17th of February, 2017
PVM TWG

PVM Solar Packages– Technical Specifications

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1 Introduction

Within the framework of the ASEP PV Mainstreaming (PVM), LGUGC is launching this first procurement window of 10,000 Solar Home Systems (SHS), 2,500 for each of the 4 preselected Electric Cooperatives (ECs) in Regions 11 and 12. The bidders are requested to offer their best products and services for off-grid member-consumers, according to the technical specifications and certification requirements below.

2 SHS package – Technical design

2.1 Levels of service

Two levels of service were designed under the PVM to meet the basic power demand of most rural customers. The first service should offer a minimum energy of 35 Wh per day for light, radio and USB charger, while the second, higher service level should offer at least 88 Wh per day to allow for additional appliances, such as a LED-TV.

Service 1: Lower service (only lighting, radio and USB charger)

Component / Accessory	Qty	Power (W)	LED size (Lm)	Usage (h/day)	Energy (Wh)	Total Lm	Lm.h/day
Light (bedroom)	1	2	200	4	8	200	800
Light (living room)	1	2	200	4	8	800	800
Radio / MP3	1	1		5	5		
Torch Lamp	1	1		5	5		
Mobile Charger / USB	1	3		3	9		
Total					**35**	**400**	**1600**

Service 2: Higher service (more lights, radio, USB charger and plug for appliances as TV)

Component / Accessory	Qty	Power (W)	LED size (Lm)	Usage (h/day)	Energy (Wh)	Total Lm	Lm.h/day
Light (external)	1	1	100	8	8	100	800
Light (bedroom)	2	2	200	4	16	400	1600
Light (living room)	1	3	300	3	9	300	900
Radio / MP3	1	1		5	5		
Torch Lamp	1	1		5	5		
Mobile Charger / USB	1	3		3	9		
TV (not supplied by EC)	0	9		4	36		
Total					**88**	**800**	**3300**

2.2 Package sizing & design

The two electrical services described above have been used to size the SHS packages, each package matching one service level. The panels have been intentionally oversized to accept smaller storage capacity, to maintain satisfactory autonomy level and for quick recharging rate.

The Bidder cannot contest this sizing and is not allowed to propose its own sizing. The minimum SHS power and battery capacity for each kit shall be considered in its bid.

Minimum characteristic requirements for the SHS packages:

Package	Daily consumption (Wh/d)	Min PV Power (Wp)	Min Battery Capacity (Ah)
1	35 Wh/day	**30 Wp**	**6 Ah**
2	88 Wh/day	**50 Wp**	**12 Ah**

2.3 Standard requirements (LG, IEC, etc.)

Package certification

The PVM component of the ASEP is intended to provide "**reliable, efficient, safe and easy to install and to operate**" SHS. In line with this, it will prioritize Lighting Global (LG) verified solar products. However, given the limited number of LG-verified products in the market matching the specifications of the PVM design, a compromise was decided for the first phase of the project to jump start program implementation. For the first bidding window, the Bidder has 3 options for SHS quality certification:

1) The SHS package manufacturer has already obtained or at least engaged the LG-QTM (Quality Test Method) verification process for the product proposed. The payment of the first invoice or attestation from LG must be submitted. Alternatively, LG-ISM (Initial Screening Method) test results on the proposed product, with commitment to engage the QTM, are also acceptable.
2) The SHS package manufacturer has already obtained a full LG-QTM verification on a similar product (such as an SHS package with PV module between the range of 10-100Wp and at least 2 light points).
3) The solar package is IEC 62257-9-5 and/or IEC 62124 certified by an Internationally recognised certifying body.

Note that after the first window, the conditions for procurement will be:

1) The Bidder should have already obtained an LG QTM verification for the product proposed; and/or
2) The solar package is IEC 62257-9-5 and/or IEC 62124 certified by an Internationally recognised certifying body.

