United Nations Development Programme
Information & Technology Management
Smart Infrastructure Services

UNDP Haiti Field Office Petionville

Annex 1 - Terms of Reference:

Smart Solar Hybrid PV System for UNDP Haiti FO Petionville, contributing to Create Smart UNDP Facilities Powered by Renewable Energy

Solar PV Capacity (kWp)	Battery Capacity (kWh)	Renewable Fraction (%)	CO_2 Reductions (tons/year)
15	60	79.5%	19.3

Terms of Reference: Solar Hybrid PV System

UNDP Haiti Field Office Petionville

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Acronyms

AI - Artificial Intelligence
GHG - Green House Gas
GET – Green Energy Team
ICT - Information and Communications Technology
IoT - Internet of Things
O&M - Operation and Maintenance
ITM - Information and Technology Management
PCMM - Power Consumption Measuring and Monitoring
SDGs - Sustainable Development Goals
TOR - Terms of Reference
UAT - User Acceptance Test
UNDP – United Nations Development Programme

Terms of Reference: Solar Hybrid PV System

UNDP Haiti Field Office Petionville

Scope of the Document

The Terms of Reference (TOR) sets the requirements to facilitate smart and clean energy solutions to secure activities in **UNDP Haiti Field Office (FO)** by supplying, installing, commissioning (including complete civil works), and after-sales services for the solar hybrid PV system at the **UNDP Haiti FO**. An overall high-quality system is expected, as the system will be a showcase for other compounds.

Structure of the Document

The ToR include the following components:

1. Introduction
2. Project Description
3. Statement of Work
4. Price and Delivery Schedule Forms
5. Project Management and Communication Plan

All the requirements included in this ToR are numbered and boxed.

1. Introduction

The **UNDP Haiti FO**, in cooperation with the UNDP Information & Technology Management (ITM) Green Energy Team, has taken initial steps toward implementing a solar PV installation on their premises. This endeavor will comprise of **15 kWp solar PV** with a **60 kWh Lithium-Ion battery** system.

The load has been estimated from appliance list and using PCMM sensors for similar equipment in CO, local energy resources, and data provided by the Haiti UNDP FO colleagues in the site assessment. Based on the projection of the load consumption of the server room, the new solar PV system will be able to cover approximately 79.5% of the electricity consumption.

Switching to renewable energy implies strong environmental incentives. Going solar will save approximately 19.3 tons of CO_2 emissions yearly, effectively reducing Haiti FO's carbon footprint and environmental burden. This will institute the United Nations Sustainable Development Goals while being an opportunity to promote green energy solutions and inspire local economies to adopt similar solutions.

A solar installation in Haiti FO will enhance business continuity and work environment, as well as reduce climate impact. All while promoting sustainable development in the region.

1.1 Sustainable Development Goals

The Sustainable Development Goals (SDGs) are the blueprint for achieving a better and more sustainable future for all. They address the global challenges we face, including poverty, inequality, climate, environmental degradation, prosperity, and peace and justice. The Goals interconnect, and to leave no one

behind, we must achieve each Goal and target by 2030.[1] As a leading agency in the fight against climate change, UNDP is committed to "walking the talk" by demonstrating that we run our operations in a resources-efficient, sustainable, and accountable way.

Figure 1 - The Global Goals for Sustainable Development

Substantial progress has been achieved in making UNDP "greener," more resilient operations both at Head Quarters and in many COs and Regional Centers. Around the world, our offices are working to minimize the environmental impact associated with operations, from green building renovations and sustainable procurement practices to staff training and bicycling programs. By now, over 20 UNDP COs – out of 167 - have installed or are installing photovoltaic systems to reduce Green House Gas (GHG) emissions and enhance office energy security. Recently UNDP adopted a 'Climate Neutrality and Sustainability Plan for Global UNDP Operations' committing UNDP to reduce GHG emissions by 10% over five years and achieving climate neutrality for global operations starting effective 2014 [2].

1.2 Smart UN Facilities

The concept of Smart UN Facilities revolves around using data insights and interconnected technologies to transform UN COs and related facilities into "smart" premises; in effect, local capacity to carry out the UN's goals is augmented. This concept is rooted in two aspects, which are manifested in multiple technology systems provided by ITM:

1. Fourth Industrial Revolution – the advent of connected technologies, including robotics, the Internet of Things (IoT), and autonomous vehicles.
2. Smart cities – utilization of sensors for data collection, insights, analysis, and subsequent enhancement of services.

