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IMPACT STUDY OF THE ENERGY (SOLAR PHOTOVOLTAIC SYSTEMS) REGULATIONS 2012

On behalf of

Energy and Petroleum Regulatory Authority (EPRA)

FINAL REPORT

November 2019

PROJECT INFORMATION

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(Formerly Energy Regulatory Commission)

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Project Title

Consultancy Services for Impact Study of the Energy (Solar Photovoltaic Systems) Regulations, 2012

Report Title

Final Report

Consultant's Details

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EXECUTIVE SUMMARY

Sustainable Energy Initiative Ltd. was contracted to undertake an Impact Study of The Energy (Solar Photovoltaic Systems) Regulations, 2012 by the Energy and Petroleum Regulatory Authority (EPRA). The main objective of the study was to assess the impact of the Regulations on the development of the solar photovoltaic industry in Kenya. The study targeted EPRA licensees in the Solar PV field, unlicensed solar PV installers, solar PV training institutions, solar PV promoters and government agencies.

From this targeted population, one hundred and thirty-two (132) holders of various classes of vendor licenses (V1, V2, and C1) and ninety-eight (98) holders of different classes of technician licenses (T1, T2, and T3) were sampled. A total of one hundred eight (108) and one hundred fourteen (114) licenced firms (vendors/ contractors/ importers/ manufacturers) and technicians, respectively were interviewed. Additionally, fifteen (15) unlicensed technicians were studied. These respondents were spread in five geographical regions namely Nairobi and its environs, Kisumu, Eldoret, Nakuru, and Mombasa.

A sample of five (5) solar PV training institutions and sixteen (16) government and non-governmental agencies that promote solar PV industry was selected from the target population. The organisations were requested to fill a study questionnaire for information gathering with the guidance of a field assistant. The data collected was then analysed and discussed.

The study results show that the solar PV projects implemented in the country range from pico plug-and-play to the complex grid-tied and hybrid systems. The most common are the stand-alone systems bigger than 300 Wp. Other common systems are solar street lighting, hybrid systems more than 1 kW and solar water pumping. Only a few vendors deal with grid-tied systems with transformer and selling power to the grid. The big solar PV projects are mainly handled by experienced firms (over 10 years) that have several highly qualified technicians with T3 licence in their employment. Further, there are indications that vendors with a higher number of licensed technicians in their employment handle few, high capacity projects in a year whereas those with no licensed technicians handle a large number of small projects including the pico plug and play and stand-alone systems of not more than 300 W. All the vendors have a licensed lead technician with the majority of them employing T3 license holders. Sixty three percent of the lead technicians

have a bachelor's degree with seventeen percent having post graduate qualifications. Only a few lead technicians (1%) are certificate holders who can only be licensed as T1 technicians.

Fifty four and eighty nine percent of the vendors and technicians, respectively affirmed that the licences they hold allow them to serve their customers adequately. However, they feel there is a need for expansion of the scope of work that the T1 and T2, and by extension V1, license holders are authorised to carry out. The view on the classification is shared by majority of the training institutions and solar PV promoters (government and non-governmental agencies) who are of the opinion that the division of technician license classes into T1, T2, and T3 together with division of the level of work that each class can undertake is not appropriate. Thus, they suggested creation of additional classes of licenses in the future. Further, it was noted that both T1 and T2 license holders are already engaging in projects that are above the maximum authorized capacity for their respective class licenses i.e. less than 100 Wp and 300 Wp for T1 and T2, respectively. The training institutions are of the opinion that there is a need to amend the regulations so as to incorporate more specialized technician categories. Thus, there is general consensus among the stakeholders on the need to expand the license categories. It is important to note that those who think the categorization is adequate feel that more fragmentation could cause confusion in the industry.

Eighty percent of the technicians consider the respective academic qualification requirements for licensing T1, T2, and T3 technicians to be appropriate and sixty six percent of the government agencies and non-governmental organisations are in concurrence. The most popular solar PV course among the technicians is T1/T2 followed by T3 Grid-tied and T3 Hybrid. Further, the technicians think the courses they have attended are relevant to the solar PV industry, comprehensive, and the delivery time is adequate. However, they suggest that the courses can be improved by including topics on system inspection, testing, and commissioning, PV system troubleshooting & diagnostics, sizing and standards, mini- and micro- grids, among others.

As part of the qualification process, technicians take examinations that are administered by EPRA. Majority of the technicians are of the opinion that the examinations are fair (96%), transparent (97%), and offered conveniently in terms of time (87%). However, there were proposals to devolve administration of the exams. Ninety six and ninety five percent of the vendors and technicians, respectively, understand the licensing process used by EPRA. Further, they rate the level of

difficulty in applying for a license as either easy or moderate and think the process of renewing their licenses is convenient. In terms of the speed with which EPRA processes and issues licenses, both new licenses and renewals, majority of the licensees are of the opinion that it is either satisfactory or fast and that the license fees charged by EPRA is either low or fair.

Seventy five percent of the technicians are of the view that the requirement to practise for at least two years before applying for a license upgrade is appropriate. In addition, seventy eight and ninety one percent of the technicians and vendors, respectively agree that continuous professional development (CPD) attained through training is a better way for a technician to upgrade from one license class to another.

Sixty seven and seventy four percent of the vendors and technicians, respectively think the one-year validity period of a license is inadequate. However, thirty eight percent of the technicians proposed a three-year validity period whereas forty three percent of the vendors favour two years. It is noteworthy that the vendors who propose three years is a sizeable group representing twenty nine percent. Opinion is divided on the provision for cancellation of any license that is not renewed for two (2) consecutive years without informing the Authority in writing of the intention and reasons for not renewing. Forty nine percent of the vendors favour license cancellation after non-renewal for a period of four years whereas forty five percent of the technicians prefer three years. It is worth noting that the number of technicians who are in favour of a four-year period is also significant at thirty percent. There is a proposal that the license should not be cancelled but rather impose an annual fine payable for the years not renewed.

Sixty eight percent of the vendors have licensed lead technician in their employment. Further, sixty percent of the licensed technicians have their licenses attached to a firm with ninety three percent having attached their licenses for less than five years. Additionally, about sixty three percent of the technicians who have attached their license to a firm have had previous license attachments. Ninety seven and seventy percent of the vendors and technicians, respectively confirm that there are no challenges in the working relationship between the firms and the licenced technicians. However, more firms are contented with the relationships than the technicians. Opinion is divided on whether one technician should be permitted to commit their license to more than one vendor with more technicians favouring this arrangement, and they would prefer to have the commitment

extended to three firms. It is clear that the technicians are neither in control of the technical aspects of the projects nor finances.

The design, installation, repair and maintenance of solar PV systems is supposed to be carried out in accordance with the relevant Kenya standards. However, the regulation does not specify which standards these are. Most licensees allude to using various local and international standards. Additionally, majority of the vendors are of the view that the minimum warranty periods for solar PV systems and components provided for in the regulations are practical.

As part of the regulation enforcement, EPRA should inspect business premises and solar PV installation sites. Eighty five percent of the vendors stated that their businesses had been inspected. However, it is worth noting that most of the installed sites might not have been inspected with only forty two percent each of the vendors and technicians having had sites they have installed solar PV systems inspected.

The respondents stated the following as some of the notable impacts of the Energy (Solar PV Systems) Regulations 2012 on the social-economic development of Kenya:

i. enhanced professionalism in the PV industry
ii. creation of a pool of qualified technicians
iii. reduction of the number of faulty solar PV installations
iv. job creation
v. confidence of clients in working with licensed technicians
vi. clarity of roles according to academic and professional qualifications
vii. improved public acceptance of solar PV as a viable option
viii. streamlined works in solar PV installation
ix. reduction of greenhouse gases (GHG) and global warming, among others.

The solar PV industry has grown with large capacity systems in the megawatt range being implemented as stand-alone, grid-tied, or hybrid systems. There is also a growing interest in micro/mini-grid systems and solar water pumping in the market. Thus, from the foregoing, there is need for review of the regulations to better serve the growing solar PV industry. In addition, the study identified thirty-three Standards that are relevant to solar PV and recommends adoption of the same in the regulations. These will help drive and uphold the industry standards.

The licensees indicated that some of the licenses issued under the current regulations are limited in scope. Others felt that the T3 class is too broad and there may be need to break it down. Based on the study findings, we propose re-classification of the technician, contractor, and vendor/manufacturer licenses as follows:

Technician License Class	***Scope of work***	***System description***	***System maximum capacity***
ST1	Design, install, commission, maintain, and repair	A single inverter, single charge controller, single or multiple panels	Not more than 400 watts
ST2	Design, install, commission, maintain, and repair	PV Array, a single inverter/Charger connected to grid or a backup generator, a charge controller and multiple batteries.	Not more than 2 kW, charge controller up to 70 amperes and multiple batteries. Solar water pumping systems not more than 2 kW
ST3	Design, install, commission, maintain, and repair	Grid-tied or a hybrid or a direct current coupled with a single battery inverter and multiple batteries	Grid-tied not more than 50 kW; single phase, hybrid system not more than10 kW, direct current coupled with a single battery inverter, multiple batteries; solar water pumping system not more than 50 kW
ST4	Design, install, commission, maintain, and repair	Grid-tied, hybrid, and solar water pumping systems	Any capacity

We found that the vendors have multiple licenses to take care of importation, sale, design and installation of solar PV systems. Thus, it is quite cumbersome to clean up the actual list of vendor licensees. Hence, we propose that all contractors be authorised to import and sell solar PV products for the scope of work that they are authorised to conduct. Additionally, to facilitate importation of parts for the manufacture of components, and sale of the finished solar PV components, we propose one manufacturer's license class whose holders' do not necessarily have to engage in systems installation. Thus, we propose re-classification of the contractor licenses as follows:

Contractor License Class	***Scope of work***	***System description***	***System maximum capacity (kW)***	Required technician license
SC1	Design, install, commission, maintain, and repair	A single inverter, single maximum power point tracking charge controller, single or multiple panels and a single battery system	Not more than 400 watts and battery system to a maximum of 12 volts	ST1
SC2	Design, install, commission, maintain, and repair	PV Array, a single inverter/Charger connected to grid or a backup generator, a charge controller and multiple batteries	Not more than 2 kW, MPPT of up to 70 Amperes, battery system up to 48 volts. Solar water pumping systems not more than 2 kW	ST2
SC3	Design, install, commission, maintain, and repair	Grid-tied or a hybrid or a direct current coupled with a single battery inverter and multiple batteries	Not more than 10 kW, battery system up to 48 volts. Grid-tied not more than 50 kW; single phase Hybrid system not more than10 kW, battery system up to 48 volts; solar water pumping system not more than 50 kW	ST3
SC4	Design, install, commission, maintain, and repair	Grid-tied, hybrid, and solar water pumping systems	Any capacity	ST4
SM	Manufacture and sell	Import *parts* necessary *for the manufacture* of solar PV components, manufacture and sell solar PV components and systems	Any capacity	None

Other revisions of the current regulations are given in the draft regulations provided in Appendix A.

ABBREVIATIONS AND NOTATIONS

AC	Alternating Current
BCC	Battery Charge Controllers
BOS	Balance-of-System
CEC	Clean Energy Council
CFL	Compact Fluorescent Lamp
CPD	Continuous Professional Development
DC	Direct Current
EES	Electrical Energy Storage
EPC	Engineering, Procurement, and Construction
EPRA	Energy and Petroleum Regulatory Authority
ERC	Energy Regulatory Commission
GHG	Greenhouse Gases
ICT	Information and Communications Technology
JKUAT	Jomo Kenyatta University of Agriculture & Technology
KAM	Kenya Association of Manufacturers
KCIC	Kenya Climate Innovations Centre
KEBS	Kenya Bureau of Standards
KEREA	Kenya Renewable Energy Association
KIE	Kenya Institute of Education
KPLC	Kenya Power & Lighting Company
KRA	Kenya Revenue Authority
kV	Kilovolt
kW	Kilowatt
LED	Light Emitting Diode
MoEP	Ministry of Energy and Petroleum
MPPT	Maximum Power Point Tracking
MW	Megawatt
NABCEP	North American Board of Certified Energy Practitioners
NGO	Non-Governmental Organisation

NITA	National Industrial Training Authority
OEM	Original Equipment Manufacturer
PCE	Power Conversion Equipment
PV	Photovoltaic
PVCMS	PV Commissioning & Maintenance
PVDS	PV Design Specialist
PVES	Photovoltaic Energy System
PVIP	PV Installation Professional
PVIS	PV Installer Specialist
PVTS	PV Technical Sales
PVSI	PV System Inspector
QTM	Quality Test Method
REA	Rural Electrification Authority
RENAC	Renewables Academy
RIA	Regulation Impact Assessment
SAPVIA	South African Photovoltaic Industry Association
SEI	Sustainable Energy Initiative
SHS	Solar Home Systems
SPS	Stand-alone Power System
SPSS	Statistical Package for Social Sciences
SPTQ	Solar PV Technician Qualification
STC	Standard Test Conditions
ToRs	Terms of Reference
V	Volts
W	Watt

CHAPTER ONE
INTRODUCTION

1.1. Background

Kenya receives a solar insolation of 4-6 Kw/m^2. This solar resource makes solar photovoltaic (PV) ideal for heating, pumping, and lighting applications among others. The resource can be harnessed for perpetuation of sustainable energy in the country. To achieve this, the country requires quality solar PV components and well trained technical personnel to carry out design and installations of solar PV systems. This can be achieved through well designed regulatory frameworks, through a regulatory body.

The Energy and Petroleum Regulatory Authority (EPRA) is a single sector regulatory agency established under section 9(1) of the Energy Act, 2019 with the responsibility of among other matters:

i) Economic and technical regulation of electric power (except licensing of nuclear facilities) renewable energy, energy efficiency, and downstream petroleum subsectors.
ii) Supervision and technical regulation of the upstream petroleum sector.

The Authority was formerly named the Energy Regulatory Commission (ERC) established under the Energy Act, 2006 (now repealed).

The Authority has been implementing the Energy (Solar Photovoltaic Systems) Regulations, 2012 which were gazetted on 28th September 2012 via Legal Notice No. 103. These Regulations were promulgated under The Energy Act, 2006 which has since been repealed and replaced by the Energy Act, 2019. However, the Regulations were saved and will continue to be in force pursuant to the transitional provisions of the Energy Act, 2019. The regulations provide for the following, inter alia:

a. Licensing of all persons involved in the manufacture, importation, distribution, promotion, sale, design or installation of any Solar PV systems;
b. Collection of data on Solar PV systems installed in the country;
c. Ensuring the manufacture, design, installation, repair and maintenance of Solar PV systems is done as per the relevant Kenyan Standards;
d. Ensuring fair business practices in the Solar PV industry.

Due to dynamic nature of markets, regulations are developed and reviewed to serve contemporary needs of all the stakeholders. Regulations development, implementation and review is therefore a consultative and cyclic process, as depicted in Figure 1.1.

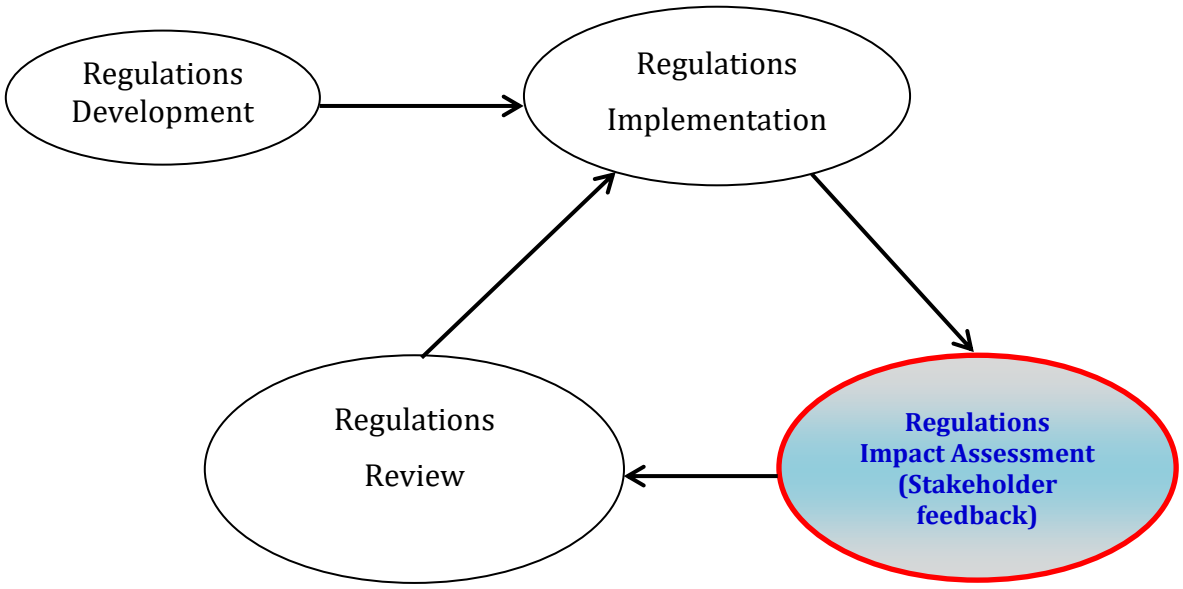

Figure 1.1: Cycle of regulations review

As demonstrated in Figure 1.1, the assessment of impacts of existing regulations is a vital process in the cycle. This exercise generates data that is fed into the regulations' review process.

1.2. Study Objectives

The study team conducted a study to assess the impact of the Energy (Solar Photovoltaic Systems) Regulations 2012 since gazettement on the development of the solar PV industry in Kenya. The objectives of the study were:

i) To assess the appropriateness of the different classes of licence in regulating the manufacturing, importation, distribution, design and installation of solar PV systems/components with a view of aligning them with the current market needs;

ii) To identify any gaps in the qualifications, experience and certifications required for the different technicians' licenses;

iii) To assess the effectiveness of the process used in issuances of licenses in the different classes;

iv) To establish the challenges in working relationship between licensed solar PV technicians and the firms in which they are attached

v) To assess the effectiveness of the general license conditions, e.g. the validity period and the upgrade period for licenses;

vi) To assess compliance of the regulations with the Kenya Constitution, Energy Act, 2019, environmental laws and other laws that have been enacted;

vii) To identify Kenyan and International Standards relating to manufacture, design, installation and maintenance of solar PV that the regulations should be aligned to;

viii) To assess the effectiveness of the regulations in enforcing the relevant Kenyan Standards;

ix) To assess the adequacy of the documentation required in the regulations e.g. completion certificates, registers, returns on systems installed and imported in regulating the solar PV industry;

x) To assess the relevance of the warranties provided for in the regulations to the product life;

xi) To assess the effectiveness of inspection and enforcement provided in the regulation;

xii) Establishing the challenges in enforcing the provisions of the regulations and penalties provided for in the regulations;

xiii) To establish the economic and social impacts of the regulations;

xiv) To benchmark with other global existing regulations relating to manufacture, design, installation and maintenance of solar PV.

1.3. Study Outputs

The following were the outputs of the assignment:

i) A work plan for execution of the assignment. The assignment was carried out in six (6) months from the commencement date.

ii) An inception report with details of understanding of the assignment, proposed methodology and a detailed activity schedule. This included data collection and analysis tools and these were validated by the Authority.

iii) A draft Report highlighting the findings of the study based on the study objectives.

iv) A report on a stakeholders' validation workshop documenting stakeholders' and experts' inputs.

v) A final report to EPRA comprising:

- A final report incorporating stakeholder feedback
- A concise executive summary

- Proposed amendments to the regulations
- Policy Brief on the Solar Photovoltaic Industry
- The following annexes:
    - Terms of Reference
    - Inception report
    - A controlled copy of the reviewed solar PV Standards
    - Reviewed regulations relating to solar PV
    - Copies of other Acts and Regulations reviewed in the study
    - List of places visited
    - List of people interviewed and their contacts
    - List of references and bibliography.

1.4. Scope of Work

The period of interest for the study was March 2013 to February 2019. To meet the study objectives, SEI carried out the following activities:

i. Identified the stakeholders affected by the Energy (Solar Photovoltaic Systems) Regulations, 2012 as solar PV systems installers/technicians, contractors, vendors, importers, manufacturers, government agencies and partners, solar PV promoters and solar PV training institutions.

ii. Developed a data collection tool and that was validated by the Authority, which was used to gather data/information to meet the study objectives.

iii. Developed a standard sample size of stakeholders (installers, contractors, vendors, importers, manufacturers, government agencies).

iv. Analysed the data and information gathered from various stakeholders and proposed amendments to the regulations.

v. Assessed the social and economic impact of the regulations using existing literature on solar PV industry; no end user data was collected.

1.5. Organization of the report

This report comprises of six chapters. The background information, study objectives, outputs, and scope are presented in Chapter One. The methodology employed to execute the study is outlined in Chapter Two. In Chapter Three, we discuss the legal requirements for regulations review whereas in Chapter Four we present solar PV curriculum development and review in Kenya, accreditation programmes in other jurisdictions, and review the Kenya and

International Standards relevant to solar PV. The findings of the field study are reported in Chapter Five and finally, the study conclusions and recommendations are presented in Chapter Six.

CHAPTER TWO

STUDY METHODOLOGY

To achieve the study objectives, Sustainable Energy Initiative (SEI) carried out document analysis and field studies. In document analysis, SEI analysed the different classes of licenses, the licensing process, license requirements, compliance of the regulations with the Constitution of Kenya, challenges in enforcement. In the field studies, SEI analysed the economic and social impacts of the regulations and thereafter identified gaps in the regulations. SEI also benchmarked the regulations with other relevant existing global regulations. SEI has proposed amendments to the Energy (Solar Photovoltaic Systems) Regulations, 2012 based on the study findings. The methodology set out in the following sections was employed to deliver the study objectives.

2.1. Identification of stakeholders

SEI obtained data from EPRA on the licensed solar PV systems installers/technicians, contractors, vendors, importers, and manufacturers. The team also identified training institutions, government agencies and other organisations that have interests and are affected by the regulations.

2.2. Development of data and information gathering tools

The project team developed tools for the purposes of collecting relevant data and information (see Appendix B). The questionnaires were administered to licensees ranging from technicians to contractors, importers and manufacturers of solar PV systems. Other stakeholders who were interviewed include solar PV technician training institutions, the Kenya's development partners and NGOs involved in the solar PV industry e.g. GiZ, JICA, Ministry of Energy and Petroleum, REREC, and Kenya Power regarding the regulations, the licensing process, enforcement tools and the enforcement process. The tools covered both technical and legal aspects relating to the regulations and were used during the study for the following:

2.2.1. Technical Aspects

i) To assess the understanding of the requirements in the regulations by solar PV systems installers, contractors, vendors, importers, manufacturers.

ii) To assess the appropriateness of the different classes of licences in regulating the solar PV industry in Kenya.

iii) To identify any gaps in the qualifications, experience and certifications required for the different technician licenses.

iv) To assess the effectiveness of the process used in issuances of licenses in the different classes.

v) To establish if there are challenges in working relationship between licensed solar PV technicians and the firms in which they are attached.

vi) To assess the effectiveness of the general license conditions e.g. the validity period and the upgrade period for licenses.

vii) To assess the adequacy of the documentation required in the regulations e.g. completion certificates, registers, returns on systems installed and imported.

viii) To assess the relevance of the warranties provided for in the regulations to the product life.

2.2.2. Legal Aspects

i) To establish EPRA's licensing process and the challenges faced in implementing the same from the perspective of the technical staff at EPRA. We sought to understand EPRA's license classification system and the extent to which it has been effective in achieving the aims of the regulations.

ii) To establish the extent to which EPRA's licensing regime takes into account the devolved system of government introduced pursuant to the Constitution of Kenya, 2010.

iii) To establish the enforcement tools available to EPRA, the process of enforcement of the regulations, the extent to which these enforcement tools have been effective as well as any suggestions for improvement.

iv) To find out the complaints received from licensees regarding the licensing and/or enforcement process taking into account the various activities in the solar PV value chain including technicians, contractors, manufacturers and importers.

v) To find out the complaints received from consumers, manufacturers, and contractors regarding the work or professionalism of solar PV technicians licensed by the EPRA.

vi) To find out the complaints received from consumers regarding the quality of equipment or installation work carried out by a licensed technician or contractor.

vii) To establish the extent to which consumers have been able to enforce warranties attached to solar PV equipment as stipulated in the regulations.

viii) To establish the extent to which the licensees utilize the dispute resolution mechanisms contained in the regulations and the Energy Act.

ix) To establish if there is any legal action faced by the EPRA as a result of implementation or enforcement of the regulations.

2.3. Sampling technique

There are several installers, contractors, vendors, importers, manufacturers, and government agencies who are stakeholders in the solar PV industry in Kenya. It was not feasible for all of them to participate in the study. This section discusses the sampling approaches that were used in the survey. This was informed by the Terms of Reference (ToRs) and took cognisance of the target respondent clusters that were differentiated by their roles and functions in the solar PV sub-sector and are also widely distributed across the 47 Counties of Kenya.

2.3.1. Sampling methods

In determining the sampling technique to apply for this survey, the study team considered the pros and cons of the various techniques and settled for a mix of the probabilities based stratified sampling, purposive, and snowballing as the main sampling methods for the study. The decision to combine the three sampling methods was informed by the profile of the targeted respondents and the expected outcome of the survey. The rationale for each of the three sampling methods is presented in Table 2.1.

Table 2.1: Sampling methods

Method	Rationale
Purposive sampling	Informed by the fact that the survey essentially[1] targeted respondents that are within a specific sub-sector i.e. the Solar PV, 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 the Solar PV sector such as EPRA, REREC, GIZ, SNV-Kenya, Kenya Climate Innovations Centre (KCIC), Ministry of Energy and Petroleum (MoEP), KRA, KPLC, KAM, KEBS.
Stratified sampling	Based on the argument that the research targeted several respondent clusters which included importers, distributors, technicians and others. Within these respondent clusters, and the specific actors are largely heterogeneous thus, requiring a structured approach that takes into consideration the main

[1] The word essentially is used because there are particular elements of the survey that have a respondent cluster that is not within any consolidated database with specific reference to informal, unregistered and unlicensed service providers

Method	Rationale
	clusters, sub-groups and the heterogeneous characters of the actors within. The respondents included both licensed and unlicensed solar PV technicians/installers, vendors, contractors, importers, manufacturers and training institutions (Strathmore Energy Research Centre, University of Nairobi, JKUAT, Nairobi Technical Training Institute, Eastlands College of Technology).
Snowball sampling	This method was included to ensure that the survey captured data from actors that are not within the EPRA databases but who may have input and information that is relevant and informative to the study. This specifically refers to informal, unregistered or unlicensed actors who provide a range of services in the solar PV sub-sector in Kenya.

2.3.2. The distribution of survey respondents

The sample size and distribution are spread across the licensed actors within the EPRA database based on the various licences i.e. *C1*, *V1* and *V2* for the installers, dealers as well as manufacturers and importers, respectively as well as the three categories of technician licenses i.e. *T1*, *T2* and *T3*. The statistics provided by the EPRA on the distribution of solar PV licensees is presented in Table 2.2

Table 2.2: Licensees population distribution

Vendor/contractor Class	Population Size (*N*)		Technician Licences	Population Size (*N*)
V1	309		***T1***	19
V2	420		***T2***	287
C1	266		***T3***	395

In addition, the survey also targeted a reasonable sample of respondents that fall outside this distribution identified through the purposive sampling process. These are mentioned in Table 2.1. This being an infinite cluster of respondents, the distribution was based on the purposive snowball sampling process and principles.

2.3.3. Target sample size

In determining the appropriate sample size of respondents that would be adequate to bring out instructive and well-balanced output for the survey, the consultants considered various factors as follows:

Logistical factors:

- Distribution of actors is wide spread (across 47 Counties)
- Limited time and resources to conduct the study
- Mainstream Solar PV actors are confined in the major cities and towns.

Research ethics and assumptions:

- Survey sample included unlicensed Solar PV installers/technicians
- Sampling as a means to determine distribution of survey respondents
- Availability of respondent and willingness to participate is key

To determine the sample size, the following generic statistical sampling formula was applied.

$$\text{F} = \frac{z^2 p(1-p)/E^2}{1 + \left\{z^2 p(1-p)/E^2 N\right\}}$$

Table 2.3 presents the variables used for determining the sample size.

Table 2.3: Variables used for determining sample size

Variable:	*Value:*	*Rationale:*
Confidence level	95%	Set at 95% because the survey dealt 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*)	0.04	A provision for the variance in results from a survey conducted using random sampling. This has been determined to be approximately 4% for a finite population and with 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*

Variable:	*Value:*	*Rationale:*
Z-score *(z)*	1.96	The number of standard deviations from the mean score associated with the population size. Obtained using the formulae: *Z = probability argument (1 – Alpha value)* = 1.96
Sample size (**F**)	Varied	Based on the EPRA database lists for the various license categories
Population size *(N)*	Varied	This is differentiated by the various respondent clusters as was obtained from the EPRA databases. The specific distribution of the various respondent clusters is presented in Table 2.4.

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

Table 2.4: Respondent clusters' sample size

Vendor/ contractor class:	***Respondent Sample Size:***	***Total population (N)***	***% of N***		***Technician Licences:***	***Respondent Sample Size***	***Total population (N)***	***% of N***
V1	41	309	13.3%		***T1***	7	19	36.8%
V2	59	420	14.0%		***T2***	35	287	12.2%
C1	32	266	12.0%		***T3***	56	395	14.2%
Total	**132**	**995**	**13.3%**			**98**	**701**	**14.0%**

2.3.4. Emerging trends, assumptions and basis for inclusion

From the EPRA database, 95% of the licensees are in the following regions:

1. Nairobi and its environs
2. Kisumu
3. Nakuru
4. Mombasa
5. Eldoret

It is worth noting that the majority of licensees are based in Nairobi. The companies that were targeted as respondents are the ones identified as controlling a big portion of the solar PV market in the 2018 the Kenyan Solar Photovoltaic Industry baseline study and others. The

installer/technician licensee respondents were identified through random sampling distributed in the five regions.

Through application of the snowball sampling method, the enumerators identified unlicensed solar PV operators who were willing to engage in guided discussions as a control measure. The list of the respondents is given in Appendix C.

2.4. Data and information collection

2.4.1. Desktop study

The team undertook detailed review of the Energy (Solar Photovoltaic Systems) Regulations 2012, the Energy Act 2019 and Energy Policy 2018. Additionally, the team obtained and reviewed the Kenyan and International Standards relating to solar PV industry. The team also obtained accreditation programmes on solar PV from other jurisdictions for benchmarking.

Further, the team analysed complaints received from licensees regarding the licensing and/or enforcement process. This took into account the various activities in the solar PV value chain that involves technicians, contractors, manufacturers and importers. Complaints received from consumers, manufacturers, and contractors regarding the work or professionalism of solar PV technicians licensed by the EPRA and also those received from consumers regarding the quality of equipment or installation work carried out by a licensed technician or contractor were also analysed.

2.4.2. Using information gathering tool

EPRA sent out an introduction letter together with the data gathering tools through email to various stakeholders (licensees) prior to face-to-face interview. This was then followed by a visit by field assistants to some selected stakeholders to verify, validate, and where necessary seek clarification on the information given. Some of the stakeholders could not afford time for the physical interview. Under such circumstances, the field assistants conducted telephone interviews and, in a few cases, the respondents simply returned the completed questionnaires without any form of interview.

2.5. Data, services, and facilities provided by EPRA

To facilitate the smooth running of the study, the project team were provided with the following by EPRA:

1. Register of all licensed solar PV systems manufacturers, importers, vendors, technicians and contractors in Kenya.

2. Information on the sales volumes in watts, and value of solar PV systems and components manufactured, sold and installed for the duration under study.
3. Information of all unsuccessful solar PV systems manufacturers, importers, vendors, technicians, and contractors' license applications.
4. Information on suspended and revoked licenses.
5. A record of all enforcement actions taken by the Authority in enforcing the regulations.
6. A record of complaints received from members of the public regarding the professionals licensed under the regulations.
7. A detailed description of the licensing process.
8. Letters of approval for importation of solar PV system components.
9. A record of complaints received from the licensees regarding the licensing process.
10. Average turn-around time for the licensing process.
11. Any litigation commenced against the Authority regarding the regulations.
12. Any complaints to the Ombudsman regarding EPRA's implementation and/or enforcement of the regulations.
13. Final draft Solar PV Curriculum.
14. An introduction letter that was presented to the interviewees.

2.6. Data analysis and reporting

After collecting the data using the information gathering tool and interviews, the project team undertook a detailed review and analysis of the responses from the various stakeholders. The collected data was analysed qualitatively and quantitatively. The quantitative analysis used Statistical Package for Social Sciences (SPSS). The quantitative outputs were presented in tables, charts and graphs. Qualitative statements were also extracted from the software and analysed.

The team has drawn conclusions on the appropriateness of the different classes of licence in regulating the solar PV industry, the effectiveness of;

i) the licensing process of the different classes
ii) the general license conditions
iii) the regulations in enforcing the relevant Kenyan Standards
iv) inspection and enforcement provided in the regulation.

The team has identified the gaps in;

i) the qualifications, experience and certifications required for the different technician licenses
ii) the documentation required in the regulations.

Additionally, the team has established the challenges in the working relationship between licensed solar PV technicians and the firms in which they are attached, and enforcing the provisions of the regulations and penalties provided for in the regulations. Further, the team has assessed the relevance of the warranties provided for in the regulations to the product life and evaluated the economic and social impacts of the regulations.

The project team has undertaken a review of the regulations in light of the Energy Act 2019, environmental and safety laws, and did not identify any contradictory of *ultra vires* clauses in the regulations. The team also identified Kenyan and International Standards relating to manufacture, design, installation and maintenance of solar PV that the regulations should be aligned to. Additionally, suitable jurisdictions were identified and a review of similar accreditation programmes in such jurisdictions undertaken. Finally, from the study findings, we have proposed amendments to the Energy (Solar Photovoltaic Systems) Regulations 2012.

CHAPTER THREE
LEGAL REQUIREMENTS

3.1 Compliance of the regulations with the Kenya Constitution and Energy Act, 2019

The consultants examined the existing and proposed regulations in light of the provisions of the Constitution of Kenya (GOK, 2010) and the Energy Act 2019 (GOK, 2019) to determine if: -

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.

3.1.1 Authority to make the regulations

The constitution of Kenya 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*" (Art. 94 (5))

Additionally, sub-article (6) of Article 94 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 93 of the Energy Act, 2019 empowers the cabinet secretary for energy to make regulations to give effect to Part IV of the Act and specifically to make regulations for "S. 93 (2) (r) *licensing and management of renewable energy sources including but not limited to wind, solar, hydro, biogas, biomass, cogeneration, municipal waste and tidal energy."*

Section 75 of the Act further empowers the cabinet secretary for energy, working in conjunction with the relevant energy sector entities to exercise such powers as are necessary to

provide "*an enabling framework for the efficient and sustainable production, distribution and marketing of biomass, solar, wind, small hydros, municipal waste, geothermal and charcoal;*" and to promote "*the development of appropriate local capacity for the manufacture, installation, maintenance and operation of basic renewable technologies such as bio-digesters, solar systems and turbines;"*

We are therefore of the view that the Authority has the statutory power and authority to make the solar PV regulations. We note that under the fourth schedule of the Constitution, energy regulation is a shared function of the national and county governments. However, we note that the division of the roles between the national and county governments has been clarified and paragraph 2 (l) of the fifth schedule provides "*Certification of petroleum tanker drivers, electrical workers and contractors, **solar system installation technicians and contractors*** (emphasis ours*)"* as a function of the national government.

3.1.2 The Proposed Regulations are not *Ultra Vires*

Sir. William Wade and Christopher Forsyth in their book *Administrative Law* (Wade & Forsyth, 2009) at page 753 state that "…. subordinate legislation is necessarily subject to the principle of ultra vires. Since delegated powers of legislation are nearly always given for specific purposes, their use for other purposes will be unlawful. One clear case of legislation being condemned for improper purposes was the Western Australian decision that regulations prescribing bus routes were invalid since their object was to protect the state-owned trains from competition."

Article 95 (6) which is quoted above provides that an act of parliament empowering an entity to make subsidiary legislation shall: -

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 section 95 (6), it is liable to be struck down by a court either wholly or in part.

We have reviewed the proposed 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***
Licensing	**S. 11 (a)** issue, renew, modify, suspend or revoke licences and permits for all undertakings and activities in the energy sector;
Prescribing form of application for a license and license fees	**S. 11 (d)** prescribe the form and manner in which any application for any authority, licence, consent or approval under this Act shall be made and the fees payable in respect of such application;
Issuance of compliance orders	**S. 11 (e)** make and enforce directions to ensure compliance with this Act and with the conditions of licenses issued under this Act
Enforcement of Standards	**S. 11 (g)** formulate, set, enforce and review environmental, health, safety and quality standards for the energy sector in coordination with other statutory authorities;
Inspection	**S. 11 (j)** enter, inspect and search any premises where an offence is being committed or is suspected to have been committed
Imposition of fines and penalties	**S. 11 (l)** impose such sanctions and fines not exceeding one hundred thousand shillings per violation per day for a maximum of thirty days;
Resolution of disputes	**S. 11 (i)** investigate and determine complaints or disputes between parties over any matter relating to licences and licence conditions under this Act;
Collection of energy data	**S. 10 (jj)** it is a function of the Authority to "collect and maintain energy data;"

3.2 The Regulation Making Process Under the Statutory Instruments Act No. 23 of 2013

3.2.1 Introduction

On 14th January 2013, the then President of Kenya H. E. Mwai Kibaki assented to the Statutory Instruments Act[2] (the 'SI Act'); the date of commencement of the Act was stated as 25th January

[2] No. 23 of 2013

2013. The purpose of the 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[3] (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'[4] 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.

3.2.2 Regulation Making Process under the SI Act

1. Public Consultation

The SI Act places emphasis on public consultation especially where the proposed regulation is likely to "have a direct, or a substantial indirect effect on business" or "restrict competition"[5] The consultation must be made with persons with expertise in the relevant field and those likely to be affected by the statutory instrument. It must involve notice and deadlines for submission of comments.