Component certification

In addition to the above certification, each main component of the package should comply with the Technical Specifications presented in this document and with the following minimum standards:

PV module	**Imperatively required:**	**IEC 61215 and IEC 61730 and IEC 50380**
	Preferred:	IEC 62716
	Preferred:	IEC 62548
Charge controller	**Imperatively required:**	**CE marked**
	Preferred:	IEC 62509
Battery	**Imperatively required:**	**UL 1642**
	Preferred:	PVGAP PVRS 5/5A and IEC 61960
	Preferred:	IEC 61427-1
Light (LED)	Preferred:	IEC 127
General	Preferred:	IEC 62093

2.4 Warranty and after sales services requirements

The Bidder shall provide the following minimum warranty durations for each main component:

- Module: 5 years + 80% of initial power after 20 years (linear)
- Charge controller: 2 years
- Vending Machine: 2 years
- Battery: 2 years
- Appliances: 1 year

The Warranty shall start on the date the SHS package is certified as having passed the independent LGUGC verification.

The Winning Bidder will assist the EC through every means possible to ensure the repair/replacement of faulty parts (covered by the warranty) within two weeks at no cost to the EC.

3 Solar component & system technical specifications

In addition to the above standards, the Bidder shall select packages/components according to the following specifications.

3.1 Solar module & support

- **PV module**:
  - Only Silicon crystalline technology (poly or mono). Thin film is not acceptable.
  - 36 cells in series.
  - Positive tolerance only on nominal power.
  - Aluminium frame required: marine grade / minimum thickness of frame 30mm.
  - High transmission and high strength tempered glass.
  - Equipped with a waterproof junction box (IP65) and the pre-assembled PV cable.
  - A label complying with IEC 50380 shall be placed to the rear of the module with main characteristics (manufacturer, type and reference, serial number, peak power, Isc – Impp, Voc – Vmpp, standards …).
  - For each package, all modules shall be identical (same brand, model and size).
- **Cable:**
  - Class II and certified for PV application.
  - Outdoor cable shall be UV resistant.
  - Minimum length of the cable from PV module to the charge controller shall be 5m.
- **Mounting structure:**
  - Galvanized steel pole fixed on a support beam or along the pasha board, out of shade.

- Designed to last at least 20 years of outdoor exposure under local conditions.
- Shall be rated for wind up to 120km/h.
- Tenderer shall provide structural design calculations and drawing of the typical mounting structure.

3.2 Battery

- **Storage battery** shall be Lithium-based with a nominal voltage of around 12Vdc:
  - Lithium-Ion (LI) shall be 11.1V = 3 packs of 3.7V.
  - Lithium-Ion-Phosphate (LFP) shall be 12.8Vdc = 4 packs of 3.2V. LFP is preferred.
- The battery package shall include the Battery Management System (BMS) designed for solar application and overcharge protection.
- A label with the battery's main characteristics (manufacturer, type and reference, serial number, capacity, nominal voltage, date of manufacturing, standards …) shall be placed on the battery.
- The bidder shall provide instructions to ECs and households on how to dispose of worn batteries.

3.3 Battery box and controller

- The **charge controllers** should have the following minimum specifications:
  - Controller shall be specifically designed and developed for Lithium based battery management. The supplier shall provide proof of this.
  - The printed circuit boards (PCB) shall be coated with heavy duty varnish to protect from corrosion.
  - The controllers shall be machine manufactured (no manual assembly and welding).
  - Controller shall have microprocessor, with static regulation. PWM is preferred. DC-DC converter with MPPT is also possible, but not required.
  - Well protected against short-circuits, overload, reverse polarity and lightning.
- The SHS shall be equipped with a **sealed battery box** (with tamper-proof screws, metallic seals or equivalent) to ensure that end-users cannot access any terminals from the battery and from the charge controller to connect extra appliances. Only special plugs and connectors can be used to reduce risks of tampering. The battery box seal shall be the same as that used by ECs in kWh meters for grid customers.
- Load connection to the Battery Box shall be "Plug & Play" type: easy to install, remove and replace.
- The battery box shall be delivered with all support or fixing system needed.
- Indication of the **battery State Of Charge (SOC)** and PV production shall be included in a manner that is easily understandable to every customer. An alarm when battery is low or when there is low voltage should be included.
- The battery shall be dismountable and replaceable by a qualified technician.
- A **label** with main characteristics of the SHS (manufacturer/assembler, type and reference, serial number, individual ID number, battery capacity, PV peak power, standards …) shall be placed on the battery box.
- The charge controller shall be easily dismountable and replaceable by a qualified technician. For this topic, the procedure to maintain the continuity of the prepayment credit must be provided.

