STOCKTAKING OF EXISTING STANDARDS IN WEST AFRICAN COUNTRIES AND RELEVANT INTERNATIONAL STANDARDS FOR SOLAR SYSTEMS AND ELABORATION OF DRAFT ECOWAS REGIONAL STANDARD FOR PLUG-AND-PLAY SOLAR HOME SYSTEMS KITS

JOINT VENTURE:		SOLAR ENERGY INSTITUTE OF THE UNIVERSIDAD POLITÉCNICA DE MADRID **(UPM-IES)**
		PHOTOVOLTAIC RURAL ELECTRIFICATION STUDIES, SL **(PVRES)**

Objective: ***To carry out the stocktacking of existing standards in West African countries and relevant international standards for solar systems and elaboration of a draft ECOWAS Regional standard for plug-and-play Solar Home Systems kits with capacity from 10W to 350W.***

Analysis and elaboration based on:

- *Range of power*
- *Type of technology*
- *Minimum requirements for key aspects: truth in advertising, durability, system quality, lumen, maintenance and warranty.*
- *Special requirements: performance reporting requirements, Pay-as-you go, IP Test methods for PV modules, integrated water protection assessment and outdoor cable policy.*
- *Harmonization with existing international standards such as the Lighting Global Quality Standards and IEC norms*

Tasks to develop the Objective:

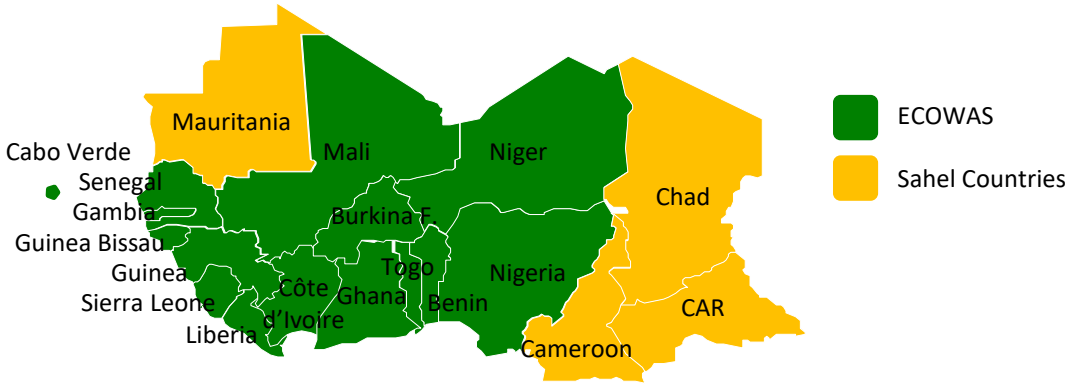
Task i) *Assessment and comparison of the existing quality specifications and standards for solar systems at national, regional and international level*

Task ii) *Assessment of available products and their quality in the ECOWAS region (imported and manufactured in the region)*

Task iii) *Proposal of a draft ECOWAS standard for plug-and-play SHS kits with capacity from 10W to 350W*

CONTEXT

Regional Off-Grid Electrification Project (ROGEP)



244 million people without electricity access

Task i) *Quality specifications and standards for SHSs*

OBJECTIVES

1. **Identification, assessment and analysis of existing standards**
2. **Critical review of the identified standards**
3. **Impact evaluation of the standards**
4. **Identification of the most suitable standard for ECOWAS**

Task i) *Quality specifications and standards for SHSs*

HISTORICAL REVIEW

Classification:

- **Background (before 2010)**
- **Present (after 2010)**
  - **Regional**
  - **National**
  - **International**

HISTORICAL REVIEW

SHS evolution

Before 2010

- **1st generation ('80s)**: 12 V_{DC} adapted from vehicle batteries
- **2nd generation ('90s)**: specific PV technology: 12 V_{DC} CFL lamps, solar batteries and solid state charge controllers
- Installed by qualified and trained technicians
- Big systems (> 50 Wp and > 50 kg)

After 2010

- **3rd generation (2010)**: Li-Ion batteries, LED lighting, microelectronic for control, MPPT
- Plug-and-play
- Small systems (< 30 Wp and < 6 kg)
- Pico-systems (< 10 Wp)
- Pay-As-You-Go (PAYG)

HISTORICAL REVIEW

Institution	Name of the standard	Publication date
CCE	Programme Régional d'Utilisation de l'Energie Solaire Photovoltaïque dans les Pays du Sahel **(PRS)**	1989
UPM-IES	Universal Technical Standard for Solar Home Systems **(UTSfSHS)**	1998
GTZ	Quality Standards for Solar Home Systems and Rural Health Power Supply **(GTZ report)**	2000
IEA-PVPS	Survey of National and International Standards, Guidelines & QA Procedures for Stand-Alone PV Systems (2nd edition) **(IEA-PVPS survey)**	2004
IEC	IEC 61194 Ed. 1.0 Characteristic parameters of stand-alone photovoltaic (PV) systems	1996
	IEC 61724 Ed. 1.0 Photovoltaic system performance monitoring - Guidelines for measurement, data exchange and analysis	1998
	IEC/TS 62257-1 Ed. 1.0 Recommendations for small renewable energy and hybrid systems for rural electrification - Part 1: General introduction to rural electrification	2003
	IEC 62124 Photovoltaic Stand-Alone Systems Design Qualification and Type Approval	2000
PV-GAP	Quality Management in Photovoltaics **(PVGAP)**	2003
Bolivia Government & The World Bank	Decentralized Infrastructure for Rural Transformation **(IDTR)**	2003
ONE-Morocco	Global Rural Electrification Program **(PERG)**	2002
IEEE	IEEE P1526/D1 Draft Recommended Practice for Testing the performance of Stand-Alone Photovoltaic Systems **(IEEE)**	2000
Brazil Government	LUZ PARA TODOS (Light for all) - Programa Nacional de Universalização do Acesso e Uso da Energia Elétrica **(LUZ PARA TODOS)**	2003