[3] No. 1 of 2019

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

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

2. *Preparation of a Regulatory Impact Statement*

Section 6 of the SI Act enjoins all regulatory-making authority to, where a proposed regulation imposes significant costs on the society or part thereof, prepare a regulatory impact statement. The SI Act[6] stipulates the contents of a regulatory impact statement which includes: -

- A statement of objectives;
- Statement of the effects of the proposed statutory instrument;
- Other practicable means of achieving the same ends which may be either regulatory or non-regulatory;
- Cost-benefit analysis (economic, social and environmental) of the proposed statutory instrument and any alternatives of achieving the same objectives, and;
- Reasons why alternatives to the statutory instruments are not preferable.

The Cabinet Secretary must obtain and consider independent advice on the adequacy of regulatory impact statements and must sign a certificate stating that the requirements of the SI Act regarding regulatory impact statements have been complied with and that he is satisfied with the adequacy of the regulatory impact statement.

The regulatory impact statement must be published in the Kenya *Gazette* and a local 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.

3. *Laying of the Statutory Instruments before the Committee*

Section 11 of the SI Act requires that all statutory instruments must be sent to the responsible clerk of the National Assembly for tabling before parliament; the statutory instruments must be accompanied by an explanatory memorandum prepared in simple and clear language stating, among others, the reasons why the instrument is necessary, its objects and the statutory underpinning thereof.

3.2.3 Impact of the SI Act on the Authority

The SI Act applies to any statutory instrument made after the commencement date (25th January 2013) and the proposed amendments to the Solar (Photovoltaic Systems) Regulations 2012

[6] Section 7 (1) *ibid*

would be subject to the SI Act. It is important to ensure that all steps required under the SI Act are followed keenly to avoid the resultant amendments 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.

CHAPTER FOUR

SOLAR PV CURRICULUM, ACCREDITATION, AND STANDARDS

4.1. Solar PV curriculum development and review in Kenya

4.1.1 Background

Prior to the gazettement of the Energy (Solar Photovoltaic Systems) Regulations, 2012, it was estimated that there were about 800-1000 solar PV technicians practicing in the Kenyan market (KEREA, 2012). Majority of the technicians were found to be skilled but untrained. They provided a necessary service to end-users since the demand for solar PV systems in the country was consistently increasing to address challenges of lack of grid supply in rural areas. However, the quality of the services offered by some technicians was wanting as there was little or no oversight of the sector.

The Energy Regulatory Commission (ERC) gazetted the Energy (Solar Photovoltaic Systems) Regulations, 2012 that were aimed at streamlining the solar PV industry in Kenya. In particular, the regulations were meant to mitigate the inconsistency in quality of installations that led to health and safety risks for clients, which slowed the uptake of solar PV systems. The regulations require that only licensed technicians are allowed to design and install solar PV systems. To be licensed, technicians are required to have undertaken a solar PV course allowing them to practice within the following parameters:

a. Class T1, which entitles the holder to carry out solar PV system installation work for single PV module or single battery DC system of up to 100 Wp.
b. Class T2, which entitles the holder to carry out solar PV system installation work for medium size PV systems i.e. multiple modules of up to 300 Wp or multiple batteries which may include an inverter.
c. Class T3, which entitles the holder to carry out solar PV system installation work for advanced systems, including grid connected and hybrid solar PV systems.

In response to these changes in the solar PV sector; the Kenya Renewable Energy Association (KEREA) entered into collaboration with UNDP to implement joint activities. The solar PV training curriculum was drafted under this collaborative framework, aimed at harmonizing existing curricula.

The Kenya Institute of Education (KIE) had provided a training curriculum and training manuals intended for use by training institutions in the country (KEREA, 2012). The trained

technicians would be required to undergo accreditation by National Industrial Training Authority (NITA) before applying for a license from the Energy Regulatory Commission (ERC). For each cluster of technicians, skills assessment/trade test guidelines were included in the curriculum.

NITA is mandated with the development of the solar PV training curricula, accreditation of training institutions and trainers offering the courses, and assessment of trainees against clearly defined competency standards.

4.1.2 First Solar PV curriculum

The solar PV training curriculum was developed and structured to meet the Energy Regulatory Commission's licensing requirements for the classifications (T1, T2 and T3). It also took into consideration the NITA's trade test guidelines and structure.

i) T1 course

This was to provide competence in carrying out solar PV system installation work for single PV module or single battery DC system of up to 100 Wp.

ii) T2 course

This was designed to provide competency in carrying out installation work for medium size PV systems i.e. multiple modules of up to 300Wp or multiple batteries, which may include an inverter. The main objective of the lessons in the T2 course was to provide the learner with an expanded view of solar PV systems; by introducing the concept of multiple system components, inverters and corresponding technical and policy dynamics.

iii) T3 course

The course was designed to provide competence in carrying out solar PV system installation work for advanced solar PV systems, including grid connected and hybrid systems. The advanced course therefore, aimed to provide a trainee who has already acquired solid technical expertise with the necessary skills to design, plan and install more complex systems.

4.1.3 Curriculum review

i) Review of T1, T2 technician training curriculum

A curriculum review workshop retreat was held on the 27th of June to the 1st of July 2016 by stakeholders from training institutions, regulatory Commission, private practitioners and the sponsoring development agency. The workshop concluded that there was a need to amend the

Energy (Solar Photovoltaic Systems) Regulations, 2012 to expand the scope of works undertaken by T1 and T2 technicians. The proposals were:

- Expand the scope of T1 technician to 200 Wp
- Expand the scope of T2 technician to 1000 Wp

However, due to the dynamics in the industry, this scope might still not be appropriate in the near future. Currently, there are solar panels rated above 200 W meaning a T1 licensee as proposed cannot install some of the high rated single panels.

ii) Review of T3 technician training curriculum

A consultancy was undertaken by Renewables Academy (RENAC) for NITA between July and November 2017. It was found that the T3 technician training should be offered in nine courses to cover the entire scope instead of offering one single course (RENAC, 2017). The specific conclusions were:

- The content of T3 level PV courses cannot be adequately delivered in a single 4-week course as the number of subjects to be covered is too large; thus, several shorter and more manageable courses should be offered.
- No single training institution (for the foreseeable future) is likely to have all the facilities and staff required to teach all the lesson units required for a T3 level course; thus, training should take place at different training institutions.
- To do a T3 level course, entry requirements need to be T1 and T2 or equivalent, especially with regard to practical skills; electrical engineering degrees are not currently offering the necessary practical skills required.

The following nine (9) courses were recommended in place of a single course:

- ❖ Installation of the DC-side of large PV systems
- ❖ PV grid-tied systems (without battery storage) – installation and commissioning
- ❖ PV grid-tied systems (without battery storage) – design and sizing
- ❖ PV grid-tied systems (with battery storage) – installation and commissioning
- ❖ PV grid-tied systems (with battery storage) – design and sizing
- ❖ Large off-grid PV-only systems (DC-coupled and AC-coupled) – installation and commissioning
- ❖ Large off-grid PV-only systems (DC-coupled and AC-coupled) – design and sizing

- Large off-grid PV-diesel hybrid systems (DC-coupled and AC-coupled) – installation and commissioning
- Large off-grid PV-diesel hybrid systems (DC-coupled and AC-coupled) – design and sizing.

The discussion mainly focused on the training. There is need to re-look at the scope of work for T3 licensee which is currently very large, and see if it would be appropriate to divide the scope.

4.2. Solar PV Accreditation in other jurisdictions

The team reviewed accreditation for countries that have programs that meet similar objectives as the Kenyan solar PV regulations. The programs reviewed were for South Africa, Australia, and USA. It was noted that all these countries have independent bodies accrediting the technicians and contractors. Details of the programmes are as follows.

4.2.1 South Africa

South Africa has no regulations governing the solar PV sector. However, there are bodies such as the South African Photovoltaic Industry Association (SAPVIA) formed by the industry players (SAPVIA, 2017). This is a not-for-profit body that consists of active players in South Africa's photovoltaic market who have a genuine, invested presence in the country. The association promotes the growth of the country's solar PV electricity market, and aims to contribute to the country's renewable energy roll-out. The programmes focus on education, skills development, and training. They build installer capacity as well as improve standards development and compliance in line with international best practice. Further, the association developed and adopted mechanisms and standards to ensure quality and safe embedded solar PV installations. The PV GreenCard programme is one of such mechanisms.

The PV GreenCard is an as built report for the Solar PV system owner and a checklist for the installer. Qualified installers issue it to their clients on the completion of a project. It contains details of the installation such as type of PV modules and PV inverters used, as well a checklist of all the necessary installation steps that were completed. The installer can use the PV GreenCard to declare compliance with relevant standards as well as safety guidelines for PV installation. This enhances investor confidence, commitment from participating industry players and empowerment of the Solar PV system owner.

SAPVIA has developed the Solar PV technician qualification (SPTQ) that will serve as the benchmark for professionals in the industry once adopted.

4.2.2 Australia

Australia has a not-for-profit body, Clean Energy Council (CEC), that represents and works with businesses operating in or supporting the development of renewable energy (such as solar, wind, hydro, bioenergy, geothermal and marine) and energy storage, along with solar installers (Clean Energy Council, 2018). CEC is a membership association of companies who work in or support the clean energy sector. CEC offers accreditation for the various work and responsibilities that can be encountered in the industry. There are two broad categories of accreditation for individuals working on solar PV systems. These are the grid-connect and stand-alone power system (SPS). Each of these categories is then divided into design only, install only, and design and install. Any of these accreditations mandates the individual to design, install or design and install solar systems in the respective category. The installer must hold an electrical license to qualify for this accreditation. Those accredited to carry out solar systems design only are not responsible for any part of the installation.

In addition, there is battery storage accreditation for individuals who want to design and/or install battery storage systems that are connected to the grid. One must hold grid-connect solar accreditation before applying for battery storage accreditation. Thus, the scope of work is determined by the solar accreditation held e.g. an individual who is accredited to only design solar systems can only design battery storage systems and not install.

An applicant needs to complete the relevant training units required for the type of accreditation they would like to apply for. Thus, copies of the following documents need to be submitted for certification and make payment for application:

- Training certificates
- Public liability insurance (at least $5 million)
- Electrical licence (if applying for grid-connect install)
- Working at heights certificate (if applying for grid-connect install or SPS install).

Applicants undergo an online assessment as well as practical assessment for those seeking Install Only, and Design and Install accreditation. Design Only applicants do not undergo any practical assessment.

Accreditation lasts for one year and is renewed annually, via continuous professional development. For renewal, an applicant is required to complete 100 points of eligible training and professional development. This is to ensure installers are up-to-date with changes in the industry, and that accredited installers have all the information required to comply with the necessary standards.

4.2.3 USA

Different states in the USA have different programmes regulating or/and accrediting solar PV practitioners. The most common of these is the North American Board of Certified Energy Practitioners (NABCEP). NABCEP offers voluntary personnel certification for professionals in the renewable energy industry. NABCEP Board Certifications are earned by demonstrating an individual's training, experience, and passing a rigorous exam. Individuals seeking certification must meet the requirements established by the NABCEP Board of Directors, agree to a Code of Ethics, pay all required fees, and pass an examination.

NABCEP Board certifications include (NABCEP, 2018):

i) The PV Installation Professional (PVIP)

The certification validates competence to perform in the role of PV Installation Professional, which encompasses PV design, installation, operations, commissioning and maintenance. The applicant is required to have worked and performed well in a decision-making role, which had a material impact on the quality and serviceability of the PV installation. This may include individuals employed as lead installers, system designers, project managers, site managers, foreman, electricians, system engineers, and quality assurance/ commissioning agents.

ii) The PV Design Specialist (PVDS)

The certification recognizes the advanced experience and skill of PV system designers. This Certification demonstrates proven ability to configure the mechanical and electrical design components of PV systems. The applicant must have designed and drawn the plans for the installations. All systems must have a minimum rating of 1 kW DC (STC).

iii) The PV Installer Specialist (PVIS)

The Certification is for those who are highly competent with all aspects of PV installation processes. The aspects include installing DC and AC PV system conductors, raceways, system monitoring, control, communication hardware, and developing safety plans. The applicant shall have performed in a decision-making role, which had material impact on the installation. PVIS

applicants must have a high level of competency with all aspects of PV installation including DC and AC PV system conductors, and grounding and bonding systems. All systems must have a minimum rating of 1 kW DC (STC).

iv) The PV Commissioning & Maintenance Specialist (PVCMS)

The Certification highlights expertise in the areas of operations, maintenance, and commissioning. It spotlights ability to apply verification protocols, critically analyse systems, and implement preventive and corrective maintenance procedures for PV systems. The applicant is required to have played a decision-making role related to commissioning or maintenance. The PVCMS Certification combines operations, maintenance and commissioning tasks into one job specialty. All verification protocols and preventive and corrective maintenance operations are assessed. All systems must have a minimum rating of 1 kW DC (STC).

v) The PV Technical Sales (PVTS)

The Certification demonstrates knowledge and expertise in qualifying prospects, site analysis, performance analysis and financial incentives of PV systems. Certified Professionals can collect technical requirements, analyse customer needs to determine energy usage to advise and provide customers with the most appropriate solution for their situation. The PVTS certification has seven categories. They have different academic qualifications requirements and experience in PV installation systems sales-related activities.

vi) The PV System Inspector (PVSI)

PVSI recognizes the advanced experience and skill of inspecting residential and commercial photovoltaic systems. This Certification is for those who are highly knowledgeable of PV systems, applicable codes and ordinances, and assessing the safety and operation of PV systems. There are no specific pre-requisites to taking a PVSI exam. Applicants should know how to assess the safety and operation of a system, be able to verify code compliance via interpretation of design plans and building documents, conduct on-site inspections, and report results.

To qualify for the examination, applicants for all categories of accreditations except the PVSI need to complete Occupational Safety and Health Administration (OSHA) Outreach Training Program for the Construction Industry training. In addition, they need to have undergone advanced solar PV training and completed projects in the area of speciality they are seeking

accreditation i.e. installation, design, services on installation. The projects are specified in terms of Project Credits[7].

Certification lasts for three years. To recertify, the PV professionals are required to undertake 18 hours of continuing education; 6 hours specific to Electric (National Electric Code) Codes, 6 hours specific to Job Task Analysis in their area of accreditation, 6 hours PV Technical or Non-technical of which 2 hours must be Building and/or Fire Codes. Further, the professionals need to document certain minimum number of project credits completed during the three-year certification period.

From the foregoing, it is evident that different countries are at different levels of development of solar PV industry and thus, accreditation programmes and regulation. The US and Australian accreditation programmes are elaborate, and the South African one is still under development with no formal regulation. However, the three jurisdictions under review all have training programmes for solar PV professionals. Accreditation requires the technicians to demonstrate proficiency in the area they seek accreditation e.g. installation, design. It is also clear that continuous professional development is important to keep abreast with the changes in the sector. Thus, during recertification, the accredited persons need to demonstrate that they have been active in the sector.

4.3. Standards Relevant to Solar PV

Solar PV standards that can be adopted in the regulations are divided into PV module, inverter, battery, systems, and miscellaneous ones covering various components/systems. These standards are summarized in the following sub-sections categorised as those relating to solar PV components and system installation.

4.3.1 Solar PV components

1. ***KS IEC/TS 61836: 2016 Solar photovoltaic energy systems - Terms, definitions and symbols***

This Technical Specification deals with the terms, definitions and symbols from national and international solar photovoltaic standards and relevant documents used within the field of solar photovoltaic (PV) energy systems.

[7] The project credits are: each system of 1 – 999 kW earns 2 Project Credits and 1 MW and above 3 Project Credits.

2. ***KS IEC 61215:2005 Crystalline silicon terrestrial photovoltaic (PV) modules- Design qualification and type approval***

This Standard outline the requirements for the design qualification and type approval of terrestrial crystalline silicon PV modules suitable for the long-term operation in general air climate described in IEC 60721-2-1. The Standard does not however, apply to modules used with concentrated sunlight.

The object of the test sequence under this standard is to determine the electrical and thermal properties of the module and to show beyond reasonable doubt, incorporating constraints of cost and time, that the module is capable of withstanding prolonged exposure in climates described in the scope. The actual lifetime of the modules qualified will depend on their design, their environment and conditions they are operated in.

3. ***KS IEC 62108: 2007 Concentrator Photovoltaic (CPV) Modules and assemblies- Design Qualification and Type approval***

This Standard outline the minimum requirements for the design qualification and type approval of concentrator photovoltaic modules and assemblies suitable for sustained operation in general open-air climates. The test sequence is partly based on the design qualification and type approval of flat-plate terrestrial crystalline silicon PV modules defined in IEC 61215. Slight modifications have been made to the tests to account for the special features of CPV receivers and modules which is synonymous with high current density and rapid temperature changes.

The object of this test Standard is to determine the electrical, mechanical, and thermal properties of the CPV modules and assemblies, and to demonstrate beyond reasonable doubt considering constraints of cost and time that CPV modules and assemblies are capable of withstanding prolonged exposure in climates. The actual lifetime of CPV modules and assemblies depends on the design, production, and environmental conditions under which they are operated.

4. ***KS IEC 61646: 2008 Thin-film terrestrial photovoltaic (PV) modules- Design qualification and type approval***

This standard outlines the requirements for the design qualification and type approval of terrestrial, thin-film photovoltaic modules suitable for prolonged operation in general open-air climates.

The object of the test sequence under this standard is to determine the electrical and thermal properties of the module and to show beyond reasonable doubt, incorporating constraints of cost and time, that the module is capable of withstanding prolonged exposure in climates described in the scope.

5. ***KS IEC 61730-1: 2004 Photovoltaic (PV) Module Safety Qualification- Part 1: Requirements for construction***

The Standard outlines the fundamental construction requirements for photovoltaic modules to provide safe electrical and mechanical operation during their expected lifetime. This Part 1 explicitly focusses on the requirements of construction. The Standard attempts to cover the basic constructional requirements for various classes of PV modules though cannot be considered to include all national or regional building codes. For example, marine and vehicle applications are not covered as well as modules with AC inverters.

The objective of the Standard is to provide guidance in validating the fundamental construction of PV modules to guarantee electrical and mechanical safety. These requirements help to minimize possibilities of internal breakdown of the module that could possibly result in fires, electrical shock, and personal injury. The Standard emphasizes on basic safety construction requirements.

6. ***KS IEC 61730-2: 2004 Photovoltaic (PV) Module Safety Qualification- Part 2: Requirements for testing***

This standard describes the testing requirements for PV modules to provide safe electrical and mechanical operation during their expected lifetime. Specific topics are covered to assess the prevention of electrical shock, fire hazards and personal injury due to mechanical and environmental stresses. This standard is structured such that in a single set of PV module samples, both safety and performance evaluation can be carried out.

The object of this standard is to provide a testing sequence to verify the safety of PV modules whose construction adhere to KS IEC 61730-1. The test sequence and pass criteria are designed to unearth the potential breakdown of internal and external components of the PV modules that would result in fire, electric shock and personal injury. Test categories include general inspection, electrical shock hazard, fire hazard, mechanical stress, and environmental stress.

7. ***KS IEC 61853: 2011 Photovoltaic (PV) module performance testing and energy rating Part 1: Irradiance and temperature performance measurements and power rating***

This standard describes requirements for evaluating PV module performance in terms of power rating over a range of irradiances and temperatures.

The object of the standard is to define a testing and rating system which provides the PV module power at maximum power operation for particular defined conditions. In addition, this part provides a full set of characterization parameters for the module under various values of irradiance and temperature.

8. ***KS IEC 60891: 2009 Photovoltaic devices – Procedures for temperature and irradiance corrections to measured I-V characteristics***

The Standard defines the procedures to be followed for temperature and irradiance corrections to the measured current-voltage (I-V) characteristics of photovoltaic devices. It also defines the procedures used to determine factors relevant for these corrections.

9. ***KS IEC 60904-1-1:2017: Photovoltaic devices Part 1-1: Measurement of current-voltage characteristics of multi-junction photovoltaic (PV) devices***

The Standard describes procedures for the measurement of the current-voltage characteristics of multi-junction PV devices in natural or simulated sunlight. The Standard is applicable to single PV cells, sub-assemblies of such cells or entire PV modules. It covers the additional requirements for the measurement of current-voltage characteristics of multi-junction PV devices.

10. ***KS IEC 62116: 2008 Test procedure of islanding prevention measures for utilities-interconnected photovoltaic inverters***

This standard provides a test procedure to validate the robustness of anti-islanding techniques or measures implemented by commercially-available utility-interconnected PV inverters. Minimum requirements are used in the test procedure described under this standard. However, additional requirements or more stringent criteria may be specified if demonstrable risk can be shown.

11. ***KS IEC 61683:1999 Photovoltaic systems - Power conditioners - Procedure for measuring efficiency***

This standard establishes guidelines for measuring the efficiency of power conditioners used in standalone as well as utility-interactive PV systems. The output shall be a stable AC voltage at constant frequency or stable DC voltage. Calculation of efficiency is from direct measurement of input and output power in the factory.

12. ***KS IEC 62894: 2014 Photovoltaic inverters- Data sheet and name plate***

This standard describes data sheet and nameplate information for photovoltaic inverters in grid parallel operation. The data sheet information is a detailed technical description of key parameters of the inverter whereas the name plate provides a summary of key parameters and is attached on the body of the inverter. The object of this standard is to provide minimum information required to configure a safe and optimal system with photovoltaic inverters.

13. ***KS IEC 62109-1:2010 Safety of power converters for use in photovoltaic power systems Part 1: General requirements***

This Standard applies to the power conversion equipment (PCE) for use in PV systems where a uniform technical level with respect to safety is necessary. The Standard defines the minimum requirements for the design and manufacture of PCE for protection against electric shock, energy, fire, mechanical and other hazards. The Standard provides general requirements applicable to all types of PV PCE.

The Standard covers PCE connected to systems not exceeding maximum PV source circuit voltage of 1500 V DC. The equipment may also be connected to systems not exceeding 1000 V AC at the AC mains circuits, non-mains AC load circuits, and to other DC source or load circuits such as batteries. This standard may be used for accessories for use with PCE, except where more appropriate standards exist.

14. ***KS IEC 62109-2:2011 Safety of power converters for use in photovoltaic power systems Part 2: Particular requirements for inverters***

The Standard clearly outlines the specific safety requirements for grid-interactive and stand-alone inverters. The standard covers grid-tied, stand-alone, or multiple mode inverters supplied by single or multiple PV modules grouped in various configurations which may be intended to be used with batteries or other forms of storage.

15. ***KS IEC 61427-1:2013 Secondary cells and batteries for renewable energy storage - General requirements and methods of test - Part 1: Photovoltaic off-grid application***

The Standard gives general information relating to the requirements for the secondary batteries used in photovoltaic energy systems (PVES), and typical methods of testing used for the verification of battery performances. It also deals with cells and batteries used in photovoltaic off-grid applications.

This standard outlines the following in detail:

- Types of batteries used in off-grid photovoltaic applications
- Items to be considered when selecting battery capacity for off-grid applications
- Storage, transportation, and operating conditions for batteries
- Particular operating conditions experienced by secondary batteries during their use in photovoltaic applications
- Tests necessary to approve validity of batteries for use in off-grid systems
- Required documentation, safety provisions, and markings required on batteries

16. ***KS IEC 61427-2:2015 Secondary cells and batteries for Renewable Energy Storage - General Requirements and methods of test - Part 2: On-grid applications***

This standard relates to secondary batteries used in on-grid Electrical Energy Storage (EES) applications. It provides the associated methods of test for the verification of their endurance, properties and electrical performance in such applications. The tests are to be performed under general test conditions where accuracy of measuring equipment, test object considerations and test object battery selection and size considerations and the test plans are fully addressed by the standard.

The necessary tests outlined by the standard are all battery endurance tests which are intended to determine the suitability of the battery design to accept and deliver energy in on-grid energy systems. The results on the battery properties and electrical performance are to be tabulated in the tables provided in the standard.

17. ***KS IEC TS 62257-8-1:2007 Recommendations for small renewable energy and hybrid systems for rural electrification - Part 8-1: Selection of batteries and battery management systems for stand-alone electrification systems - Specific case of automotive flooded lead-acid batteries available in developing countries***

This standard gives guidelines on the selection of flooded lead acid batteries and is particularly useful for checking the capability of locally made car and truck batteries for use in solar

applications. It outlines several tests that are necessary for easy discrimination of automotive flooded lead acid batteries for PV applications. The standard also discusses the necessary type of battery documentation, installation rules, relevant safety measures for both users and environment, and best disposal procedure for dead batteries.

18. ***KS 1709-1:2009 Batteries for use in photovoltaic power systems - Specification Part 1: General requirements***

This Standard specifies general requirements and methods of test for secondary cells and batteries used in photovoltaic power systems. It does not include specific information relating to battery sizing, method of charge or PV system design. It provides guidance in understanding battery charging requirements in relation to the operational parameters that affect overall PV system design and battery performance. The standard should aid in battery selection, evaluation, and PV system design, and provides methods of test for evaluating the selected battery.

19. ***KS 1709-2:2009 Batteries for use in photovoltaic power systems - Specification Part 2: Modified lead-acid batteries***

This Standard specifies requirements and a simplified regime of methods of test for modified lead-acid batteries for use in PV power systems. It also provides regulations and installation conditions to be complied with to ensure the life and proper operation of the installations as well as the safety of living in proximity to the installation.

20. ***KS 1709-4:2009 Batteries for use in photovoltaic power systems - Specification Part 4: Recommended practice for sizing lead-acid batteries for photovoltaic (PV) systems***

The scope of this standard describes a method for sizing both vented and valve regulated lead acid batteries in photovoltaic (PV) systems. It is meant to assist system designers in sizing lead-acid batteries for residential, commercial and industrial PV systems.

21. ***KS IEC 62509:2010 Battery charge controllers for photovoltaic systems - Performance and functioning***

This standard establishes minimum requirements for the functioning and performance of battery charge controllers (BCC) used with lead-acid batteries in terrestrial photovoltaic (PV) systems. The main aims are to ensure BCC reliability and to maximize the life of the battery. The Standard is to be used in conjunction with IEC 62093 which determines the construction requirements for the intended installation which include enclosure, physical connection

sturdiness and safety. Features addressed by this standard include photovoltaic generator charging of a battery, load control, protection functions, interface functions.

22. KS 2542:2017: Off-grid solar photovoltaic lighting kits - Requirements

Off-grid lighting appliances or kits that can be installed by a typical user without employing a technician shall meet the requirements specified in this Standard. The kits are generally comprised of a light source (LED, CFL or other), a rechargeable energy storage device (usually a battery), an energy generation device or source (PV module, dynamo, AC grid, unregulated DC input, or other), and internal electronics. Lighting appliances or kits with PV modules larger than 10 W (peak power under STC) are beyond from the scope of the standard.

4.3.2 Solar PV system installation

1. KS IEC 61724-1:2017: Photovoltaic system performance - Monitoring

The Standard outlines equipment, methods, and terminology for performance monitoring and analysis of photovoltaic (PV) systems. It addresses sensors, installation, and accuracy for monitoring equipment in addition to measured parameter data acquisition and quality checks, calculated parameters, and performance metrics. It also serves as a basis for other standards which rely upon the data collected.

2. KS IEC/TS 61724-2:2016: Photovoltaic system performance Part 2: Capacity evaluation method

Photovoltaic system performance evaluation using the capacity evaluation method shall follow the framework procedure specified in the Standard. The standard specifies a framework procedure for comparing the measured power produced against the expected power from a PV system over a short period of time (a few relatively sunny days). The test procedure was created with the primary goal of facilitating the documentation of a performance target. The methodology can be used whenever the goal is to verify system performance at a specific reference condition chosen to be a frequently observed condition.

3. KS IEC/TS 61724-3:2016: Photovoltaic system performance Part 3: Energy evaluation method

Photovoltaic system performance evaluation using the energy evaluation method shall follow the framework procedure specified by the Standard. The Standard defines a procedure for measuring and analysing the energy production of a specific PV system relative to expected electrical energy production for the same system from actual weather conditions as defined by

the stakeholders of the test. The test procedure was created with the primary goal of facilitating the documentation of a performance guarantee. The method described is intended to address testing of a specific deployed PV system over the full range of relevant operating conditions and for a sustainable time (generally a complete year). It is also intended to verify long-term expectations of energy production to capture all types of performance issues, including not only response to different weather conditions, but also outages or instances of reduced performance of the plant that may arise from grid requirements, operational set points, hardware failure, poor maintenance procedures, plant degradation, or other problems. The system performance is characterised by quantifying the energy lost when the plant is unavailable and the extent to which the performance meets expectations when the plant is functioning.

4. ***KS IEC 62124:2004: Photovoltaic (PV) stand-alone systems – Design verification***

Design and performance of photovoltaic (PV) stand-alone systems shall be verified as specified in the Standard to ensure that the components operate properly together as specified by the system manufacturer. The performance test consists of a check of the functionality, the autonomy and ability to recover after periods of low state-of charge of the battery, and hence gives reasonable assurance that the system will not fail prematurely.

5. ***KS IEC 62093:2005: Balance-of-system components for photovoltaic systems - Design qualification natural environment***

This standard establishes requirements for the design qualification of Balance-of-system (BOS) components used in terrestrial photovoltaic systems. It is written for dedicated solar components such as batteries, inverters, charge controllers, system diode packages, heat sinks, surge protectors, system junction boxes, Maximum power point tracking devices and switch gear but may be applied to other BOS components. It also has test sequences to determine the performance characteristics of each BOS components.

The standard clearly outlines in detail the sampling procedure for components to be tested, the necessary marking on each component and the documentation containing important information relevant to each component. It goes to the extent of highlighting the particular information (if relevant) that shall be indicated on the components. Once the components have been tested the judgement that it has passed the design qualification tests shall be done in accordance to the outlined pass criteria.

6. ***KS IEC 62446:2009 Grid connected photovoltaic systems - Minimum requirements for system documentation, commissioning tests and inspection***

The Standard defines minimal information and documentation required to be handed over to a customer following the installation of a grid connected PV system. It also describes the minimum commissioning tests, inspection criteria and documentation expected to verify the safe installation and correct operation of the system and for periodic retesting. The Standard is applicable to grid connected PV systems only.

The Standard is for use by system designers and installers of grid connected solar PV systems as a template to provide effective documentation to a customer. It should also assist in verification/inspection of a grid connected PV system after installation and for subsequent re-inspection, maintenance or modifications.

7. ***KS IEC 61727:2004: Photovoltaic (PV) systems – Characteristics of the utility interface***

The Standard applies to utility-interconnected photovoltaic (PV) power systems operating in parallel with the grid and utilizing static non-islanding inverters. It outlines the requirements for interconnection of PV systems to the utility low voltage distribution system. The Standard describes specific recommendations for systems up to 10 kVA such as may be utilised on individual residences, either single or three-phase.

8. ***KS 1673-1:2004: Solar photovoltaic power systems – Design, installation, operation, monitoring and maintenance — Code of practice Part 1: General PV system requirements***

This Standard specifies requirements for the design, installation, operation, monitoring and maintenance of photovoltaic power systems. It covers requirements for photovoltaic systems intended for use on buildings such as domestic, school, office and industrial building, and whose total output power does not exceed 12 000 peak watts. The Standard emphasizes the optimization and functionality of the system with an in-built safety aspect at every stage.

The Standard is intended to be used by engineers, planners, maintenance supervisors, dealers, and all maintenance personnel involved in the design, operation, inspection, troubleshooting, repair, and maintenance of stand-alone photovoltaics systems. The standard is intended to form a basic reference document for use in all photovoltaic installations in Kenya. It is intended to promote high quality photovoltaics in such a way as to generally promote the adoption of photovoltaic power as a viable energy source.

9. ***KS 1673-2-5:2003: Generic specification for solar photovoltaic systems — System design, installation, operation, monitoring and maintenance Part 2: Test procedures for main components Section 5: Test procedures for luminaires***

This part of KS 1673 has been developed to standardize the test procedures for luminaires for use in photovoltaic home systems as described in KS 1673-1. This procedure has been written around luminaires that incorporate high efficiency fluorescent lamps of either the tubular or compact type, suitable for operation on a DC 12 V supply. The object of the test procedure is to verify compliance with the requirements specified in KS 1673-1.

10. ***KS IEC 62253:2011 Photovoltaic pumping systems-Design qualification and performance measurement***

The objective of this standard is to establish requirements to be able to verify the system performance characteristics of the PV pumping system. The standard defines requirements for design, qualification and performance measurements of photovoltaic pumping systems in stand-alone operation. It outlines the test set-up, the measurements and deviations to be taken and checklist for the data required to be taken.

This standard:

- Defines requirements for design, qualification and performance measurements of photovoltaic pumping systems in standalone operation
- Establishes a PV pumping system design verification procedure
- Design features addressed are: power vs flow rate characteristics at constant pumping head, pumping head vs flow rate characteristics at constant speed, system design parameters and requirements, system specification, documentation requirements, system design verification procedure

11. ***IEC/TS 62548 2013: Photovoltaic (PV) arrays – Design requirements***

This Technical Specification outlines the design requirements for photovoltaic (PV) arrays including DC array wiring, electrical protection devices, switching, and earthing provisions. The scope includes all parts of the PV array up to but not including energy storage devices, power conversion equipment or loads.

The objective of this Technical Specification is to address the design safety requirements arising from the particular characteristics of PV systems. DC systems, and PV arrays in particular, pose some hazards in addition to those derived from conventional AC power

systems. Some of these are the ability to produce and sustain electrical arcs with currents that are not greater than normal operating currents.

In grid connected systems the safety requirements of this Technical Specification are however, critically dependent on the inverters associated with PV arrays complying with the requirements of IEC 62109-1 and IEC 62109-2.

The current regulations do not clearly specify which standards are to be met by the importers and manufacturers of solar PV components and devices and by the contractors and technicians in solar PV installations. Therefore, it is envisioned that inclusion of these standards as requirements for all solar PV installations would greatly enhance the quality and reliability of the installed solar PV systems.

CHAPTER FIVE

FIELD STUDY FINDINGS

5.1. Current status of the solar PV sector

5.1.1 Introduction

To identify gaps in the Solar PV Regulations since their implementation six years ago, stakeholders were identified who would provide their views on matters related to licensing, qualifications, and working relationship of the licensed technicians and vendors. Views on sufficiency of regulations of solar PV industry as appertains to quality and warranties were also obtained from the stakeholders. The stakeholders who were contacted were generally categorised into four groups: Solar PV Vendors/Contractors/Importers/Manufacturers, Installers/Technicians, Training Institutions, and Promoters/ Policy administrators/ Financiers/ Industry associations.

A total of one hundred and eight (108) and one hundred and fourteen (114) licenced firms (vendors/contractors/importers/manufacturers) and technicians, respectively and fifteen (15) unlicensed technicians were interviewed. The regional coverage of the licensees was Nairobi and its environs 188, Eldoret 11, Kisumu 10, Nakuru 6, and Mombasa 7. Five training institutions and sixteen promoters/policy administrators/financiers/industry associations were also interviewed.

Only 82% of the targeted number of respondents in the vendor category were interviewed. The target was not achieved owing to the fact that the population that was used to determine the sample sizes did not take into account the fact that the majority of the vendors have multiple licenses. The target for T1 technician licensees was also not achieved; their population is very small as seen from Table 2.4. Table 5.1 shows the distribution of the licensees.

Table 5.1: License distribution

Vendors/contractors/importers/manufacturers		***Technicians***	
License held	*Percentage (%)*	*License held*	*Percentage (%)*
C1 & V1 & V2	43	T1	7
C1 & V2	36	T2	37
C1 or V1 or V2	21	T3	56

It can be seen from Table 5.1 that about 79% of the vendors have more than one license. This may be attributable to the fact that with the current licence classifications, if a vendor would like to be involved in multiple activities in the sub-sector, they need to acquire a license for each activity. For example, a vendor who imports and sells solar PV systems as well as install the systems needs to apply for both V2 (import) and V1 (sell and install up to 300 Wp) and C1 if the project is bigger than 300 Wp. Since there are some contractors who design and implement their projects, it would be desirable if the scope of the licenses can be such that one license that can be used when executing a solar PV project right from design to installation.

It is also evident from Table 5.1 that the majority of the licensed technicians hold class T3 licence and the minority are T1 holders. This shows that the market has skilled personnel to handle grid-tied and hybrid systems and with high educational qualifications that allow them to be licensed in class T3.

5.1.2 Work experience

About 46% and 48% of the technicians have been licensed for between 1-3 and over 3 years, respectively. Table 5.2 depicts the experience of solar PV technicians.

Table 5.2: Solar PV Systems Technicians' installation experience

Experience (Years)	*Percentage*
Less than 1	8
1-4	28
5-10	41
More than 10	23

Most technicians have been installing solar PV systems for between 5 – 10 years as seen from Table 5.2. The technicians with installation experience ranging between 1 – 4 years and over 10 years account for 28 and 23%, respectively of the technicians. The new entrants with less than one-year experience constitute 8% of the technicians. This further attests to the fact that the market has a pool of skilled and competent solar PV technicians.

Figure 5.1: Duration in Business

shows the duration for which the vendors have been in business.

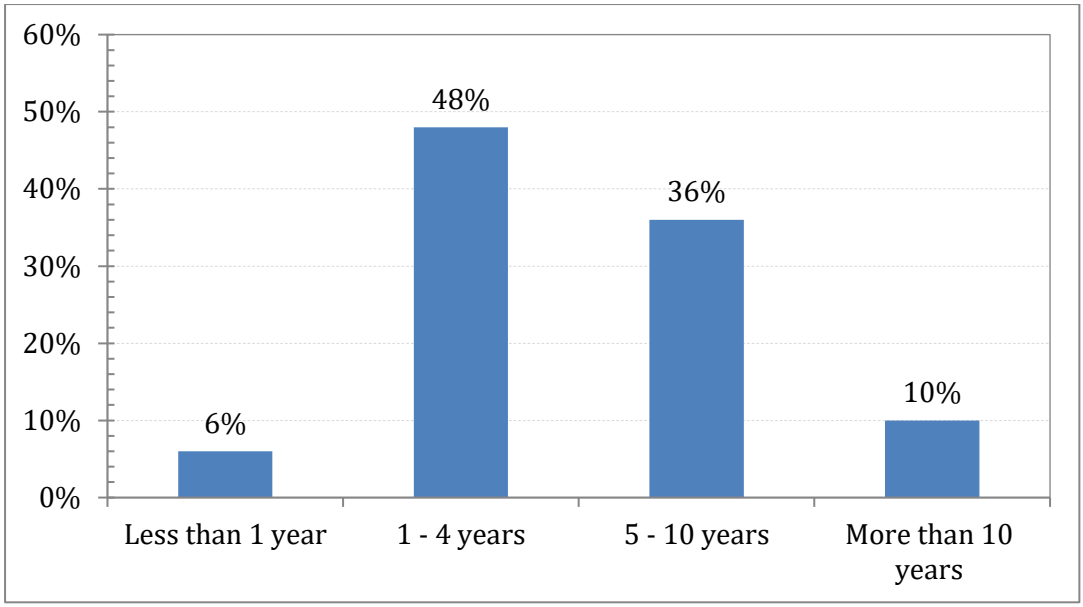

Figure 5.1: Duration in Business

It can be seen from Figure 5.1 that 46% of the vendors have been in the solar PV business for five years and above. These are deemed to be conversant with the issues affecting the solar PV industry. Further, it can be observed from Table 5.3 that the vendors who have been in business for more than one year are able to transact substantive volumes of business in terms of average number of projects (generally more than 100) as well as projects of higher capacity.