3.4 Prepayment system

The bidder shall include a basic **prepayment system** with control device for both solar packages, which will disconnect the load when credit is empty. Credit shall be purchased by end-users at "Selling Points" organised by the EC. SHS will be utilized by ECs, as utility companies, to provide an electricity service and not by a solar distributor who sells on an instalment/lease basis. Thus, consumers will only pay for the service when they need electricity. The main specifications are the following:

- The system shall operate even if there is **no GSM signal** at end-user's house and/or if there is no Internet/Data connection at "selling point".
- The way to **reload the credit** shall be simple and reliable (code on keyboard, scratch card …).
- The credit paid by one customer shall be unique and dedicated only to his own kit. No possibility to use the same code, scratch card for another kit.
- Credit should be generated in terms of "**days of operation**". The minimum number of days (credit) shall be adjustable by the EC. Number of days for each transaction shall also be adjustable. "Energy-based operation" either in Ampere-hour or Watt-hour if available is preferred.
- The prepayment system shall include a "**standby credit function**" (activated only by qualified technicians) which allows the system to run without reloading credit, in exceptional circumstances.
- The end-user shall have access to the number of **remaining days**.
- The **selling interface/tool** (Seller software or Mobile application) used to generate the code (or equivalent support) shall also record (locally or on a remote web server) every transaction in a database. Every transaction should include at least the following: customer name, customer account ID, site identification number, date of transaction, credit bought and system type.
- An estimated 20 "Vending Machines" will be required per EC.
- All **transaction data** shall be accessible to the EC and shall be exportable in a specific format (e.g. CSV file type) to be used by EC in its own customer management software. The format should then be compatible with most common management software.
- The **software** should provide data and dashboards for monitoring individual customers, individual Solar Packages and vendor performance.

3.5 Lamp & Cable

The SHS package shall include lamps, cables, sockets, switches, plugs, adaptors, etc.

- Each **lamp** shall be made of high efficiency LEDs with an efficiency of at least 90 lm/W. Each lamp shall have a minimum of 100 lm with a wide light distribution angle.
- The light points (2 in package 1 and 4 in package 2) described in the Service level table are expected to be 100lm - 200lm - 300lm. 2 or 3 lamps of 100lm each could be provided instead of lamps of respectively 200 or 300lm.
- If a diffuser is included, the cover should be dismountable to remove dust and insects.
- Expected lifetime shall be at least 20,000 hours.
- The **indoor cable** shall have a minimum cross-section of 0.5mm² and a minimum length of 5m for the closest light. The bidder shall ensure that the voltage drop between charge controller and the farthest lamp or appliance doesn't exceed 2%. Vendors shall provide voltage drop calculation.
- The **switches** should be able to withstand a high cycle level, installed at maximum height of **1.2m,** and accessible to children.

3.6 Bundled appliances (phone charger, radio and torch light)

The Bidder shall include in each SHS package the following bundled appliances as part of the procurement:

- Min. one **USB adaptor** for mobile phone charging (5V)
- One **radio AM/FM** (could be integrated on the battery box or independent with an internal battery)
- One **torch lamp** of minimum 50 Lumen and with a minimum autonomy of 5 hours at 50 Lm.