HISTORICAL REVIEW

Only applied in the framework of a certain Project
Dead after the project finishes

Institution	Name of the standard	Publication date
CCE	Programme Régional d'Utilisation de l'Energie Solaire Photovoltaïque dans les Pays du Sahel **(PRS)**	1989
UPM-IES	Universal Technical Standard for Solar Home Systems **(UTSfSHS)**	1998
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	IEC 61724 Ed. 1.0 Photovoltaic system performance monitoring - Guidelines for measurement, data exchange and analysis	1998
	IEC/TS 62257-1 Ed. 1.0 Recommendations for small renewable energy and hybrid systems for rural electrification - Part 1: General introduction to rural electrification	2003
	IEC 62124 Photovoltaic Stand-Alone Systems Design Qualification and Type Approval	2000
PV-GAP	Quality Management in Photovoltaics **(PVGAP)**	2003
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ONE-Morocco	Global Rural Electrification Program **(PERG)**	2002
IEEE	IEEE P1526/D1 Draft Recommended Practice for Testing the performance of Stand-Alone Photovoltaic Systems **(IEEE)**	2000
Brazil Government	LUZ PARA TODOS (Light for all) - Programa Nacional de Universalização do Acesso e Uso da Energia Elétrica **(LUZ PARA TODOS)**	2003

HISTORICAL REVIEW

General approach but rarely applied

Institution	Name of the standard	Publication date
CCE	Programme Régional d'Utilisation de l'Energie Solaire Photovoltaïque dans les Pays du Sahel **(PRS)**	1989
UPM-IES	Universal Technical Standard for Solar Home Systems **(UTSfSHS)**	1998
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	IEC 61724 Ed. 1.0 Photovoltaic system performance monitoring - Guidelines for measurement, data exchange and analysis	1998
	IEC/TS 62257-1 Ed. 1.0 Recommendations for small renewable energy and hybrid systems for rural electrification - Part 1: General introduction to rural electrification	2003
	IEC 62124 Photovoltaic Stand-Alone Systems Design Qualification and Type Approval	2000
PV-GAP	Quality Management in Photovoltaics **(PVGAP)**	2003
Bolivia Government & The World Bank	Decentralized Infrastructure for Rural Transformation **(IDTR)**	2003
ONE-Morocco	Global Rural Electrification Program **(PERG)**	2002
IEEE	IEEE P1526/D1 Draft Recommended Practice for Testing the performance of Stand-Alone Photovoltaic Systems **(IEEE)**	2000
Brazil Government	LUZ PARA TODOS (Light for all) - Programa Nacional de Universalização do Acesso e Uso da Energia Elétrica **(LUZ PARA TODOS)**	2003

HISTORICAL REVIEW

Adopted by some countries but rarely applied and updated

Institution	Name of the standard	Publication date
CCE	Programme Régional d'Utilisation de l'Energie Solaire Photovoltaïque dans les Pays du Sahel **(PRS)**	1989
UPM-IES	Universal Technical Standard for Solar Home Systems **(UTSfSHS)**	1998
GTZ	Quality Standards for Solar Home Systems and Rural Health Power Supply **(GTZ report)**	2000
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	IEC 61724 Ed. 1.0 Photovoltaic system performance monitoring - Guidelines for measurement, data exchange and analysis	1998
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PV-GAP	Quality Management in Photovoltaics **(PVGAP)**	2003
Bolivia Government & The World Bank	Decentralized Infrastructure for Rural Transformation **(IDTR)**	2003
ONE-Morocco	Global Rural Electrification Program **(PERG)**	2002
IEEE	IEEE P1526/D1 Draft Recommended Practice for Testing the performance of Stand-Alone Photovoltaic Systems **(IEEE)**	2000
Brazil Government	LUZ PARA TODOS (Light for all) - Programa Nacional de Universalização do Acesso e Uso da Energia Elétrica **(LUZ PARA TODOS)**	2003

LESSONS FROM THE HISTORICAL REVIEW

INITIAL AIM

- Guarantee of good service, reliability and performance of the SHSs
- Avoid possible fraudulent practices by installers and manufacturers
- Developed for PVRE programs

STUBBORN REALITY

- Lack of sustainability: only applied to the program for which they were created
- Lack of application: documents without application, without quality control and without associated labs
- Lack of update: without feedback from its appliocation

LESSONS FROM THE HISTORICAL REVIEW

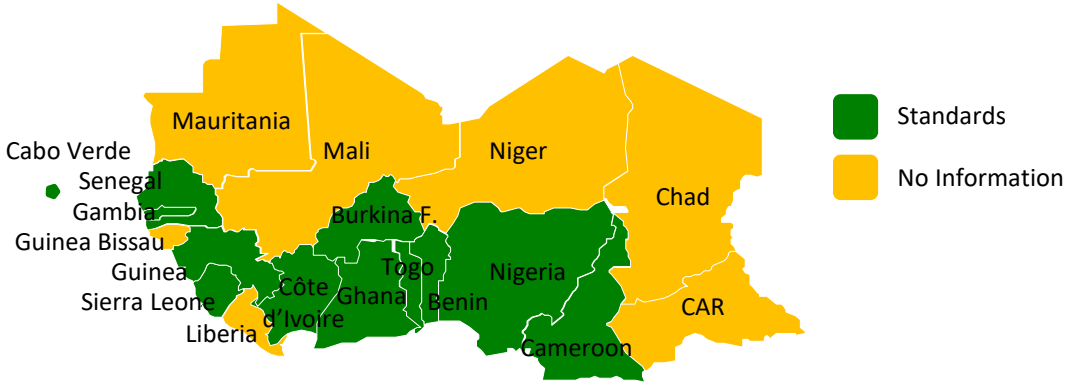
The long-awaited Prince Charming

- **An "alive" standard**: being applied and updated, and recognized by the involved stakeholders
- **Linked to quality testing procedures**: at laboratory but also at market level
- **In the range from 10 to 350Wp**
- **Complete**: covering not only the system as a whole but also their components
- **Applicable to the ECOWAS region**