[1] About the Sustainable Development Goals (https://www.un.org/sustainabledevelopment/sustainabledevelopment-goals/

[2] UNDP - Greening the Blue Initiative (http://www.greeningtheblue.org/what-the-un-is-doing/unitednationsdevelopment-programme-undp)

Given the benefits, it makes the first step in transitioning into a low-carbon and digital organization through the smart integration of various equipment. As it is depicted below, Figure 2 shows the main technologies that set and establish Smart UN Facilities, including:

- Smart Energy & Mobility
- Smart Connectivity - ICT, Business Intelligence & AI
- Smart Data & Internet of Things
- Smart Security

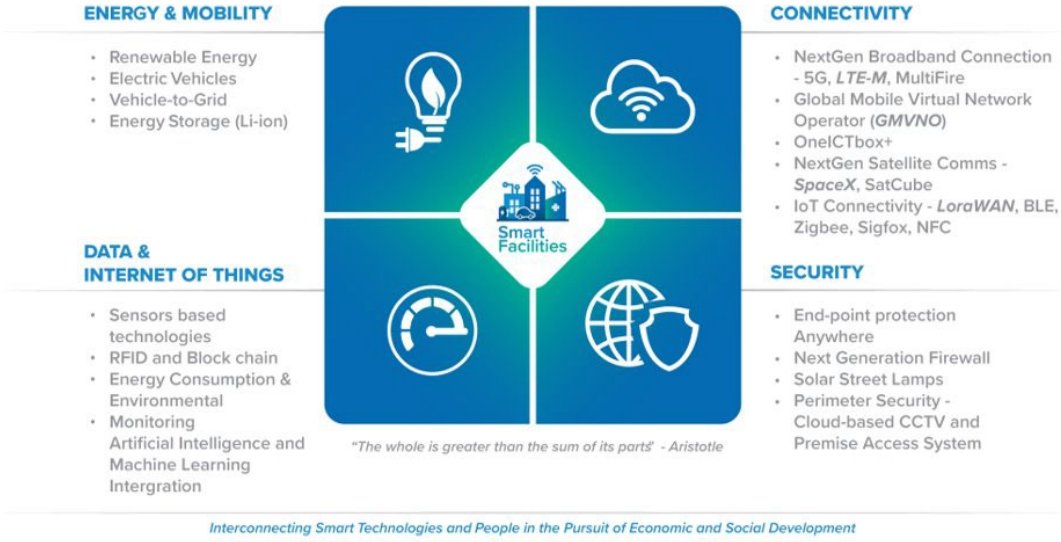

Figure 2 - Smart UN Facilities Framework

1.3 Seven Step Green Energy Process

The use of the United Nations Development Group's recommended 7-Step Project Management Methodology is being adopted for this project. The approach is a holistic end-to-end process with a preliminary assessment of project practicability and the post-installation operation & maintenance. This solution is depicted in Figure 3 below and elaborated in the subsequent text.

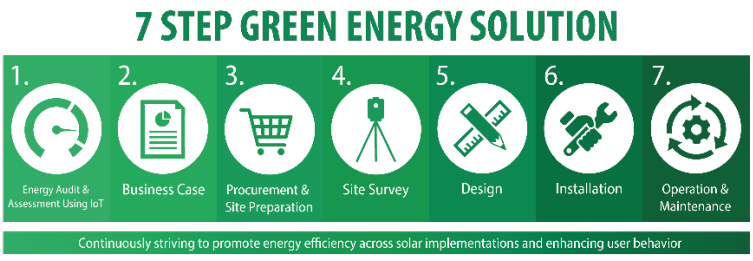

Figure 3 - Seven Step Green Energy Solution

Step 1: Energy Audit & Assessment using IoT

a. The FO installs Internet of Things (IoTs) devices to measure their load consumption, if applicable.
b. ITM monitors the quality of the grid and generators through IoT devices. The proposed solution for the solar PV system should be compatible with this monitoring system.

c. The FO is required to complete a **Preliminary Site Survey** form, which will provide detailed information on the physical structure and the electrical installations.
d. The CO can choose to have a technical assessment mission to carry out the Preliminary Site Survey of the premises.

Step 2: Business Case

a. This step serves to provide essential information and data for decision-making. With the information gathered during Step 1 and FO schematics, ITM compiles a load profile of the energy consumption for the respective FO. This enables an analysis resulting in the drafting of a business case that presents potential green energy solutions for the FO.

Step 3: Procurement & Site Preparation

a. Compilation and publication of solicitation documents will be carried out in accordance with UNDP rules as applied by the procurement unit in such projects.
b. Before the bids are placed, all interested vendors perform a **Pre-bid Site Visit** to collect all the detailed data required for them to formulate their offer.
c. Evaluation of bids/proposals will be carried out by UNDP and, if desired, a government representative/focal point.

Step 4: Site-survey – vendor

a. The vendor carries out an **After-award Site Survey** to exhaustively consider all aspects that can adversely affect the implementation of the project and information for the final project's design, including required materials/equipment and time frames.
b. The goal of the After-award Site Survey is for the vendor to confirm all information previously collected and assessed. There should not be any extra costs after the site visit, and if any extra costs may occur after the contract award, these shall be taken individually by UNDP, to assess their applicability and justification.
c. The vendor acts as the implementer, working closely with the focal point at the FO, where necessary, and ITM exercises technical oversight and project management. Submission of the final **Site Survey Report** marks the end of this step.