3.7 Optional color TV

The Bidder shall offer in option (not included in the basic offer) a **color LED TV** with the following minimum specifications:

- Nominal 12V color LED TV
- Minimum screen size: 15.6”
- Build-in TV tuner for analogue antenna; compatibility with DVB-T2 or DVB-S2
- Analogue antenna
- Speakers and remote control included
- Min. one USB port and one SD card reader
- Audio/video input
- High efficiency, LEAP verified
- Maximum power: 12W (nominal) and 0.4W (standby)
- Safe operation voltage range: 10 to 16Vdc
- Compliance CE/RoHS
- Warranty of 2 years
- Detailed user’s manual for the TV and remote control

In addition, the bidder shall provide with the TV:

- DC cable of min. 5m length and min. 0.75mm² (Maximum voltage lost: 2%)
- Connector compatible with the battery box

3.8 Other accessories

The Bidder shall include all necessary **accessories** for supporting or fixing components (module, battery box, appliances, switches, cable ties, etc.) during installation and for assessing warranty claims.

3.9 Spare parts

The Bidder shall include in their bid a minimum **stock of spare parts** for each EC. Each stock shall have the following minimum quantities:

- Module :2%
- Module support :1%
- Controller :2%
- Batteries :1%
- Lamps :5%
- Portable lamp :2%
- Radio :2%
- Vending Machine :3 units

The technical specifications are the same as for the main components above.

3.10 Toolbox

The Bidder shall provide **electrical toolboxes**, at least 10 per Lot, with the necessary tools for EC technicians to troubleshoot, repair and replace main components like panel, battery, charge controller and lamp. The toolbox shall contain at least the following items:

- 1 set of jewellers' screw drivers
- 1 Philip screw driver (medium)
- 1 slotted (-) screw driver (medium)
- 1 side cutter
- 1 long nose plier
- 1 alligator/square jaw plier
- 1 digital multimeter 0-10A_{DC} / 1-200V_{DC} with fuse protection (10A)
- 1 gas/butane solder
- 1 magnifying glass
- 1 rechargeable LED flashlight
- 1 robust toolbox

The Bidder shall also include any other specific tools for required adjustments on the SHS packages by EC technicians, e.g. adapted tool for tamperproof screws.

4 Trainings and support

The Winning Bidder shall be required to provide adequate training to the EC technicians responsible for post-installation services.

4.1 Training of EC technicians on SHS installation and O&M

The Bidder shall present in detail how it will organize the training of EC Technicians and which material it will provide, based on the following requirements:

- The Training should be designed for technicians who have background as electricians and have the aptitude to understand what a solar system is, how it works, how to maintain, how to diagnose breakdowns or faults and, to some extent, how to repair or replace parts.
- The Training shall allow the EC technicians to conduct (without support) maintenance, repairs, system moving, as well as new installations, of SHS Packages and Vending Machines, beyond the training.
- Each EC will be requested to provide 10 to 15 technicians to attend the training. They can be either internal staff or outsourced.
- The EC trainees should be able to train the vending agents on the field with the selling terminals/tools provided by the Winning Bidder.
- The Training should be simple and provided by a skilled trainer.
- The Training shall be conducted in English but the Trainer shall be assisted by a technician able to translate to local dialect when needed.

The Winning Bidder shall be responsible to deliver the following **support materials**:

- Training materials, posters, tools, etc.
- Demo Kits, similar to the SHS packages installed (from the stock)
- Guideline for EC technicians
- Training Certificate to attendees

The Winning Bidder shall provide **technical support/assistance** to the EC staff throughout its contract.

The EC will provide the training room, food and accommodation for participants.