Task i) *Quality specifications and standards for SHSs*

PRESENT - NATIONAL

Benin	IEC	**Niger**	N/A
Burkina Faso	IEC	**Nigeria**	IEC
Cap Verde	N/A	**Sierra Leone**	IEC
Côte D'Ivoire	IEC	**Senegal**	**NS 13-004 + NS 13-005 + IEC**
Gambia	IEC	**Togo**	IEC
Ghana	**GS 536:2002 + IEC**	**Mauritania**	N/A
Guinea Bissau	N/A	**Tchad**	N/A
Guinea Conakry	IEC	**Cameroon**	IEC
Liberia	N/A	**Central Republic of Africa**	N/A
Mali	N/A		



PRESENT - NATIONAL

Ghana

GS 536: 2002 - Electrical Generating Systems - Standardised requirement for the application of photovoltaic (PV) systems

- Minimum requirements, tests and inspections for components and installation
- Stand alone systems from 20 W to 500 W
- PV modules, mounting structure, lead acid batteries, charge regulators, inverters, lamps (range 5W to 20W) and the installation.
- Deep cycle test for batteries

PRESENT - NATIONAL

Senegal

***NS 13-004 (2004)*.-Batteries stationnaires au plomb. Prescriptions générales et méthodes d'essai. Batteries au plomb de type ouvert**

- Standard about stationary lead-acid batteries based on the ***IEC-60896***
- General requirements and test methods, for all types of stationary lead-acid batteries
- Exception: valve batteries

***NS 13-005 (2004)*.- Régulateur de charge des batteries au plomb/acide**

- Charge controllers for 12-and-24V PV systems
- Specification and corresponding test methods

Task i) *Quality specifications and standards for SHSs*

PRESENT - REGIONAL

ECOSTAND 054: 2015 - TECHNICAL SPECIFICATIONS FOR OFF-GRID LIGHTING PRODUCTS

Based on:

- **IEC/TS 62257-9-5**
- **Integrated Water Protection Assessment**

Current state:

- **Draft**

Task i) *Quality specifications and standards for SHSs*

PRESENT - INTERNATIONAL - IEC

TC 82: 29 specifications (20 corresponding to the IEC 62257 series)

Comp	Standard
PV	*IEC 61215-1:2016 Terrestrial photovoltaic (PV) modules - Design qualification and type approval - Part 1: Test requirements*
PV	*IEC 62548:2016 Edition 1.0 (2016-09-28) Photovoltaic (PV) arrays - Design requirements*
REG	*IEC 62509:2010 Edition 1.0 (2010-12-16) Battery charge controllers for photovoltaic systems - Performance and functioning*
INV	*IEC 62920:2017 Edition 1.0 (2017-07-26) Photovoltaic power generating systems - EMC requirements and test methods for power conversion equipment*
BAT	*IEC 61427-1:2013 Secondary cells and batteries for renewable energy storage - General requirements and methods of test - Part 1: Photovoltaic off-grid application.*
BAT	*IEC 60896-11:2002 Stationary lead-acid batteries - Part 11: Vented types - General requirements and methods of tests*
SYST	*IEC TS 61836:2016 Edition 3.0 (2016-12-13) Solar photovoltaic energy systems - Terms, definitions and symbols*
SYST	*IEC 62093:2005 Edition 1.0 (2005-03-29) Balance-of-system components for photovoltaic systems - Design qualification natural environments*
SYST	*IEC 62124:2004 Edition 1.0 (2004-10-06) Photovoltaic (PV) stand alone systems - Design verification*
SYST	*IEC 62253:2011 Edition 1.0 (2011-07-15) Photovoltaic pumping systems - Design qualification and performance measurements*
SYST	***IEC TS 62257-1:2015 to IEC TS 62257-12-1:2015 series Recommendations for renewable energy and hybrid systems for rural electrification***
SYST	***IEC TS 62257-9-5:2018 Edition 4.0 (2018-06-12) Recommendations for renewable energy and hybrid systems for rural electrification - Part 9-5: Integrated systems - Laboratory evaluation of stand-alone renewable energy products for rural electrification***

Task i) *Quality specifications and standards for SHSs*

PRESENT - INTERNATIONAL - IEC

IEC TS 62257-9-5:2018 Edition 4.0 (2018-06-12) *Recommendations for renewable energy and hybrid systems for rural electrification - Part 9-5: Integrated systems - Laboratory evaluation of stand-alone renewable energy products for rural electrification*

- **Quality testing procedures for SHSs including the most recent innovations in the market**
- **A set of general test methods:**
  - Initial Screening Method (ISM)
  - Quality Test Method (QTM)
  - Market Check Method (MCM)
  - Accelerated Verification Method (AVM)
  - Pay-as-you-go (PAYG) Method

Task i) *Quality specifications and standards for SHSs*

PRESENT - INTERNATIONAL – LIGHTING GLOBAL – IEC 62257-13-1

Lighting Global Quality Standards for plug-and-play Solar Home Systems kits

- Covered aspects:
  - Truth in advertising
  - Durability
  - System quality
  - Lumen maintenance
  - Warranty
- 10 W up to 350 W
- testing procedure: ***IEC 62257-9-5:2018***
- Continuously updated: last version 2.5 was done in September 2018
- Battery technologies: Pb-acid; Li-Ion, $LiFePO_4$, NiMH
- PAYG
- USB and 5 V ports
- Non-plug-and-play SHSs included
- Specifications for basic components: PV modules, lamps, batteries, charge control units, cables, switches, connectors and protective devices.