Table 5.3: Business age, number of projects and total capacity handled per year

Business age (No. of years)	***Average No. of Solar PV projects per year***	***Highest annual total capacity of Solar systems handled (kW)***
Less than 1 year	10 – 50	10 - 50
1 – 4 years	More 100	200 - 1,000
5 – 10 years	More 100	More than 1,000
More than 10 years	More 100	More than 1,000

Figure 5.2 shows the annual average number of projects handled by the firms.

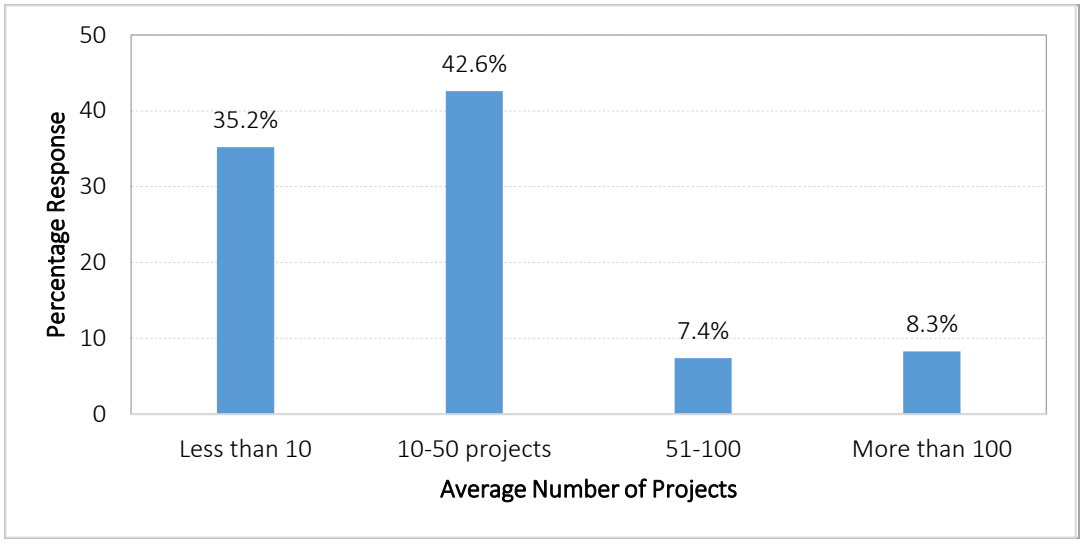

Figure 5.2: Average number of projects handled per year

It can be observed from Figure 5.2 that most of the vendors handle between 10-50 projects per year with those handling less than 10 projects being sizeable at 35%. There are few firms (about 15% of the players) that are handling over 50 projects per year.

Figure 5.3 shows the average total capacity of systems handled by the vendors per year.

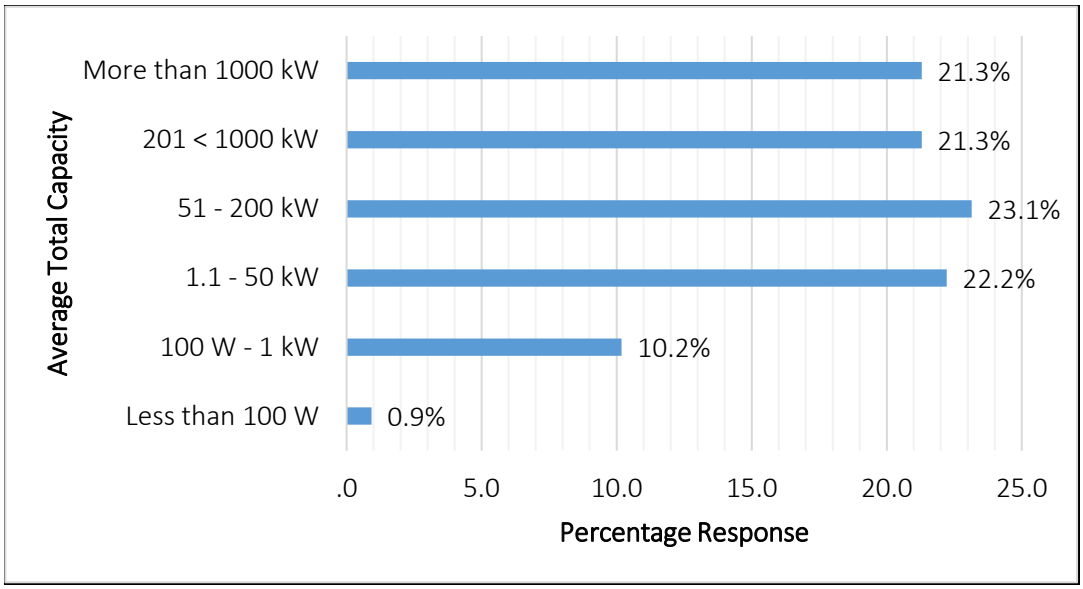

Figure 5.3: Average total capacity of solar PV systems handled per year

It can be observed from Figure 5.3 that close to 90% of the vendors handle systems that are larger than 1 kW. Further, it can be seen that the DC systems that are less than 100 W account for less than 1% of the systems handled. This implies that the size of installations has grown in

capacity and there is little work for T1 and T2 licensees whose scope of work is capped at 100 and 300 Wp, respectively.

The vendors are handling various solar PV systems ranging from simple pico plug-and-play DC systems to grid-tied systems with transformer as can be seen from Figure 5.4.

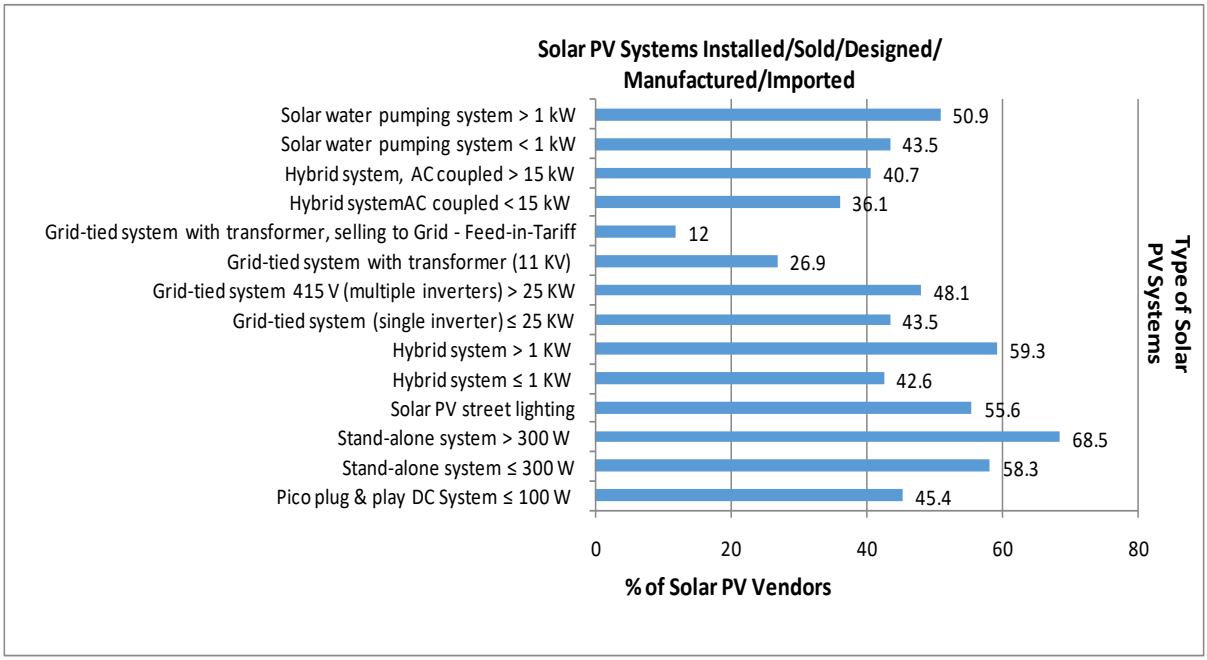

Figure 5.4: Types of solar PV Systems handled

It can be observed from Figure 5.4 that the most commonly handled solar PV systems are the Stand-alone systems that are bigger than 300 W; handled by 68.5% of the vendors. The other systems that are handled by more than 50% of the vendors include Stand-alone systems less than 300 W (58.3%), solar street lighting (55.6%), Hybrid systems more than 1 kW (59.3%), and solar water pumping (50.9%). All the vendors handle multiple solar PV systems with a few attesting to dealing with grid tied systems with transformer and selling power to the grid. This small number of grid-tied projects is due to the fact that there are not many projects for feed-in-tariff in the country. Again, it is evident that there is little work for the T1 and T2 technicians. In addition, there is quite some work on the advanced grid-tied and hybrid systems including those with multiple inverters and transformer.

Whereas all vendors have a licensed lead technician, it has emerged that there is a relationship between the license class of the lead technician in a firm and the size of projects handled by the firm as can be seen in Table 5.4.

Table 5.4: Relationship between licensed technicians in firm and size of projects handled

Attributes: Technician license class, number of technicians, and age of the business	***Types of systems handled***
✓ 0 – 3 technicians ✓ Lead technicians hold T1 license and few having T2 licenses	▪ Pico plug and play ≤100 W (PV panel, battery) ▪ Stand-alone system ≤ 300 W (PV array, battery, inverter, charge controller) ▪ Stand-alone system > 300 W (PV array, battery, inverter, charge controller ▪ Solar water pumping system < 1 kW ▪ Solar water pumping system > 1 kW
✓ More than 3 licensed technicians ✓ T2 technicians	• Solar PV street lighting • Hybrid system ≤ 1 kW (PV array, battery, inverter, charge controller, auxiliary) • Hybrid system > 1 kW (PV array, battery, inverter, charge controller, auxiliary) • Hybrid system AC coupled > 15 kW (Multiple inverters)
✓ More than 3 technicians ✓ More than 5 years' experience in solar PV ✓ Firms handling grid-tied systems, have over 10 years' experience and T3 technicians	♦ Solar PV street lighting ♦ Hybrid system ≤ 1 kW (PV array, battery, inverter, charge controller, auxiliary) ♦ Hybrid system > 1 kW (PV array, battery, inverter, charge controller, auxiliary) ♦ Grid-tied system (Single inverter) ≤ 25 kW ♦ Grid-tied system 415 V (Multiple inverters) > 25 kW ♦ Grid-tied system with transformer (11 kV) – Self consumption ♦ Grid-tied system with transformer, selling to Grid – Feed-in-Tariff ♦ Hybrid system AC coupled < 15 kW (Single inverter) ♦ Hybrid system AC coupled > 15 kW (Multiple inverters)

It can be observed from Table 5.4 that the big solar PV projects are mainly handled by experienced firms (over 10 years) that have several highly qualified technicians with T3 licence in their employment as expected. The distribution of the three technician license classes for lead technician is shown in Figure 5.5.

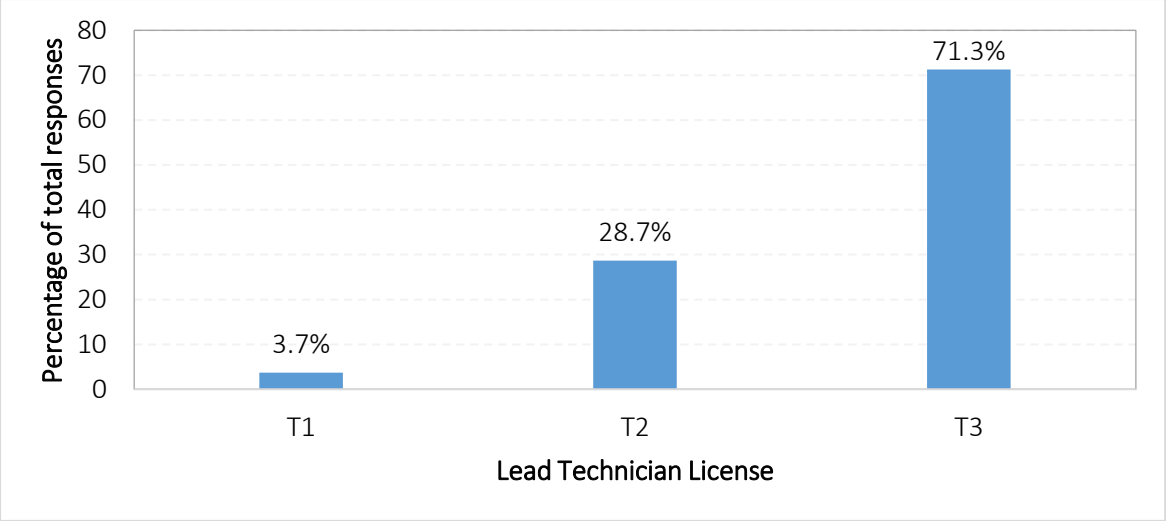

Figure 5.5: Lead technician license class distribution

It can be seen from Figure 5.5 that most vendors (over 70%) have T3 license holders as lead technicians whereas less than 4% of the firms have T1 holders as lead technicians. This observation does not agree with the tallies on the highest academic qualification of the lead technician: only 1% of the lead technicians are certificate holders as seen from Figure 5.6.

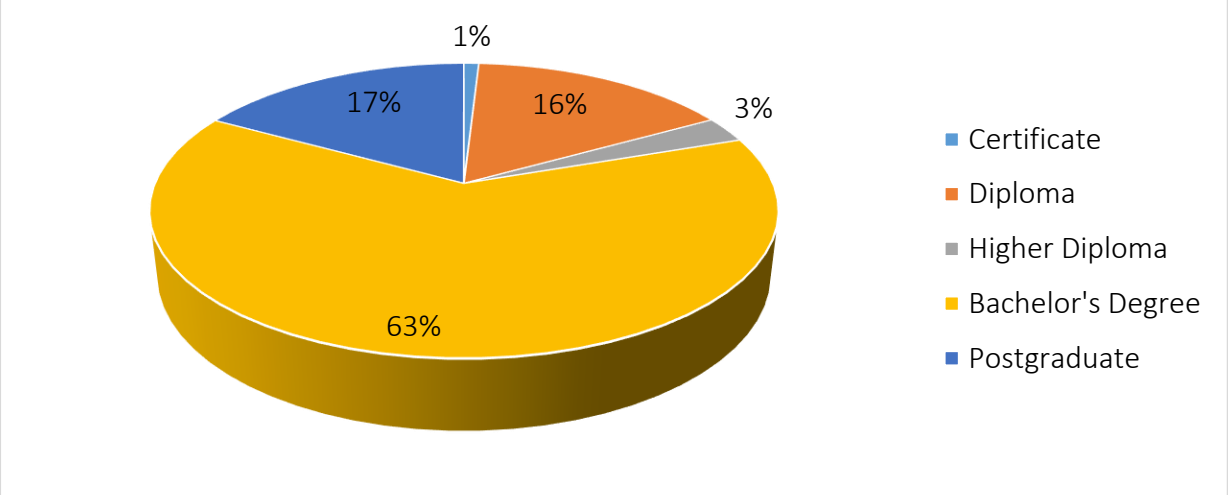

Figure 5.6: Lead technician's highest academic qualification

T1 license holders have a minimum of Electrical Government trade test certificate. Therefore, it is expected that the percentage of lead technicians whose highest academic qualification is a certificate would closely match the percentage of lead technicians with T1 license. One reason that could cause the discrepancy is that there could be some diploma holders who at the time of license application do not have the requisite experience to be licensed as T2 technicians and thus, are licensed as T1.

Figure 5.7 shows the distribution of the number of licensed PV Technicians employed by the firms.

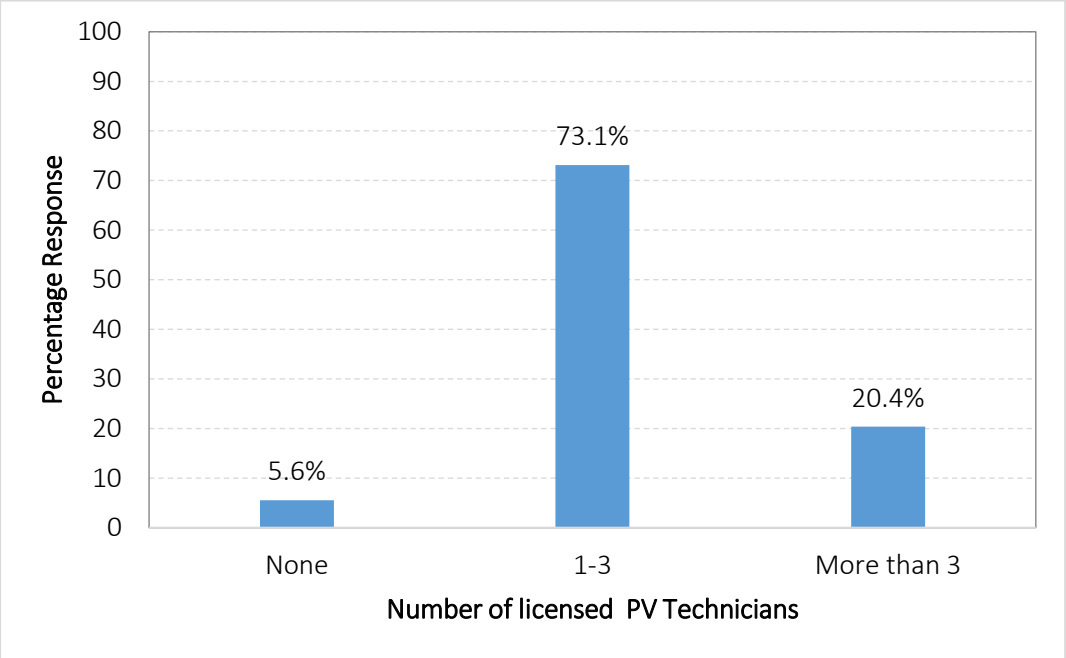

Figure 5.7: Number of Licensed PV Technicians Employed

It can be seen from Figure 5.7 that the percentage of firms with no licensed technician in their employment is 5.6%. This contradicts an earlier observation that all the firms have a licensed lead technician. One of the reasons for this contradiction may be due to the fact that some firms have a CEO who is the lead licensed technician and thus, they do not view themselves as being in employment. It can also be observed that most firms (73.1%) have 1-3 licensed technicians in their employment. The firms that have 1–3 technicians handle an average of 51 – 100 solar PV projects in a year whereas those with more than 3 technicians handle more than 100 projects per year.

Some of the firms with no licensed technicians were seen to be handling more than 100 projects per year with 69% attesting to handling projects of less than 1 kW whereas 28% confirmed to handle systems with a capacity greater than 1 kW but less than 50 kW.

Twenty four percent of the vendors with more than three licensed technicians recorded handling less than 10 solar PV projects per year. However, these projects were seen to be those above 200 kW. Thus, indications are that vendors with a higher number of licensed technicians in their employment handle few, high capacity projects in a year whereas those with no licensed technicians handle a large number of small projects including the pico plug and play, stand-

alone system more than 300 W (PV array, battery, inverter, charge /controller, and solar water pumping systems.

Only 55% of the vendors think the importation and tax exemption of solar PV products is clear to importers whereas 41% think it is not and 4% did not give their views. The reasons given for lack of clarity are mainly to do with definition of the components that are tax exempt. It appears there is need for a clear list of components to be developed and include specialized solar equipment such as inverters and accessories e.g. special communication and DC cables

KRA requires importers of PV systems to obtain clearance from the EPRA prior to goods being allowed into the country Most of the vendors (72%) think the process of obtaining clearance from EPRA is convenient and only 28% think it is not convenient. The suggestions made for improving the process of obtaining clearance from the EPRA are focused on interlinking KRA and EPRA systems to minimize time and the need for vendors' representative visiting EPRA.

Importation and sale of plug-and-play devices i.e. off the shelf ready-made kits that do not require installation, is currently not regulated. Most of the vendors (54%) think that these too should be regulated, whereas 46% think the status quo should be maintained. However, there are certain devices that the vendors think ought to be exempt from regulation with the suggestion that KEBS should be more stringent in control of these devices to ensure only good quality products are brought into the country. The products include solar lamps and lanterns, light bulbs, PV Kits, home systems, torches, DC Fridges, and solar powered radios.

Further, 63% of the government and non-governmental agencies are of the opinion that regulation of the plug-and-play devices (off the shelf ready-made kits that do not require installation) is not necessary. They support their view as follows:

- ✓ KEBs can cover the small units
- ✓ Market has sufficient commercial incentives to self-regulate
- ✓ Globally, regulation of off the shelf kits is still a challenge due to fast changing designs and applications in that segment.

However, the remaining 37% of the agencies are of the view that there is a need to expand the scope to include this segment in the regulations for the following reasons:

- ♦ The need to protect consumers and standards are important
- ♦ Need to regulate emerging systems

- A categorization of solar appliances could be considered based on the productive use potential or economic impact
- VAT exemption for productive-use solar appliances can greatly stimulate the uptake of products by rural customers.

5.2. Licensing

5.2.1 Licence classes

Most vendors consider it necessary for EPRA to license vendors of solar PV systems; 92% of the firms affirmed this whereas only 8% thought it is unnecessary. Some of the views given by the latter group are that if the available solar PV systems are of good quality and the proper standards are followed, the vendors cannot change anything. Thus, they emphasise the need for standards enforcement of the solar PV components that are imported or manufactured locally.

Most vendors and technicians, 54% and 89%, respectively confirmed that the licences they hold allow them to serve their customers adequately whereas 46% and 11%, respectively neither agreed nor disagreed and disagreed. The licensees with licence limitations cited the capping of T1 and T2 technicians as the main hindrance and thus, recommend extension of the scope of work that these two classes are mandated to carry out.

Majority of the technicians (68%) are of the opinion that the division of technician license classes into T1, T2, and T3 together with division of the level of work that each class can undertake is appropriate. The ones of a contrary view suggested that diploma, higher diploma and bachelor degree holders should automatically qualify for T2 license, among others. However, they acknowledge the need to tie experience to academic qualifications in licensing criteria. The technicians propose additional license classes to include: micro grid design, hybrid and grid-tied complex power systems, a class above T3 for specialists, solar water pumping, and T4 for BSc holders with at least 7 years' experience and EBK registration.

Majority of the training institutions (80%) are of the opinion that the division of technician license classes into T1, T2, and T3 together with division of the level of work that each class can undertake is not appropriate and suggested the following for improvement:

- ✓ T1 license is no longer relevant and should be scrapped
- ✓ T1 and T2 licenses are a bit prohibitive on the maximum system size allowed under the respective classes and needs to be reviewed upwards

- ✓ Merge the T1 and T2 licenses into one license or upgrade the T1 scope to include DC and AC loads
- ✓ T3 license can be split into more specialized licenses
- ✓ T3 the level of work is a lot more than what is captured. For example, for one to carry out an Engineering, Procurement, and Construction (EPC) work for a 40 MW PV plant, one needs to carry out a feasibility study which will include; due diligence, a bankable project financial appraisal, and a technical design. The design begins from the DC generation to the step-up transformers, substation, to the evacuation line. This is not fully captured in the licensing requirements.

Further, 60% of the training institutions suggested creation of additional classes of licenses in the future. The remaining 40% of the institutions were contented with the current classes and did not see the need for additional ones. Some of the proposed new classes include:

- ♦ A special license for solar powered vehicles which is the future. These classes will incorporate different safety and design aspects in some specialized uses of solar technology
- ♦ Add some specialized licenses for solar water pumping, biogas, mini grids etc.
- ♦ Enhance T3 licensing to include several categories such as DC only, DC-AC without connection to the grid and DC–AC including substation.

Most (50%) of the solar PV promoters (government and non-governmental agencies) felt that the current categories of PV vendors are not sufficient. Some of the reasons given are:

- ♦ There is overlap between the categorization of the market players and the category names are confusing e.g. vendors are often also importers of products
- ♦ Independent after sales service providers missing. Common in township and village level
- ♦ Contractor classes are ambiguous - C1 and V1 overlap. Make the categories clearer and resolve overlap
- ♦ Need proper classification in terms of capacity to carry out works
- ♦ Need to clarify roles: design, installation, O & M
- ♦ There is a need to expand the categories.

Those that agree that the categories are sufficient (44%) gave the following reasons and 6% have no opinion on the matter:

- More categories would cause industry chaos. It is also easy to manage fewer market categories
- Categories are sufficient only that there is a challenge in supervision and enforcement of compliance to regulations per class.

Figure 5.8 depicts the opinion of the promoters on the adequacy of the categorisation of the technician licenses into T1, T2, and T3 together with the level of work that each class can undertake.

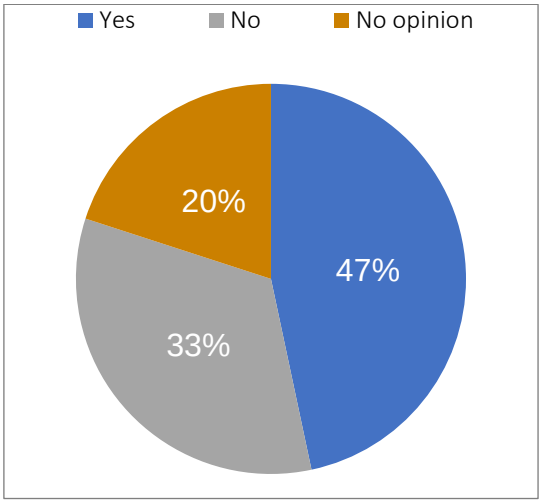

Figure 5.8: Promoters - Adequacy of categorization of technicians

It is clear from Figure 5.8 that opinion is divided down the middle on the categorisation among the promoters. Those who think that the categorization is adequate gave the following reasons:

- More fragmentation will cause confusion in the industry
- Categories were based on broad consultation

Those who are of the opinion that the categorisation is inadequate gave the following reasons:

- Need to give more details on limits of each category not only in plant capacity but other aspects as well including design, installation, commissioning, economic viability analysis, and operations and maintenance. Refer to Energy Management Regulations.
- Need to expand scope for T1 and T2 which are very limited.

There is also the thinking that the name *technician* is not appropriate especially for T3. Thus, there is a suggestion that this should change to Solar Engineer or Certified Solar Engineer. However, this needs to be handled cautiously as the term "engineer" is protected under The Engineers Act, 2012 and shall only be applied to persons or bodies fulfilling the requirements of the Act.

5.2.2 Qualification, experience, and certification requirements

Figure 5.9 shows the licensed technicians' highest academic qualifications.

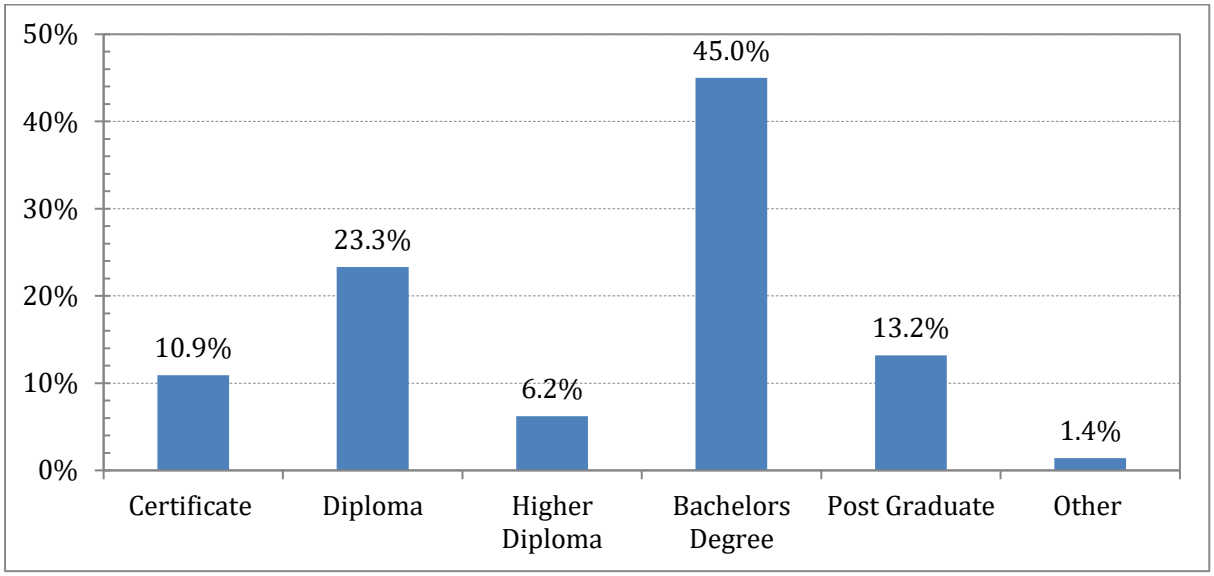

Figure 5.9: Licensed technician's academic qualifications

It is notable from Figure 5.9 that over 87% of the technicians hold either diploma or higher diploma or bachelors or postgraduate degrees. These qualifications allow them to be licensed as either class T2 or T3 technicians depending on their solar installation experience. This agrees well with the earlier finding reported in section 5.1 that the majority of the lead technicians in firms are either Class T2 or T3 license holders as depicted in Figure 5.5. About 80% of the technicians consider the respective academic qualification requirements for licensing as a T1, T2, and T3 technician to be appropriate. The 20% who consider the requirements to be inappropriate re-emphasised the need for change in the license classifications and particularly increasing the scope of T1 and T2.

Table 5.5 shows the types of solar PV systems installed by technicians holding various license categories.

Table 5.5: Systems installed by different technician categories

Technician license	***Types of solar PV systems installations***
T1 Technicians	▪ Pico plug and play $\leq$100 W ▪ Stand-alone system $\leq$ 300 W (PV array, battery, inverter, charge controller)

Technician license	*Types of solar PV systems installations*
	▪ *Stand-alone system > 300 W* (PV array, battery, inverter, charge /Controller ▪ Solar water pumping system ≤ 1 kW ▪ *Solar water pumping system > 1 kW*
T2 Technicians	▪ All installed by T1 technicians ▪ Solar PV street lighting ▪ Hybrid system ≤ 1 kW (PV array, battery, inverter, charge controller, auxiliary) ▪ *Hybrid system > 1 kW* (PV array, battery, inverter, charge controller, auxiliary) ▪ *Hybrid system AC coupled > 15 kW* (Multiple inverters
T3 Technicians	▪ All installed by T2 technicians ▪ Grid-tied system (Single inverter) ≤ 25 kW ▪ Grid-tied system 415 V (Multiple inverters) > 25 kW ▪ Grid-tied system with transformer (11 kV) ▪ Grid-tied system with transformer, selling to Grid – Feed-in-Tariff ▪ Hybrid system AC coupled < 15 kW (Single inverter)

It is clear from Table 5.5 that both the T1 and T2 license holders install systems whose capacity is bigger than that mandated in the regulations i.e. T1 small systems up to 100 Wp and T2 medium systems up to 300 Wp. This signifies obsolescence of the license classification and thus, calls for review of the same.

The technicians have attended various solar PV courses with some attending multiple courses. The percentages of the technicians who have attended various courses is given in Table 5.6.

Table 5.6: Solar PV courses attended by technicians

Courses attended	*Percentage of Technicians:*
TI	10%
T1/T2	42%
T3 (Grid-Tied)	32%
T3 Hybrid	26%
Solar Water Pumping	16%
Solar Mini-grid Training	19.4%
Product specific training	16%

The most popular courses are the T1/T2, T3 Grid-tied and T3 Hybrid as seen from Table 5.6. This may mean that there is a critical mass of people with skills required to handle the advanced solar PV projects.

In addition, over 99% of the technicians think the courses they have attended are relevant to the solar PV industry, 77% say the courses are comprehensive, and 72% are of the opinion that the course delivery time is adequate. The technicians made the following suggestions on how the solar PV training can be improved:

i) Include training on tools and equipment for testing PV systems
ii) Include system inspection, testing, and commissioning
iii) Lay more emphasis on sizing and standards
iv) Make the trainings modular
v) Look into ways and means of lowering the cost of training to make it more affordable.

Most vendors (82%) are of the view that their licensed technician's knowledge of solar PV systems is adequate for their business. However, 18% think the technician's knowledge is either partly adequate or completely inadequate for the business. Those that think the technicians are inadequate said that some technicians have licenses but lack enough experience for some products and projects, whereas there are also some skilled and competent technicians who are not licensed. Thus, they recommend that there should be continuous knowledge acquisition even by the licensed technicians. This recommendation is quite in place given that the field of solar PV is very dynamic and thus, one needs to keep abreast with new developments through continuous professional development.

The views of the firms are supported by 66% of the promoters who feel that the technicians have the necessary skills and competence to handle jobs assigned to them. However, they feel

that continuous professional development (CPD) is necessary and that these technicians need to be trained in accredited training institutions. They allude to having observed the following shortcomings in the licensed personnel:

- There is skills and knowledge gap because solar energy training has not been fully institutionalized in institutions of higher learning
- Most technicians have limited experience and are familiar with very few systems or manufacturers or models
- There are insufficient skills in design and financial appraisal of projects
- T2 technicians are limited in their scope while T3 technicians have a broad span which without sufficient experience might lead to poorly executed projects.

The remaining 34% of the promoters are of the opinion that the technicians' skills are not sufficient for the following reasons:

- ✓ There is a need to expand the scope to include more skills like engineering experience
- ✓ More skills are needed in project management, safety, and documentation
- ✓ More standardized and tailor-made training/course should be part of training in institutions of higher learning.

Most training institutions (60%) agree that the regulations need to be amended to facilitate comprehensive training of technicians, to harmonize the syllabus contents and training periods (cumulative hours) and to incorporate more specialized technician categories. However, 40% of the institutions feel there is no need to amend the regulations to facilitate comprehensive training of technicians, but rather an improvement in terms of enforcement to ensure all trainings adhere to the set standards.

The training institutions suggested the following to facilitate impartation of knowledge to trainees:

- Synchronization or harmonization of syllabus across all training institutions
- Need to have uniformity of training periods; the regulator should specify this in terms of how many hours of training one needs for each license class to ensure harmony across all training centres
- The course content needs to be revised to include topics on electrical installation, wiring systems, and more practical skills
- Introduce knowledge or background in electrical engineering as a pre-requisite for solar PV courses.

However, some of these responsibilities do not solely rest with the regulator, but rather are joint efforts with other agencies e.g. curriculum development and review and setting the entry requirements for the trainings are not within the mandate of the regulator.

Majority of the government agencies and non-governmental organisations (63%) are of the opinion that the qualification requirements of electrical engineering diploma or degree are adequate for licensing T1, T2, and T3 technicians as can be seen from Figure 5.10.

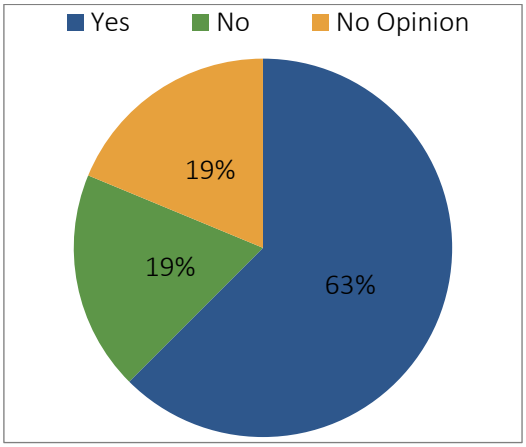

Figure 5.10: Promoters - Academic and professional qualifications requirement for Licensing

It is also notable from Figure 5.10 that 19% of the promoters feel that the requirements are inadequate whereas 19% have no opinion. The inadequate view is supported by the following reasons:

- ✓ T3 Technicians requirements need to be enhanced to require more professional experience since they usually deal with large systems
- ✓ Design should be carried out by experienced engineers.

Most (80%) of the training institutions are of the view that the level of experience required for licensing under the various technician classes is appropriate. However, 20% of the institutions are of the view that the level of experience required for licensing T3 technician is not appropriate citing the following reasons:

- ♦ T3 license incorporates hybrid systems with genset or wind, AC/DC coupling and this requires one to have multi-disciplinary experience in electrical as well as DC, medium and low voltages
- ♦ T3 license requires one to have experience in high voltage transmission & distribution e.g. for mini-grids, substation construction, and PV plants etc besides the basic knowledge of PV systems.

The above sentiments can be addressed by expanding the training coverage for the technicians licensed to handle the advanced systems.

Different training institutions have various training equipment including solar PV kit, inverters –on grid and off grid, generator solar PV-diesel hybrid, battery backup system kit, well and pumping equipment, solar cooling, PV modules, PV system site survey equipment: (solar path finder, irradiance meters, inclinometers), PV system design tools: advanced design software, PV system commissioning tools: impedance testers, earth resistance testers, PV system analysers kit, among others. These equipment are useful in training design, installation, testing and troubleshooting of solar PV systems of different complexities including grid-tied and hybrid systems.

As part of the qualification process, technicians take examinations that are administered by EPRA. Majority of the technicians are of the opinion that the examinations are fair, transparent, and offered conveniently in terms of time at 96%, 97%, and 87%, respectively. However, only 59% think the location where the examinations are administered is convenient. This lower rating may be due to the fact that the examinations are offered centrally at EPRA's Nairobi offices which may not be convenient for technicians based in regions outside Nairobi. Thus, it may be worthwhile to consider setting up more examination centres in other counties.