The Bidder shall propose in its bid a detailed **training program** organized in 3 parts:

1) Solar kits training workshop (before installation): at EC headquarter, 2 days.
    a. Basics on Solar Energy, Solar systems, sizing, etc. (theory)
    b. Prepayment and Credit Vending system
    c. Installation of new kits and moving existing kits
    d. Maintenance
    e. Troubleshooting, replacement and repair
    f. Data collection and reporting (logbook)
2) On-the-Job Training (during installation): in the field, minimum of 10 days.
    a. Best locations for solar panel, box, lamps, etc.
    b. Best fixing techniques
    c. Testing and commissioning
    d. Credit vending process
    e. Customer training
3) Final workshop (after installation): at EC headquarter, 1 day.
    a. Review of learning
    b. Open forum
    c. Evaluation

4.2 Post-Installation and Commissioning Instructions for member-consumer

The Bidder shall present how it will provide instructions to every member-consumer after installation and which material it will provide, based on the following requirements:

- Dedicated to rural Member-Consumers who have zero electricity/technical background.
- Very simple and straightforward with key information, easy to understand.
- Conducted in English, Tagalog or Bisaya, with the occasional assistance of the EC technician able to translate when needed.
- Provided just after the installation (and before acceptance by the EC technician) to each customer, if possible to at least 2 adult family members.

The Winning Bidder shall deliver the following **support materials**:

- Visual aids for each training team (large poster A0, comic strip, movie, etc.)
- User's Manual for every member-consumer (weatherproof plasticised folder or A4 poster)

The Winning Bidder shall train the EC to train a group of Member-Consumers (e.g., 15 member-consumers) using a demo kit (similar to the one installed). Simple media support such as posters with pictures and sketches can be used to explain the basics of the SHS (how it works, how to use properly, how to diagnose breakdowns or faults). The Bidder shall propose in its bid a detailed **training program** covering at least the following topics:

1. What is a PVM Solar Kit
    - Solar kit operating principles: "Catch-Store-Use", sunlight conditions, shading, daily energy available, battery charge and discharge, status indicators, protections
    - System components, type of appliances
2. What are user's responsibilities

- Load management, service levels and limitations
- Proper operation, misuse, and no-use for extended periods
- Warranties and limits of the system
- User maintenance items, as panel cleaning and prevention of shading

3. How to pay for the service
   - Prepayment and credit management (how to purchase credit and reload the system)
4. In case of problem
   - Basic troubleshooting guide for users
   - How to get service support

5 Technical documentation

5.1 User's Manual

The Manual must include the following **topics/messages**:

- System operating principles: "Catch-Store-Use", sunlight conditions, shading, daily energy available, battery charge and discharge, status indicators, protections
- System components, type of appliances
- Load management and limitations, proper operation, misuse, and no-use for extended periods
- Prepayment and credit management (how to purchase credit and reload the system)
- Warranties and limits of the system
- User maintenance items, as panel cleaning and prevention of shading
- Basic troubleshooting guide for users
- How to get service support

5.2 Technical Guideline for EC Technicians

The Guideline must include the following **topics**:

1. A complete **list of components** (all system sub-items), with associated specifications, warranties and ordering references.
2. Complete **Installation instructions**:
   a. Detailed instructions to choose the best locations/places for components and to install the solar module, the wiring and the lamps.
   b. A recommended post-installation **acceptance test procedures**, including all appropriate test procedures.
3. Complete **Training instructions**:
   a. System operating principles, load management requirements, warranties and limits of the system, impact of shading/dirt of the array and how to check and avoid it, user maintenance checks and how to conduct them, how to get service support.
   b. How to operate and manage the vending unit, the credit sales to customers and the reporting to EC (transaction data transfer).
4. Complete **O&M instructions**:
   a. A recommended routine **maintenance schedule**, with inspection/maintenance instructions.

b. Specific **care and maintenance guide** for the system and components (controller, battery, PV module, lamps, etc.).

c. A detailed **troubleshooting guide** referencing all the system sub-items. This shall include repairs and diagnostic procedures that can be done by the EC or a qualified third party. Repairs and procedures not to be attempted by non-electricians and/or electricians unfamiliar with photovoltaic systems shall also be identified.

d. **Recycling** procedure for main components.