Task i) *Quality specifications and standards for SHSs*

PRESENT - INTERNATIONAL – LIGHTING GLOBAL – IEC 62257-13-1

Lighting Global Quality Standards for plug-and-play Solar Home Systems kits

Associated documents

- ***IEC 62257-9-5:2018:*** *defines all the quality test methods for SHS kits*
  - ***Initial Screening Method (ISM)***
  - ***Quality Test Method (QTM)***
  - ***Market Check Method (MCM)***
  - ***Accelerated Verification Method (AVM)***

- ***Global LEAP testing*** (fans and TV)
- ***USB Battery Charging specifications Revision 1.2***
- ***IESNA LM-80-08***
- ***AC Charger Safety Approval Policy (Lighting Global)***
- The ***IEC 60065*** (for TVs and radios) and ***IEC 60335*** (for fans)
- ***Integrated Water Protection Assessment***
- ***Lighting Global Solar Home System Kit Testing Policy: Outdoor-rated cables***
- ***Quality Assurance for Pay-as-you-go (PAYG) Energy Systems***

Task i) *Quality specifications and standards for SHSs*

EVALUATION REGARDING 63 KEY TECHNICAL ASPECTS

Component	Feature for possible consideration	GS 536: 2002	ECOSTAND 054	IEC 61215-1	IEC TS 61836	IEC 62093	IEC 62124	IEC 62253	IEC 62509	IEC 62548	IEC 62920	IEC TS 63049	IEC 61427-1	IEC 60896-11	IEC TS 62257-9-	SHS-KQS 2.4
PV module	Peak power (watts - W)	■		■	■					■						■
	Maximum point voltage (volts - V) and current (amperes - A)	■		■						■						■
	Technology			■												■
	Certification according to the international standard IEC-61215	■		■			■	■		■						■
	PV marked (name manufacturer, serial number, country origin, etc)	■		■												■
Module support structure	Materials (aluminium, steel, etc)															
	Corrosion	■					■									
	Wind resistance						■									
	Module tilt recommendations	■														
	Other															
Charge Controller	Operation voltage (V)	■				■			■							■
	Deep discharge protection	■							■							■
	Load-disconnection voltages (V)	■				■			■							■
	Load-reconnection voltage (V)								■							
	Warning voltage (low battery voltage)	■							■							■
	Load-disconnection, load-reconnection and warning voltages accurate	■							■							■
	End-of-charge voltage	■							■							■
	Temperature correction	■							■							
	Section cable allowed (mm^2)	■					■									
	Reverse current leakage protection	■							■							■
	Battery fuse protection						■									■
	Box protection category (IP)	■	■													■
	Protection against reversed polarity	■							■							■
	Protection against induced over-voltages	■							■							■
	self-power consumption	■							■							■
	Other															■
Battery	Type of technology (lead - SLI, no-maintenance, tubular - lithium, nickel, etc)	■	■			■										■
	Nominal voltage (V)	■				■										■
	Nominal capacity (Amperes hour - Ah)	■	■			■	■									■
	Maximum depth of discharge (% of the nominal capacity)	■														
	Useful capacity of the battery (Ah)	■	■				■									■
	Cycle life of the battery	■	■													■
	Self-discharge rate						■									■
	Certification (IEC-61427-1)	■														

Task i) *Quality specifications and standards for SHSs*

2) Comparison of the identified standards

Comparison

Component	Parameter of possible consideration	GS 536: 2002	ECOSTAND 054	IEC 61215-1	IEC TS 61836	IEC 62093	IEC 62124	IEC 62253	IEC 62509	IEC 62548	IEC 62920	IEC TS 63049	IEC 61427-1	IEC 60896-11	IEC TS 62257-9-5	SHS-KQS 2.4
Lamps	Technology (low consumption, LED, etc)	■														■
	Power consumption (W)	■				■										■
	Operation voltage (V)	■				■										■
	Luminous yield (lm/W)	■	■													
	Luminous flux (lm)	■	■													■
	On/off cycles resistance	■														
	Hours of functioning		■													■
	Other															■
Inverters	Maximum power					■										
	Battery voltage	■				■										
	Low battery voltage protection	■														
	Over voltage protection															
	Temperature correction															
	Section cable allowed (mm^2)						■									
	Battery fuse protection						■									
	Box protection category (IP)															
	Protection against reversed polarity															
	Self-power consumption															
Plug-and-play SHS kit	Correct balance between the sizes of battery (Ah), PV module (Wp) and loads (W)	■	■				■									
	PV module peak power (W)															■
	DC or AC system															
	Plug-and-play kit availability															■
	Wiring sections (mm^2) and outdoor cable quality	■														
	Pay-as-you go (PAYG) system availability															■
	Integrated water protection		■													■
Manufacturer self-reported information	Manufacturer information	■	■	■			■									■
	Product information	■	■	■			■									■
	Warranty	■	■													■
	Self-certification information	■														■