5.2.3 Licensing process

Majority of the vendors (96%) and technicians (95%) understand the licensing process used by EPRA. Further, a total of 89% and 94% of the vendors and technicians, respectively rate the level of difficulty in applying for a license as either easy or moderate; only 11% of the vendors and 6% of the technicians rate the license application as difficult. Additionally, 81% and 82% of the vendors and technicians, respectively think the process of renewing their license is convenient whereas 19% and 18%, respectively are of the opinion that it is inconvenient. In terms of the speed with which EPRA processes and issues licenses, both new licenses and renewals, 28% and 14% of the vendors and technicians, respectively think the process is slow whereas the remaining 72% and 86% think it is either satisfactory or fast.

Most of the vendors (95%) and technicians (96%) think that the license fees charged by EPRA is either low or fair; only 5% and 4%, respectively think the fees is high.

Some of the suggestions made by the licensees for improving the license application process include making the online process work smoothly, educating applicants about the online

system, creating a demo page on the application process, electronic payment, reduction of the processing time, sending renewal notification to licensees when expiry date approaches, issuing licenses online/electronically, EPRA to visit sites to verify the work done instead of relying on oral interviews and written exams only. Some of these suggestions like the notification before license expiry are easy to implement and would help reduce cases where licensees operate without a valid license. Creating awareness on the services offered is a continuous exercise and therefore, EPRA should take advantage of the forums where there are solar PV licensees to educate them on the online system.

5.2.4 General conditions for licenses

A solar PV system technician license holder is required to practise for at least two years before applying to upgrade the license. Majority of the technicians (75%) are of the view that this duration is adequate. Those who consider the period to be inadequate made the proposals given in Table 5.7.

Table 5.7: Proposed practising period for license upgrade

Proposed practise period	*Percentage of technicians*
Three years	67.7
Four years	12.9
Five years	17.7
Other	1.7

It is clear from Table 5.7 that most of the technicians who think two years is inadequate consider three years to be favourable.

About 78% of the technicians and 91% of the vendors agree that continuous professional development (CPD) attained through training is a better way for a technician to upgrade from one license class to another. The licensees who either partly or wholly disagreed with this license upgrade method suggested that both CPD and practical experience should be used to establish the technician's competency.

Most vendors (67%) and technicians (74%) think the one-year validity period of a license is inadequate whereas the remaining 33% and 26% are of the opinion that it is adequate. The proposed validity periods are presented in Table 5.8.

Table 5.8: Proposed license validity period

Proposed validity period (years)	*Vendors (%)*	*Technicians (%)*
Two	42.5	18.8
Three	37.0	38.3
Four	4.1	25.0
Five	12.3	15.6
Other	4.1	2.3

It can be seen from Table 5.8 that most vendors and technicians favour a validity period of two (2) and three (3) years, respectively. It is worth noting that for the vendors group, the proponents of the three (3) year validity period are also quite a sizable percentage at 37%. However, it is important that the validity period is aligned with the three-years stipulated in the Act for electrical installation workers and contractors.

The regulations provide for cancellation of any license that is not renewed for two (2) consecutive years without informing the Authority in writing of the intention and reasons for not renewing. Most vendors (53%) think this provision is inappropriate whereas a similar proportion (54%) of technicians think the duration is appropriate. Those who consider the duration inappropriate proposed extension as shown in Table 5.9.

Table 5.9: Proposed license cancellation period for non-renewal

Proposed duration	*Vendors (%)*	*Technicians (%)*
3 years	29	45
4 years	49	30
Other	22	25

It is clear from Table 5.9 that most vendors favour license cancellation after non-renewal for a period of four years whereas most technicians prefer three years. It is worth noting that the number of technicians who are in favour of a four-year period is also significant (30%). There was also a proposal that the license should not be cancelled but rather impose an annual fine payable for the years not renewed. However, if the validity period is extended to three-years as proposed, then the cancellation for non-renewal needs to be after a reasonable period after the expiry. Under the current regulations, licensees are required to apply for licence renewal thirty

(30) days prior to expiry. Thus, a grace period of about six months before cancellation will be adequate.

The majority (55%) of vendors are of the opinion that members of the public recognize the vendor's/ contractor's license issued by EPRA whereas the rest are of a different opinion. On the other hand, 54% of the technicians think their license is not recognised by the members of the public. The suggestions relevant to changing the form of the license include introduction of more security features, digitization of the card, issuance of a certificate in addition to the card, and creating public awareness through media and other public forums.

5.3. Design, installation, repair and maintenance

The design, installation, repair and maintenance of solar PV systems is supposed to be carried out in accordance with the relevant Kenya Standard. However, the regulation does not specify which standard this is. Most vendors and technicians (92% of each group) alluded to using various local and international standards and only 8% does not use any standards.

On the quality of solar products installed in the country, the government and non-governmental agencies have mixed reactions. Some of their observations include:

- It is difficult to pin-point causes of poor quality of installations, whether workmanship or product quality. KEBS and KRA might not have capacity to eliminate poor quality products in the market.
- Poor quality batteries are prevalent in the market
- Good quality components are used in medium and large-scale installations but small off-the-shelf kits market is still infiltrated with poor quality products, mainly from Asia
- Quality of products installed is not assured because there is a huge range of products in the market which overwhelm consumers ability to assess the quality
- Standalone systems have improved due to quality improvement frameworks such as Lighting Global
- Some good quality products like Yingi and Trina are not in the local market
- There is need to control quality at the country of origin.

The respondents gave their views on how the solar PV standards in the country can be improved as follows:

- Increasing public awareness among stakeholders who in turn will help in improving the standards
- Consumers need to have a system or ways of verifying quality
- Incorporating Lighting Global certification for standalone systems, which is the main quality standard
- Revising KS 2542, using the revision being done on IEC 62297. Currently, IEC 62297 is under revision (the basis of KS 2542) that will be adopted by International Electrotechnical Commission (IEC), for systems up to 350 W. It will be worth for EPRA to adopt the Standard through the appropriate statutory paths.
- EPRA and KEBS should be more pro-active in their approach to standard development
- There is need for more stringent penalties and enforcement of the same.

Most vendors (84%) have had their solar PV system design tools approved by EPRA whereas the remaining 16 % have not.

It is clear that there is need for clear guidance on the specific standards that should be used to improve the quality of the installations, both components and workmanship. In addition, the standard that specifies the requirements to be met by the unregulated plug-and-play devices also needs to be clearly stated.

5.4. System and components warranties

Vendors are required to give warranties for various solar PV components that they handle. Table 5.10 shows the warranty periods given for various components and the respective percentage of vendors.

Table 5.10: Current components warranties

Components	***Warranty Period***		
	Offered by firm	***Offered by manufacturer***	***Required minimum warranty period***
1. Controller/ Regulator	*0 – 1 year* 0: 8% ½ year: 52% 1 year: 38%	*½ – 1 year* ½ year: 46% 1 year: 54%	*10 years*
2. Inverter	*5 – 12 years* 5 years: 5% 5 – 10 years: 43% 10 years: 51%	*10 - 25 years* 10 years: 54% 10 – 15 years: 42% 25 years: 4%	*10 years*

Components	*Warranty Period*		
	Offered by firm	*Offered by manufacturer*	*Required minimum warranty period*
3. Battery	*5 – 20 years* 5 years: 36% 10 years: 39% 10 – 15 years: 25%	*20 – 25 years* 10 – 15 years: 3% 20 years: 64% 25 years: 33%	*1 year*
4. Light bulbs/LED	*0 – 5 years* 0: 16% 1 – 5 years: 48% 5 years: 36%	*5 years*	*1 year*
5. Panels	*10 – 15 years* 10 years: 33% 10 – 12 years: 43% 12 – 15 years: 24%	*10 – 25 years* 10 years: 16% 10 – 15 years: 44% 15 – 25 years: 38%	*20 years*
6. Light fittings/device	*0 – 2 year* 0: 36% ½ year: 39% 1 – 2 years: 25%	*½ – 2 years* ½ – 1 year: 35% 1 year: 24% 1 – 2 years: 41%	*2 years*

It can be observed from Table 5.10 that most vendors give warranties for the various components that they handle. However, it can be seen that some vendors do not give warranties for Controller/Regulator, Light bulbs/LED, and Light fittings/device (8%, 16%, and 36%, respectively). Further, it can be seen that there is a mismatch between the required minimum warranty periods for controller/ regulator, battery, and light bulbs/LED and the periods given by both the vendors and the manufacturers. The regulations stipulate minimum warranty periods of 10 years and 1 year for the controller/ regulator and battery and light bulbs/LED, respectively. However, the manufacturers and vendors of controllers/ regulators give warranty periods ranging between 6 months and 1 year, those for battery 5 – 25 years, and the ones for light bulbs/LED 0 – 5 years. The minimum warranty period requirements for the other components are in tandem with the manufacturers' warranty periods.

Table 5.11. shows the estimated number of component failures reported to vendors in the last one year before expiry of warranty period.

Table 5.11: Reported number of failed components

Component:	*Approx. no of failures in the last one year*
Controller/Regulator	0 - 20
Inverter	0 - 15
Battery	0 - 20
Light bulbs/ LED	20 - 36
Panels	0 - 20
Light fittings/ device	6 - 50

Most vendors recorded few or no failure of controllers, inverters, solar panels and batteries but indicated high incidences on the part of the light bulbs/LED and light fittings as seen from Table 5.11. Hence, their reluctance to give extended warranty periods for these components. Overall, 76% of the vendors think that the minimum warranty validity period stipulated in the regulations is practical whereas 24% of them are of a different opinion.

Table 5.12 shows the minimum warranty period proposed by the vendors for various solar PV system components.

Table 5.12: Proposed minimum warranty period for solar PV system components

Component:	*Manufacturers' warranty (years)*	*Current minimum warranty (years)*	*Proposed warranty (years)*	*Percentage of Vendors*
Controller/ Regulator	½ – 1	10	0 – 1	36%
			2 – 10	34%
			10 – 15	27%
Inverter	10 - 25	10	0 – 1	24%
			1 – 5	41%
			5 – 10	4%
			10 – 25	5%
Battery	20 – 25	1	0 – 1	24%
			1 – 5	40%
			5 – 10	7%
			10 – 15	1%
Light bulbs/ LED	5	1	0 – 1	12%
			1 – 5	84%
			5 – 10	2%
			10 – 15	2%
Panels	10 – 25	20	0 – 1	7%
			1 – 5	33%
			5 – 15	4%
			15 – 25	56%
	½ – 2	2	0 – 1	70%

Component:	*Manufacturers' warranty (years)*	*Current minimum warranty (years)*	*Proposed warranty (years)*	*Percentage of Vendors*
Light fittings/ device			2 – 5	13%
			5 – 10	11%
			10 – 25	6%

It can be observed from Table 5.12 that most vendors propose warranty periods of 0 – 1, 1 – 5, 15 – 25, and 0 – 1 year for controller/regulator, light bulbs/LED, panels, and light fittings/devices, respectively. These proposed warranty periods are all reasonably aligned with the respective manufacturers' warranty periods. It is worth noting that the warranty periods proposed by most vendors for inverters and batteries are a lot shorter than the warranty periods given by the manufacturers. This is despite the fact that the vendors reported few failures of these components in the preceding one year. The minimum warranty periods stipulated in the regulations for most components agree well with the manufacturer's warranty periods except for the controller/regulator and the battery. The manufacturer's warranty period for the controller/regulator and battery is between ½ – 1 and 20 – 25 years, respectively whereas the corresponding minimum period is 10 and 1 year.

The government and non-governmental agencies gave their views on how the component warranties provided in the regulations can be improved as follows:

- Through consumer awareness
- Ensuring local agents are in a position to meet their warranty obligations
- Establish a robust consumer complaints platform and the regulator to follow up on all reported complaints to ensure they are addressed
- By introducing stricter government policies on consumer protection and a clear channel for communicating complaints to the government
- Industry players to be compelled to include warranties in their products. KEBS should also certify products.

5.5. Documentation

5.5.1 EPRA

EPRA maintains a register of all licensed solar PV systems manufacturers, importers, vendors, technicians, and contractors. However, as reported elsewhere in this report, for the C1, V1, and V2 licensees, there is need to keep a clear record of the entities with multiple licenses. Further, the contact information of the licensees needs to be current and at the very least include an

email address and mobile phone number. It would also be useful to include the physical address.

5.5.2 Licensees

The regulations require vendors to provide information to EPRA on the annual sales volumes in watts, and value of solar PV systems and components manufactured, sold and installed by the 31st March of the year following the manufacture, sale or installation. It emerges that 82% and 72% of the vendors and technicians, respectively file their returns as required but the remaining 18% and 28% do not.

Vendors are required to give certain documents to their customers. Table 5.13 shows the percentage of vendors who issue various documents.

Table 5.13: Documents issued to customers

Documents issued	***Responses received***
Purchase receipt	91%
Signed system design declaration	64%
Signed system completion certificate	73%
User manuals	88%

It can be seen from Table 5.13 that the documents that are issued by most vendors are the Purchase Receipt at 91% and the User Manual at 88%, and the least issued is the Signed System Design Declaration at 64%. It is important that all these documents are issued since they give very important details on the installation.

5.6. Regulation enforcement

As part of the regulation enforcement, EPRA should inspect business premises and solar PV installation sites. This role has been executed as evidenced by the 85% of the vendors whose businesses have been inspected. In addition, 42% each of the vendors and technicians have had sites they have installed solar PV systems inspected. However, it is worth noting that the site inspections are below 50%. Of those who alluded to the sites having been inspected, 4% each for the vendors and technicians were found to be non-compliant whereas the rest were compliant. The non-compliances were due to lack of commissioning certificate with the required information, no warning labels affixed, and the fact that there were installations of solar PV system that had batteries done by T1 license holders which they are not authorised to undertake.

It should be noted that 82% and 89% of the vendors and technicians, respectively attested to affixing appropriate safety and health warning labels on completed solar PV installations/components. In addition, 75% of the technicians issue a completion certificates to consumers on completed solar PV installations.

The majority of both the vendors and technicians -83% and 86%, respectively- are of the opinion that the penalties provided for in the regulations are adequate whereas the remainder think they are inadequate. Thus, they recommend various amendments or additional sanctions for licensees who do not comply with the regulations including license withdrawal/suspension/cancellation, heavy penalties for none standard products that do not comply with regulations, confiscation at customs of solar products imported by unlicensed entities.

Only about 1% and 6% of the vendors and technicians, respectively have had their previous license cancelled under the provisions of the regulations whereas the remainder have not. However, both categories of licensees did not give reasons for the cancellations.

Figure 5.11 shows the distribution of government and non-governmental agencies responses to adequacy of penalties for non-compliance.

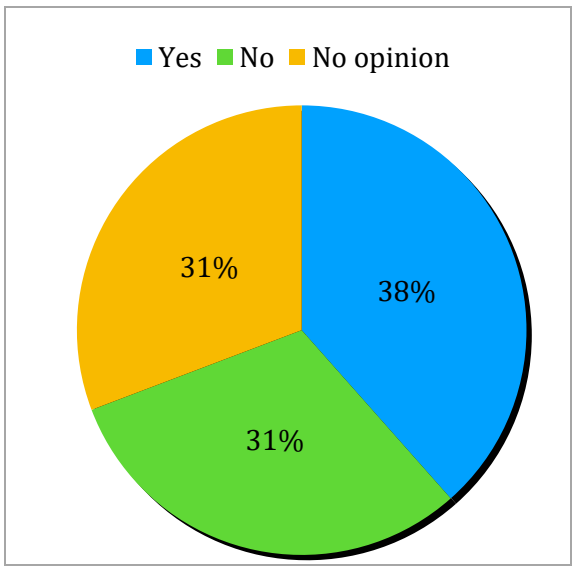

Figure 5.11: Promoters - Adequacy of penalties for non-compliance

It is worth noting that the responses were almost evenly spread between affirmative, negative and no opinion. The high number of no-opinion responses could be an indication that there has not been serious non-compliance or that there has not been a lot of penalties meted out.

Those who are of the opinion that the penalties are inadequate gave the following reasons:

- The penalties are not properly structured. The penalties should be stratified and threshold set clearly. Penalties could include suspension of license for some time until remedial action has been carried out and verified before restoration.
- The court process is too long and too slow, and solar expertise is not necessarily available to the courts.
- Penalties are too light for some serious offences. Raise penalties in Clause 16 to 3 years and Ksh.2.5 million or both.

5.7. Working relationship between licensed technicians and the firms

Most vendors (68%) have the lead technician in their employment and only 32% of the vendors have formalized working arrangements with the technician. Further, 60% of the licensed technicians have their licenses attached to a firm with the remaining 40% not attached to any firm. Table 5.14 shows the duration the licenses have been attached to firms.

Table 5.14: License attachment duration

Period attached	*Percentage*
Less than 1 year	32
1-4 years	61
More than 5 years	7

It appears from Table 5.14 that the license attachments are either short-lived or there are many licensees (97%) who have practised for less than five years. Only 7% of the technicians have had their license attached to the same firm for more than five years. Table 5.15 gives the trend of previous licence attachments before the current one.

Table 5.15: Previous license attachments

No. of other firms	*Percentage*
None	37.5
One	38.5
Two and above	24.0

It can be observed from Table 5.15 that only 37.5% of the technicians have not attached their licence to any other firm, other than the one currently attached to. The other 62.5% have previously attached their licenses to other firms.

The formal arrangements could be the platforms that facilitate one technician being attached to several firms and engagement on a case by case basis as and when there is need. This latter category accounts for 40% of the technicians. The roles of the licensed technician in the firms are mainly design, installation, testing and commissioning, consultancy, and project development, operation and maintenance each with a response rate of more than 50%. Only 35% of the technicians are involved in company management.

The majority of both vendors and technicians -97% and 70%, respectively- confirm that there are no challenges in the working relationship between the firms and the licenced technicians. However, it is clear that more firms are contented with the relationships than the technicians.

The government and non-governmental agencies gave their observations on the working relationship between licenced technicians and the firms that they are attached to as follows:

- Technician licensee engaged on short term contract have no project ownership
- There is too much migration/duplication of license by firms. EPRA has no way of controlling relationships between firms and licensees
- Some companies have built internal capacity by training and having technicians in their employment and thus, they cut costs related to short term engagement of technicians
- Some firms are more interested in profit for the company and only see the technician's license as a means to achieve their financial targets. The licensees do not play any important role in the quality of products sold by the company.
- Some licensees work in companies that do not carry out large projects for which their licenses allow, hence limiting technician's exposure and use of his knowledge and skills.
- When licensees are taken in by multinational firms, they get exposed to better work experience than in classroom training.
- Technicians are disadvantaged and in weak negotiating position with contractors.

Opinion is divided on whether one technician should be permitted to commit their license to more than one vendor; 49% and 57% of the vendors and technicians, respectively think this should be allowed whereas the remainder think it should not. The fact that more technicians would prefer to be allowed to attach their licences to more firms may be due to the challenges they face i.e. they are neither in control of the technical aspects nor finances. Of the vendors and technicians who favour multiple license commitment, 80% and 86%, respectively think there should be capping on the number of firms that the license can be attached to whereas the

remaining 20% and 14% do not favour capping. The respondents who favour multiple commitment of license suggested the capping of the number of firms as shown in Table 5.16.

Table 5.16: License attachment - maximum number of firms

Maximum number of firms	*Technicians (%)*	*Vendors (%)*
Two	35	15
Three	48	68
Four	7	6
Other	10	11

It is evident from Table 5.16 that majority of both the vendors and technicians prefer to have the license attached to a maximum of three (3) firms.

To enhance the standard and quality of the solar PV installations and instil professionalism in the industry, it is important that firms hire qualified technicians to oversee their work. They ought to be involved in all matters relating to these projects since they have the skills and competencies. The market has a pool of licenced technicians, majority of whom are T3 license holders meaning they can handle even the advanced systems. Thus, the issue of multiple license attachment does not arise.

5.8 Impacts of the regulations

5.8.1 From Past Studies

The solar resource in Kenya can be harnessed for perpetuation of sustainable energy in the country. To achieve this, the country requires quality solar components and well trained technical personnel to carry out design, installations and commissioning, and maintenance of solar photovoltaic systems. To support this, the solar PV regulations have been in force since gazettement in 2012. The regulations provide for the following, inter alia:

a. Licensing of all persons involved in the manufacture, importation, distribution, promotion, sale, design or installation of any Solar PV systems;
b. Collection of data on Solar PV systems installed in the country;
c. Ensuring the manufacture, design, installation, repair and maintenance of Solar PV systems is done as per the relevant Kenyan Standards;
d. Ensuring fair business practices in the Solar PV industry.

Solar PV systems range from the smallest pico-applications, such as solar lanterns and small mobile-phone chargers, via solar home systems (SHS) installed in private households and mini-grids at village level to utility-scale, grid-connected plants. Therefore, although solar PV is often considered a distinct type of technology, it is clear that solar PV systems are quite different in terms of scale, capital-intensity, technological characteristics, target groups and competing technologies. The current regulations do not deal with the pico range of products.

The baseline study of 2018 (Rencon Associates Ltd , 2018) estimated that the installed capacity of solar PV systems in 2017 was 78.1 MWp. The study further established that the solar PV regulations had a positive impact on the industry and that they achieved the intended purpose. It is notable from the study report that the regulations have brought order in the PV market, the quality of PV products and components available in the market, the installation quality of the systems, and systems performance have all improved. In addition, the reported systems failures and malfunctions have reduced.

Some investors, community groups and the government agencies such as REREC and KPLC have created a mini-grids market for PV and PV-Diesel/Wind hybrid systems. In a mini-grid, centrally generated solar PV power, complemented by either diesel generators or battery storage or both supplies electricity to several consumers through a local distribution system. The mini-grids are meant to cost effectively accelerate rural electrification. Many county governments, institution and even corporates have adopted solar PV for area security or streets lighting leading to improved security and people can have longer working hours. In most parts of the arid and semi-arid areas of Kenya, mostly parts of Eastern Kenya, North-Eastern, Coast and parts of Rift Valley, NGOs, county governments use solar powered pumps, mostly borehole solar pumps for provision of water to communities and institutions. This has improved the livelihoods and quality of life of the people living in these areas.

The Baseline Study (Rencon Associates Ltd , 2018) found that the main challenges and barriers identified were taxation, high cost of PV, consumer awareness, financing, inadequate policy and regulation, lack of enforcement of standards and regulations and skills availability and adequacy. In addition, the application of import duties and taxes on PV equipment and accessories and lack of clarity on taxation was identified as a hindrance.

The Study also found that the solar panel was the most reliable component of PV systems. Further, it was established that the battery was the most unreliable and causes most failures

followed by the inverter; the charge controller is the most reliable BOS component of PV systems. The Study also tried to find out the adequacy and competency of PV personnel to service the industry across all levels of PV systems including large SHS, hybrid, grid-tied, and engineering, procurement and construction (EPC) kind of PV works .The main observation was that skills at all levels are available to a great extent but inadequate meaning that the industry does not have enough supply of trained and competent personnel to provide professional PV business and technical services. Business skills are the most inadequate.

The study concluded that the Kenyan market and products landscape had changed dramatically over the last 5 years. New PV products and services such as plug and play products, solar pumping, mini-grids and grid-tied PV systems had gained prominence and their demand was on the rise. Thus, new policies and strategies need to be developed and this would be an opportune time for comprehensive review of the regulations with a view to widening the scope to cover market segments with most national benefits.

5.8.2 Stakeholders' views

Majority of the technicians (77%) are of the opinion that the Solar PV regulations have had an in impact on the social-economic development of Kenya. They cited some of the notable impacts as job creation, enhanced professionalism in the industry, reduced number of faulty installations, streamlined works in solar PV installation, created a pool of qualified technicians, improved public acceptance of solar PV as a viable option, reduction of greenhouse gases (GHG) and global warming.

Among the promoters, 46% felt that the regulations have been successful or adequate. Some of their comments on this are:

- ✓ The intended purpose of licensing, quality and awareness has been successfully done
- ✓ The regulations have helped improve quality and sanitize the industry
- ✓ The regulations have cleaned the industry and brought clarity of roles
- ✓ The regulations have assisted in developing local skills and helped sanitize the market.

However, the remaining 54% indicated that the regulations are not adequate in assisting to promote the quality of the solar components in Kenya and best practice in the development of the sector. These respondents gave the following reasons:

- ♦ Need to improve on categorization of solar technicians so as to keep up with emerging technologies

- There is a need to build capacity to ensure the country has qualified technicians
- There is inconsistency with policy on importation of solar PV and actual customs importing process, due to lack of awareness of customs personnel on regulations. Need to harmonize this.
- The inconsistency in taxing of specific appliances and/or components of stand-alone solar home systems has led to confusion within private sector and increased complexity of clearing processes
- There are a lot of substandard equipment in the market thus, the effectiveness of the regulations is questionable
- Oral interviews conducted by EPRA are very shallow in terms of hands-on experience required for licensing technicians.

Further, the respondents recommended the following to improve the current solar PV regulations:

- Certify companies which have done a good job
- Promote local content in projects
- Make it easier for households and small businesses to benefit more for investing in solar PV by for example, making it easier to sell excess power to the grid
- Licensing of solar PV technicians should not only be through oral interviews but should be supported by documented work and experience.

CHAPTER SIX

CONCLUSION AND WAY FORWARD

The Energy (Solar Photovoltaic Systems) Regulations, 2012 have been in force for the last six years. The study team gathered views from a cross section of stakeholders ranging from solar PV licensees -both technicians and firms-, government and non-governmental agencies who are promoters of solar PV, and training institutions. The regulations have done well in shaping the solar PV industry. The stakeholders attest to the fact that there is more order, professionalism, and the standards and quality of the installations have improved, which has boosted customer confidence. This has led to greater acceptance of solar PV technology as an alternative source of electricity leading to more installations, and hence creating employment in this sector.

Despite the notable strides made so far in the solar PV industry, there are gaps that have been brought to the limelight, which is an indicator that these regulations have served their time and are due for review. Some of the key issues that have been identified include the classification of the technician licenses and specifically the T1 and T2 classes who are authorised to carry out installation work for systems up to 100 Wp and 300 Wp, respectively. By the time the regulations were first developed, the industry was at its infancy and the classes were adequate for the market. Today, the industry has grown with large capacity systems in the megawatt range being implemented as stand-alone, grid-tied, or hybrid systems. The market has also seen growing interest in micro/mini-grid systems and solar water pumping. There is also some notable confusion in the classification of the firms -contractors, vendors, manufacturers, and importers. As a result, most of the firms have multiple licenses to cover the full scope of their business interests.

The field of solar PV has different PV technologies that differ in terms of technological maturity. Thus, it is pertinent that the professionals in this field regularly update their skills through continuous professional development to keep abreast with new developments. The stakeholders recognise the important role played by CPD and this is the practice in some other jurisdictions.

The regulations prescribe adherence to Kenya Standards in the design, installation, repair and maintenance of solar PV systems. However, they fall short of specifying the relevant standards. This has led to non-uniformity in conformity to this requirement. In fact, some stakeholders alluded to using county government standards whereas others have no idea of any such

requirement. Thus, there is need to clarify the applicable standards. The quality of consumer devices that do not need any installation has also been found to be questionable.

There are major developments in ICT that have necessitated change in the way business is transacted. For example, the use of online systems for application and processing of licenses, and electronic payment systems are realities that did not exist when the regulations were developed. The conveniences that the ICT based systems create cannot be over emphasised.

It is clear from the fore going that there is need to amend The Energy (Solar Photovoltaic Systems) Regulations, 2012 to address the identified shortcomings Thus, we recommend as follows:

1. Re-classify the technician licenses into four and expand the scope of work as follows;
    a. Class ST1 - Design, install, commission, maintain, and repair solar PV systems with a single inverter, single charge controller, single or multiple panels not more than 400 watts.
    b. Class ST2 - The technician may design, install, commission, maintain, and repair solar PV systems with PV array of not more than 2 kW, a single inverter/charger connected to grid or a backup generator, a charge controller of up to 70 amperes and multiple batteries. The technician may also design, install, commission, maintain, and repair solar water pumping systems of a capacity not exceeding 2 kW.
    c. Class ST3 - The technician may design, install, commission, maintain, and repair solar PV systems, grid-tied not more than 50 kW or single-phase, hybrid systems not more than 10 kW or direct current coupled with a single battery inverter and the technician may connect multiple batteries. The technician may also design, install, and commission solar water pumping systems of a capacity not more than 50 kW.
    d. Class ST4 – The technician may design, install, commission, maintain, and repair grid-tied or hybrid or solar water pumping systems of any capacity.

    Demonstrating practical experience gained through working under the supervision of a licensed technician is key and therefore, the license applicants should produce evidence in terms of project completion certificates and design documentation. This is in addition to meeting the prescribed academic and professional qualifications.

2. Expand the mandate of the firms so that all contractors can import or sell solar PV components and design, install, commission, maintain, and repair solar PV system according to the following mandated scope:
    a. Class SC1 - which shall entitle the contractor to import or sell solar PV products, design, install, commission, maintain, and repair solar PV systems with a single inverter, single maximum power point tracking charge controller, single or multiple panels not more than 400 watts. The licensee shall be required to be, or to have in his employment a Class ST1 technician.
    b. Class SC2 - which shall entitle the contractor to import or sell solar PV products, design, install, commission, maintain, and repair solar PV systems with PV array of not more than 2 kW, a single inverter/charger connected to grid or a backup generator, a charge controller of up to 70 amperes, and multiple batteries. The contractor may also design, install, commission, maintain, and repair solar water pumping systems of a capacity not more than 2 kW. The licensee shall be required to be, or to have in his employment a Class ST2 technician.
    c. Class SC3 - which shall entitle the contractor to import or sell solar PV products, design, install, commission, maintain, and repair solar PV systems, grid-tied not more than 50 kW or single phase, hybrid systems not more than 10 kW or direct current coupled with a single battery inverter and the contractor may connect multiple batteries. The contractor may also design, install, commission, maintain, and repair solar water pumping systems of a capacity not more than 50 kW. The licensee shall be required to be, or to have in his employment a Class ST3 technician.
    d. Class SC4 - which shall entitle the contractor to manufacture, import or sell solar PV products, design, install, commission, maintain, and repair grid-tied or hybrid or solar water pumping systems of any capacity. The licensee shall be required to be, or to have in his employment a class ST4 technician.
    e. Class SM – Which shall entitle the licensee to import parts necessary for the manufacture of solar PV components, and to manufacture and sell solar PV components and systems.
    f. Both the technician and contractor licenses to be valid for a period of three years, to align with the three-years stipulated in the Act for electrical installation workers and contractors. However, the licensees may be given a choice to renew for one year only. The technicians need to demonstrate that they were practicing during this period and up dated their skills through continuous professional development. We recommend a

two-part credit points system; CPD and project credit points. The CPD credit points may be earned through attending or giving seminars, workshops or trainings, and publishing papers. The weighting of the project points (hands-on experience) will be earned for design or installation and commissioning or operation and maintenance work carried out by the licensee and will depend on the project size; 1 point for projects not more than 400 W, 2 points for projects ranging between 401 W and 2 kW, 2 points for projects ranging between 2.1 kW and 50 kW, and 4 points for projects larger than 50 kW. For license renewal, a licensee requires to have accumulated 30 credit points, of which a minimum of 25 points will be project credit points. To avoid a rush during the last year of the license validity, we recommend that the licensee is required to accumulate 10 credit points per year.

3. Twenty-two Kenya Standards that are relevant to solar PV components which manufacturers and importers should adhere to were identified. In addition, we recommend that manufacturers and importers of off-grid solar photovoltaic lighting kits of up to 10 W have their products registered by the Authority on meeting the requirements of KS 2542:2017 or other equivalent International Programmes for such products. Further, we identified eleven Kenya and International Standards that are relevant to installations that the technicians and contractors should adhere to in their design, installation, and maintenance of the solar PV systems.
4. Take advantage of ICT and allow online application of licenses and filing of returns. This can also be extended to electronic issuance of licenses if the Authority's ICT infrastructure allows.

The above proposals are incorporated in the amended draft regulations in Appendix A.

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APPENDICES

APPENDIX A: PROPOSED ENERGY (SOLAR PHOTOVOLTAIC SYSTEMS) REGULATIONS, 2019

The Energy Act, 2019

(No. 1 of 2019)

The Draft Energy (Solar Photovoltaic Systems) Regulations, 2019

In exercise of the powers conferred by Section 93 (2) (r) of the Energy Act, 2019, the Cabinet Secretary for Energy makes the following Regulations –

Part 1 - Preliminaries

Citation

1. These regulations may be cited as the Energy (Solar Photovoltaic Systems) Regulations, 2019.

Application

2. (1) These regulations shall apply to a solar PV system manufacturer, importer, vendor, technician, contractor, system owner, a solar PV system installation and consumer devices.

(2) Where alternating current electricity is involved, the Electric Power (Electrical Installation Work) Rules, 2006 or any other subsequent rules shall apply.

Definitions

3. In these regulations, unless the context otherwise requires: -

a) ***"advanced solar PV training"*** means a course(s) covering design, installation and commissioning of grid-tied systems, grid-tied systems with storage, off-grid PV systems, DC coupled and AC coupled, Off-grid PV-Fuel hybrid;

b) ***"Authority"*** means the Energy and Petroleum Regulatory Authority established pursuant to Section 9 of the Act;

c) ***"Act"*** means the Energy Act, 2019;

d) ***"basic solar PV training"*** means a course in design, installation and commissioning of a stand-alone DC

coupled system of not more than 400 W with a system voltage of 12 V.

e) ***"battery based system"*** means an electrical energy supply system based on a battery without an integrated charging source or the charging source on site, and may include a single DC battery up to 200 Ah;

f) ***"consumer devices"*** means off-the-shelf, readymade kits with no installation required, and may include PV lanterns, DC phone chargers, complete solar PV kits or home systems, battery chargers, fans, and solar powered consumer electronic goods of a capacity not exceeding 10 watts peak;

g) "***Continuing Professional Development***"", means the process of tracking and recording the learning, skills and experience a solar technician gains as they work beyond the initial training;

h) ***"contractor"*** means a body corporate engaged in the design, installation and commissioning of solar PV systems;

i) ***"grid-tied system"*** means a solar PV system that is connected and synchronised to an existing grid. The system feeds power into the grid reducing the load powered by the grid;

j) ***"hybrid system"*** means a solar PV system incorporating other electricity generation sources such as diesel generator or wind generator;

k) ***"intermediate solar PV training"*** means a course in design, installation and commissioning of a DC coupled PV system of not more than 2 kW with an auxiliary

grid/generator backup through an inverter-charger with a system voltage of not more than 48 V;

l) ***"Kenya Standard"*** shall have the meaning assigned to it under Standards Act, Cap 496;

m) ***"kW"*** means kilowatt;

n) ***"licensee"*** means the holder of a license issues under these regulations;

o) ***"manufacturer"*** means an entity that makes solar PV systems, components or consumer devices through a process involving converting or assembling of raw materials into finished solar PV systems, components or consumer devices;

p) ***"photovoltaic or PV"*** means the direct conversion of sunlight into electric current;

q) ***"PV array"*** means an interconnected system of PV modules that function as a single electricity-producing unit;

r) ***"revoke"*** means to withdraw and invalidate a license issued under these regulations;

s) ***"solar cell"*** means a solid-state device that converts the energy of sunlight directly into electricity by photovoltaic effect;

t) ***"solar PV module"*** means a packaged interconnected assembly of solar cells, also known as photovoltaic cells;

u) ***"solar photovoltaic system or solar PV system"*** means a system consisting of photovoltaic modules, electrical, mechanical connections and mountings, and regulating

or modifying electrical output components that generate and provide electricity;

v) ***"solar PV system installation"*** means a set up comprising of a solar PV system, modules and components fixed at a specific site for the provision of electricity service;

w) ***"solar PV technician or technician"*** means a person licensed under these regulations to undertake the design, installation and/ or commissioning of solar PV system;

x) ***"suspend"*** means to temporarily and for a defined period of time, withdraw and invalidate a license issued under these regulations;

y) ***"system design tools"*** means equipment, software, spreadsheets, charts, or matrices used in the design, installation, testing and maintenance of solar PV systems;

z) ***"warranty"*** means an assurance or guarantee given to the purchaser by a manufacturer or his agent stating that a product will perform as stated, is reliable and free from known defects and that the manufacturer shall, without charge, repair or replace defective parts within a given time limit and under certain conditions.

Part II – Licensing of Solar PV Technicians

Requirement for Licensing of Technicians

4. (1) A person shall not design, install, commission, maintain or repair a solar PV system unless he is licensed by the Authority.

(2) To be licensed by the Authority as a technician, a person shall be required to have the prescribed education qualifications and experience as set out in the Schedule 1, and appropriate certification recognized by the Authority.

Classes of Solar PV Technician Licences

5. The Authority may, on receipt of an application, grant the applicant one of the following classes of licenses and the licensee shall be entitled to undertake work within the scope indicated along license: -

(a) **Class ST1 –** Design, install, commission, maintain, and repair solar PV systems with a single inverter, single charge controller, single or multiple solar PV modules not more than 400 watts.

(b) **Class ST2 -** The technician may design, install, commission, maintain, and repair:

i. solar PV systems with PV array of not more than 2 kW, a single inverter/charger connected to grid or a backup generator, a charge controller of up to 70 amperes and multiple batteries.

ii. The technician may also design, install, commission, maintain, and repair solar water pumping systems of a capacity not more than 2 kW.

(c) **Class ST3** - The technician may design, install, commission, maintain, and repair:

i. grid-tied solar PV systems of a capacity not more than 50 kW;

ii. single phase Hybrid systems not more than 10 kW direct current coupled with a single battery

inverter and the technician may connect multiple batteries, and;

iii. solar water pumping systems of a capacity not more than 50 kW.

(d) **Class ST4** – The technician may design, install, commission, maintain, and repair grid-tied or hybrid or solar water pumping systems of any capacity.

Authority may Examine Technicians

6. The Authority may cause an applicant for a technician's license, including applicant's for upgrading of technician's licenses, to be examined in such manner as it may determine and upon any matter or thing in connection with the application for the purpose of ascertaining the applicant's qualification and suitability for grant of the class of license to which the application relates.

Part III – Licensing of Contractors and Manufacturers

Requirement of Licensing of Contractors and Manufacturers

7. (1) A person shall not engage in the importation, manufacture, sale or installation of solar PV systems or solar PV system components without a valid license issued by the Authority.

