☐	No ☐	Not sure ☐	
	Measure and record ***peak*** supply in different periods	Yes ☐	No ☐	Not sure ☐	
	Provide for ***time-of-use*** metering	Yes ☐	No ☐	Not sure ☐	
	The eligible Prosumer shall bear all costs related to the meter and setting up the interconnection with the Licensee's network	Yes ☐	No ☐	Not sure ☐	
	A net metering facility shall have a visibly open, lockable, manual disconnect switch, which is accessible by a Licensee and clearly labelled **or**; (vii) The generation system must be designed to shut down or disconnect and cannot be manually overridden by the customer upon loss of utility power; and (viii) The generation system must be warranted by the manufacturer to shut down or disconnect upon loss of utility power; and (ix) The generation system must be properly installed and operated, and inspected and/or tested by the distribution utility personnel.	Yes ☐	No ☐	Not sure ☐	
	The Prosumer shall inform and seek approval of the Licensee prior to the execution of any replacement or modifications to the net metering system or the connection point	Yes ☐	No ☐	Not sure ☐	
	Any net metering system causing interference or unacceptable parameters	Yes ☐	No ☐	Not sure ☐	

	to the Licensee's system shall be disconnected until the issues are resolved				
	A Licensee shall provide to prosumers electricity services at non-discriminatory rates that are identical, with respect to rate structure, retail rate components, and any monthly charges, to rates approved by the Authority	Yes ☐	No ☐	Not sure ☐	
	Prosumers shall be obliged to pay the Licensee interconnection costs associated with their installation	Yes ☐	No ☐	Not sure ☐	
	Prosumers shall be compensated for electrical energy supplied to the Licensee with a credit for each unit exported in a billing period	Yes ☐	No ☐	Not sure ☐	
	Each exported unit shall grant the customer a net metering credit of 50% of the exported unit	Yes ☐	No ☐	Not sure ☐	
	A prosumer shall be billed for the difference between the discounted exported units and the energy supplied by the Licensee during a billing period in accordance with the applicable standard retail tariff schedule rates	Yes ☐	No ☐	Not sure ☐	
	If the Prosumer is, after the application of unit discount, a net exporter during the billing period, he shall not be billed for any energy supplied by the Licensee and shall carry forward any surplus credits to the next billing period	Yes ☐	No ☐	Not sure ☐	
	Any unused credits shall be forfeited at the end of the Licensee's financial year	Yes ☐	No ☐	Not sure ☐	
	Units generated and consumed on-site shall not attract any compensation or charge	Yes ☐	No ☐	Not sure ☐	

	Net metering Prosumers shall not be entitled to any monetary compensation for capacity, reactive power, voltage and frequency support or other benefits their systems may provide	Yes ☐	No ☐	Not sure ☐	
	The Licensee shall endeavour to avail the distribution system at all times. However, he shall not be liable for occurrences of network downtime as a result of faults and a net metering Prosumer shall not be compensated for any deemed generation during such time	Yes ☐	No ☐	Not sure ☐	
	For billing purposes, licensees shall not estimate the electricity consumed and generated by net-metered Prosumers during any billing period	Yes ☐	No ☐	Not sure ☐	
	Prosumers shall grant personnel of the Licensee access to their property for the purpose of maintaining and/or reading the meter	Yes ☐	No ☐	Not sure ☐	
	Where a Prosumer vacates the premises where a net-metering system is installed and terminates or transfers the corresponding net metering system agreement, he shall forfeit any remaining credits	Yes ☐	No ☐	Not sure ☐	
	Ownership of any carbon credits accruing to the Prosumer shall remain vested with him, unless otherwise specified by any other laws of Kenya	Yes ☐	No ☐	Not sure ☐	

Please give any additional comments to questions 23 - 54 in the following table

Question No.	**Additional Comments**

77. Who should own the electricity meter used for net-metering measurements?

1) Distribution Licensee/retailer ☐	(2) Prosumer ☐

78. Please give reasons for your answer in (55).

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79. Which financial/ social/ environmental/ economic impacts on Kenya's economy and the distribution licensee/retailer are likely to result from net metering?

a) Kenya's economy

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……..…

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……...……

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……...

b) Distribution licensee/ retailer

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……...…

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……...…

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……...……

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……...

THANK YOU FOR YOUR COOPERATION IN COMPLETING THIS QUESTIONNAIRE

APPENDIX B3: RESPONDENT'S PROFILE

SOLAR PV CONTRACTORS (EPC)

Name	
County	
Telephone contact	
E-mail Address	
Website	
Contact Person	
Date of visit	

PROSUMERS/ OWNERS

Name	
Physical Location	
County	
Telephone contact	
E-mail Address	
Website	
Contact Person	
Date of visit	