Task i) *Quality specifications and standards for SHSs*

IDENTIFICATION OF THE MOST SUITABLE STANDARD FOR ECOWAS

The two best options are:

1- Ghana National Standard GS 536:2002

- Not updated after 2002
- New components not included: LED lamps, Li-ion batteries, plug and play, PAYG

2- Lighting Global SHS Kits Quality Standards 2.5 (IEC 62257-13-1)

- Not only plug-and-play products
- It is the most recent norm and "is alive“ (last version Dec 2018)
- Modern testing procedures (IEC 62257-9-5:2018)
- Large spectrum of appliances (10 – 350 Wp)
- Several battery technologies: : Pb-acid; Li-Ion, LiFePO4, NiMH
- Pay-As-You-Go system
- USB and 5 V ports included
- Easy tests
- 31 SHS kits certified

Task ii) *Assessment of available products in the ECOWAS REGION*

OBJECTIVES

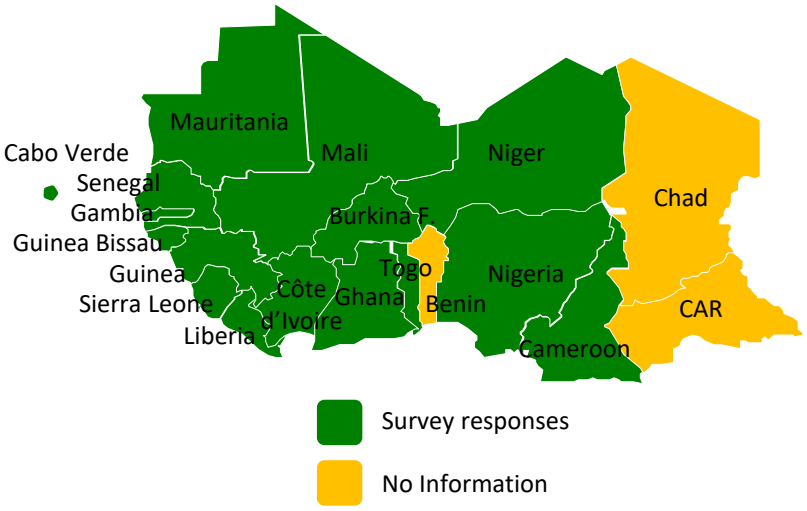
1. **Identify the most popular plug-and-play SHS kits**
2. **Comparison between technical notes and IEC 62257-9-5:2018**
3. **Identify local manufacturers and assemblers**

Task ii) *Assessment of available products in the ECOWAS REGION*

IDENTIFICATION OF THE MOST POPULAR PLUG-AND-PLAY SHS KITS

Survey of Local companies

COUNTRY	Contacted	Plug&Play kits	Certified by LG
SIERRA LEONE	2	0	0
MAURITANIA	4	2	1
NIGER	1	0	0
LIBERIA	3	2	0
CHAD	1	0	0
TOGO	1	1	1
NIGERIA	1	1	0
BENIN	0	0	0
BURKINA FASO	3	0	1
GUINEA	1	0	0
CENTRAL AFRICA REPUBLIC	0	0	0
CAMEROON	2	1	1
MALI	5	1	1
SENEGAL	1	1	0
CÔTE D'IVORE	1	0	0
GHANA	5	5	2
CABO VERDE	1	1	1
THE GAMBIA	0	0	0
GUINEA-BISSAU	2	1	1
TOTAL	**34**	**16**	**9**



Task ii) *Assessment of available products in the ECOWAS REGION*

Comparison between technical notes and IEC 62257-9-5:2018

Component	Feature for possible consideration	IEC TS 62257-9-5	
		Equivalent Parameter or Comment	Section
PV module	Peak power (watts - W)	Pmpp,STC	Annex Q
		Pmpp,TMOT	Annex Q
	Maximum point voltage (volts - V) and current (amperes - A)	Isc,STC; Voc,STC; Impp,STC; Vmpp,STC	Annex Q
		Isc,TMOT; Voc,TOMT; Impp,TMOT; Vmpp,TMOT	Annex Q
	Technology		
	Certification according to the international standard IEC-61215	IEC-61215-2 or test programme using a solar simulator or outdoor PV module I-V characteristics test	Annex Q
	Other	Physical and water ingress protection test (IPxx)	Annex U, Annex V
Charge Controller	Operation voltage (V)	Average charging voltage (V)	Annex R
		Standard operation voltage (V)	Annex H
		DC ports assessment	Annex EE
	Deep discharge protection	Active deep discharge protection	Annex S
		Deep discharge protection specifications by battery type (V/cell)	Annex L
	Load-disconnection voltages (V)	Deep discharge protection voltage (V)	Annex S
		End of discharge voltage (V/cell)	Annex K
	Load-reconnection voltage (V)		
	Warning voltage (low battery voltage)	"The DUT is not required to provide indication of the fault condition"	Annex DD
	Load-disconnection, load-reconnection and warning voltages accurate	"The DUT is not required to provide indication of the fault condition"	Annex DD
	End-of-charge voltage	Maxumum charge voltage / cell (V/cell)	Annex K
	Temperature correction		
	Section cable allowed (mm^2)		
	Reverse current leakage protection	Miswiring protection	Annex DD
	Battery fuse protection	Miswiring protection	Annex DD
	Box protection category (IP)	Physical and water ingress protection test (IPxx)	Annex U, Annex V
	Protection against reversed polarity	Protection test - reverse polarity battery connection	Annex DD
	Protection against induced over-voltages	Overcharge protection specification by battery type	Annex L
		Active overcharge protection; overcharge protection voltage (V)	Annex S
	self-power consumption	Standby loss current	Annex S
	Other	Time before switching to low-power mode	Annex S