(2) The Authority shall, from time to time, publish a notice setting out the types of solar PV components and solar PV systems to which this regulation applies.

Classes of Contractor and Manufacturer Licenses

8. (1) The Authority may, on receipt of an application, grant the applicant one of the following classes of licenses and the licensee shall be entitled to undertake work within the scope indicated along license: -

(a) **Class SC1 -** which shall entitle the contractor to: -

i. import and sell solar PV components provided that the solar PV module rating shall not exceed 400 watts peak and inverters shall not exceed a capacity of 400 watts.

ii. design, install, commission, maintain, and repair solar PV systems with a single inverter charge controller, single or multiple solar PV modules not more than 400 watts.

The licensee shall be required to be, or to have in his employment a Class ST1 technician.

(b) **Class SC2 -** which shall entitle the contractor to: -

i. import and sell solar PV and solar water pumping components provided that the inverters sold or offered for sale shall not exceed a capacity of 2 kW

ii. design, install, commission, maintain, and repair solar PV systems with PV array of not more than 2 kW, a single inverter/charger connected to grid or a backup generator, a charge controller of up to 70 amperes and multiple batteries.

iii. design, install, commission, maintain, and repair solar water pumping systems of a capacity not more than 2 kW.

The licensee shall be required to be, or to have in his employment a Class ST2 technician.

(c) **Class SC3** - which shall entitle the contractor to: -

i. import and sell solar PV systems and components and solar water pumping systems provided that the inverters sold or offered for sale shall not exceed a capacity of 50 kW.

ii. design, install, commission, maintain, and repair grid-tied solar PV systems of not more than 50 kW or single phase, hybrid systems not more than 10 kW or direct current coupled with a single battery inverter and the contractor may connect multiple batteries.

iii. design, install, commission, maintain, and repair solar water pumping systems of a capacity not more than 50 kW.

The licensee shall be required to have in his employment a Class ST3 technician.

(d) **Class SC4** - which shall entitle the contractor to: -

i. import and sell solar PV systems and components and solar water pumping systems.

ii. design, install, commission, maintain, and repair grid-tied or hybrid or solar water pumping systems of any capacity.

The licensee shall be required to have in his employment a Class ST4 technician.

(e) **Class SM** – Which shall entitle the licensee to import parts necessary for the manufacture of solar PV components, and to manufacture and sell solar PV components and systems.

An applicant for this license shall not be required to have in his employment, a licensed solar PV technician.

(2) Applicants for contractor licenses shall, together with their applications for licenses, submit their system design tools for approval by the Authority.

Contractors to maintain

9. Applicants for contractor licenses shall maintain professional indemnity cover of a minimum value specified in Schedule 5.

Professional Indemnity Cover

Part IV - General Provisions Regarding Licenses

Application for Licenses

10. (1) Applications for grant of the various classes of technician, contractor, or manufacturer licenses shall be made electronically or in any other manner that the Authority may, from time to time, prescribe and shall be accompanied by the information and documentation specified in Schedule 2 and proof of payment of the application fees specified in Schedule 3.

(2) The Authority shall process all applications and communicate the outcome to the applicants in writing expeditiously and in any event no later than: -

i. sixty days from the date of receipt of the application in the case of applications for new technician's licenses or upgrades of existing technician licences.
ii. Thirty days from the date of receipt of the application in the case of applications for new contractor and manufacturer licenses or upgrades of existing contractor licenses
iii. Thirty days from the date of receipt of the application for applications for renewal of both technician and contractor licenses.

(3) Successful applicants shall, upon payment of the license fees specified in Schedule 3, be issued with a license document in a form that the Authority may, from time to time, prescribe.

Validity of Licenses

11. (1) Licenses issued under these regulations shall be valid for a period of three (3) years from the date of issue unless the applicant applies for a licence valid for a one (1) year period.

(2) The application and renewal fees for one (1) year validity shall be a third of the application or renewal fees specified in Schedule 3.

Renewal of Licenses

12. (1) An application for renewal of a license shall be made thirty days prior to the date of expiry of the license.

(2) A licensed technician who wishes to renew their license shall demonstrate to the Authority accumulation of at least thirty credit points through Continuous Professional Development as outlined in Schedule 4.

(3) A licensee who makes an application for renewal of a license after its date of expiry shall be liable to the penalty set forth in regulation 27.

(4) Any license issued and is not renewed for six months after its date of expiry shall, unless the license holder has before expiry of the license informed the Authority in writing of the intention and reasons not to renew the license, not be eligible for renewal and will require the licensee to apply for the license anew.

Upgrading of Licenses

13. (1) A licensee who wishes to upgrade from one license class to another shall make an application to the authority for such an upgrade at least one (1) year after issuance of the current licence.

(2) The Authority shall approve the upgrading of a technician's license if the technician has met the required

academic and professional qualifications, and practical hands-on experience as outlined in Schedule 4.

(3) The Authority shall approve upgrading of a contractor license where the contractor demonstrates that he has in his employment a licensed solar PV technician appropriate to the class of license for which the upgrade is sought.

(4) The upgrading of a license shall be subject to the licensee paying the license fee for the class of licence to which the upgrade is sought.

Replacement of Lost or Defaced Licenses

14. Where a licensee demonstrates to the Authority that a license issued under these regulations has been defaced, destroyed or lost, the Authority may, on payment of the fees prescribed in Schedule 3 issue a duplicate license.

Suspension or Revocation of Licenses

15. (1) The Authority may suspend or revoke any license issued under these regulations where it is satisfied that a licensee has breached the provisions of these regulations or any conditions attached to the license.

(2) The Authority shall, prior to suspending or revoking a license under this regulation, by notice in writing afford the licensee an opportunity to show cause why the license should not be suspended or revoked.

(3) A notice to show cause issued hereunder shall contain sufficient information to enable the licensee discern the specific incidences of non-compliance in issue.

(4) A licensee shall be entitled to appear before the Authority with or without representation to show cause why his license should not be revoked.

Part V – Importation and Manufacture of Solar PV Systems, Components and Consumer Devices.

Products to conform to the Kenya Standard

16. (1) A manufacturer or importer of solar PV systems, components, and consumer devices shall ensure that the products conform to the relevant Kenya Standard set out in Schedule 6 or any other subsequent or replacement standards.

(2) A manufacturer or importer of solar PV systems shall not offer for sale solar PV products, components, and consumer devices without the appropriate safety and health warning labels being affixed.

Solar Lighting Kits to be Registered with the Authority

17. (1) Manufacturers or importers of off-grid solar photovoltaic lighting kits of up to 10 watts shall have their products registered by the Authority on meeting the requirements of KS 2542:2017 or subsequent revisions or other equivalent International Programmes for such products. The Authority shall publish other equivalent programmes for lighting products from time to time.

(2) The Authority shall maintain and publish on its website a register of all approved solar lighting kits.

Products to carry Warranties

18. A manufacturer, vendor, technician, or contractor shall provide a warranty to the customer for the components in the solar PV system and the PV Installation for the periods set out in Schedule 7.

Part VI - Design, Installation and Maintenance of Solar PV Systems

Requirement of System Design Declaration

19. (1) A licensed technician or contractor shall design a solar PV system to meet the requirements outlined in IEC/TS 62548 2013 or any subsequent or replacement standard.

(2) A licensed technician or contractor shall prepare a system design declaration indicating: -

a) An analysis of the user's electrical energy needs;

b) The specifications of the proposed solar PV solution including the brands of the components, their country of origin, capacity and number of solar modules to be installed.

c) The full price of the installation including potential costs likely to be incurred during the installation.

d) Layout of the area where the proposed installation is to be done.

e) The duration of the proposed installation.

f) Any work that is required to be done by the user to prepare the site for the installation.

(2) Where a consumer purchases any individual solar system component, the technician or contractor shall indicate that fact in the system design declaration.

(3) A system design declaration must be signed by both the technician or contractor and the consumer prior to the commencement of the installation work and a counterpart thereof given to the consumer.

Installation Work

20. (1) A contractor or technician shall ensure that any solar PV installation work is carried out and complies with the

relevant Kenya Standard and all other relevant technical, legal and regulatory requirements applicable in Kenya.

(2) Where installation work requires structural building work, the technician or contractor shall ensure that: -

a) the structural building work is undertaken by a qualified and duly registered professional.

b) any county government or national government permits and approvals required for the installation are obtained by the consumer prior to the installation work.

(3) Upon conclusion of the installation, the technician or contractor shall train the user on the safe use, maintenance, and disposal of the solar PV system.

Certificates, Warranty and Documentation

21. (1) A technician or contractor shall upon completion of installation work issue the consumer with the following documentation: -

a) A completion certificate including a declaration that the consumer has been trained on the safe use and maintenance of the solar PV system;

b) A warranty for the installation workmanship;

c) The "as built" system design;

d) The name of the manufacturer or vendor from whom the solar PV system or components were purchased;

e) Warranties on the solar PV system or components issued by the manufacturer or vendor;

f) User manuals with respect to the system;

g) Instructions for the safe disposal of the system and system components in accordance with the Environment Management and Co-ordination Act, 1999 and any regulations, rules or guidelines issued thereunder with respect to the disposal of electronic waste.

(2) The technician or contractor shall ensure that a warranty issued under this part is valid for the minimum periods set out in Schedule 7 and covers: -

a) The quality and workmanship of the installation.

b) Compliance of the installation with the system design declaration.

c) The quality and appropriateness of generic system components such as wires, switches and sockets.

Part VII - Register of Licensed Practitioners and Provision of Data

Authority to Maintain Register of Licensees

22. The Authority shall maintain and publish on its website a register of all licensed solar PV systems technicians and contractors.

Provision of Data

23. (1) All licensees under these regulations shall continuously provide the Authority with information on the solar PV systems installed in watts, and value of solar PV systems and components manufactured, sold and installed during the three-year license period.

(2) All technicians and contractors shall provide the Authority with information on the installed project capacity and location on commissioning of the installation.

(3) The Authority shall, from time to time, prescribe and publish the format and time durations in which the data required under this part shall be provided.

(4) All technicians and contractors shall maintain the records required under this part for a period of five years

Part VIII – Powers of Inspection and Penalties for Contravention

Powers of Inspection

24. The Authority or its agent may carry out inspection, in relation to the compliance with these Regulations, in accordance with section 11 of the Act.

Compliance Orders

25. (1) Where the Authority finds that any provisions of these Regulations have been contravened by a technician or contractor, or that a condition has arisen which may lead to the contravention of these Regulations, the Authority may issue a compliance order compelling the person to comply with the regulations.

(2) An order issued under regulation 25 shall state: -

a) the specific provisions which have been or are likely to be contravened;

b) the measures which should be taken to rectify the contravention; and

c) the period within which the order shall be complied with.

Part IX – Offences and Penalties

Practising without a License

26. (1) A person who, without a license issued by the Authority: -

a) undertakes the importation, manufacture, sale, design, installation, commissioning, maintenance, or repair of solar PV system

b) Undertakes importation, manufacture or sale of consumer devices

commits an offence and shall, upon conviction be liable to a maximum fine of one million Kenya shillings.

(2) Where a person is charged with offences under this regulation, he may request the Authority to compound the offence and prescribe a fine to be paid and upon payment of such fine, the Authority shall withdraw any criminal complaint against the person.

(3) Where the Authority compounds an offence and the person charged with committing the offence pays the prescribed penalty, the Authority shall withdraw the criminal complaint against the person.

Other Offences and Fines

27. (1) A licensee who is found to be guilty of any of the offences listed below shall be liable to the fine or penalty indicated beside the offence.

Offence	**Fine/ Penalty**
a) Late renewal of a license	Kshs. 100 for every day the license is not renewed
b) Practicing with an expired license	Kshs. 10,000 for every day the violation occurs.
c) Undertaking works in excess of the scope provided under the issued license	Kshs. 10,000 per incident.

d) Offering for sale solar PV systems, components and consumer devices that do not meet the relevant Kenya Standard	Kshs. 5,000 for every component that does not meet the Kenya Standard.
e) Failing to provide a consumer with a system design declaration prior to commencing installation works	Kshs. 20,000 per incident.
f) Failing to provide a consumer with a completion certificate with respect to an installed solar PV system	Kshs. 20,000 per incident.
g) Failing to provide the consumer with warranty covering the matters specified in regulation 19.	Kshs. 20,000 per incident.
h) Failing to submit data to the Authority in the manner specified in regulation 21.	Kshs. 5,000
i) Providing inaccurate or incomplete data to the Authority	Kshs. 5,000
j) Preventing an officer or duly notified agent of the Authority during working hours, from entering into and inspecting any premises where a licensed	Kshs. 20,000 for every day that the incident persists.

activity taking place or
suspected to be taking place.

(2) The fines or penalties in 27 (1) above are without prejudice to the Authority's right to suspend or revoke the licensee's license.

(3) Where a licensee has previously been penalised for an offence and commits another such offence, the fine payable shall be two times the amount provided for such an offence.

(4) Where installation had taken place in violation of these regulations, the responsible licensee shall decommission the installation at their own cost and where the licensee fails to do so, the Authority may cause the system to be decommissioned at the cost of such licensee.

(5) Payment of penalties or fines hereunder shall not absolve or indemnify a licensee from any obligations to compensate a consumer.

(6) Any fines or penalties which are not paid shall be a civil debt recoverable summarily.

Part X - Complains, Disputes and Appeals

Complaints and Disputes to be Referred to the Authority

28. Any complaints and/or disputes between a consumer and a licensee or between two or more licensees shall be referred to the Authority for resolution in accordance with the Energy (Complaints and Disputes Resolution) Regulations 2012 or any replacement of the same.

Appeals

29. A licensee or consumer who is dissatisfied or aggrieved by a decision of the Authority shall lodge an appeal with the Energy and Petroleum Tribunal.

Part X1 – Transition and Repeal

Transitional Provisions	30. The transition provisions set out in the Schedule 8 shall apply.
Repeal L.N. No.103 of 2012	31. The Energy (Solar Photovoltaic Systems) Regulations, 2012 are repealed.

SCHEDULES

Schedule 1 – Qualifications and Experience for Licensing

1. To be licensed as a Solar PV Technician, an applicant must have a minimum of any one of the following combinations of academic and professional qualifications, and job experience.

Class	Minimum Academic and Professional Qualifications	Minimum Experience
ST1	KCPE, Electrical Government Trade Test 2 and Basic Solar PV Training from an accredited institution	Completion reports of at least three (3) solar PV systems each not less than 100 watts that the applicant has been involved directly.
ST2	KCSE, Certificate in Electrical and Electronics and Intermediate Solar PV Training from an accredited institution; or Bachelor of Science or Higher National Diploma or Diploma in Electrical and Electronics Engineering and Intermediate Solar PV Training from an accredited institution; or	(1) Completion certificates of at least three (3) solar PV systems each not less than 1 kW that the applicant has been involved directly. (2) Design documentation of at least three (3) installed systems each of at least 1 kW that the applicant has been involved directly.

Class	Minimum Academic and Professional Qualifications	Minimum Experience
	Bachelor of Science degree with at least three (3) units/courses specific to electrical engineering and Intermediate Solar PV Training from an accredited institution	
ST3	Bachelor of Science or Higher National Diploma or Diploma in Electrical and Electronics Engineering and Advanced Solar PV Training from an accredited institution; or	(1) Completion certificates of at least three (3) grid-tied systems each 15 kW and one (1) hybrid system not less than 3 kW that the applicant has been involved directly. (2) Design documentation of at least five (5) systems each not less than 3 kW that the applicant has been involved directly.
	Bachelor of Science degree with at least three (3) units/courses specific to electrical engineering and Advanced Solar PV Training from an accredited institution	
ST4	Holder of class ST3 license and Bachelor of Science degree in Electrical and Electronics Engineering	(1) Completion certificates of at least three (3) systems each not less than 50 kW that the applicant has been involved directly. (2) Design documentation of at least five (5) systems each of not less than 50 kW that the applicant has been involved directly.

ST4 license holders shall be required to demonstrate skills in financial analysis of energy projects.

Schedule 2 – Information and Documentation to Accompany Applications for Licenses

A. **Technician License**

1. Solar PV training certificate from an accredited institution.
2. Complete an application form documenting all requirements
3. Completion certificates detailing the following
   a) System location
   b) Date system completed
   c) System information (PV array size, number of inverters and total cumulative inverter capacity)
   d) Name and phone number of installation contractor
   e) Name and phone number of Applicant's supervisor
   f) Description of work performed by the Applicant
4. Design documentation signed and stamped by the company they worked for.
5. Non-Electrical/ Electronic certificate holders should provide proof to have undertaken adequate training in electrical engineering.
6. Pass examination administered by the Authority.

B. **Contractor License**

New Application

1. Completed online application;
2. Scan of original copy of certificate of incorporation or business registration certificate;
3. Scan of original copy of CR 12 from registrar of companies or CR 13 from the Business Registration Service, that is not older than 12 calendar months from the date of issue;
4. Scan of original copies of identification documents (National IDs or Passports) for all the company's directors;
5. Scan of original copy of a valid Work Permit Class "G" for foreign directors working in Kenya or notarized declaration of non-residence for foreign directors not residing in Kenya;
6. Scan of original copy of a valid Single Business Permit from the County Government;
7. Scan of original copy of PIN Certificate;
8. Scan of original copy of a valid tax compliance certificate;
9. Proof of Occupancy of the Company Office;

10. Signed consent letter between the contractor and solar PV technician attested by Commissioner for Oaths clearly indicating the engagement period that shall not be less than one (1) year;
11. Commissioning Instruments that shall be prescribed by the Authority from time to time;
12. Professional Indemnity Cover where applicable, upon successfully completing the process.

Renewal

1. Completed online application;
2. Scan of original copy of CR 12 from registrar of companies or CR 13 from the Business Registration Service, that is not older than 12 calendar months from the date of issue;
3. Scan of original copies of identification documents (National IDs or Passports) for all the company's directors;
4. Scan of original copy of a valid Work Permit Class "G" for foreign directors working in Kenya or notarized declaration of non-residence for foreign directors not residing in Kenya;
5. Scan of original copy of a valid Single Business Permit from the County Government;
6. Scan of original copy of PIN Certificate;
7. Scan of original copy of a valid tax compliance certificate;
8. Proof of Occupancy of the Company Office;
9. Signed consent letter between the contractor and solar PV technician attested by Commissioner for Oaths clearly indicating the engagement period that shall not be less than one (1) year;
10. Proof of professional Indemnity Cover.

Schedule 3 – License Fees

1. To be licensed as a solar PV system technician, the following fees shall apply:

Class of license	Application Fees (Kshs)	License Fees (Kshs)	Renewal Fees (Kshs)	Replacement Fees (Kshs)
ST1	250	1,000	2,250	500
ST2	500	2,000	3,000	500

ST3	750	3,000	4,500	500
ST4	1,500	4,000	6,000	500

2. To be licensed as a solar PV system contractor, the following fees shall apply:

Class of license	**Application Fees (Kshs)**	**License Fees (Kshs)**	**Renewal Fees (Kshs)**	**Replacement Fees (Kshs)**
SC1	1,000	2,000	3,000	1,000
SC2	2,000	3,000	4,500	1,000
SC3	3,000	5,000	6,000	1,000
SC4	4,000	7,500	9,000	1,000
SM	3,000	5,000	6,000	1,000

Schedule 4 – Continuous Professional Development

A. Licence renewal

The licensee shall accumulate a minimum of 10 credit points per year and thus, 30 points at the expiry of the license as follows:

1. Attending relevant trainings or seminars or workshops; 0.2 credit points per contact hour
2. Giving relevant seminar or training or workshop as a resource person; 0.5 credit points per contact hour
3. Presenting a paper on a relevant topic at a conference or publishing a paper in a journal; each paper 2 credit points
4. Project credit points earned through experience gained from design, installation and commissioning, operation and maintenance of solar PV projects according to the class of license as follows:

License Class	***Project credit points earned for Design or Installation or Commissioning or Maintenance or Repair***	***Project size***
ST1	1	Maximum 400 W

ST2	2	401 W - 2 kW
ST3	3	2.1 - 50 kW
ST4	4	Above 50 kW

The project credit points shall account for a minimum of 25 points.

B. Licence upgrade

For a licensee to upgrade a license:

1. S/he shall have met the minimum academic and professional qualifications for the license class s/he wishes to upgrade to as outlined in Schedule 1.
2. S/he shall have worked under the supervision of a licensed technician in the higher category s/he wishes to upgrade to and earned project credit points as follows:

License Upgrade		***Required project credit points***	***Project credit points earned for Design or Installation or Commissioning or Maintenance or Repair of each project under supervision***	***Project size***
From	**To**			
ST1	ST2	18	2	401 W - 2 kW
ST2	ST3	27	3	2.1 - 50 kW
ST3	ST4	36	4	Above 50 kW

Schedule 5 – Prescribed Professional Indemnity Cover for Contractors

Every licensed Contractor shall take out and maintain a professional indemnity insurance policy as follows:

License Class	**Minimum Professional indemnity cover (Kshs)**
SC2	1,000,000.00

SC3	5,000,000.00
ST4	10,000,000.00

Schedule 6 – Kenyan and International Standards relevant to Solar PV Systems

Component Standards
1. KS IEC/TS 61836: 2016 Solar photovoltaic energy systems - Terms, definitions and symbols 2. KS IEC 61215:2005 Crystalline silicon terrestrial photovoltaic (PV) modules- Design qualification and type approval 3. KS IEC 62108: 2007 Concentrator Photovoltaic (CPV) Modules and assemblies- Design Qualification and Type approval 4. KS IEC 61646: 2008 Thin-film terrestrial photovoltaic (PV) modules- Design qualification and type approval 5. KS IEC 61730-1: 2004 Photovoltaic (PV) Module Safety Qualification- Part 1: Requirements for construction 6. KS IEC 61730-2: 2004 Photovoltaic (PV) Module Safety Qualification- Part 2: Requirements for testing 7. KS IEC 61853: 2011 Photovoltaic (PV) module performance testing and energy rating Part 1: Irradiance and temperature performance measurements and power rating 8. KS IEC 60891: 2009 Photovoltaic devices – Procedures for temperature and irradiance corrections to measured I-V characteristics 9. KS IEC 60904-1-1:2017: Photovoltaic devices Part 1-1: Measurement of current-voltage characteristics of multi-junction photovoltaic (PV) devices 10. KS IEC 62894: 2014 Photovoltaic inverters- Data sheet and name plate 11. KS IEC 62109-1:2010 Safety of power converters for use in photovoltaic power systems Part 1: General requirements 12. KS IEC 62109-2:2011 Safety of power converters for use in photovoltaic power systems Part 2: Particular requirements for inverters 13. KS IEC 61427-1:2013 Secondary cells and batteries for renewable energy storage - General requirements and methods of test - Part 1: Photovoltaic off-grid application

14. KS IEC 61427-2:2015 Secondary cells and batteries for Renewable Energy Storage - General Requirements and methods of test - Part 2: On-grid applications
15. KS IEC TS 62257-8-1:2007 Recommendations for small renewable energy and hybrid systems for rural electrification - Part 8-1: Selection of batteries and battery management systems for stand-alone electrification systems - Specific case of automotive flooded lead-acid batteries available in developing countries
16. KS IEC 62116: 2008 Test procedure of islanding prevention measures for utilities-interconnected photovoltaic inverters
17. KS IEC 61683:1999 Photovoltaic systems - Power conditioners - Procedure for measuring efficiency
18. KS 1709-1:2009 Batteries for use in photovoltaic power systems - Specification Part 1: General requirements
19. KS 1709-2:2009 Batteries for use in photovoltaic power systems - Specification Part 2: Modified lead-acid batteries
20. KS 1709-4:2009 Batteries for use in photovoltaic power systems - Specification Part 4: Recommended practice for sizing lead-acid batteries for photovoltaic (PV) systems
21. KS IEC 62509:2010 Battery charge controllers for photovoltaic systems - Performance and functioning
22. KS 2542:2017: Off-grid solar photovoltaic lighting kits - Requirements

Installation Standards

1. KS IEC 61724-1:2017: Photovoltaic system performance – Monitoring
2. KS IEC/TS 61724-2:2016: Photovoltaic system performance Part 2: Capacity evaluation method
3. KS IEC/TS 61724-3:2016: Photovoltaic system performance Part 3: Energy evaluation method
4. KS IEC 62124:2004: Photovoltaic (PV) stand-alone systems – Design verification
5. KS IEC 62093:2005: Balance-of-system components for photovoltaic systems - Design qualification natural environment

6. KS IEC 62446:2009 Grid connected photovoltaic systems - Minimum requirements for system documentation, commissioning tests and inspection
7. KS IEC 61727:2004: Photovoltaic (PV) systems – Characteristics of the utility interface
8. KS 1673-1:2004: Solar photovoltaic power systems – Design, installation, operation, monitoring and maintenance — Code of practice Part 1: General PV system requirements
9. KS 1673-2-5:2003: Generic specification for solar photovoltaic systems — System design, installation, operation, monitoring and maintenance Part 2: Test procedures for main components Section 5: Test procedures for luminaires
10. KS IEC 62253:2011 Photovoltaic pumping systems-Design qualification and performance measurement
11. IEC/TS 62548 2013: Photovoltaic (PV) arrays – Design requirements

Schedule 7 – Minimum Warranty on Solar PV Systems and Components

Component	**Warranty period**
Controller/regulator	**5 years**
Inverter	**5 years**
Battery – lead acid	**2 years**
Battery – lithium ion	**5 years**
Panels	**10 years**
Workmanship	**1 year**

Schedule 8 – Transitional Clauses

a) All solar photovoltaic technicians, contractors, vendors, importers and manufacturers licences issued by the Authority under the Energy (Solar Photovoltaic Systems) Regulations, 2012 shall become invalid one (1) year after these regulations come into force.

b) Holders of the existing licences shall be transitioned to the new classes under the following conditions:

Old Licence Class	New Licence Class	Requirements
T1	ST1	(1) Provide a list of all solar PV projects undertaken in Kenya, in a format specified by the Authority (2) Payment of the new licence renewal fees.
T2	ST2	(1) Provide a list of all solar PV projects undertaken in Kenya, in a format specified by the Authority (2) Payment of the new licence renewal fees.
T3	ST3 or ST2	(1) Provide a list of all solar PV projects undertaken in Kenya, in a format specified by the Authority. The projects must include at least three (3) grid-tied system of capacity not less than 15 kWp and one (1) hybrid PV system of capacity not less than 3 kWp that the applicant has been involved directly, else the applicant shall be transitioned to ST2 (2) Payment of the new licence renewal fees.
T3	ST4	(1) Bachelor of Science degree in Electrical and Electronics Engineering (2) Provide a list of all solar PV projects undertaken in Kenya, in a format specified by the Authority. The projects must include at least three (3) systems each not less than 50 kW that the applicant has been involved directly. (3) Payment of the new licence renewal fees.
V1, V2 or C1	SC1, SC2, SC3 or SC4	(1) Payment of the new licence renewal fees (2) Provide valid licence renewal documents

		(3) Provide a list of all solar PV projects undertaken in Kenya, in a format specified by the Authority
V2	SM	Payment of the new licence renewal fees

c) The Authority may verify the details of projects provided before transitioning the applicant to a new license class.
d) The fines in regulation 27 (1) shall apply for any falsified records.
e) The application for transition shall be processed within sixty days (60) from the date of application during which time the existing licence shall remain valid.

Schedule 9 – Application Forms

Form EPRA 001

APPLICATION FOR A SOLAR PV SYSTEM TECHNICIAN LICENCE

The Director General

Energy and Petroleum Regulatory Authority

P.O. Box 42681- 00100, GPO

NAIROBI

I, …….. hereby apply to be licensed as a Solar PV System technician in accordance with the Energy (Solar Photovoltaic Systems) Regulations, 2019 for the following class* of license-

(a) Class ST1 – Design, install, commission, maintain, and repair solar PV systems with a single inverter, single charge controller, single or multiple modules not more than 400 watts.

(b) **Class ST2 -** The technician may design, install, commission, maintain, and repair:

i. solar PV systems with PV array of not more than 2 kW, a single inverter/charger connected to grid or a backup generator, a charge controller of up to 70 amperes and multiple batteries.

ii. design, install, commission, maintain, and repair solar water pumping systems of a capacity not more than 2 kW.

(c) **Class ST3** - The technician may design, install, commission, maintain, and repair:

i. grid-tied solar PV systems of a capacity not more than 50 kW;

ii. single phase, hybrid systems not more than 10 kW direct current coupled with a single battery inverter and the technician may connect multiple batteries, and;

iii. solar water pumping systems of a capacity not more than 50 kW.

**(Delete classes that do not apply)*

I commit to carry out all solar PV system sales and installation works in accordance with the Energy (Solar Photovoltaic Systems) Regulations, 2019 and any Regulations and by-laws for the time being in force thereunder.

Purpose of Application: New Application❑ Renewal ❑ (Please tick (✓) as appropriate)

1. Name of applicant ……
(Block capitals, surname first)
2. Income Tax Personal Identification Number: ……
3. Postal Address……
4. Email Address: ……
5. Telephone number(s): ……
6. Date of Birth: ……
7. Nationality: ……
8. Name and address of present employer, if any ……
……
……
9. Name of present job……
10. Academic qualification: ……
    a) ……
    b) ……

11. Professional Qualification (Government Trade Test Certificate etc.):

    a) ……

    b) ……

    c) ……

    (Insert additional lines as appropriate)

12. Work experience (including apprenticeship (if any):

    a) ……

    b) ……

    c) ……

    (Insert additional lines as appropriate)

13. Do you have any knowledge of Occupational Safety and Health Regulations: Yes ❑ No ❑

14. Have you applied for a license in the past? Yes ❑ No ❑ If yes,

    i. License No ……

    ii. Issued on ……

    iii. Issued by ……

15. Has any previous application for a licence been rejected under these regulations? Yes ❑ No ❑ (If Yes, give details)

    ……

    ……

    ……

16. Has any previous licence been cancelled under these regulations? Yes ❑ No ❑ (If Yes, give details)

    ……

    ……

    ……

I declare that the particulars given by me are true and accurate. I understand that it is an offence to give false information in an application for a licence.

Date: …… Signature of Applicant: ……

REFEREES

(The following details to be completed by two independent referees who must have known the applicant's ability very well, preferably in the trade)

1st Referee

I declare that the particulars given by the applicant in this form are true and correct to the best of my knowledge.

Full Name: ……..

(Block letters, surname first)

Occupation: ……..

Postal address: ……..

……

Email Address: .....

Telephone number(s): .....

Solar PV system licence No. (If any) ……..

I have known the above person for …….. years.

Position held at present……

Date……Signature of 1st referee……

2nd referee

I declare that the particulars given by the applicant in this form are true and correct to the best of my knowledge.

Full Name: ……..

(Block letters, surname first)

Occupation: ……..

Postal address: ……..

……

Email Address: ……

Telephone number(s): ……

Solar PV system licence No. (If any) ……..

I have known the above person for …….. years.

Position held at present……

Date…….. Signature of 2nd referee……

Form EPRA 002

APPLICATION FOR A SOLAR PV SYSTEM CONTRACTOR/ MANUFACTURER LICENCE

(A separate application form must be completed in respect of each separate business establishment)

The Director General

Energy and Petroleum Regulatory Authority

P.O. Box 42681, 00100 GPO

NAIROBI

I/We …….. hereby apply to be licensed as a solar PV system contractor / vendor (delete as appropriate) in accordance with the Energy (Solar Photovoltaic) Regulations, 2019 for the following class* of licence-

a) **Class SC1 -** which shall entitle the contractor to: -

iii. import and sell solar PV components provided that the maximum solar module size shall be 400 watts peak and inverters shall not exceed a capacity of 400 watts.

iv. design, install, commission, maintain and repair solar PV systems with a single inverter charge controller, single or multiple solar modules of a capacity not exceeding 400 watts.

The licensee shall be required to be, or to have in his employment a Class ST1 technician.

b) **Class SC2 -** which shall entitle the contractor to: -

i. import and sell solar PV and solar water pumping components provided that the inverters sold or offered for sale shall not exceed a capacity of 2kW watts

ii. design, install, commission repair and maintain solar PV systems with PV array of not more than 2 kW, a single inverter/charger connected to grid or a backup generator, a charge controller of up to 70 amperes and multiple batteries.

iii. design, install, commission, repair and maintain solar water pumping systems of a capacity not more than 2 kW.

The licensee shall be required to be, or to have in his employment a Class ST2 technician.

c) **Class SC3** - which shall entitle the contractor to: -

iii. import and sell solar PV systems and components and solar water pumping systems provided that the inverters sold or offered for sale shall not exceed a capacity of 50kW.

iv. design, install, commission repair and maintain grid-tied solar PV systems of not more than 50 kW or single phase, hybrid systems not more than 10 kW or direct current coupled with a single battery inverter and the contractor may connect multiple batteries.

v. design, install, commission repair and maintain solar water pumping systems of a capacity not more than 50 kW.

d) **Class SC4** - which shall entitle the contractor to manufacture or import or sell solar PV products, design, install, and commission grid-tied or hybrid or solar water pumping systems of any capacity. The licensee shall be required to be, or to have in his employment a class ST4 technician. *

**(Delete classes that do not apply)*

I/ We commit to carry out all design distribution, promotion, sale and installation work for solar PV system undertaken by me/ ourselves in accordance with the Energy (Solar Photovoltaic) Regulations, 2019and any rules and by-laws for the time being in force thereunder.

Purpose of Application: New Application❑ Renewal ❑ (Please tick (✓) as appropriate)

1. Name of applicant

   ……

   ……

2. Details of applicant:

   a) Income Tax Personal Identification Number: ……

   b) Postal Address: ……

   c) Email Address: ……

   d) Telephone number(s): ……

   e) LR/ Plot No……Building Name……

   f) Street/: ……

   g) Town/County: ……

3. Location of business premise(s)

   a) ……

   b) ……

   c)……

(Insert additional lines as appropriate)

4. Give full details of proprietors or partners owning business or directors/shareholders of the company, as applicable.

Name	Nationality
.....	.....
.....	.....
.....	.....

(Insert additional lines as appropriate)

5. State if you are or any of your partners/directors is an un-discharged bankrupt. (If so, indicate the names).

   a) .....

   b) .....

   c).....

(Insert additional lines as appropriate)

6. For new applications, certified copies of the following documents should be submitted with the application for a licence:

   a) If Kenyan, a copy of ID card, or if non-Kenyan, a copy of current work permit together with copies of pages 1and 5 of the passport;

   b) Relevant entry permits(s) for non-citizens;

   c) Copy of Business name Registration Certificate or Certificate of Incorporation and Memorandum and Articles of Association in case of a company (whichever is applicable).

   d) Lease agreement or letter from landlord confirming tenancy.

   e) PIN and VAT certificates.

   f) Valid Tax compliance certificate

   g) Any other document that may be required by the Commission from time to time

7. For renewal of a licence, only a photocopy of the current licence should be submitted

8. Name and address of bank(s) or financial institution(s) where the business account(s) is/are maintained

   a) .....

   b) .....

   c) .....

(Insert additional lines as appropriate)

9. List of licensed Solar PV system technician(s)

Full name	Licence No.
……	……..
……	……..
……	……..

(Insert additional lines as appropriate)

10. Previous solar PV system work experience

……

……

……

(Insert additional lines as appropriate)

11. Have you applied for a license in the past? Yes ❑ No ❑ If yes,

i. Licence No……..

ii. Issued on……..

iii. Issued by……..

12. Has any previous application for a licence been rejected under these regulations? Yes ❑ No ❑ (If Yes, give details)

……

……

……

13. Has any previous licence been cancelled under these regulations? Yes ❑ No ❑ (If Yes, give details)

DECLARATION

I/We hereby, declare that the information I/we have provided in the application is true and accurate. I/We understand that it is an offence to give false information in an application for a licence.

Signature of Applicant ……Date ……..

Signature of Applicant ……Date ……..

Signature of Applicant ……Date ……..

REFEREES

(The following details to be completed by two different and independent referees, who would vouch your competence to operate as a contractor / vendor (delete as appropriate) if licensed, your technical ability having already been established. Persons who may not understand what is involved in running a business cannot be accepted as referees).

1st Referee

I certify that the information given in this form is true and correct to the best of my knowledge

Full name……..

(Block letters, surname first)

Occupation……..

Postal address……..

Email Address: ……

Telephone number(s): ……

Date…….. Signature of 1st referee……

2nd Referee

I certify that the information given in this form is true and correct to the best of my knowledge

Full name: ……..

(Block letters, surname first)

Occupation: ……..

Postal address: ……

Email Address: .....

Telephone number(s): .....

Date: …….. Signature of 2nd referee ……

APPENDIX B: INFORMATION GATHERING TOOLS

ENERGY (SOLAR PHOTOVOLTAIC SYSTEMS) REGULATIONS, 2012

REGULATORY IMPACT ASSESSMENT

BACKGROUND

Kenya receives a solar insolation of 4-6 kW/m^2. This solar resource makes solar photovoltaic ideal for heating, pumping and lighting applications. This resource can be harnessed for perpetuation of sustainable energy in the country. To achieve this, the country requires quality solar components and well trained technical personnel to carry out design and installations of solar photovoltaic systems.

The Energy and Petroleum Regulatory Authority (EPRA) is a single sector regulatory agency established under section 9(1) of the Energy Act, 2019 with the responsibility of among other matters:

iii) Economic and technical regulation of electric power (except licensing of nuclear facilities) and downstream petroleum subsectors.

iv) Supervision and technical regulation of the upstream petroleum sector.

The Authority was formerly named the Energy Regulatory Commission (ERC) established under the Energy Act, 2006 (now repealed).

The Authority has been implementing the Energy (Solar Photovoltaic Systems) Regulations, 2012 which were gazetted on 28th September 2012 via Legal Notice No. 103. These Regulations were promulgated under The Energy Act, 2006 which has since been repealed and replaced by the Energy Act, 2019. However, the Regulations were saved and will continue in force pursuant to the transitional provisions of the Energy Act, 2019. The regulations provide for the following, inter alia:

e. Licensing of all persons involved in the manufacture, importation, distribution, promotion, sale, design or installation of any Solar PV systems;
f. Collection of data on Solar PV systems installed in the country;
g. Ensuring the manufacture, design, installation, repair and maintenance of Solar PV systems is done as per the relevant Kenyan Standards;
h. Ensuring fair business practices in the Solar PV industry.