Task ii) *Assessment of available products in the ECOWAS REGION*

Comparison between technical notes and IEC 62257-9-5:2018

Battery	Type of technology (lead - SLI, no-maintenance, tubular - lithium, nickel, etc)	Battery chemistry (VRLA, NiMH, etc.)	Annex D
	Nominal voltage (V)	Battery nominal voltage (V)	Annex D
	Nominal capacity (Amperes hour - Ah)	Battery capacity - Cb (Ah)	Annex K, Annex D
	Maximum depth of discharge (% of the nominal capacity)		
	Useful capacity of the battery (Ah)		
	Cycle life of the battery	Battery durability test - capacity loss of storage - δC (%)	Annex BB
	Self-discharge rate		
	Other	Battery round-trip energy efficiency ηb (%)	Annex K
Lamps	Technology (low consumption, LED, etc)	All product lighting technologies used (e.g. fluorescent tube, LED). If the product uses LEDs, are the LEDs high-power or low-power?	Annex D
	Power consumption (W)	Power consumption (W)	Annex FF
	Operation voltage (V)	Appliance operating voltage range (V)	Annex EE, Annex FF
	Luminous yield (lm/W)		
	Luminous flux (lm)	Luminous flux (lm)	Annex I, Annex T
	On/off cycles resistance		
	Hours of functioning	Lumen maintenance at 2,000 h (%)	Annex J
		Lumen maintenance at 1,000 h (%)	Annex J
		Lumen maintenance at 500 h (%)	Annex J
	Other	Light distribution (degrees)	Annex T
		Correlated colourtemperature (K)	Annex I

Task ii) *Assessment of available products in the ECOWAS REGION*

Comparison between technical notes and IEC 62257-9-5:2018

Inverters	Maximum power		
	Battery voltage		
	Low battery voltage protection		
	Over voltage protection		
	Temperature correction		
	Section cable allowed (mm^2)		
	Battery fuse protection		
	Box protection category (IP)	Physical and water ingress protection test (IPxx)	Annex U, Annex V
	Protection against reversed polarity		
	Self-power consumption	Standby loss current	Annex S
Plug-and-play SHS kit	Correct balance between the sizes of battery (Ah), PV module (Wp) and loads (W)		
	PV module peak power (W)	Pmpp,STC	Annex Q
	DC or AC system		
	Plug-and-play kit availability	"the IEC TS 62257-9-5 ed 4,0 removed the restriction that all connections shall be plug-and-play"	Foreword
	Wiring sections (mm^2) and outdoor cable quality		
	Pay-as-you go (PAYG) system availability	QTM or AVM testing	Sections 6, 9 and 10
	Integrated water protection	Physical and water ingress protection test (IPxx)	Annex U, Annex V

Task ii) *Assessment of available products in the ECOWAS REGION*

Comparison between technical notes and IEC 62257-9-5:2018

Manufacturer self-reported information	Manufacturer information	Official customer facing/brand name	Annex D
		Public manufacturer contact information	Annex D
	Product information	Product name	Annex D
		Product model number	Annex D
		Battery package type	Annex D
		Charge/discharge rate at which the battery capacity is specified	Annex D
		All product charging system types (e.g. solar module, AC power, dynamo)	Annex D
		1) if the product has AC power charging, whether an adapter is included	Annex D
		2) if the product has solar charging, the active PV material (e.g., mono-Si, poly-Si, CIS)	Annex D
		3) if the product has solar charging, the peak power rating of the PV module(s) at STC	Annex D
		All included product features (e.g. mobile device charging, radio)	Annex D
		If the product has mobile device charging, are adapters included?	Annex D
		All optional product features (e.g. mobile device charging, radio)	Annex D
		Description of any advertised capabilities to charge specific devices or provide specific USB charging modes	Annex D
		Description of product warranty terms, including duration; high resolution product photograph on a white or transparent background.	Annex D
	Self-certification information	All manufacturer company certifications and markings (e.g. ISO 9000, UL, CE);	Annex D
		All product certifications and markings (e.g. UV-resistant plastic, UV-free LEDs, hightemperature batteries);	Annex D
		All component-level certifications and markings (e.g. IEC 62133 for battery safety);	Annex D
		Documentation of UN 38.3 testing and a description of individual cell protection measures for all Li-ion batteries included with the system;	Annex D
		Manufacturer declaration regarding the adequate sizing of current carrying conductors used in the product (only required for Size B products as defined in 6.1);	Annex D
		Manufacturer declaration that all cables intended to be used outdoors, such as cables connecting the PV module, are appropriately protected against UV radiation and water ingress (only required for Size B products as defined in 6.1);	Annex D
		Confirmation of AC-DC charger approval from a recognized consumer electronics safety regulator, such as UL (if product includes an AC-DC charger)*;	Annex D
		If the expedited method described in Clause J.6 is requested, IESNA LM-80-08 data (minimum 6 000 h) from the LED manufacturer and a picture that shows where the temperature should be measured on the LED array.	Annex D

Task ii) *Assessment of available products in the ECOWAS REGION*

Comparison between technical notes and IEC 62257-9-5:2018

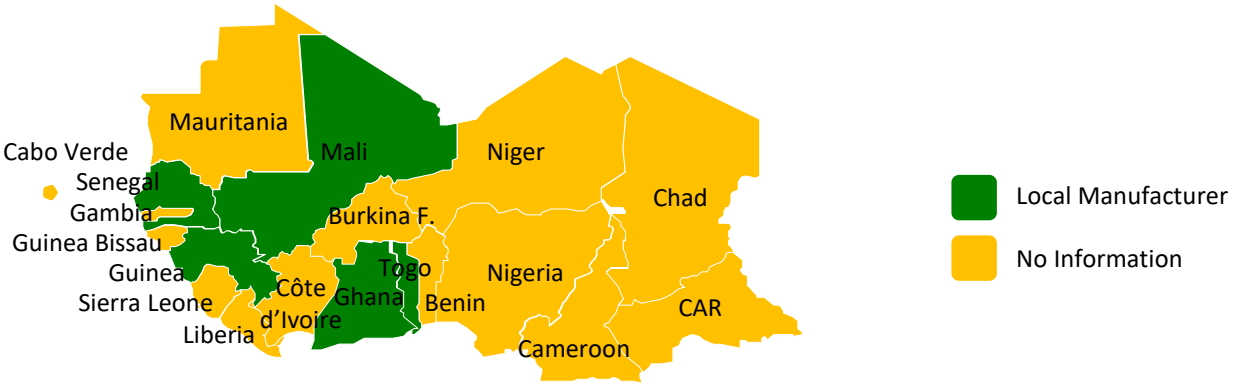
Example: Plug-and-play SHS kits

Technical feature	BBOXX	BERCOTECH	BONERGIE	CANADIAN S.	EVEREXIDE	FLYING L.	FOSERA	GREENLIGHT P.	NIWA SOLAR	OMNIVOLTAIC	SOLAR RUN	YANDALUX	KYA Energy G.	Nadji-Bi G.	BBOXX
Correct balance between the sizes of battery (Ah), PV module (Wp) and loads (W)	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
PV module peak power (W)	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
DC or AC system	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Plug-and-play kit availability	■	■	■	■	■	■	■	■	■	■	■	■	■		■
Wiring sections (mm^2) and outdoor cable quality															
Pay-as-you go (PAYG) system availability							■	■	■	■	■	■	■		
Integrated water protection	■	■		■	■	■	■	■	■	■	■	■	■		■
Warranty	■	■			■		■	■	■	■	■	■			
Self-certification information	■	■			■		■	■	■	■	■	■			

Task ii) *Assessment of available products in the ECOWAS REGION*

Local Manufacturers/assemblers

Local solar Manufacturers and Assemblers			
N°1	**Company**	**Country**	**Product**
1	Horonya Solar	Mali	Assembly of PV modules
2	Rkomp Solar	Guinée	Assembly of PV modules
3	Nadji-Bi Group	Sénégal	Assembly of PV modules, plug-and-play SHSs, solar lanterns and pico-systems
4	Strategic Power Solutions	Ghana	Assembly of PV modules
5	KYA Energy Group	Togo	Assembly of plug-and-play SHSs



Task ii) *Assessment of available products in the ECOWAS REGION*

Conclusions

- Most of the products are imported and SHS are not mostly plug-and-play.
- 39 local private solar companies and assemblers have been contacted.
- They commercialize their solar PV products in 15 countries of the West Africa.
- 16 SHS kits identified (some of them locally manufactured)
- Lead-acid technology is predominant in imported batteries.
- Only 6 plug-and-play kits have Lighting Global certification.
- Most of the analysed SHS kits fulfil of the requirements to be certified.

Task ii) *Assessment of available products in the ECOWAS REGION*

Conclusions

Possible barriers for the certification:

1- Difficulty in obtaining the certification due to:

- Preconception of hard quality test procedures
- Lack of dedicated laboratories in West Africa

2- Market is not requiring this certification

3- Preconception of the long time to get the certification

4- Cost of certification

Task iii) *Proposal of a draft ECOWAS standard for plug-and-play SHS kits with capacity from 10W to 350W*

PROPOSAL

Solar Home System Kits Quality Standards 2.5 of the Lighting Global

that it is being transformed into the

IEC 62257-13-1

WHY THIS PROPOSAL?

The long-awaited Prince Charming

- **An "alive" standard**: being applied and updated, and recognized by the involved stakeholders
- **Linked to quality testing procedures**: at laboratory but also at market level
- **In the range from 10 to 350Wp**
- **Complete**: covering not only the system as a whole but also their components
- **Applicable to the ECOWAS region**

WHY THIS PROPOSAL?

SHS Kits Quality Standards 2.5 of the Lighting Global – IEC 62257-13-1

- **It is an "alive" standard**:
  - It is being applied to several PVRE programs worldwide
  - 31 certified products and continuously accrediting new ones
  - Backed by a reputed international organization ensuring continuity and rigor
  - Continually updated to integrate proven innovations and to extend its scope of application
  - It is being transformed into the IEC 62257-13-1
- **Linked to quality testing procedures**:
  - According to the IEC 62257-9-5:2018: Quality Test Method, Accelerated Verification Method and Market Check Method
  - Verify compliance not only at the level of units sent for certification, but at level of the products offered in the market
  - Easy-to-implement tests: Considering socio-economic conditions of the countries promoting PV rural electrification programs

WHY THIS PROPOSAL?