The Authority would like to conduct a study to assess the impact of the Energy (Solar Photovoltaic Systems) Regulations 2012 since gazettement and identify any gaps that should be addressed.

This questionnaire has been designed by EPRA to assist in:

i) Assessment of the appropriateness of the different classes of licence in regulating the manufacturing, importation, distribution , design and installation of solar PV systems/components with a view of aligning them with the current market needs;

ii) Identification of any gaps in the qualifications, experience and certifications required for the different technicians licenses;

iii) Assessment of the effectiveness of the process used in issuances of licenses in the different classes;

iv) Establishing the challenges in working relationship between licensed solar PV technicians and the firms in which they are attached

v) Assessment of the effectiveness of the general license conditions, e.g. the validity period and the upgrade period for licenses;

vi) *Assessment of compliance of the regulations with the Kenya Constitution, Energy Act, 2019, environmental laws and other laws that have been enacted;*

vii) *Identification of Kenyan and International Standards relating to manufacture, design, installation and maintenance of solar photovoltaics that the regulations should be aligned to;*

viii) *Assessment of the effectiveness of the regulations in enforcing the relevant Kenyan Standards;*

ix) *Assessment of the adequacy of the documentation required in the regulations e.g. completion certificates, registers, returns on systems installed and imported in regulating the solar PV industry;*

x) *Assessment of the relevance of the warranties provided for in the regulations to the product life;*

xi) *Assessment of the effectiveness of inspection and enforcement provided in the regulation;*

xii) *Establishing the challenges in enforcing the provisions of the regulations and penalties provided for in the regulations;*

xiii) *Establishing the economic and social impacts of the regulations;*

xiv) *Benchmarking with other global existing regulations relating to manufacture, design, installation and maintenance of solar photovoltaics.*

Sustainable Energy Initiative Ltd. has been contracted by EPRA to undertake the survey. Your organisation/you have been identified to participate in the survey as a stakeholder affected by the Energy (Solar Photovoltaic Systems) Regulations, 2012. Your participation in this survey is of paramount importance.

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.

B.1. Solar PV Systems Installers/Technicians

SOLAR PV SYSTEMS INSTALLERS/TECHNICIANS

Please tick (☐) as appropriate

1. **Do you have a Technician License?**

1. Yes ☐	2. No ☐

2. **If your answer above is *Yes*, what class of license do you hold and for how long have you been licensed?**

License class	1. T1 ☐	2. T2 ☐	3. T3 ☐
Duration	1. Less than 1 year ☐	2. 1-3 years ☐	3. More than 3 years ☐

3. **If your answer above is *No*, why are you not licensed?**

_____

_____

4. **The class of license you hold allows you to serve your customers adequately. (Please choose one response)**

1. Agree ☐	2. Disagree ☐	3. Agree / Disagree to a certain extent ☐

5. **If your response above is *2 or 3*, please explain**

_____

_____

6. **What is your highest academic qualification?**

1. Certificate ☐	2. Diploma ☐	3. Higher Diploma ☐
4. Bachelor's Degree ☐	5. Postgraduate ☐	6. Other (Specify)

7. **What is your area of specialization?**

1. Electrical ☐	2. Electronics ☐	3. Other (Specify)

8. **How long have you been installing solar PV systems?**

(1) Less than 1 year ☐	(2) 1 - 3 years ☐	(3) 3 -5 years ☐
(4) 5 – 10 years ☐	(5) More than 10 years ☐	

9. **What course(s) have you attended on solar PV?**

1. T1 ☐	2. T1/T2 ☐	3. T3 Grid-Tied ☐	4. T3 Hybrid ☐
5. Solar Water Pumping ☐	6. Solar mini-grid training ☐	7. Product Specific Training (***Specify***)	

10. **How relevant were the courses that you attended on solar PV?**

Course name: _____

1. Relevant ☐	2. Not Relevant ☐	3. Other (Please explain)

Course name: _____

1. Relevant ☐	2. Not Relevant ☐	3. Other (Please explain)

Course name: _____

1. Relevant ☐	2. Not Relevant ☐	3. Other (Please explain)

11. How comprehensive were the courses that you attended on solar PV?

Course name: _____

1. Adequate ☐	2. Not Adequate ☐	3. Other (Please explain)

Course name: _____

1. Adequate ☐	2. Not Adequate ☐	3. Other (Please explain)

Course name: _____

1. Adequate ☐	2. Not Adequate ☐	3. Other (Please explain)

12. Was the delivery time for the solar PV course that you attended adequate?

Course name: _____

1. Yes ☐	2. No ☐

Course name: _____

1. Yes ☐	2. No ☐

Course name: _____

1. Yes ☐	2. No ☐

13. Give suggestions on how the solar PV training can be improved e.g. content, time taken to cover the training, level of detail, dynamism with sector trends, relevance to the Kenyan context, and any other aspects

_____

_____

_____

14.* What type(s) of solar PV system have you installed? Please indicate your level of expertise in each system design and installation *(1 is lowest, 5 is highest)

Solar PV system	**Installed**	**Level of expertise**				
		1	**2**	**3**	**4**	**5**
Pico plug & play DC system ≤ 100 W (*PV panel, battery*)	☐	☐	☐	☐	☐	☐

Stand-alone system ≤ 300 W (*PV array, battery, inverter, charge controller*)	☐	☐	☐	☐	☐	☐
Stand-alone system > 300 W (*PV array, battery, inverter, charge controller*)	☐	☐	☐	☐	☐	☐
Solar PV street lighting	☐	☐	☐	☐	☐	☐
Hybrid system ≤ 1 kW (*PV panel, battery, inverter, charge controller, auxiliary)*	☐	☐	☐	☐	☐	☐
Hybrid system > 1 kW (*PV array, battery, inverter, charge controller, auxiliary)*	☐	☐	☐	☐	☐	☐
Grid-tied system (*Single inverter*) ≤ 25 kW	☐	☐	☐	☐	☐	☐
Grid-tied system 415 V *(Multiple inverters*) > 25 kW	☐	☐	☐	☐	☐	☐
Grid-tied system with transformer (11kV)	☐	☐	☐	☐	☐	☐
Grid-tied system with transformer selling to grid	☐	☐	☐	☐	☐	☐
Hybrid system AC coupled ≤ 15 kW (*Single inverter*)	☐	☐	☐	☐	☐	☐
Hybrid system AC coupled >15 kW (M*ultiple inverters*)	☐	☐	☐	☐	☐	☐
Solar water pumping system ≤ 1 kW	☐	☐	☐	☐	☐	☐
Solar water pumping system >1 kW	☐	☐	☐	☐	☐	☐

15. Do you install solar PV systems above the capacity limited by your license?

1. Yes ☐	2. No ☐

16. Is your license attached to a firm?

1. Yes ☐	2. No ☐

17. If your response above is *Yes*, how long has your license been attached to the firm?

(1) Less than 1 year ☐	(2) 1-4 years ☐	(3) More than 5 years ☐

18. How many firms has your license been attached to previously?

1. None ☐	2. One ☐	3. Two and above ☐

19. If your license is attached to a firm, what is the current contract agreement with the firm?

1. Permanently employed	☐	2. Annual contract	☐
3. Less than 1 year contract	☐	4. Part time contract	☐
5. Project based contract	☐	6. Self employed	☐
7. Lease of license	☐	8. Other (Specify)	

20. What service(s) do you offer the Company your License is attached to?

1. Company Management	☐	2. Design	☐
3. Installation	☐	4. Manage Team/ Department	☐
5. Testing & Commissioning	☐	6. Consultancy	☐
7. Project Development, Operation and Maintenance	☐	8. Other (Specify)	

21. Are there any challenges in the working relationship between yourself and the firm(s) in which you are attached?

1. Yes	☐	2. No	☐

22. If your answer above is *Yes*, please explain the nature of challenges faced

_____

_____

_____

23. What is the *average number* of solar PV projects you handle in a year?

(1) Less than 10 ☐	(2) 10 - 50 ☐	(3) 51 - 100 ☐	(4) More than 100 ☐

24. What is the *average total capacity* of solar PV systems that you install in a year?

(1) Less than 100 W ☐	(2) 100 W -1 kW ☐	(3) 1.1 – 50 kW ☐
(4) 51 – 200 kW ☐	(5) 201 kW – 1,000 kW ☐	(6) More than 1,000 kW ☐

25. In the last five (5) years, what has been your highest annual total installed capacity of solar PV systems?

(1) Less than 1 kW ☐	(2) 1 < 10 kW ☐	(3) 10 < 50 kW ☐
(4) 50 < 200 kW ☐	(5) 200 < 1,000 kW ☐	(6) More than 1,000 kW ☐

26. Are you guided by any local or international standards in your solar PV installation?

1. Yes	☐	2. No	☐

27. If your answer above is *Yes*, please give the standard(s) used

_____

_____

28. Do you affix the appropriate safety and health warning labels on completed solar PV installations?

1. Yes ☐ (Please provide a sample copy)	2. No ☐

29. Do you issue a completion certificate to consumers after installation of a solar PV system?

1. Yes ☐ (Please provide a sample copy)	2. No ☐

30. Has the EPRA or its agents ever inspected a site at which you have installed a solar PV system?

1. Yes ☐	2. No ☐

31. If the response above is *Yes*, what were the findings of the inspection?

1. Compliant ☐	2. Non-compliant ☐

32. If the site was *Non-compliant*, what provisions of the regulations had been contravened?

_____

_____

33. Do you file returns with EPRA on the solar PV systems installed annually?

1. Yes ☐	2. No ☐

34. In your opinion, are the academic qualifications required for licensing as a T1, T2 and T3 technician appropriate?

1. Yes ☐	2. No ☐

35. If your answer above is *No*, what changes would you propose and to what classes of licenses?

_____

_____

_____

36. In your opinion is the level of experience required for licensing under the various technician classes appropriate?

1. Yes ☐	2. No ☐

37. If your answer above is *No*, what changes would you propose and to what classes of licenses?

_____

_____

_____

38. In your opinion, is the division of technician license classes into T1, T2 and T3 technicians together with division of the level of work that each class can undertake appropriate?

1. Yes ☐	2. No ☐

39. **If your answer above is *No*, what changes would you propose and to what classes of licenses?**

_____

_____

_____

40. **In your opinion, what would be a more practical division of the level of work that technicians can undertake?**

_____

_____

_____

41. **What additional classes of licenses, if any, would you like the regulator to create and why?**

_____

_____

_____

_____

42. **Do you understand the process used by the EPRA in licensing of solar PV technicians?**

1. Yes ☐	2. No ☐

43. **How would you rate the level of difficulty of applying for a technician's license?**

1. Easy ☐	2. Reasonable ☐	3. Difficult ☐

44. **Please suggest improvements to the process of applying for a technician's license.**

_____

_____

_____

_____

45. **In your opinion, is the manner in which examinations (both oral and written) for technicians are administered: -**

Fair	1. Yes ☐	2. No ☐
Transparent	1. Yes ☐	2. No ☐
Convenient in terms of time	1. Yes ☐	2. No ☐
Convenient in terms of location	1. Yes ☐	2. No ☐

46. **Please suggest improvements to the manner in which examinations for technicians are administered**

_____

_____

_____

47. **What is your view regarding the amount of license fees charged by EPRA for technician's licenses?**

1. Low ☐	2. Fair ☐	3. High ☐

48. How do you rate the speed with which EPRA processes and issues licenses for technicians, both new licenses and renewals?

1. Slow ☐	2. Satisfactory ☐	3. Fast ☐

49. Suggest improvements that can make EPRA expedite the processing and issuance of licenses

_____

_____

_____

50. In your opinion, do members of the public recognize the technician's license issued by the EPRA?

1. Yes ☐	2. No ☐

51. Please suggest any changes to the *form* of the license issued by the EPRA.

_____

_____

_____

52. In your opinion, is the process of renewing the technician's license convenient?

1. Yes ☐	2. No ☐

53. In your opinion, is the one (1) year validity period of a license adequate?

1. Yes ☐	2. No ☐

54. If your answer above is *No*, what validity period would you consider to be adequate?

1. Two years ☐	2. Three years	☐	3. Four years ☐
4. Five years ☐	5. Other (specify)		

55. In your opinion, is the two (2) year practice period requirement for license upgrade adequate?

1. Yes ☐	2. No ☐

56. If your answer above is *No*, what practicing period would you consider to be adequate?

1. Two years ☐	2. Three years	☐	3. Four years ☐
4. Five years ☐	5. Other (specify)		

57. Continuous Professional Development (CPD) attained through training is a better way for a technician to upgrade from one license class to another. Pick one response below.

1. Agree ☐	2. Neither agree nor disagree ☐	3. Disagree ☐

58. **If your response above is *Disagree*, which other better ways do you suggest for upgrading from one license class to another?**

_____

_____

59. **Have any of your previous licenses ever been cancelled under provisions of the regulations?**

1. Yes ☐	2. No ☐

60. **If your answer above is *Yes*, please give details why the license was cancelled.**

_____

_____

61. **In your opinion, is the *two (2) consecutive years period non-renewal license cancellation* rule appropriate?**

1. Yes ☐	2. No ☐

62. **If your answer above is *No*, what period would you consider to be appropriate?**

1. Three years ☐	2. Four years ☐	3. Other (specify)

63. **The EPRA requires that technicians commit their license to the exclusive use of one vendor/contractor. Should one technician be permitted to commit himself/herself to more than one vendor/contractor?**

1. Yes ☐	2. No ☐

64. **If your answer above is *Yes*, should there be a limit to the number of firms to which a technician can commit his/her license?**

1. Yes ☐	2. No ☐

65. **If your answer above is *Yes*, how many firms ?**

1. Two ☐	2. Three ☐	3. Four ☐	4. Other (specify)

66. **In your opinion, are the penalties for non-compliance provided in the regulations adequate?**

1. Yes ☐	2. No ☐

67. **What amendments or additional sanctions would you recommend for technicians who do not comply with the regulations?**

_____

_____

_____

68. **Do you think the regulations have had any impact on the social/economic development of Kenya?**

1. Yes ☐	2. No ☐

69. **If your response above is *Yes*, give some of the notable impacts**

_____

_____

_____

THANK YOU FOR YOUR COOPERATION IN COMPLETING THIS QUESTIONNAIRE

B.2. Solar PV Systems Vendors/ Contractors/ Importers/ Manufacturers

SOLAR PV SYSTEMS VENDORS/CONTRACTORS/IMPORTERS/MANUFACTURERS

Please tick (☐) as appropriate

1. **What class of license do you hold?**

1. C1 ☐	2. V1 ☐	3. V2 ☐

2. **What is your lead technician's highest academic qualification?**

1. Certificate ☐	2. Diploma ☐	3. Higher Diploma ☐
4. Bachelor's Degree ☐	5. Postgraduate ☐	6. Other (Specify)

3. **Is your lead technician licensed?**

1. Yes ☐	2. No ☐

4. **If your answer above is *Yes*, please specify the class of license**

1. T1 ☐	2. T2 ☐	3. T3 ☐

5. **If your answer above is *No*, why is the technician not licensed?**

_____

_____

6. **Is your lead technician an employee of your firm or you have a formal arrangement with him/her?**

1. Employee ☐	2. Formal arrangement ☐

7. **What is your lead technician's area of specialization?**

1. Electrical ☐	2. Electronics ☐	3. Other (Specify)

8. **How many licensed solar PV technicians are employed by your firm?**

1. None ☐	2. 1-3 ☐	3. More than 3 ☐

9. **How many technicians per license class are employed by your firm?**

1. T1	2. T2	3. T3

10. **How long have you been consistently selling/ installing/ designing/ manufacturing/ importing solar PV systems?**

(1) Less than 1 year ☐	(2) 1 - 4 years ☐	(3) 5 -10 years ☐	(4) more than 10 years ☐

11. **What type(s) of solar PV systems do you sell/install/design/ manufacture/ import?**

Pico plug & play DC system ≤ 100 W (*PV panel, battery*)	☐
Stand-alone system ≤ 300 W (*PV array, battery, inverter, charge controller*)	☐
Stand-alone system > 300 W (*PV array, battery, inverter, charge controller*)	☐

Solar PV street lighting	☐
Hybrid system ≤ 1 kW (*PV array, battery, inverter, charge controller, auxiliary)*	☐
Hybrid system > 1 kW (*PV array, battery, inverter, charge controller, auxiliary)*	☐
Grid-tied system (S*ingle inverter*) ≤ 25 kW	☐
Grid-tied system 415 V *(Multiple inverters*) > 25 kW	☐
Grid-tied system with transformer (11 kV) – Self consumption	☐
Grid-tied system with transformer, selling to Grid – Feed-in-Tariff	☐
Hybrid system AC coupled < 15 kW (S*ingle inverter*)	☐
Hybrid system AC coupled > 15 kW (M*ultiple inverters*)	☐
Solar water pumping system < 1 kW	☐
Solar water pumping system >1 kW	☐

12. The class of license you hold allows you to serve your customers adequately. (Please choose one response)

1. Agree ☐	2. Neither agree nor disagree	☐	3. Disagree ☐

13. If your response above is *2 or 3*, what are your license limitations?

_____

_____

14. My licensed technician's knowledge of solar PV systems is adequate for the business. (Please choose one response)

1. Agree ☐	2. Neither agree nor disagree	☐	3. Disagree ☐

15. If your response above is *Disagree*, what areas would you like them to improve on?

_____

_____

16. What is the contract agreement with your licensed technician?

1. Permanently employed ☐	2. Annual contract ☐
3. Less than 1 year contract ☐	4. Part time contract ☐
5. Project based contract ☐	6. Self employed ☐

7. Lease of license ☐	8. Other (Specify)

17. What is the role of the licensed technician in your Company?

1. Company Management ☐	2. Design ☐
3. Installation ☐	4. Manage Team/ Department ☐
5. Testing & Commissioning ☐	6. Consultancy ☐
7. Project Development, Operation and Maintenance ☐	8. Other (Specify)

18. Are there any challenges in the working relationship between your firm and the licensed technician?

1. Yes ☐	2. No ☐

19. If your answer above is *Yes*, please explain the nature of challenges faced

_____

_____

_____

20. What is the *average number* of solar PV projects you handle in a year?

(1) Less than 10 ☐	(2) 10 - 50 ☐	(3) 51 - 100 ☐	(4) More than 100 ☐

21. What is *the average total Capacity* of solar PV systems that you install/manufacture/ import/sell in a year?

1. Less than 100 W ☐	2. 100 W -1 kW ☐	3. 1.1 – 50 kW ☐
4. 51 – 200 kW ☐	5. 201 kW – 1,000 kW ☐	6. More than 1,000 kW

22. In the last five (5) years, what has been your highest annual total capacity of solar PV systems installed/ manufactured/ imported/ sold?

1. Less than 1 kW ☐	2. 1 < 10 kW ☐	3. 10 < 50 kW ☐
4. 50 < 200 kW ☐	5. 200 < 1,000 kW ☐	6. More than 1,000 kW ☐

23. Continuous Professional Development (CPD) attained through training is a better way for a technician to upgrade from one license class to another. Pick one response below.

1. Agree ☐	2. Neither agree nor disagree	☐	3. Disagree ☐

24. If your response above is *Disagree*, which other better ways do you suggest for upgrading from one technician license class to another?

_____

_____

25. Do you file your annual returns with EPRA of products sold/installed/ manufactured/ imported?

1. Yes ☐	2. No ☐

26. If the answer to the above question is *No*, why?

27. What is the *minimum* warranty duration on solar PV systems and components that you offer your customers?

Component	*Warranty period (years)*	
	Offered by your firm	*Offered by the manufacturer*
1. Controller/Regulator		
2. Inverter		
3. Battery		
4. Light Bulbs/LED		
5. Panels		
6. Light fittings/device		

28. For each component, record the number of failures reported by your customers *before expiry* of the warranty period in the last one (1) year?

Component	*No. of failed components in the last one (1) year*
1. Controller/Regulator	
2. Inverter	
3. Battery	
4. Light Bulbs/LED	
5. Panels	
6. Light fittings/device	

29. In your opinion, are the mandated warranty periods provided for in the regulations practical?

1. Yes ☐	2. No ☐

30. If your answer above is *No*, please give reasons

_____

_____

31. Give the practical warranty period for each component

Component	*Proposed Warranty period*
1. Controller/Regulator	
2. Inverter	

3. Battery	
4. Light Bulbs/LED	
5. Panels	
6. Light fittings/device	

32. What documentations do you give your customers after selling them solar PV systems or components?

Document issued	*Check Box*
1. Receipt of purchase	☐
2. Signed system design declaration (*Owner/User signs agreement with the design)*	☐
3. Signed system completion certificate (*Please provide a sample copy*)	☐
4. User Manuals	☐
5. None of the above	☐
6. Other (please specify)	

33. Do you affix the appropriate safety and health warning labels on completed solar PV installations/components?

1. Yes ☐ (Please provide a sample copy)	2. No ☐

34. Are you guided by any local or international standards in your solar PV system design, installation, repair and maintenance?

1. Yes ☐	2. No ☐

35. If your answer above is *Yes*, please give the standard(s) used

_____

_____

36. Is your solar PV system design tool(s) approved by the EPRA?

1. Yes ☐	2. No ☐

37. Do you understand the process used by the EPRA for licensing vendors/contractors/ manufacturers/ importers of solar PV systems and components?

1. Yes ☐	2. No ☐

38. How would you rate the level of difficulty in applying for a vendor/contractor's License?

1. Easy ☐	2. Moderate ☐	3. Difficult ☐

39. **Please suggest any improvements to the process of applying for a vendor/contractor/ manufacturer/ importer license.**

_____

_____

_____

40. **What is your view regarding the amount of license fees charged by EPRA for Vendor/contractor license?**

1. Low ☐	2. Fair ☐	3. High ☐

41. **How do you rate the speed with which EPRA processes and issues vendor/contractor licenses, both new licenses and renewals?**

1. Slow ☐	2. Satisfactory ☐	3. Fast ☐

42. **Suggest improvements that can make EPRA expedite the processing and issuance of licenses**

_____

_____

_____

43. **The EPRA requires that technicians commit their license to the exclusive use of one vendor. Should one technician be permitted to commit himself/herself to more than one vendor?**

1. Yes ☐	2. No ☐

44. **If your answer above is *Yes*, should there be a limit of the number of firms to which a technician can commit his/her license?**

1. Yes ☐	2. No ☐

45. **If your answer above is *Yes*, how many?**

1. Two ☐	2. Three ☐ 3. Four ☐	4. Other (specify)

46. **In your opinion, is the *two (2) consecutive years period non-renewal license cancellation* rule appropriate?**

1. Yes ☐	2. No ☐

47. **If your answer above is *No*, what period would you consider to be appropriate?**

(1) 3 years ☐	(2) 4 years ☐	(3) Other (specify)

48. **In your opinion, do members of the public recognize the vendor's/contractor's license issued by the EPRA?**

1. Yes ☐	2. No ☐

49. **Please suggest any changes to the form of the license issued by the EPRA.**

_____

_____

_____

50. **In your opinion, is the process of renewing the Vendor/contractor/ manufacturer/ importer license convenient?**

1. Yes ☐	2. No ☐

51. In your opinion, is the one (1) year validity period of a license adequate?

1. Yes ☐	2. No ☐

52. If your answer above is *No*, what validity period would you consider to be adequate?

1. Two years ☐	2. Three years	☐	3. Four years ☐
4. Five years ☐	5. Other (specify)		

53. Have any of your previous licenses ever been cancelled under provisions of the regulations?

1. Yes ☐	2. No ☐

54. If your answer above is *Yes*, please give details why the license was cancelled

_____

_____

55. Has your business ever been inspected by the EPRA or her agents?

1. Yes ☐	2. No ☐

56. Has the EPRA or her agents ever inspected a site at which you have installed a solar PV system?

1. Yes ☐	2. No ☐

57. If the answer above is *Yes*, what was the inspection finding?

1. Compliant ☐	2. Non-compliant ☐

58. If *non-compliant*, what provisions of the regulations had been contravened?

_____

_____

_____

59. In your opinion, are the penalties for non-compliance provided under the regulation adequate?

1. Yes ☐	2. No ☐

60. What amendments or additional sanctions would you recommend for licensees who do not comply with the regulations?

_____

_____

_____

61. In your view, is it necessary for the EPRA to license vendors of solar PV systems?

1. Yes ☐	2. No ☐

62. If your answer above is *No*, please give reasons

_____

_____

63. **The KRA requires importers of PV systems to obtain clearance from the EPRA prior to goods being allowed in the country. Is the process of receiving clearance from the EPRA convenient?**

1. Yes	☐	2. No	☐

64. **Suggest ways of improving the process of obtaining clearance from the EPRA**

_____

_____

_____

65. **Is the importation and Tax Exemption of solar PV products clear to importers?**

1. Yes	☐	2. No	☐

66. **If the answer to the above question is *No*, explain why?**

_____

_____

_____

67. **Importation and sale of consumer devices, i.e. off the shelf ready-made kits that do not require installation is currently not regulated. Do you think EPRA should extend regulation to the importation and sale of these devices?**

1. Yes	☐	2. No	☐

68. **If your answer above is *Yes*, are there certain consumer devices that ought to be exempt from regulation?**

1. Yes	☐	2. No	☐

69. **If your answer above is *Yes*, please list the devices that should be exempt**

_____

_____

_____

THANK YOU FOR YOUR COOPERATION IN COMPLETING THIS QUESTIONNAIRE

B.3. Technical Training Institutions

TECHNICAL TRAINING INSTITUTIONS

1. **What type(s) of solar PV systems do you conduct training on?**

Pico plug & play DC system ≤ 100 W (*PV panel, battery*)	☐
Stand-alone system ≤ 300 W (*PV array, battery, inverter, charge controller*)	☐
Stand-alone system > 300 W (*PV array, battery, inverter, charge controller*)	☐
Solar PV street lighting	☐
Hybrid system ≤ 1 kW (*PV array, battery, inverter, charge controller, auxiliary)*	☐
Hybrid system > 1 kW (*PV array, battery, inverter, charge controller, auxiliary)*	☐
Grid-tied system (S*ingle inverter*) ≤ 25 kW	☐
Grid-tied system 415 V *(Multiple inverters*) > 25 kW	☐
Grid-tied system with transformer (11 kV) – Self consumption	☐
Grid-tied system with transformer, selling to Grid – Feed-in-Tariff	☐
Hybrid system AC coupled < 15 kW (S*ingle inverter*)	☐
Hybrid system AC coupled > 15 kW (M*ultiple inverters*)	☐
Solar water pumping system < 1 kW	☐
Solar water pumping system >1 kW	☐

2. **How long has the institution been training solar PV technicians?**

1. Less than 1 year ☐	2. One – five years ☐	3. More than 5 years ☐

3. **Do you have training equipment?**

1. Yes ☐	2. No ☐

4. **If the answer to the above question is *Yes*, please list the main training equipment**

_____

_____

_____

_____

_____

5. **How many solar PV trainers does your institution have?**

(1) 1-3 ☐	(2) 4-6 ☐	(3) More than 6 ☐ (Specify no.)

6. How many trainers per license class?

1. T1	2. T2	3. T3	4. Unlicensed

7. How many solar PV technicians has your institution trained since inception of the programs?

(1) Less than 100 ☐	(2) 100 - 250 ☐	(3) 250 - 500 ☐	(4) Over 500 ☐ (Specify no.)

8. How would you rate your knowledge of solar PV standards?

1. High ☐	2. Average ☐	3. Low ☐

9. The regulations classification of licenses is in line with our ideal curriculum (Please choose one response)

1. Agree ☐	2. Neither agree nor disagree	☐	3. Disagree ☐

10. Continuous Professional Development (CPD) attained through modular unit by unit training is a better way for one to upgrade from one license class to another. Pick one response below.

1. Agree ☐	2. Neither agree nor disagree	☐	3. Disagree ☐

11. If your response above is *Disagree*, which other better ways do you suggest for upgrading from one technician license class to another?

_____

_____

12. The regulations need to be amended to facilitate comprehensive training of technicians. (Choose one response)

1. Agree ☐	2. Disagree	☐	3. Do not know ☐

13. If you agree with the above statement, please explain why?

_____

_____

_____

_____

14. Outline areas in which the regulations need to be amended to facilitate adequate impartation of knowledge to trainees

_____

_____

_____

_____

_____

_____

_____

_____

THANK YOU FOR YOUR COOPERATION IN COMPLETING THIS QUESTIONNAIRE

B.4. Government and non-governmental organisations

QUESTIONS TO GOVERNMENT AND NON-GOVERNMENTAL ORGANISATIONS OFFICERS

1. Kindly provide a brief overview on how your organization has been involved in the solar PV industry in the last five (5) years?
   - As a Solar PV Client
   - As a promoter of solar PV
   - As a Policy Administrator for energy Policies
   - Other
2. Which categories of solar PV is your organisation interested in?

Solar PV system	***Installed***
Pico plug & play DC system ≤ 100 W (*PV panel, battery*)	☐
Stand-alone system ≤ 300 W (*PV array, battery, inverter, charge controller*)	☐
Stand-alone system > 300 W (*PV array, battery, inverter, charge controller*)	☐
Solar PV street lighting	☐
Hybrid system ≤ 1 kW (*PV panel, battery, inverter, charge controller, auxiliary)*	☐
Hybrid system > 1 kW (*PV array, battery, inverter, charge controller, auxiliary)*	☐
Grid-tied system (S*ingle inverter*) ≤ 25 kW	☐
Grid-tied system 415 V *(Multiple inverters*) > 25 kW	☐
Grid-tied system with transformer (11kV)	☐
Grid-tied system with transformer selling to grid	☐
Hybrid system AC coupled ≤ 15 kW (S*ingle inverter*)	☐
Hybrid system AC coupled >15 kW (M*ultiple inverters*)	☐
Solar water pumping system ≤ 1 kW	☐
Solar water pumping system >1 kW	☐

3. The Energy and Petroleum Regulatory has been implementing the Solar PV Regulations gazetted in 2012, to assist promote the quality of the solar components in the Kenyan and promote best practice in the development of the sector. How would you rate the success of the regulations? Discuss
4. Are the different categories of PV companies sufficient (i.e. *C1 - All Contractors, V1 – Vendors, V2 - Manufacturers and Importers)?*
   Discuss the answer above.
5. Do you think the licenced technicians of different classes have the requisite skill and competency to handle the jobs they are mandated to?
6. What shortcomings have you witnessed/observed in licensed personnel?

7. What observations have you made on the relationship between licensed technicians and the firms they are attached to?
8. Is the categorisation of technician licenses into T1, T2 and T3 together with the level of work that each class can undertake appropriate? Are these classes of sufficient? Discuss the answer above
9. Are the academic and professional qualifications required for licensing T1, T2, and T3 technicians appropriate/adequate?
10. Do you think the regulations are comprehensive enough or are there market segments that should not be covered in the regulations?
11. Importation and sale of consumer devices, i.e. off the shelf ready-made kits that do not require installation is currently not regulated, do you think that the EPRA should extend regulation to the importation and sale of these device?
12. How can the enforcement of warranties be made more effective?
13. In your opinion, are the penalties for non-compliance provided under the regulation adequate?
14. What is your remark on the quality of solar products installed?
15. Are you conversant with the solar PV standards in the country? How can they be improved?
16. What changes would you recommend for the current solar PV regulations?

APPENDIX C: LIST OF RESPONDENTS

C.1. VENDORS

S. No.	Vendor Name	License Class	Address
	(a) Nairobi and its environs		
1	Schneider Electric (Kenya) Ltd.	C1, V1, V2	P.O. BOX 46345– 00100 NAIROBI EMAIL: kamal.gupta@schneider-electric.com
2	Cp Solar Resources Ltd.	C1, V2	P.O. BOX 36-00517 NAIROBI Email: khes@smart-solar.co.ke
3	Solar Works E.A. Ltd	C1, V2	P.O. BOX 28546-00100 NAIROBI Email: solarworks@ymail.com
4	Solargen Technologies Ltd.	C1, V1, V2	P.O. BOX 103522-00100 NAIROBI Email: abubakar.aidaruz@gmail.com
5	Glob-All Power Solutions Ltd.	C1, V2	P.O.BOX 1308-00208 NGONG
6	Alamdar Trading Company Ltd.	V2	P.O. BOX 40956 – 00100 NAIROBI
7	Challa Communications Ltd.	V2	P.O. BOX 57054 – 00202 NAIROBI
8	Three D Solutions Ltd	C1	Aturmathew@yahoo.com, 254739014014
9	Powergen Renewable Energy East Africa Ltd.	C1, V2	P.O. BOX 345 – 00502 NAIROBI EMAIL: mark@windgenpower.com
10	Davis & Shirtiff	V1, V2	P.O. BOX 41762-00100 NAIROBI EMAIL: solar@dayliff.com
11	Eenovators Ltd.	C1, V1, V2	P.O. BOX 50583- 00200 NAIROBI EMAIL: info@eenovators.com
12	Sun Transfer Kenya Investments Ltd	C1, V2	P.O.BOX 4617-00200 NAIROBI kirubi@suntransfer.com
13	Histoto Ltd.	C1, V2	P.O. BOX 9115 -00100 NAIROBI Email: info@histoto.com
14	Questsworks Ltd.	C1, V2	P.O. BOX 18724 –00500 NAIROBI EMAIL: INFO@RESOL.CO.KE
15	Centre For Alternative Technologies LTD	V1	nawir@cat.co.ke
16	Streamlan Solutions (Ea) Ltd.	C1, V1, V2	P.O. BOX 452- 00100 NAIROBI
17	Energy Saving Solutions Ltd	C1, V2	P.O. BOX 13504 – 00800 NAIROBI
18	Amac Technologies (K) Ltd.	V1, V2	P.O. BOX 1398 - 00618 NAIROBI
19	Hydro East Africa Ltd.		
20	Hilalium & Sons (Ur Home) Ltd		
21	Asachi Ltd.	V2	info@asachi.co.ke
22	Dream Ep Global Energy (Kenya) Ltd	V1	lokoth@epge.com
23	Sess Solutions	C1 V2	sesssolutions@gmail.com

S. No.	Vendor Name	License Class	Address
24	Kisima Electromechanicals Ltd.	C1 V2	info@kisimaem.com
25	Transafrica Water Systems Ltd.	V1, V2	P.O. BOX 1179- 00502 NAIROBI Email: info@transafricawater.com; 0722 347 254
26	Lean Energy Solutions Ltd.	C1, V1, V2	P.O. BOX 121- 00606 NAIROBI Email: dinesh@leansolutions.co.ke/info@leansolutions.co.ke; 0716457677
27	Sunculture Kenya Ltd	C1, V2	P.O.BOX accounts@sunculture.com; 0712687244 / 0702 521 931; jackline.mumbi@sunculture.com
28	Generation Kenya Ltd	V1, V2	P.O. BOX 8564-00300 NAIROBI; 0712818289; sales@generationkenyaltd.co.ke
29	Besca Engineering Co.Ltd.	V1, V2	info@bescaengineering.co.ke, 0712837661
30	Asachi Ltd.	V1, V2	P.O. BOX 9096- 00200 NAIROBI info@asachi.co.ke
31	Astonfield Solesa Solar Kenya Ltd.	C1, V1	P.O. BOX 14077-00800 NAIROBI tpopat@astonfield-solesa.com
32	Dream Ep Global Energy (Kenya) Ltd.	C1, V1, V2	P.O. BOX 856- 00606 NAIROBI Email: mutungi.japheth@gmail.com
33	Miale Solar Inventions Ltd.	C1, V2	P.O. BOX 5940-00200 steve@spa-Ltd. .com
34	Burhani Engineers Ltd.	C1, V2	P.O. BOX 21111 – 00505 NAIROBI
35	Lensim Investments Ltd.	V1, V2	P.O. BOX 35589 – 00100 NAIROBI
36	Black Wealth Enterprises Ltd.	C1, V1, V2	725493994
37	Solarpoa (East Africa) Ltd	C1, V1, V2	P.O. BOX 50714- 00100 NAIROBI
38	Belectric Ltd.	C1, V2	
39	Energy Intelligence Ltd	C1, V1, V2	
40	Metsec Cables Ltd.	V1, V2	P.O. BOX 10454- 00400 NAIROBI Email: yoursolutionsLtd. @gmail.com
41	Go Solar Systems Ltd.	C1, V1, V2	P.O. BOX 74231-00200 NAIROBI EMAIL: kibe@gosolarltd.com
42	Knights and Apps Ltd.	C1, V1, V2	P.O. BOX 1535- 00502 NAIROBI EMAIL: info@knightsandapps.com
43	Sterling and Wilson Private	C1, V2	P.O.BOX 38795-00100 NAIROBI nairobi@sterlingwilson.com
44	Sandor Engineering Consultant Company Ltd.	C1, V2	P.O. BOX 7119-01000 THIKA
45	Blue Clean Technologies (K) Ltd.	C1	726217333
46	Eco Desh Power Solutions	C1, V1, V2	