SHS Kits Quality Standards 2.5 of the Lighting Global – IEC 62257-13-1

- **In the range from 10 to 350Wp:**
  - Match with this assignment
  - Wide enough to cover the needs felt by population
  - IEC 62257 also includes pycosystems (less than 10W)
- **Complete**:
  - covering not only the system but also their components
  - Extended to non-plug-and-play SHS → local suppliers collect components and build their own SHS products
  - Consider PAYG: adapted low-cost financing and payment
  - Wide range of battery technologies and LED lamps
  - USB and 5V ports included

SHS Kits Quality Standards 2.5 of the Lighting Global – IEC 62257-13-1

Key revisions during the IEC process

- **Li-ion battery safety requirements**
- **PV module reliability and durability**
- **New performance reporting requirements**

SHS Kits Quality Standards 2.5 of the Lighting Global – IEC 62257-13-1

Suggestions of Improvement

WEAKNESS	*RECOMMENDATION*
Support structures for PV modules are not included	1- to include specifications about the supporting structure of the PV module
User manual guidance does not include how to install the PV module	2- to include instructions about the PV modules installation in the manual
User manual guidance does not include recommendations to use the system	3- Consider including these recommendations in the user's manual

SHS Kits Quality Standards 2.5 of the Lighting Global – IEC 62257-13-1

Recommended procedures for the adoption in the ECOWAS region

- **Main findings**:
  - Among the plug-and-play kits identified, only 6 have Lighting Global certification and only 4 kits dispose PAYG option
  - The other kits are not certified but their technical data suggest that they could be certified
  - Necessary to remove the barriers for the certification of local products

SHS Kits Quality Standards 2.5 of the Lighting Global – IEC 62257-13-1

Recommended procedures for the adoption in the ECOWAS region

- **Barrier 1**: Lack of dedicated laboratories in the whole West Africa
  - There are just two laboratories for kits from 10W to 350W: China and USA
  - The laboratory in Kenya covers just pico-systems
- **Three different solutions**:
  1. To create a laboratory in the ECOWAS region
  2. To strengthen the Kenyan laboratory
  3. To help local actors to certify their kits in the existing laboratories

SHS Kits Quality Standards 2.5 of the Lighting Global – IEC 62257-13-1

Recommended procedures for the adoption in the ECOWAS region

Solution	Advantages	Disadvantages
1- To create a lab in ECOWAS region	• The cost of the certification would be minimised for the local actors. • The application of the Market Check Method would be easier due to proximity reasons.	• Implementing a new lab is an important investment in facilities, equipment, training and salaries of adequate qualified technicians. • The independency of any other interest different than the technical strictness is always easier to preserve with the remoteness of the labs in charge to do the tests. • The time to implement a new lab is longer than required by ROGEP.
2- To strengthen the Kenyan lab	• The certification cost would be reduced for local actors due to the greater proximity. • The cost of the extension of this lab would be lower than the implementation of a new lab. • The independency to do strict quality tests could be higher with the lab out of the region.	• The time to strength the Kenyan lab could be longer than required by ROGEP program. • The procedure to send kits to the Kenyan lab could imply costs and logistic difficulties. • Although the application of the Market Check Method would be possible due to the proximity of the lab, it would be necessary specific protocols.

SHS Kits Quality Standards 2.5 of the Lighting Global – IEC 62257-13-1

Recommended procedures for the adoption in the ECOWAS region

Solution	Advantages	Disadvantages
3- To help local actors to certify their kits in the existing labs	• The barrier of the cost of the certification would be eliminated. • There is no investment for new labs. • Labs in USA and China, with a deep experience, are used. • It could be implemented in the short term. • ROGEP has funds for this kind of measures	• The procedure to send the kits to the labos in USA and China could imply logistic difficulties. • The application of the Market Check Method to assure the sustainability of the quality of the kits in the market could be difficult to implement. • The financial support to the local companies could be seen as an unfair competition by the foreign companies.

- **Recommended procedure 1:** *Together with the approval of this draft standard, it would be necessary to implement one of these three alternative solutions to enhance the certification of the existing and the possible future Solar Home System kits in the ECOWAS and Sahel regions.*

SHS Kits Quality Standards 2.5 of the Lighting Global – IEC 62257-13-1

Recommended procedures for the adoption in the ECOWAS region

- **Barrier 2**: The actual market is not demanding this certification
- **Possible solution**:

    1. To sensitize the population about the importance of acquiring only certified products to ensure their long-term service and reliability.

❖ **Recommended procedure 2:** *ROGEP program should finance just Solar Home Systems certified according to the draft standard here proposed.*

❖ **Recommended procedure 3:** *ROGEP should implement radio and TV campaigns to sensitize population about the importance of acquiring Solar Home System kits certified by the draft standard here proposed.*

SHS Kits Quality Standards 2.5 of the Lighting Global – IEC 62257-13-1

Recommended procedures for the adoption in the ECOWAS region

- **Barrier 3**: Lack of appropriate and comprehensive policy, regulatory and institutional frameworks
- **Possible solutions**:

    1. Adoption of this standard at National level by all of the countries involved in the ROGEP program.
    2. Creation of a common framework to develop new innovative business models, get access to finance and investments and establish common legal and regulatory frameworks

❖ **Recommended procedure 4:** *to establish the political measures for the adoption of this draft standard at National level by all of the countries of the ECOWAS and Sahel regions.*

SHS Kits Quality Standards 2.5 of the Lighting Global – IEC 62257-13-1

Recommended procedures for the adoption in the ECOWAS region

- **Barrier 4**: Specific procedures should be put in place for the adoption and enforcement at country level
- **Possible solutions**:

    1. Organization of seminars with the different National Standardization Bodies and Rural Electrification Departments of the different countries to explain the standard.

❖ **Recommended procedure 5:** *to organize seminars with the different National Standardization Bodies about the proposed standard.*

❖ **Recommended procedure 6:** *to organize seminars with the different National Departments for PV Rural Electrification about the application of the proposed standard.*

❖ **Recommended procedure 7:** *to evaluate linking future funds from the World Bank/African Development Bank for PV rural electrification to the application of this standard at the national level.*