S. No.	Vendor Name	License Class	Address
47	Scandinavian Solar Systems	V1, V2	
48	Greenspark (K) Ltd.	V2	P.O. BOX 919-00600 Nairobi Email: evert@greenspark.co.ke
49	Premier Solar Solutions Ltd.	C1, V1, V2	P.O. BOX 6105 - 00100 NAIROBI Email: mnk@premiersolargroup.com
50	African Solar Designs Ltd.	C1	P.O. BOX 18092-00100 NAIROBI Email: dwairimu@africansolardesigns.com
51	Plexus Energy Ltd.	C1, V1, V2	P.O. BOX 24241- 00502 NAIROBI EMAIL: info@plexus-energy.co.ke
52	Towertech Africa Ltd.	C1	P.O. BOX 1591 00100 NAIROBI
53	Broadband Communication Network Ltd.	C1, V1, V2	P.O.BOX 10840-00400 Nairobi info@broadcom.co.ke
54	Renewvia Energy Kenya Ltd.	C1, V2	P.O. BOX 14805- 00800 NAIROBI Email: brian@renewvia.com
55	Illumina Africa Ltd.	C1, V1, V2	P.O. BOX 706- 00606 Nairobi Email: nikhil@illuminaafrica.com
56	Myxa Ltd.	C1, V1, V2	P.O. BOX 15064- 00100 NAIROBI
57	Ambalian Company Ltd.	C1, V2	P.O.BOX 22932-00100 NAIROBI
58	Equator Energy Ltd.	C1, V1, V2	EMMANUEL@EQUATORENERGY.NET
59	Harmonic Systems Company Ltd.	C1, V2	P.O. BOX 45690-00100 NAIROBI MARK@HARMONICAFRICA.COM
60	Strauss Energy Ltd.	V2	P.O. BOX 15028 -00100 NAIROBI Email: tony.nyagah@straussenergy.com
61	Polyphase Systems Ltd.	C1	P.O. BOX 500-00606 NAIROBI
62	Dream Power Ricciardi Engineering and Consulting Srl Ltd.	C1, V1, V2	P.O. BOX 24866- 00502 NAIROBI admin@dreampwr.com
63	Mobisol Kenya Ltd	V2	P.O.BOX 40553-00100 Nairobi admin@mobisol.co.ke
64	Villas Electrical Suppliers Ltd	**V2**	0772 247 798
65	Orb Energy Private Ltd.	C1, V2	P.O. BOX 10643- 00100 NAIROBI EMAIL: ramin.nadimi@orbenergy.com
66	Ofgen Ltd.	C1, V2	P.O. BOX 5652- 00506 NAIROBI souleiman@ofgen.co.ke
67	Sustainable Power Solutions Kenya Ltd.	C1, V2	P.O. BOX 202 - 00517 NAIROBI EMAIL: spskenya@powersolutions.co.za
68	Millenia Ltd.	C1, V1, V2	info@millenia.co.ke, 0722540854
69	Pathfinder Investments Ltd.	C1, V1, V2	P.O. BOX 272 – 00618 RUARAKA
70	Geo Solarworks Technology Ltd	C1, V2	P.O.BOX 30832 -00100 NAIROBI

S. No.	Vendor Name	License Class	Address
71	Contralinks Solutions and Services Ltd.	C1, V1, V2	725229485
72	Hyperteck Electricals Ltd	C1, V1, V2	-
73	August Auto Agencies	V1, V2	-
74	Nabico Ltd	C1, V1	-
75	Aspectus Ltd	C1	-
76	Television Sales	V1, V2	P.O.BOX 45525-00100, NAIROBI Email: telesales@wananchi.com; 0720705079
77	Epicenter Africa Ltd.	C1, V1, V2	P.O. BOX 5978-00200 NAIROBI Email: info@epicenterafrica.com
78	Chloride Exide (K) Ltd	V1, V2	P.O. BOX 14242 -00800 NAIROBI Email: info@chlorideexide.com / customerservice@chlorideexide.com
79	Williamson Power Ltd	C1	adrian@williamson.co.ke; 0729615685/0733766077
80	Total Kenya Plc.	V2	P.O. BOX 30736-00100 NAIROBI EMAIL; john.mikisi@total.co.ke
81	Power Options Ltd.	C1, V2	P.O. BOX 4221 – 00200 NAIROBI EMAIL: info@poweroptionsltd.com; 0716611126
82	Suntech Power Ltd.	V1, V2	P.O. BOX 2768 –00200 NAIROBI
83	Golden Gate Cargo Services Company Ltd.	C1, V2	P.O. BOX 22878 – 00610 NAIROBI; 0727142483
84	Greenlink Solar Ltd.	V1, V2	P.O. BOX 68115-00200 NAIROBI; 0722803703
85	Electrowatts Ltd.	V1	711465014
86	Vista Energy Co Ltd	V1	info@vistaenergy.co.ke
87	Powermax Solar Solutions Ltd	V2	712821394
88	International Energy Technik Ltd.		717300511
89	Power & Solar System Ltd		725849478
90	Davis & Shirtliff Ltd.	V1, V2	P.O. BOX 41762-00100 NAIROBI EMAIL: solar@dayliff.com
91	Equatorial Energies	C1, V2	P.O Box 762-00208 Ngong; 0727 509 224
92	Sagemcom Kenya Limited	C1, V1, V2	P.O. Box 30523 - 00100, Nairobi, Kenya Phone: +254 20 2711727, Mob: +254 740 636 448
93	Solibrium-Solar	V1, V2	info@solibrium-solar.com
94	Enable Green Energy	V2	technical@ege.co.ke; +254 (0) 705 166 122
	(b) Mombasa		

S. No.	Vendor Name	License Class	Address
95	Texas Systems Ltd.	V1, V2	E: liju@texas-alarms.com (Technician: Lijesh Kunnath); Tel: 0711125312
96	Exact Marketing Services Ltd.	V1, V2	E: hetham@exact.co.ke/ info@exact.co.ke (Abdil Nassir Road, Bondeni, Mombasa); Tel: 0736606466
97	Sollatek Electronics (K) Ltd.	V1, V2	Email: Imran.khan@sollatek.co.ke (Sollatek Building Opp. Bamburi cement, Technician: Imran Khan); Tel: 0725546865
98	Clean Power Ltd.	V1, V2	E: sales@cleanpower.co.ke (Technician: Sabastian Robert Mwakumbaku, Haile sellasie road mombasa); Tel: 0727954518
99	Ye Shure Declarations	V1, V2	yeshure@deltaexpress.co.ke; Tel: 0733422889
	(c) Eldoret		
100	Bright Sky Solar Solutions Ltd	V2	brightskysolar@hotmail.com; Tel: 0720409999
101	Dutron Ltd.	V1, V2	725917528
	(d) Kisumu		
102	Bboxx Capital Kenya Ltd	V1, V2	E: e.thuku@bboxx.co.uk; Tel: 0715276007
103	PV Tech EPZ East Africa Ltd	C1, V1, V2	E: tilen.ogola@pvtechnologyinc.net (Alpha House, Oginga Odinga Street); Tel: 0725939133
	(e) Nakuru		
104	Solinc East Africa Ltd	V1, V2	P.O. BOX 1158 – 20117 NAIVASHA EMAIL: info@ubbink.co.ke
105	Solare Energy Kenya Ltd.	V1, V2	P.O. BOX 542 -20100 NAKURU, sati@bedi.com
106	Tropical Power K Ltd.	C1, V2	P.O. BOX 1612-00502 NAIROBI EMAIL; harrison.kiprop@tropicalpower.com; 0715496024/0716154277

C.2. TECHNICIANS

S. No.	Name	License Class	Contact details
	(A) Nairobi And Its Environs		
1	Caleb Wekesa	T3	
2	Faith Mwanda	T3	
3	Arthur Mathew	T3	
4	Fred Rotich	T3	
5	Wambui Muigai	T3	
6	Titus Koech	T3	koech.titus@gmail.com; NAIROBI
7	Dennis Murithi Mbirihi	T3	dgunmurithi86@gmail.com
8	Kamal Kishor Gupta	T3	kamal.gupta@schneider-electric.com
9	Ezra Kibet	T3	
10	Martin Mutinda	T2	
11	Ibrahim	NL	P.O. BOX 6321-00200 NAIROBI EMAIL: info@powerpoint.co.ke
12	Hillary Chisebe	NL	hillarychesebe@gmail.com
13	Albert Okobio Makokha	T2	okobio11@gmail.com
14	Brian Orina Asuma	T2	borina.asuma@gmail.com
15	John Gathuto Gathee	T3	gathutojohn@gmail.com
16	Kiprotich Bii	T3	denisbii99@gmail.com
17	Vanessa Amondi Otieno	T3	nessa.amondi@gmail.com
18	Victor Okuna	T3	E: okuna91@gmail.com; Tel: 0713801506
19	Victor Mokoro Muma	T3	mokorovictor@gmail.com
20	Unknown (Histoto)	NL	
21	Alfred Ochieng	T3	
22	Peter Wairia	T2	
23	Daniel Murage	T2	muragedanie@gmail.com
24	Kennedy Ngare	T3	kochiengngare@gmail.com
25	Sospeter Lotuko	T3	sunrays@sunrayssolar.net
26	Joachim Masira	T2	newsonjoachim@yahoo.com
27	Lucy Njoroge	T2	lcymn2014@gmail.com
28	Dancan Onyinkwa	T2	dancanonyinkwa@gmail.com
29	Kenneth Kipyego Kutto	T3	kkuto@yahoo.com
30	Alex Ayoyi	T2	aayoyi@kplc.co.ke
31	John Chege Kamau	T2	Jkamauchege11@gmail.com, 0716116964/0732966406

S. No.	Name	License Class	Contact details
32	Allan Ochieng	T3	allanochieng2008@gmail.com, 0716457677
33	Samuel Alila	T3	sammyalila@gmail.com, 0710807352
34	Daniel Mutiso	T3	dan.musila@gmail.com, 0715355806
35	Dennis Makau	T3	dmlelo2@gmail.com; 0726883963
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95	Philip Wekesa	T3	o724481582
96	Alex Mwiti	T3	o710120711
97	Dickson Juma Ogutu	T3	o700043582
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C.3. SOLAR PV TRAINING INSTITUTIONS

S. No.	*Name*
1	Strathmore University Energy Research Centre (SERC)
2	Nairobi Technical Training Institute
3	University of Nairobi
4	Jomo Kenyatta University of Agriculture and Technology
5	Eastlands College of Technology

C.4. SOLAR PV PROMOTERS AND GOVERNMENT AGENCIES

S. No.	*Name*
1	Ministry of Energy and Petroleum (MOEP)
2	Energy and Petroleum Regulatory Authority (EPRA)
3	Kenya Bureau of Standards (KEBS)
4	Kenya Power and Lighting Company (KPLC)
5	Rural Electrification and Renewable Energy Corporation (REREC)
6	National Construction Authority (NCA)
7	Kenya Revenue Authority (KRA)
8	German Society for International Cooperation (GIZ)
9	Lighting Africa Kenya-IFC
10	German Chambers of Commerce Abroad (AHK)
11	Kenya - Netherlands Development Organization (SNV)
12	Kenya Climate Innovations Centre (KCIC)
13	European Investment Bank (EIB)
14	Japan International Cooperation Agency (JICA)
15	German Development Bank (KfW)
16	Kenya Association of Manufacturers

APPENDIX D: QUALITATIVE RESPONSES TO INTERVIEW QUESTIONS

The technicians who practice without a license gave the following reasons for not having a license:

- *License application is in progress*
- *Have not attained the 2 years' experience needed to qualify*
- *Never has been a requirement for the scope of work*
- *Not qualified. Only have a certificate and EPRA needs a Diploma to be licensed (**Not true**)*
- *The certificate they hold (City and Guild) is not recognized by EPRA thus hindering license application*
- *Do not know the process of getting a license*
- *The process of getting a license is hard*
- *Not interested. Solar training too expensive*
- *Bad publicity about the process. It is rumoured getting license is difficult and many applicants fail the test.*

The reasons given for lack of clarity in importation tax exemption

- *Definition of specialized solar equipment needs to be more specific and include list of components such as inverters and accessories*
- *There is a lot of ambiguity as the Act is clear that equipment for the development and generation of solar is exempt, though KRA requires that VAT exemption MUST be applied for every consignment, and sometimes very time consuming*
- *KRA and EPRA give conflicting products as to what is tax exempt or not*
- *The issue of solar accessories which are still charged VAT although the Act mentions they should be EXEMPT*
- *When importing solar accessories, e.g. special communication cable, they are not exempted yet solar panels cannot be installed without frames*
- *There is a lot of confusion in the market on the interpretation of this Act, and should be made clear to all vendors and applied to all equally*
- *Any solar installation package should come with tax/duty exemption*
- *The interpretation of list of goods that are exempt is open for discussion*
- *The law is in grey-area especially panel and mounting structures importation. There is no precise description of components to be exempted.*
- *It is not clear which solar products are exempted e.g. inverter, chargers, solar pumps*
- *There is no clarity for some of the accessories for solar system e.g. DC cabling and mounting systems*
- *It is not clear which items are exempt. The KRA says its module only. So what does solar products mean? Does it include lights, batteries, inverters, etc.? This is not clearly stated in the regulations*
- *Ensure new components like solar fridges, solar bulbs, battery be made clear to KRA by EPRA for tax exemption*
- *Tax exemption on components keeps changing without prior communication to vendors/technicians*
- *Too much bureaucracy and very cumbersome. Make the procedure of getting the tax exemption simple, short and online*
- *Inspection takes too long at port*
- *There lacks public awareness*

- *From 2014 changes have been made on VAT. It has been changing. This affects many importers*
- *Not clear what products are exempted, and which ones are not. We use dedicated monthly material for solar modules, but these are not exempted*
- *Non-licensed importers and electrical contractors should be sensitized on the importance of EPRA licenses in order to avoid importation without licenses.*

The suggestions made for improving the process of obtaining clearance from the EPRA

- *EPRA is too slow on clearance. Improve on processing speed*
- *EPRA should leave out work of clearance to KRA*
- *Clearance of imported goods should be left to KEBS*
- *Clearance should be eliminated if vendor is licensed*
- *Give a clearance for a period of time*
- *The KRA and EPRA systems to be interlinked to minimize time and need of vendors representative visiting EPRA*
- *The For importers once we get import declaration suppliers final documents and certificates of conformity you issue clearance certificate for regulated items and the same while applying for clearance certificate payment should be per product not per mode.*
- *lead technician should be the one to inspect PV systems on behalf of EPRA. EPRA should notify the company's lead technician on the importation by their company*
- *Make the available online and find a way of linking EPRA to KRA's goods clearance system*
- *Workout on renewal of license and the expiring date. They should be allowed to import while license is being renewed*
- *Not formal process – no site visit*
- *There is confusion on what is tax exempt or not*
- *They should simplify the process*
- *Allow EPRA to assist vendors/importers with handling KRA*
- *It is not only inverter, battery, PV module involved in the installation, PV combiner box, as combiner box, PV mounting, PV cables, also get exemption if not overall costing will become high*
- *The clearance process takes too long. The importer might get some tax exemption but ends up paying too much on demurrage charges which dilutes the tax exemption aspect on solar PV equipment*
- *EPRA should provide exemption certificate when bill of landing is provided so that when goods land at the port it is easier to clear them*
- *It is difficult to get tax exemptions since KRA do not seem to understand the products that are exempt*
- *EPRA should provide importers and KRA with a clear list of what is exempt and what is not*
- *KEBS should be strict in checking on quality issues*
- *Not all vendors /contractors bring in good products*
- *KRA database with template easy to share with EPRA*
- *Have different classes of non-compliance*
- *From KRA side, process not efficient*
- *This is very important: Educating KRA officials on solar products and by products*
- *Between KRA and EPRA, a list should be issued to show what is exempt*
- *If EPRA has already cleared your goods, they should send the data to KRA*

- *Exempt goods like inverters and modules should automatically be exempt from both duty and VAT. One body should be in charge of doing that*
- *The permit should then be enough to issue*
- *ERC should issue clear guidelines on the KRA process*
- *Automation, specifically when imports by air, JKIA online gives 48 hours to clear goods before storage charges*

Why it is not necessary for EPRA to license vendors of solar PV Systems

- *If the value addition of the systems was already decided when the product was manufactured, there is no need for **compliance unless they were installing or designing** the systems*
- *For businesses **purchasing locally and not importing**, we do not see the need for licensing*
- *There is competition from vendors without licenses and **EPRA is not enforcing regulations***
- *Just check quality of imports*
- *If the available solar PV systems are good quality and the proper standards are followed the vendors cannot change anything*
- *Having worked in other industries like ICT, the licensing of vendors in solar PV does not make sense*
- *This is a form of placing handles ad restrictions to doing business to only certain groups of people in the society*
- *The market is very low/small to warrant licensing.*

Inability of licensees to serve their customers adequately is due to:

- ***V1 and V2 licenses limit up to 300 Wp** which is low, it should be increased to cover bigger systems. This is due to the licensing requirement that for these license classes, they need to have T2 licensed technician in their employment. Class T2 license holders can carry out solar PV system installation work for medium systems (system incorporating a single module or multiple modules up to 300 Wp) or multiple batteries which may include an inverter.*
- ***T1 and T2 technician license holders are limited** to handle small (system incorporating a single module or multiple modules up to 100 Wp) and medium systems, respectively; **needs to be extended to 10 kW***
- *The **license classification limits the firm in grid tied system** due to license class limits*

Other responses were:

- ***Electrician licenses are still desired** depending on voltage classes as low, medium, and high*
- *Scope of **T1** license be **increased to at least 300 Wp***
- *The license limits only up to 300 W installation with multiple batteries although the technician has the capacity to do more than that*
- *Some clients require consultancy services which would be best served under a different class*
- *There is a need to adjust the qualification upwards because it is primarily an off-grid qualification*
- *It limits me from installing higher systems despite the fact that I am able to install them*
- *The license does not guarantee proper workmanship*
- *The customers are happy and adequately served because I work with a licensed person*
- *This limits me to one contractor*
- *I cannot do grid connection*
- *Other than government tenders, there is nowhere else they consider the licenses*
- *It does not matter. Customers do not ask for licenses.*

Appropriateness of the technician classes

- *For the T3 license, 2 years professional experience is a long time since engineers pick up the skills within a short period*
- *Allow T2 to apply for T3 exams as long as they undergo training*
- *T2 to increase to 10 kW*
- *T1 and T2 are competent to carry out T3 works*
- *T1–no experience after training; T2 – 1 year; T3- 1 year*
- *Line between T2 and T3 is too thin maybe a consultant grade (T4)*
- *Tie the experience to academic qualifications*
- *Introduce experience as an attachment after training*
- *Have a minimum requirement of working under qualified personnel for at least 3 years for T1, 5 years for T2 and 7 years for T3*
- *T3 usually requires no solar installation experience unlike other classes so the experience requirement should also apply to T3* ***(not true)***
- *For a relevant degree holder, only one year of experience should be required to qualify for T3*
- *Reduce the experience years by half*
- *Increase the experience to ensure one is fully qualified for the class of license*

Other views on technician license classification are:

- *Integrate solar water heating to PV*
- *All solar licenses should be under one certificate*
- *Should combine the technician license classes with the electrician licenses. If somebody does T3, then they should be able to do any electrical work*
- *Hybrid grid resistance license*
- *Those with T2 should also be licensed to do the grid connection*
- *Eliminate T1, does not meet industry needs*
- *The classes are sufficient*

The technicians who consider the respective academic qualification requirements for licensing as a T1, T2, and T3 technician to be inappropriate propose the following changes:

- *Practicality of T3 licensing is more to do with electrical systems since it is the highest level in the category that directly interacts with the grid and other hybrids*
- *A practical exam where the technicians have to make practical connections, tests and a written exam*
- *Have a separate class for degree holders*
- *EPRA does not enforce the qualifications especially on the training experience*
- *Increase the cut-off*
- *Manufacturers' recommendations*
- *Electrical guidelines*
- *Degree holder should not be allowed to sit for T2 and T3*
- *Split T3 into system designer plus operations and maintenance (Degree); and installer (Certificate or Diploma)*
- *Be clear on what T3 license can do. Specify everything*
- *Those with certificates and more than 1 MW experience in solar installation should qualify for a T1 and T2 licenses*
- *They should focus more on the experience that one has*

- *T2 and T3 should be given to those with Diplomas because what they are taught is more or less the same*
- *T3 needs to be upgraded to grid-connect solar engineer*
- *Focus more on experience; set aside for practical work*
- *T1 level of education: A person who has experience, basic education, solar training, and passes exams should be licensed*
- *T1-Certificate; T2-Diploma; T3-Degree and above*
- *Qualifications should be biased towards electrical engineering*
- *A T2 license should be able to install a grid tied connection or all aspects of T3*
- *There needs to be an equivalent of the academic qualification in terms of experience e.g. a T3 license requires a degree with 2 years' experience*
- *Diploma holders should be allowed to do T3*
- *More through training on actual systems. The T3 license should be more strict*
- *In my view, all electricians with at least a certificate in electrical engineering qualify for T2 and T3 licenses. Only T1 license requires a vast installation experience*
- *T3-Degree/diploma and 2 years of experience; T2- Degree/diploma; T1-Experience over 3 years*

The product specific courses attended by the technicians include:

- *Outback power systems*
- *Victron power systems*
- *SMA*
- *Grid interactive and off-grid system designs and solutions*
- *Outback inverters and charge controller options*
- *Solar systems programming and set-up*
- *Renewable energy applications*
- *NABSEP*
- *Grid direct solar electric design and installation*
- *Performance modelling of PV systems*
- *Entrepreneurship in solar PV*
- *Assessing customers energy needs*
- *Solar PV components (panels, batteries, charge controllers, inverters),*
- *Solar PV appliances (lights, refrigerators, tv, radio, water pumping)*
- *DAS information systems and remote management*
- *Appropriate technologies for developing world*
- *Multimode and micro grid battery system*
- *Operations and maintenance*
- *Smart grid*
- *Pool heating*

The technicians made the following suggestions on how the solar PV training can be improved:

Course content

- ✓ *Include training on tools and equipment for testing PV systems*
- ✓ *System inspection, testing commissioning of end user*
- ✓ *Introduce training on methods of PV systems troubleshooting & diagnostics*
- ✓ *System sizing – cover widely*
- ✓ *Have a standard training curriculum. Different centres training for different times*

- ✓ *Incorporate site visits after training to acquire hands-on experience*
- ✓ *The T3 hybrid applications are not well covered*
- ✓ *Improve the content especially T2*
- ✓ *Scale up the scope of T1*
- ✓ *Incorporate more training sessions and refresher courses to create more awareness on emerging issues*
- ✓ *More emphasis on sizing and standards*
- ✓ *Increase capacity for T2 above 300 W*
- ✓ *The sector is changing fast i.e. the scope of work for T1 is no longer relevant to market needs*
- ✓ *Training for hybrid should integrate areas of mini-grid and micro-grid which are coming up in Kenya*
- ✓ *Include training for PV enthusiasts with no electrical background*
- ✓ *Provide avenues for capacity building to facilitate license upgrade*
- ✓ *More hands-on courses and regular updating*
- ✓ *Focus on ideals i.e. creating a mini-grid model for proper training*
- ✓ *Should be pragmatic i.e. competence based*
- ✓ *Engagement of OEM (Original Equipment Manufacturer)*
- ✓ *Content should be up to date with current market trends and products*
- ✓ *More emphasis on online systems for big solar PV systems*
- ✓ *Distribution / transmission training should be incorporated*
- ✓ *Content is shallow and needs to be expounded. Didn't cover much on relevance with Kenyan context.*
- ✓ *T3 content should be improved to factor in the physical aspect*
- ✓ *Improve content on solar water pumping*
- ✓ *Content should be informed by industry needs*
- ✓ *Development of curriculum and content should be industry driven*
- ✓ *Periodic review of training content to match the changing technology*
- ✓ *Ensure the training curriculum is market driven.*
- ✓ *Courses should be reviewed from time to time to integrate industry requirements*

Course duration

- ✓ *The courses need to run longer for course content to be appreciated more*
- ✓ *The time take for solar training is too short and does not guarantee one to be a specialist. Recommend a degree in renewable energy*
- ✓ *Training should take a minimum of 2 weeks*
- ✓ *Solar water pumping projects should be 2 weeks*
- ✓ *Make trainings continuous or modular*
- ✓ *Add 3 more weeks to the T3 grid-tied training or any other training*
- ✓ *Allocate more time for T2 training*
- ✓ *Duration of training should be increased particularly for those who do not have any engineering background*

Cost

- ✓ *Work on affordability of the cost of training*
- ✓ *The courses are very short but expensive so it puts off people. These courses should be spread and made more affordable*
- ✓ *Lower the cost of training to make it more affordable*

- ✓ *Make it affordable to new entrants by incorporating the training charges into the annual fee payable*

Training institutions

- ✓ *All technical colleges should be equipped well enough to train solar as part of electrical course*
- ✓ *Incorporate training in TVETs*
- ✓ *There should be training courses in all universities and colleges*
- ✓ *Solar PV training can be improved by taking the training to the county level especially in TVET institutions*
- ✓ *Being made accessible in TVET institution*
- ✓ *Not all technicians can access the training institutions. Therefore, the commission should create more training institutions within and outside Nairobi*
- ✓ *Regulator training sessions in training centres - RIAT*
- ✓ *Create a training centre that can impact practical training skills to professionals. A centre to be similar to Kenya power training school*
- ✓ *EPRA should arrange for training and inform the technicians through emails for availability*

Others

- ✓ *Introduce refresher courses*
- ✓ *Should be more hands-on i.e. add more practical sessions*
- ✓ *Should be relevant with current market needs*
- ✓ *Intensive trainings of lecturers and instructors especially on hands-on*
- ✓ *Updating technicians on new training*
- ✓ *Check background of study person*
- ✓ *Facilities not adequate*
- ✓ *Solar modules courses are out-dated*
- ✓ *Measurement apparatus need upgrade*
- ✓ *More emphasis on emerging trends like lithium ion battery systems, etc. This should be covered adequately*
- ✓ *Emphasis in the Kenya context should be the T3*
- ✓ *should be longer; use model for practicality*
- ✓ *EPRA should create awareness on the courses*
- ✓ *Product specific should be relevant to Kenyan standards*
- ✓ *Awareness of the technicians to the regulations of the EPRA to improve standards*
- ✓ *Training on how to draft a completion certificate*

The training institutions are of the opinion that there is a need to amend the regulations so as to for the following reasons:

- ♦ *Amend the regulations to include basic background in electrical engineering as a pre-requisite. Some institutions train people who lack basic background in electrical*
- ♦ *The regulations need to be amended to align the current division of work for the T1 and T2 licensees to match the current market needs*
- ♦ *Amendment also needed to introduce some more specialized categories such as grid-tied systems and hybrid systems as separate specialization under T3 license*
- ♦ *Amend so that T3 will be more specific*
- ♦ *Make regulations in line with the Energy Act especially on net metering*
- ♦ *Harmonize curriculum across all trainers*

- *The curriculum revised in November 2017 by Renewables Academy (RENAC) and National Industrial Training Authority (NITA) but recommendations never implemented.*

The technicians suggest the following to improve the manner in which EPRA examinations are administered:

Quality

- *Improve on the practical side*
- *Eliminate multiple choice questions*
- *Test relevant content. Currently, the exam is skewed more towards electrical than solar*
- *Improve quality of questions*
- *For T3, have more design-oriented questions*
- *Involve other industry stakeholders e.g. experts and training institutions in setting exams*
- *Test more on critical thinking rather than theory application*
- *T3 exams should not be one-sided. Aspects of mini-grids should also be tested*
- *The practical exams are not adequate; need to go deeper*
- *Practical for T3 to be a bit more thorough*
- *Oral examinations to focus on practical experience and the written exams on the theory*
- *Oral examinations should be centred on the technical and relevant areas being tested*

Time

- *Time taken to do the exams needs to be increased. Give more time to oral exams*
- *More time should be added to the written exams*
- *Time taken to do the oral and written should be less*
- *Have specific timelines for examinations throughout the year*

Examination venue

- *Devolve administration of exams*
- *More testing centres*
- *Decentralization of the examination centres with not more than 3 centres.*
- *The exams should not be done in hotels. EPRA should partner with educational institutions*
- *Exam centres should be at an accessible place with parking*

Others

- *Ensure prompt feedback on exam results*
- *Should have more than one exam then compute an average*
- *The degree should be enough to qualify one into getting a license so these other exams should be phased out*
- *Issue licenses online so that there is no need for visiting office*
- *Online status of processing license should be updated real-time*

Suggestions made by vendors on improvement of licensing process:

Application

- *The licensing of the contractors should be competency based*
- *Use the credentials and other examination bodies plus field experience*
- *Have a list of requirements*
- *Reduce the licensing requirements*
- *The process of doing returns is difficult so EPRA should make it easier*
- *EPRA should improve online portal on the online system so that it works smoothly and should be made simple i.e. employ user friendly online tools*
- *Information should be easy to understand because anyone can be assigned to apply for the license*

- *All the license application and renewal to be downloadable via the system*
- *Password resetting and updating of the postal details to be worked on*
- *They should reduce the requirements and even the period is very long*
- *Licenses fees to be paid via MPESA and eliminate need for presentation of the bank slip*
- *To improve on query responses from clients*
- *Foreign partner registering company; issues on work permit*
- *System failure should be minimal*
- *Should improve in a way that both the firm and technician both involved especially during renewals of licenses*
- *Leeway of 2 weeks before expiration of the license the vendor should be allowed to renew 2 weeks before expiration*
- *Costly for newcomers in terms of tools since EPRA requires a list of tools*
- *We don't have to come to the main office to renew licenses. It can be done electronically*
- *When renewing licenses, consider removing CR12 as you have approved during application*
- *Some tools required for the licensing process are not relevant e.g. Earth-loop tester. It is expensive and most of the time is not used*
- *Some of them are too costly. You can lease some of the tools and not necessarily own them*

Approval

- *The application process is simple and straight forward but the approval process within EPRA is tedious and takes a very long time*
- *Improve approval process*
- *Time of application for licenses to be approved is too long. More than 3 months*

License issuance

- *Allow the issuance of license certificate online*
- *The duration after the EPRA visit takes too long*
- *Improve information flow. Prompt feedback*
- *Notification on status of application*
- *Fully automated like printing or renewal of licenses*

Others

- *There are a lot of cheap substandard products in the market and there should be thorough vetting on importers licensing*
- *They should practice most enforcement*
- *Companies need to get their license i.e. not to depend on a technician so as to acquire a license. So if company can get the T3/T2/T1*
- *License should last more than 2 years*
- *Site inspection after online application within one week at most*
- *The licensing of the contractors should be competency based*
- *Detach the T3 license from applications for vendor/contractor/manufacturer/import license*
- *EPRA should have a branch office in Mombasa to shorten the process*
- *Should be fast and efficient / renewal take more than a week whereby it should take less than 3 days*
- *Key factor of time delay (reduce the waiting time / processing time to a week or less)*
- *Educate people on the system – people are having challenges in migrating*
- *Involve contractors / vendors as stakeholders*

- *Verification/inspection took time*
- *Prequalification to check on the competencies, capabilities, experience, quality etc*
- *There is no awareness*
- *The license signatory should be available at all times (at EPRA)*

The suggestions made by the technicians for improving the license application process include:

- *Practical bit needs to be engaging with a model for practicality*
- *Improve the speed of information delivery*
- *Payment options should be increased e.g. introduce MPESA payments*
- *Establish methods of validating years of experience*
- *Fast track the response time*
- *Issue the license via portal*
- *Be thorough on background check so that they determine good use of equipment hence quality of work*
- *Decentralize the process (examination)*
- *The time taken is quite a long period. Should be reduced to 2 months*
- *EPRA should do due diligence to ensure those being licensed have actual experience*
- *Include a demo page in the application process*
- *Evaluation of work undertaken by actual visiting sites not written and oral interviews only*
- *Should take less days*
- *Training and examination can be online*
- *Maintain their systems (IT). I do not have to go to EPRA's offices to resent my password*
- *The online portal is usually down*
- *No need for renewal online and going there physically*
- *Eliminate the process of resending documents during renewal*
- *The process is not clear at all. Carry out some more awareness on the same*
- *Raise the cut-off requirement for T3 to accommodate degree holders only*
- *Practical exercises to be in oral examination*
- *Shorten period between application and waiting*
- *Currently the method used is still appropriate, except other times to access the portal is difficult*
- *Current process is adequate*
- *Needs to be updated such that everything can be done online as well as obtaining the license online without having to go to EPRA offices*
- *Online exams to be introduced*
- *Website shouldn't have downtimes*
- *The portal should allow new account creation when one wants to upgrade*
- *Should be digitalized. Paperwork is tedious*
- *Attachments should be saved instead of disapproving once you are logged out*
- *Follow the rules of EPRA; EPRA should enforce rules and regulations*
- *Should really check on the practical experienced when it comes to applying of the license*

The suggestions made by the vendors for improving expedition of the license processing and issuance include:

- *Online application and marketing should available*
- *The License committee should meet more often to reduce waiting time*
- *Notification to individuals or companies when licenses are almost expiring*

- *Automate the process*
- *The license signatory should be available at all times*
- *Should be approved within a week*
- *Make process automated through online portal*
- *Prompt feedback after licensing application*
- *The committee members for license renewal takes too long to approve even when all documents are in order. They should do an online approval process*
- *Digitization of the entire process*
- *Decentralization of regional offices*
- *Undertake retraining*
- *Improve customer care so that stakeholder issues can be resolved faster*
- *Decentralize your licensing to other counties*
- *Vet technicians better*
- *Have a single team that does the entire process*
- *Allow your tribunal to arbitrate cases where there is a dispute*
- *Approval should be made faster*
- *Some licenses renewal / application should e downloaded via the portal once approved*
- *Assign AC managers to work with us and guide us*
- *Make 3 year licenses*
- *Online renewal very good*
- *To make the process online and automated*
- *Less follow-ups and update everything online*
- *Digitalize platform that is user-friendly*
- *They are very fast with renewals but for new licenses they should improve on speed*
- *Satisfactory with the current process*
- *Receipts should be sent online*
- *Reduce documents requested*
- *Have a one-off license i.e. pay Ksh10,000 and get the license without having to renew it*
- *Make the applications and issuance an online activity*
- *The inspection shouldn't be delayed. It takes a lot of time*
- *Should digitalize the process (E-Citizen kind of thing)*
- *Electronic issues by the click of a button*
- *Digitalize the process*
- *Increase personnel especially on system approval of documents*
- *In case of any changes on submission of paid licenses to be communicated to all stakeholders for the effective of submission*
- *Online application and licensing should be available*
- *To make the process online automated*
- *Satellite offices in major towns; decentralization from Nairobi office*
- *Same as the above/ should reduce the protocol of application and renewal process*
- *Deploy more manpower*
- *There needs to have more people working on the licensing processes to ensure the speeding up of the processing times*
- *Waiting period for renewal is too long*
- *Improve on the speed of issuing licenses. 5 working days should be sufficient*
- *Make it online*

- *Sometimes there are delays in processing*
- *Bring down waiting period to 7 days*
- *Maintain their systems so any day companies and technicians can get their licenses without delays*
- *Review C1, V1 fee*
- *Process duration-7 days*
- *EPRA should work on improving its internal approval processes, which is somewhat slow in my own view*
- *Inform applicant via email when to collect license*
- *Approval stage is slow EPRA to find ways of expediting the process*
- *In case of any changes on submission of paid licenses to be communicated to all stakeholders for the effective way of submission*

The suggestions made by the technicians for improving expedition of the license processing and issuance include:

- *Should provide a provision whereby one can renew the license for several years instead of yearly*
- *Provide e-licenses*
- *Decentralize license renewal to major towns but first-time applicants may be required to do it in the capital*
- *Digitize renewals*
- *Create regional offices to do licensing and processing of licenses*
- *Increase EPRA staff capacity*
- *Facilitate collection of renewed licenses in our local counties and regions*
- *Make it one week after approval*
- *Digitize current hardcopy contractor licenses*
- *Increase number of printers to ensure reliability and faster processing*
- *Renewal process should not be so tricky since EPRA has all the data*
- *Adopt an online tracking system*
- *Applied and issued the same day as with renewal*
- *Ensure minimal downtime*
- *Make online system more efficient*
- *Process should be fully automated*
- *Licenses should be processed within 2 weeks after approval of the board*
- *Should incorporate feedback via emails; website downtime should be rectified*
- *Digitalize whole process then use of courier services to deliver the license*
- *There is duplication of process when a license is lost and during same period the license expires*
- *Improve their customer service. It is very poor*
- *No need to reprint license*
- *Change mode of license renewal. Give card system but payment to be done every year*
- *Use the scanned receipts instead of waiting for physical receipts*
- *Automate the process e.g. to set interview dates, track application progress etc*
- *EPRA is understaffed; the few employees are not fast enough*
- *No need to go to the office physically' MPESA should be active to pay for the fee charges*
- *Should communicate sooner/effective communication. Use the appropriate experts to communicate*

- *Online portal to accept receipts and quick responses with the bank*
- *Lessen time between application, notification of exam results and the actual handing over of license.*

The 22% and 9% of the technicians and vendors, respectively who either partly or wholly disagreed with this license upgrade method suggested the following to be better ways for upgrading:

- *CPDs together with professional oral practical interviews. This is why technicians' capability can be judged*
- *More emphasis on hands-on practical training and exposure*
- *The CPDs should be used to make technicians updated on the current emerging trends on the scope of that license and to be used for a period of like 3 years before upgrading to the next class of license.*
- *The CPDs should be a pre-requisite to sitting of exams of the next class.*
- *The CPDs should enable technicians earn professional points (increase in point how PMP certification works)*
- *The system should be tested and proven for there to be an opinion*
- *Years of exposure are adequate*
- *Going through the test, no need of other subjections*
- *The training is costly. Make them cost effective*
- *Experience in solar systems is what is paramount*
- *Consider work experience*
- *License upgrade should be based on the scope of higher profile projects carried out successfully with the preceding license*
- *Practical experience might be better than training*
- *Training alone might lead to risk of commercialization of license upgrading*
- *Experience and an increase in the number of projects handled*
- *Upgrading has been done based on the years and not actually on the CPD. It must be strictly on CPD*
- *Still need practical exposure to upgrade to ensure technician knows the job*
- *Both training and experience should be considered for upgrading*

The suggestions relevant to changing the form of the license:

- *Introduce more security features*
- *Make card systems take 5 years before replacement*
- *Incorporate more digitization*

Other proposals are:

- *EPRA can issue both card and certificate*
- *EPRA should organize forums to educate the general public about using qualified personnel to do their job and advertise on TV*
- *EPRA to carry out more media sensitization campaigns to create awareness on the existence of licensed firms and technicians who deal with solar PV installations*
- *Publicizing licenses via the media. The license is being used by briefcase companies chasing tenders. It beats the purpose of regulating the industry as technicians trade/sell their licenses*
- *Class T3 license should be issued to professional Engineers registered with Engineers Board of Kenya*
- *EPRA should issue stickers to be displayed on vendors premises "Licensed by EPRA"*

- *EPRA should create a section on the ERC where a client can view the work that you have done and the companies you have worked for*
- *Eliminate locations details and name to avoid profiling applicants*
- *EPRA should be more proactive in confirming whether installations have been done by professionals.*

The standards cited are:

- ✓ *S IEC 62109-1:2010*
- ✓ *KS 1674-2003*
- ✓ *IEC 62109-1*
- ✓ *Kenya standard, EPRA regulations on solar PV, IEC 60634*
- ✓ *ISO 450001, ISO 14000, ISO 9000, OHSAS 180001*
- ✓ *Electrical standards, BS*
- ✓ *NEPA, NREL, RS76H:2008*
- ✓ *Electrical code Kenya*
- ✓ *ISO standards, KeBS, IEC standards, IEEC standards, PV cycle*
- ✓ *IEE, ISO, SGS*
- ✓ *Kenyan grid code*
- ✓ *Total group standards*
- ✓ *Kenya standards, IEC, British standards, MEC*
- ✓ *IEE wiring regulations*
- ✓ *ICE, PAC, ROHS, Eurotins standards*
- ✓ *Makueni government standards*
- ✓ *There are softwares/information by the international bodies that take care of such*
- ✓ *IEEE SCC21, 1547, 937, 1361, 1562*
- ✓ *Safety standards*
- ✓ *IEC 6210-2.2011*
- ✓ *ISO 60 standards, lighting and rapid shutdown*
- ✓ *IEC, IEE, 2012 Energy regulations*
- ✓ *IEC, AnSci, BS*
- ✓ *From SMA design web*
- ✓ *IEEE, IEC, TC, SEMI*
- ✓ *IEC / TS 62548*
- ✓ *IEEE, Energy Act*
- ✓ *The provided by the manufacturer*
- ✓ *Service assurance*
- ✓ *ISO 9001: 2008 Certified*
- ✓ *ASTME 3010-15, ISO 29-290, BS EN50341-2-6*
- ✓ *NEC Article 690*

Views on why the minimum warranty validity period stipulated in the regulations is not practical:

- *Big variations between different manufacturers with different prices and quality assurance issues*
- *In most cases, there is no infrastructure to support the warranty*
- *The minimum warranty for charge controller does not match with the manufacturer warranties are changing with improved technology and the regulations should be reviewed to address this*
- *Warranties are based on brand and manufacturer and hence cannot be set by ERC*
- *Manufacturers not issuing such warranties*
- *The warranties are so long. It becomes costly on vendors*
- *Because they are installed in places with different environmental conditions*
- *Higher warranties are pricy, customers are not ready to pay for them*
- *Depends on the quality of device from manufacturers and cost of the item*
- *We face challenges on usage of the products by the customers hence market warranty is less than stipulated in the regulations*
- *Warranty on inverters to give practically 10 years*
- *Some product warranties are too long*
- *The manufacturers are within 5 years limit*
- *Warranty periods do not match what manufactures give*

- *10-year warranty on an inverter is rare to get from a manufacturer*
- *Warranty periods not matching what contractor and vendors get from manufactures*
- *It is reasonable to the quality in the market*

The reasons given by the vendors for not filing are:

- *No knowledge of this though I feel it should be enforced especially when a firm is renewing its annual license*
- *We have been doing it with other licensed companies*
- *I don't know the process*
- *Unlikely to get the actual figures on ground*
- *No sensitization or awareness has been done about this*
- *Complicated process especially on declarations involving purchase prices and selling (confidentially)*
- *Oversight*
- *We seek exemptions on specialized solar equipment from EPRA and therefore they have the details*
- *Have minimal solar imports.*

Recommended amendments or additional sanctions for licensees who do not comply with the regulations

- *Withdrawal/Suspension of license for a period of time e.g. one year*
- *Non-compliant vendors should be deregistered / licenses cancelled*
- *Charge a small fee*
- *Vendor should be penalized heavily for none standard products that do not comply with regulations*
- *The vendor, technician, and customer should be penalized for installation by non-registered technicians*
- *Goods should be confiscated at customs for those who are not licensed to import solar products*
- *EPRA should be strict in enforcing the regulations to improve standards and quality*
- *Non-compliant companies can be warned first and then licenses revoked for one year*
- *More sensitization of the public on the regulations is needed*
- *EPRA should withdraw the non-compliant vendors and technicians from the database and should work with local authorities*
- *Carry out more inspections on sites where solar is being installed*
- *Establish an arbitration tribunal to solve real disputes affecting clients in the solar PV market*
- *Penalties should not be too harsh to contractors/vendors. Business should be allowed to continue. no cancellation licenses*
- *The penalties should be reduced to about half a million*
- *Find a way to accommodate good technicians; EPRA should find a way to license them to avoid liabilities*
- *Organize workshops/seminars for contractor/vendors to update them on emerging issues in the industry and also collect their views*
- *Penalties for first time offenders should be different from second- and third-time offenders*
- *Introduce fines or penalties instead of cancelling the license for non-renewal*
- *Penalties should be scrapped*
- *They should be forced to undertake retraining to ensure they comply with the regulations and standards*

- *Create a database of blacklisted technicians and reason for black listing and share with the public*
- *Assess their installations first, if done correctly, advise them to get a license*
- *Assess non-compliance 3 times before penalizing them*
- *Too small a fine: 20,000 minimum fine; 100,000 company fine*
- *Detention for 6 months then they are released and allowed to resume with the work*
- *Penalty of not using the license for 6 months*
- *Widen the network of inspectors. Other bodies (government authorities) should assist with this within respective counties*
- *License downgrading*

Challenges in working relationship between firms and licensed technicians:

Challenges given by vendors:

- *Technicians moving into other companies*
- *It is expensive*
- *He is employed elsewhere*
- *Remuneration issues*

Challenges given by technicians:

- *They were not following the contract agreements*
- *Delayed payments*
- *Companies are never willing to pay, use intimidation*
- *Gender imbalance – she is the only female technician in the company with T1 license*
- *Inability of being actively involved in the projects of the company*
- *Design issues-they will prefer short cuts and prefer low quality*
- *Payment issues- they would like to be covered longer for less amount of money*
- *Some firms attach your license but do not involve you in jobs*
- *Agreements should be project-based to avoid companies using technicians' license after firing the technician*
- *Financial challenges to fund projects competition from other non-professional individual bodies*
- *Lack of transparency monitoring in relation projects carried by firms.*
- *Quality of installations was substandard*
- *Working conditions (10 hours in the sun)*
- *Very little facilitation money*
- *Mistrust between the technician and the firm*
- *Not full-time employed so as to leave from current employment for design and managing*
- *Fails to acknowledge the work/pay as per agreement. Negotiations for every low pay for the license limited scope at the license bounds.*

Economic and social impacts of the regulations

Technicians

- *Has created jobs*
- *It has created professionalism in the industry*
- *It has created a pool of qualified technicians*

- *Electricians now appreciate that solar PV work is now a specialized service which requires competence and training*
- *The regulation of solar PV technicians has given rise to qualified technicians and reduced number of faulty installations*
- *Professionals are now more engaged especially in rural areas*
- *Installation is done by qualified technicians*
- *Stand-alone systems are done professionally*
- *Professional maintenance and installation*
- *Sector has been regularized and qualified and licensed technicians are the ones who are mostly installing solar PV systems*
- *Clients feel comfortable working with licensed technicians*
- *There is fair play among technicians and the industry; recognition of technicians in the market*
- *Professionals now gain more employment in solar industry*

Quality and Safety

- *Less accidents*
- *Improve quality standards; risks have been reduced*
- *Better safety standard; quality installation*
- *Reduce substandard PV installations*
- *Made it possible to regulate quality of components getting in the country (**NOT SURE**)*
- *Safety and standards have been maintained*
- *The regulations have streamlined works in solar PV installation*
- *Improved safety assurance to the customers; assured the public that solar PV technology can serve their electricity needs; improved the quality of installation done for pubic*
- *Ensured top quality in delivery of solar PV training and installation*
- *Improved quality rural electrification*
- *Increased the quality of services and products to customers*
- *Proper installation of PV systems unlike before*

Others

- *Reduction of GHG and global warming*
- *Has improved on awareness; has created avenues for buying PV solar technology*
- *Solar PV uptake has improved*
- *There is more awareness and interest in renewable energy and solar PV in particular*
- *A lot of solar PV projects in Kenya*
- *Has brought sanity into the practice*
- *The public is accepting solar works as workable and long lasting*
- *Reduction in over-reliance in grid power*
- *Has created order in Solar PV installation reducing risks*
- *Reduced quacks in the business*
- *Availed power on competitive rates*
- *More efficient systems*
- *They have slowed down the renewable sector*
- *More and more SMEs are willing to go the solar way but initial capital investment has been a challenge and hindrance*

APPENDIX E: STAKEHOLDER VALIDATION WORKSHOP REPORT

1. Background

The Energy and Petroleum Regulatory Authority (EPRA) contracted Sustainable Energy Initiative to undertake an impact study of the Solar Photovoltaic Systems regulations 2012. Upon undertaking the study, the draft study report was uploaded by EPRA in their website and also circulated to the stakeholders to validate and give further input on the study. Further, a stakeholder validation workshop was held on 31st October 2019 at Sarova Stanley Hotel, Nairobi. The study findings were presented with a view to receiving feedback from the solar PV stakeholders.

2. Participants

The workshop participants included solar PV technicians and contractors, government agencies, non-governmental organizations involved in solar PV work, and solar PV training institutions.

3. Discussions and workshop activities

The study finding and the proposed draft regulations were presented to the participants by the team of consultants namely Dr. Keren Kaberere – Lead Consultant, Kimani Muhoro – Legal Expert, and Evan Kimani the Second Consultant and Solar PV Expert. The participants raised the following questions and comments and responses were given as shown.

a. **Study report**

Name	Organization	Question/Comment	Response
Andreas Berlepsh	KEREA	i) KEREA was not involved as one of the key stakeholders in the Solar PV sector	All the licenced technicians and contractors received a copy of the questionnaire. The percentage of participants (13.3%) provided in the report is of the stakeholders who responded to this questionnaire. Members of KEREA who are licenced technicians were involved in the study. KEREA Secretary Enos Otieno and chairperson Kamal Gupta confirmed this. Some respondents received questionnaires from KEREA and reverted through them.
Rathika Thakkar	Greenlight Planet	i) What is the number of plug and play consultants interviewed for the Solar PV Regulatory Impact Assessment	The Energy (Solar Photovoltaic Systems) Regulation 2012 did not cover plug and play devices. The need of regulation of plug and play devices be addressed in the draft regulations. SEI and EPRA to consult

Name	Organization	Question/Comment	Response
			all the players in the sector to have their views before a final draft is prepared. Meeting organized with GOGLA on the 8th of November to take inputs from this sector.
Dr. Xavier Francis	JKUAT IEET	i) There seems to be a problem with the sample size since the study KEREA who are a key stakeholder claim to not have been involved. ii) The study did not involve people who are not registered with EPRA. How can more people be licenced	i) All the licenced technicians received a copy of the questionnaire. The percentage of participants (13.3%) provided in the report is of the stakeholders who responded to the questionnaire. The sample size was determined using scientific means. Details of this provided in the draft report. ii) Each of the data collectors was tasked to find at least two unlicensed individuals.
Patrick K. Tonui	GOGLA	i) The study found that "a majority of the installed systems are of 300 Wp". Other studies seem to indicate that more than a million pico systems are sold in the Kenyan Market annually. There seems to be a gap between these two findings. ii) The study seems to focus on 10 Wp plug and play devices. A lot of the systems in development are	i) Plug and play systems are not considered installed systems the majority described relates to systems that are installed and not those that come as a ready set. ii) There is currently available a standard for plug and play systems of up to 10 Wp (KS2542:2017). There is currently no Kenyan standard covering

Name	Organization	Question/Comment	Response
		systems that are of sizes greater than 10 Wp to a maximum of 350 Wp. This is not captured in the study.	consumer devices of higher capacity (10 Wp – 350 Wp). The draft regulations provides for these to be registered under subsequent standards or equivalent international standards. Further discussons on this to be held on the 8th of November with GOGLA and some of their members.
George Musembi	Nabico Enterprises Limited	i) How does the study affect people who are primarily importers and distributers of Solar PV systems and who do not install. The cap on the systems that can be handled by technicians is not clear from the regulations	There is no limitation on importation of PV systems. The cap provided for in the draft regulations is on installation of solar PV systems. Rewording of this phrase on the regulation has been made to make this clear.
Keerthy Raghavan	Cosmosol	i) Option for renewal for 2-3 years is a good recommendation ii) Grid feed systems are very different from the typical solar photovoltaic system. As such these systems should be treated with a lot of care. iii) When are we going to have the net Metering regulations?	The net metering regulations are a totally different regulation altogether and would be discussed in a separate forum.

Name	Organization	Question/Comment	Response
Odhiambo Odawa	Technical University of Kenya	i) Very grateful that KEREA was involved in the regulatory impact study ii) It was noted that solar PV licensing courses had been thrown out of universities like the Technical University of Kenya. What is the Authority doing to ensure that universities train the licensees?	Other universities still offer the solar licensing course (JKUAT, University of Nairobi). The observation at the Technical University of Kenya may be a localized problem.
Sebastian Robert Mwakumbaku	Clean Power Kenya Limited	i) Safety signs have been part of the training requirements. Institutions should come up with proper and standardized safety signs. ii) The regulations are not clear on what happens when a contractor has a project that exceeds the allowable limit of the technicians. Is it possible to have an allowance on the maximum limit?	i) This is a good idea and will be looked at keenly when developing curriculum. ii) It is possible to do projects above the prescribed limit as long as it is under the supervision of a licensed technician of the set class
Joyce Kefa	Transafrica Water Systems	i) Importation should not be tied to selling. KEBS has enough standards. Introduction of more rules through EPRA leads to inefficiencies.	The regulation proposes methods of enforcing the standards provided by KEBS.
Andreas Berlepsch	KEREA	i) The regulation seems to focus on product importation as opposed to system importation. System importation requires high Engineering and should be more regulated.	When clearing systems. KRA recognizes products. That's how they clear the goods. Systems are regulated through contractor and technician licensing.

Name	Organization	Question/Comment	Response
Sylvester Makaka	KAM	i) Lifecycle ownership of the project should be considered. The regulations have not outlined what happens to panels and BOS components after the project has been completed	There has been a regulation developed by the stakeholders and NEMA on the disposal of e waste and specifically waste generated from solar waste. This Process has not been completed. Once it is completed, there could be a concrete answer to this. The draft regulations require that solar waste be disposed according to NEMA guidelines
Samuel Wanyoike	Licensed Technician	ii) The completion certificate aspect of the regulation should be implemented in a secure way. It may be appropriate to use an online issuing system	Security is mandatory for the success of this requirement and shall be considered in the implementation stage
Eng. Buge Wasioye	M&E consulting Engineers Limited	i) The proposal on use of CDPs is a good proposal. It may be appropriate to include capacity building as one of the avenues through which one can gain career development points.	The Draft regulations provides opportunities for licensed technicians to gain CDP points when they give trainings on solar systems.
Kiprotich	Masters student	i) Does the regulation cover instrumentation and metering? Are the meters used to inspect solar systems calibrated and by which organization?	Kenyan standard KS IEC 61557-1:2007 covers elements of instrumentation and calibration.

Name	Organization	Question/Comment	Response
Dr. Waita Sebastian	Solar Academy, University of Nairobi	i) From the research presented by SEI, is the completion certificate a standard document ii) Plug and play devices should probably be called plug and light devices. There is no play involved in any of these systems.	i) It was found that the completion certificate was not a standard document. The draft regulations describe the bare minimum that should be covered by standard completion certificate. A form shall be downloaded for each installation from the regulators website.
	LJOS	i) How much of manufacturing was integrated into the study. Did SEI consult with KAM to inculcate the manufacturing aspect of the regulation ii) It is not clear from the draft regulation how technicians who are attached to Solar Photovoltaic manufacturers will earn CDP points	i) The Kenya Association of Manufacturers was one of the organizations that was interviewed. A special category has been created in the regulations to meet the needs of manufactures. ii) No technician shall be required for manufacture category. Manufactured equipment shall need to meet the local standards quoted in the study.
Sandra		i) Is it possible to have the licensed technician involved in the day to day running of the solar PV firms? A lot of contractors have licenses only for the purpose of compliance.	The draft regulations propose that a technician has to sign the completion certificate and design declaration. This proposal will ensure that S/he is involved in every Project

Name	Organization	Question/Comment	Response
Dr. Xavier Francis	JKUAT IEET.	i) The study seems to be flavored towards a change in regulations. ii) The study does not show why there are not many technicians who are licensed as solar PV technicians. There are a large number of technicians who practice but are not included in the study. iii) What capacity assessment was done to determine the educational specification for the newly determined classes?	The point of regulations is largely to protect the consumer and the final client. There is need to ensure that the work done by technicians is quality work. To do a solar PV plant one needs to have at the very least engineering skills. In the event that the technician has not done electrical engineering, S/he should demonstrate that S/he has knowledge of three (3) Electrical engineering units
Eng. Arthur Matthew	Registered Electrical Engineer. Licensed Technician	i) The Electrical Engineering degree takes 5 years. It takes at least two years for someone to conceptualize the flow of electricity. Before someone truly understands electrical concepts five years have passed. Saying that three units related to electrical engineering are enough to enable someone work on an electrical system is simply false. Three units cannot be enough.	From the study, it was observed that persons trained in basic electrical engineering and undergone solar PV training have understanding and skills require to undertake solar PV works.

b. **Draft Energy (Solar Photovoltaic Systems) Regulations, 2019**

Name	Organization	Question/Comment	Response
Dr. Waita Sebastian	Solar Academy, University of Nairobi	i) The draft regulations limit the work of class ST1 technicians to single or multiple panels not more than 400 Watts and a single battery system to a maximum of 12 volts. The wattage of the panel implies the capacity of the single battery to be installed by these technicians is very high. Maybe even higher than what is commercially available. There should be additional clarification on that. ii) The draft regulations limit the work of ST2 technicians for to 2 kW for solar water pumping. Is this the rating of the pump or the PV array? iii) Why the limitation of battery voltage to 48 Volt for systems installed by ST3 technicians. The technicians are competent enough to determine the appropriate system voltage. iv) The regulations have not explicitly stated that the ST4 technicians should work on systems greater than 50 kWp although this seems to be implied. v) 6 months seems to be a short time after revocation for a licence to be revoked. There should be more time allowed.	i) Specifications on battery voltage to be removed from the regulations as this is limiting to the system designer. ii) The requirements for ST2 refer to the size of the array and not the motor. iii) Technicians of higher classes can do all the work of the lower classes. Systems of nominal voltage above 48V are considered special. iv) The six months was considered since the renewal period has been extended from 1 year to 3 years.

Name	Organization	Question/Comment	Response
Evan Kimani	Sustainable Energy Initiative	i) The regulations are explicit to maximum power point tracking charge controllers.	Providing design specification in a regulation is limiting. This to be changed to "Charge Controllers"
Kevin Crowford	Premier Solar Group	i) The regulations are not clear on how the current T3 technicians can be transitioned to ST4 technicians	ST4 is a new class of licence. The current T3 technicians will be transitioned to either ST3 or ST2 depending on the projects that the technicians have undertaken. On meeting the requirements of the ST4 class any of the licensed stakeholders to apply for the same.
Patrick K. Tonui	GOGLA	i) Battery warranties proposed in the draft regulations are misaligned from what is in the market. A 10 year warranty for batteries is not technically feasible ii) The regulations are not clear on the reporting of data to the authority. Is this historical data?	i) Warranty duration was made on warranty periods of premium products. Warranties of products have been adjusted to cover all products. ii) The reporting of historical data is in the last five (5) years. The regulations have been in place for this period
Eng. Fredrick Mutinda	Licensed Technician	i) The required CPD points on renewal application may not be achievable. There are not enough projects. Aspiring Technicians	i) Regulations are to license solar PV technicians. CPDs points are set to regulate ensure the technicians are practicing what they have been licensed to do and also

Name	Organization	Question/Comment	Response
		could do the exams and do practical projects as attachments. ii) EPRA can additionally carry out seminars on licensing and have them as CPD points	continuously improve on their profession. ii) Trainings by EPRA may be limiting to licensees.
Titus Mwenda	Licenced Technician	i) Are the 30 CPD points counted from the date of signing of the regulations or all historical projects done by the licensees	The provision of data for projects done will be limited to a period of 5 years. The solar PV regulations have been in place for the last 5 years
Tarwish Lemeeh Charles	Licensed Technician	i) Specifying the battery voltage and MPPTs could be limiting to design ii) Who is going to oversee transition from ST3 to ST4 iii) The Electrical Engineers registered by the Engineers Board of Kenya. What is the implication of other registration bodies such as the Kenya Engineering Technology Registration Board	i) The requirements on battery voltage and MPPT to be removed from the regulations. ii) Regulations have set out clear transition from ST3-ST4. iii) The big projects have to be signed by Electrical engineers. It is important that this engineer understands solar PV systems. The regulations are not limiting as they provide an alternative way for licensing those who do not have the EBK registration
Joyce Kefa	Transafrica Water Systems Limited	i) Warranty for products are usually provided by the manufacturers. Setting a cap on the minimum requirements on the warranty may be a problem.	The warranty periods has been adjusted to cover majority of products that are meet KEBS standards.

Name	Organization	Question/Comment	Response
		ii) Is it possible for the company to gain CDP points from offering trainings	CDP points are to be gained by technicians and not the company. If the technician administers the training then s/he gains CDP points
Victor	Redavia	i) The draft regulations require that licensees provide data on projects done in Kenya. What happens to projects that are done in other jurisdictions?	The Authority is interested in collection of data on projects done in Kenya as part of its mandate. Data on projects done in other jurisdiction are not useful
Laban Thimo	Licensed technician	i) It is possible that the reporting of data would be wrong when the limits of practicing of the license is strict. ii) Every company should provide a policy on waste management	There are fines meant to encourage the stakeholders to comply with the regulation
Sylvester Makaka	KAM	i) It is worrisome when a regulator has the power to impose fines ii) How will the fines be administered? It is possible that the officers will be punitive with the administration of these fines iii) Is the mandate of declaration of non-standard components a mandate of EPRA or of KEBS,	In the absence of fines the regulator is left with revocation of licenses or prosecution. These are seen to be harsh. The principles of natural justice to be followed in the administration of fines Registration of appliances by EPRA is not a unique system. It has been implemented for refrigerators and air-conditioners

Name	Organization	Question/Comment	Response
Odhiambo Odawa	Technical University of Kenya	i) There are a lot of projects that are being done by the members of KEREA. The members who feel that the projects are not enough should join KEREA ii) The regulations should include a provision that makes it mandatory for Solar PV companies to have interns. CDP points can be gained through this iii) Was the Kenya Qualification Authority consulted in the development of the standards	Hiring of staff may be determined by labour laws and it may not be possible to enforce regulations that forces a firm to have interns
Binagwaho Gakunju	Dlight Africa	i) What is the takeaway from the deliberations on plug and play devices	There is currently available a standard for plug and play systems of up to 10 Wp (KS2542:2017). All plug and play devices of up to 10 Wp have to comply to the requirements of this standard. At the moment there is no Kenyan standard covering consumer devices of higher capacity (10 Wp – 350 Wp). The draft regulations provide for these to be registered under subsequent standards or equivalent international standards.

Name	Organization	Question/Comment	Response
			Further discussions to be undertaken on meeting with GOGLA on 8th November 2019.
Francis	Power and Solar Systems Limited	i) The penalties are exceedingly harsh to technicians yet they have already complied. The punishment should be harsher to people doing installation work without licenses ii) There should be a better way of filing returns. There should be allowed time for reviews and correction since there are fines set for provision of wrong data to the authority.	i) Adjustments have been made on the fines. ii) The process of filling returns to be determined once the regulations are gazette.
Delilah Ibrahim	Center for alternative technologies	i) Are international certifications acceptable under the current standards?	The referenced certificates have to be approved by locally recognized institutions, for example a bachelor of science degree from other countries has to be recognized by the commission of University Education
Dr. Xavier Francis	JKUAT IEET	i) CDP does not work. We should simply do away with that requirement. The Engineers Board of Kenya as the body that registers engineers does not require CDP for maintenance of records. Why then	i) The Engineers Board of Kenya has a CDP program. Anyone who has worked in the solar PV sector knows that the inverters that were available 5 years ago are not the same inverters that are available

Name	Organization	Question/Comment	Response
		is it proposed that this be brought to the PV sector? Nothing changes in the Solar PV sector. An inverter is always an inverter ii) EPRA should reconsider what is means to be a regulator. The focus should be on the quantity of technicians that the regulations allow. The regulations should open up the system so that anyone who wants to can be licensed to carry out installations. Even lawyers and economists can be licensed. People have mid-life crisis and decide to change careers. EPRA should only look at the quality of training offered by the regulatory Authority. iii) We should not assume that everyone can afford to buy a suit and tie, have a vehicle. We should not assume that anyone can pay fines or the renewal fees.	now. In a sector like that it would be prudent to ensure that the sector players keep abreast with the best systems available. ii) The focus of EPRA Is to ensure that the Wanjikus and Otienos who pay through their last coin for electricity get quality work done. Therefore, it is imperative that everyone who works in the sector be prudently licensed. It is ok if the lawyers and economists have mid-life crisis and decide to become engineers. They should follow the right procedure. Go to college or do a grade test and get the necessary skills to be able to act in the sector. iii) There should be an incentive to enable licensee do the right thing. It is possible for the stakeholders to have a fine of KShs 100 for practicing without a licence but this would mean that it would be cheaper for contractors to pay the fine than to employ a licensed technician. The amount of fines charged can be looked at again but one should consider both sides.

Name	Organization	Question/Comment	Response
Eng. Ephantus Kamweru	REREC	i) A key aspect of the sector that has not been captured is the operation and maintenance of systems. This should be addressed. ii) How will the enforcement of warranties be addressed	The regulations provide for gaining of CDP points through operation and maintenance of solar PV systems. Among mandatory items provided to the end user are warranty documentation. If user raises an alarm to EPRA or if EPRA inspects the system to find it non-conforming, necessary measures shall be undertaken.
Maxwell	Licensed Technician. Registered Engineer	i) The transition period for the proposed regulations is one year. There should be assurance that in one year there would be enough technicians who are registered engineers to be licensed as ST4 Technicians ii) The regulations seem to have a bigger emphasis on design than construction. On licensing, the regulations require more design declarations than completion certificates iii) There is need to decouple importation from Construction work. It should be apparent from viewing a licence what the licensed	There is a good quantity of technicians that have worked on systems above 50kW. This lot shall be considered if they meet the other requirements. Design declarations ensure the technician understands the needs of the customer and supplies the customer with systems that meet customer requirements. Regulations rephrased to demonstrate one can take undertake a specific role in the solar business chain.

Name	Organization	Question/Comment	Response
		company does either importation or installation work	
Dr. Waita Sebastian	Solar Academy, University of Nairobi	i) Troubleshoot and maintenance of systems should be captured on CDP ii) It is not clear what the regulations mean by "Every day the offence is committed"	There is provision for maintenance as avenues of gaining CPD points are provisions of the draft regulations. Clarity has been made on the new amended draft regulations.
Eng Arthur Matthew	Licensed Technician. Electrical Engineering	i) The regulations require the preparation design declaration, preparation of as built drawing and issuance of completion certificates. This is a lot of work. Are there any rates defined for this work? Projects may become more expensive due to technicians charging fees	This are defined in the standards as key things that have to be undertaken by a practitioner.
		ii) Some projects do not need financial analysis this as set out in the regulation. iii) Can the penalties be looked at in terms of the licence classes? It is not logical to have a 50 kW project fined similarly to a 400 Watt project	The draft regulations specify that ST4 technicians should have knowledge of financial analysis. Penalties are imposed to ensure technician/contractor does the right thing irrespective of the system size.
John Nelson	Licensed Technicians	i) 60% of the work done in solar PV systems is mechanical. We should	i) The draft does not limit any mechanical engineer. One needs to

Name	Organization	Question/Comment	Response
		not rule out Mechanical engineers from the regulations ii) 50 kW system is limiting for T3 technicians	demonstrate that S/he has done three electrical Units/courses ii) The design requirements of large systems (greater than 50 kW) are a lot more complicated than those of solar home systems. The decision to have this separation is based on this.
Daniel Kitwi	AMDA	i) There are a lot of companies that do work in other jurisdictions. It is easier to run all projects in the region in a hub like Nairobi and this implies use of technicians from the country. This needs to be considered	Regulation address practitioners in the country.
		ii) The name of the license is a "technician license". Why is it that Engineers want to do work that is meant for technicians. The classes refer to technicians the work should be done by technicians and not engineers. iii) CDP should apply in the event of an upgrade.	Noted.

APPENDIX F: KENYA AND INTERNATIONAL STANDARDS RELEVANT TO SOLAR PV SYSTEMS

The following Standards have been submitted in soft copy.

Component Standards
1. KS IEC/TS 61836: 2016 Solar photovoltaic energy systems - Terms, definitions and symbols 2. KS IEC 61215:2005 Crystalline silicon terrestrial photovoltaic (PV) modules- Design qualification and type approval 3. KS IEC 62108: 2007 Concentrator Photovoltaic (CPV) Modules and assemblies- Design Qualification and Type approval 4. KS IEC 61646: 2008 Thin-film terrestrial photovoltaic (PV) modules- Design qualification and type approval 5. KS IEC 61730-1: 2004 Photovoltaic (PV) Module Safety Qualification- Part 1: Requirements for construction 6. KS IEC 61730-2: 2004 Photovoltaic (PV) Module Safety Qualification- Part 2: Requirements for testing 7. KS IEC 61853: 2011 Photovoltaic (PV) module performance testing and energy rating Part 1: Irradiance and temperature performance measurements and power rating 8. KS IEC 60891: 2009 Photovoltaic devices – Procedures for temperature and irradiance corrections to measured I-V characteristics 9. KS IEC 60904-1-1:2017: Photovoltaic devices Part 1-1: Measurement of current-voltage characteristics of multi-junction photovoltaic (PV) devices 10. KS IEC 62894: 2014 Photovoltaic inverters- Data sheet and name plate 11. KS IEC 62109-1:2010 Safety of power converters for use in photovoltaic power systems Part 1: General requirements 12. KS IEC 62109-2:2011 Safety of power converters for use in photovoltaic power systems Part 2: Particular requirements for inverters

13. KS IEC 61427-1:2013 Secondary cells and batteries for renewable energy storage - General requirements and methods of test - Part 1: Photovoltaic off-grid application 14. KS IEC 61427-2:2015 Secondary cells and batteries for Renewable Energy Storage - General Requirements and methods of test - Part 2: On-grid applications 15. KS IEC TS 62257-8-1:2007 Recommendations for small renewable energy and hybrid systems for rural electrification - Part 8-1: Selection of batteries and battery management systems for stand-alone electrification systems - Specific case of automotive flooded lead-acid batteries available in developing countries 16. KS IEC 62116: 2008 Test procedure of islanding prevention measures for utilities-interconnected photovoltaic inverters 17. KS IEC 61683:1999 Photovoltaic systems - Power conditioners - Procedure for measuring efficiency 18. KS 1709-1:2009 Batteries for use in photovoltaic power systems - Specification Part 1: General requirements 19. KS 1709-2:2009 Batteries for use in photovoltaic power systems - Specification Part 2: Modified lead-acid batteries 20. KS 1709-4:2009 Batteries for use in photovoltaic power systems - Specification Part 4: Recommended practice for sizing lead-acid batteries for photovoltaic (PV) systems 21. KS IEC 62509:2010 Battery charge controllers for photovoltaic systems - Performance and functioning 22. KS 2542:2017: Off-grid solar photovoltaic lighting kits - Requirements
Installation Standards
1. KS IEC 61724-1:2017: Photovoltaic system performance – Monitoring 2. KS IEC/TS 61724-2:2016: Photovoltaic system performance Part 2: Capacity evaluation method 3. KS IEC/TS 61724-3:2016: Photovoltaic system performance Part 3: Energy evaluation method 4. KS IEC 62124:2004: Photovoltaic (PV) stand-alone systems – Design verification

5. KS IEC 62093:2005: Balance-of-system components for photovoltaic systems - Design qualification natural environment
6. KS IEC 62446:2009 Grid connected photovoltaic systems - Minimum requirements for system documentation, commissioning tests and inspection
7. KS IEC 61727:2004: Photovoltaic (PV) systems – Characteristics of the utility interface
8. KS 1673-1:2004: Solar photovoltaic power systems – Design, installation, operation, monitoring and maintenance — Code of practice Part 1: General PV system requirements
9. KS 1673-2-5:2003: Generic specification for solar photovoltaic systems — System design, installation, operation, monitoring and maintenance Part 2: Test procedures for main components Section 5: Test procedures for luminaires
10. KS IEC 62253:2011 Photovoltaic pumping systems-Design qualification and performance measurement
11. IEC/TS 62548 2013: Photovoltaic (PV) arrays – Design requirements

APPENDIX G: TERMS OF REFERENCE

Impact Study of the Energy (Solar Photovoltaic Systems) Regulations 2012

A. BACKGROUND

Kenya receives a solar insolation of 4-6 kW/m^2. This solar resource makes solar photovoltaics ideal for heating, pumping and lighting applications. This resource can be harnessed for perpetuation of sustainable energy in the country. To achieve this, the country requires quality solar components and well trained technical personnel to carry out design and installations of solar photovoltaic systems.

The Energy Regulatory Commission (the Commission) is a single sector regulatory agency established under section 4(1) of the Energy Act, 2006 with the responsibility of economic and technical regulation of electric power, renewable energy and downstream petroleum subsectors.

The Commission has been implementing the Energy (Solar Photovoltaic Systems) Regulations, 2012 which were gazetted on 28th September 2012 via Legal Notice No. 103. These Regulations are assisting in the implementation of Section 103 of The Energy Act, 2006, which deals with renewable energy technologies. The regulations provide for the following, inter alia:

1. Licensing of all persons involved in the manufacture, importation, distribution, promotion, sale, design or installation of any solar PV systems;
2. Collection of data on Solar PV systems installed in the country;
3. Ensuring the manufacture, design, installation, repair and maintenance of solar PV systems is done as per the relevant Kenya Standard;
4. Ensuring fair business practices in the solar PV industry.

The Commission would like to conduct a study to assess the impact of the Energy (Solar Photovoltaic Systems) Regulations 2012 since gazettement and identify any gaps that should be addressed.

B. OBJECTIVES

The goal of the study is to assess the impact of the Energy (Solar Photovoltaic Systems) Regulations, 2012 in the development of the Solar Photovoltaic industry in Kenya.

The specific objectives of the assignment include:

i. To assess the appropriateness of the different classes of licence in regulating the manufacturing, importation, distribution, design and installation of solar PV systems/components with a view of aligning them with the current market needs;
ii. To identify any gaps in the qualifications, experience and certifications required for the different technicians licenses;
iii. To assess the effectiveness of the process used in issuances of licenses in the different classes;
iv. To find out the challenges in working relationship between licensed solar PV technicians and the firms in which they are attached
v. To assess the effectiveness of the general license conditions, e.g. the validity period and the upgrade period for licenses;
vi. To assess compliance of the regulations with the Kenya Constitution, Energy Bill, 2018, environmental laws and other laws that have been enacted;
vii. To identify Kenyan and International Standards relating to manufacture, design, installation and maintenance of solar photovoltaics that the regulations should be aligned to;

viii. To assess the effectiveness of the regulations in enforcing the relevant Kenyan Standards;
ix. To assess the adequacy of the documentation required in the regulations e.g. completion certificates, registers, returns on systems installed and imported in regulating the solar PV industry;
x. To assess the relevance of the warranties provided for in the regulations to the product life;
xi. To assess the effectiveness of inspection and enforcement provided in the regulation;
xii. To find out challenges in enforcing the provisions of the regulations and penalties provided for in the regulations;
xiii. To find out the economic and social impacts of the regulations;
xiv. To benchmark with other global existing regulations relating to manufacture, design, installation and maintenance of solar photovoltaics.

The consultant shall be required to propose specific amendments to the Energy (Solar Photovoltaic Systems) Regulations, 2012, if any, based on the findings of the study. This includes a policy brief on promotion of solar photovoltaics industry in Kenya.

C. SCOPE OF WORK

To meet the objectives of this study, the consultant will accomplish the following activities:

i. Identification of the stakeholders affected by the Energy (Solar Photovoltaic Systems) Regulations, 2012 including solar PV systems installers, contractors, vendors, importers, manufacturers, government agencies etc. and evaluate their understanding of the requirements in the regulations

ii. Develop a data collection tool (and have it validated by the Commission) which will be used to meet the study objectives

iii. Develop a standard sample size of stakeholders (installers, contractors, vendors, importers, manufacturers, government agencies)

D. DELIVERABLES OF THE CONSULTANT

- Provide a work plan to carry out the assignment. The assignment should be carried out within six (6) months from the date the contract is signed by both parties.
- An inception report with details your understanding of the assignment, proposed methodology and a detailed activity schedule. This includes data collection and analysis tools that will be validated by the Commission
- A draft Report highlighting the findings of the study as per the above objectives
- A report on a stakeholders' validation workshop documenting stakeholders' and experts' inputs. The Energy Regulatory Commission shall facilitate the stakeholder validation workshop.
- A final report to Energy Regulatory Commission (ERC) comprising:
    - A final report incorporating stakeholder feedback
    - A concise executive summary
    - Proposed amendments to the regulations
    - Policy Brief on the Solar Photovoltaic Industry
    - The following annexes:
        - Terms of Reference
        - Inception report
        - A controlled copy of the reviewed Solar Photovoltaics Standards
        - Reviewed regulations relating to solar photovoltaics
        - Copies of other Acts and Regulations reviewed in the study
        - List of places visited
        - List of people interviewed and their contacts

- The maximum delivery timelines shall be as follows:-

    a. Inception report –two (2) weeks after the commencement;
    b. Draft report – Eight (8) weeks after presentation of inception report to ERC Management through DERE;
    c. Draft final report-Three (3) weeks after incorporating comments by ERC Management
    d. Final report – Three (3) weeks after acceptance of draft final report by ERC Management.

Note: ERC will review the submitted reports in **a, b, and c** above within 2 weeks of receipt of the report and provide feedback or approval.

E. PAYMENT SCHEDULE

The following payment schedule shall apply for this assignment;

i. 30% of contract price will be paid upon presentation of an **acceptable inception report and work plan**.

ii. 30% of contract price will be paid upon presentation and **acceptance of the draft final report**.

iii. 40% of contract price will be paid upon presentation of and **acceptance of the final report**.

APPENDIX H: INCEPTION REPORT

The Inception Report which was submitted earlier in three hard copies has been submitted in soft copy.