Step 5: Design

a. The selected vendor drafts the final system design, considering findings from the site survey in the previous step.
b. As part of technical oversight, ITM must endorse the final design before the actual installation starts. Submission of the final design and implementation schedule marks the end of this step.

Step 6: Installation

a. The vendor carries out all the necessary installations, in the process giving regular progress updates to all stakeholders.
b. Critical milestones are defined, at which point, ITM makes the necessary assessments as part of the technical oversight.
c. Among other critical requirements, the step entails end-to-end testing, physical inspection of the installation, user training, and complete system documentation.

d. This step involves carrying out User Acceptance, in which all parties play a role. A signed checklist confirming full compliance with all requirements marks the end of the step, giving way to Operation & Maintenance (O&M).

Step 7: Operation & Maintenance

a. After system commissioning, a **stabilization period** starts allowing the end-user to get acquainted with the system and basic troubleshooting. Stabilization period lasts for six (6) months and also provides an opportunity to make minor adjustments in system operating logic if necessary.
b. Operations & maintenance (O&M) period starts at the end of the stabilization period. Vendor is responsible for conducting bi-annual **preventive maintenance** visits for the next three (3) years. The first preventive maintenance visit shall be completed at the beginning of O&M period.
c. Vendor is also responsible for **corrective maintenance** during the O&M period. Vendor shall follow the preventive and corrective maintenance response times as per Section 3.2. The costs of O&M visits and corrective maintenance shall be included in the initial quote.
d. UNDP ITM will carry out regular online monitoring of system's operation and performance.
e. At the end of O&M contract, UNDP ITM will support the beneficiary to sign a new O&M contract.

Communication and Publicity

Parallel to the Seven Step Green Energy Solution process of green energy solution, ITM Business Development Group and the Communications CO Team carry out the promotions of the successful project within the country and globally through the UN network. This process involves highlighting the benefits of the installed system and spreading word about the human impact. Furthermore, this aims at motivating similar installations in other parts of the country.

2. Project Description

2.1 Project Objectives

The main goal of the smart solar hybrid PV system is to provide **affordable green energy** solutions for the UN smart facility as well as **smart integrated services** like security and adaptability. ITM requires **high quality** for the system as it will also serve as a showcase on a national and international scale. The following document provides requirements and guidelines for the project, but an innovative solution proposal is highly encouraged to improve the system.

2.2 Project High Level Requirements

This project seeks to enhance the energy supply for the UNDP FO premises with renewable energy specifically feeding power to the **server room**. The current energy supply for the compound is based on a very unreliable grid with three outages per day lasting 3 hours each, and three diesel generators of 125 kVA, 100 KVA, and 45 kVA. The 125 kVA and 100 kVA generators are used interchangeably manually depending on the needs of the FO for backup power supply. However, the **only generator** that feeds the server room is the 45 kVA generator. The generator maintenance is out of the scope of this RFQ.

The requirement is for the vendor to provide a comprehensive offer for a **hybrid solar PV turnkey solution** based on the following configuration.

1. Supply a **15 kWp and 60 kWh solar PV turnkey solution**
2. Installation, User Acceptance Test (UAT), and Commissioning of the final system
3. Integration of the final solution into the facility and existing power supply
4. Provision of bi-annual maintenance and after-sales service by the local partner (for 3 years).
5. Training of the users on the system must also be provided to guarantee they will be able to perform the system's first-level operation and maintenance effectively.

The bidders must include all extra items (e.g. yearly performance reports) in their offer, and UNDP may include some, all, or none in the Purchase Order.

The hybrid setup will be based on Solar PV + Grid + Batteries + Generator. The solar PV system is required to serve as the primary energy source. During outages, the system will use the battery and the diesel generator to meet the energy requirements. The battery must be optimized to charge on energy excess from the solar PV panels, grid or the generator. The diesel generator must be the last source of energy, and whenever it is required to meet the energy requirements, the goal is to optimize its usage in an efficient way where the working load and batteries can be charged at the same time.

The hybrid solar PV system is expected to provide around 79.5% of the total electricity demand of the server room. A set of energy efficiency measures (out of the scope of this RFQ) have also been suggested (sealing openings, increasing temperature set on ACs, and providing motion sensors for ACs), which means the FO can potentially reduce its current consumption, therefore, increasing the system's renewable fraction.

The Solar PV + Grid + Batteries + Generator system must operate in a robust, intelligent, and automated manner regarding energy supply for the FO. The system's proposal shall include an

intelligent energy supply and management, prioritizing PV, and if more energy is required, supply with either the batteries or generator, depending on the battery SOC.

The weather in the premises has many variations, and due to its location, the area is prone to hurricanes, earthquakes and geological activities (See section Weather on Site). Hence, the system installed must be designed and installed to withstand these harsh climatic conditions.

Please note that infrastructure works can be one of the most sensitive parts of the project. It involves safety and dominant physical visibility directly impacting **UNDP's reputation**. The mounting structure becomes the signature and a showcase of the UN compound, as it will significantly alter the looks of UN facilities. The solar panel installation will become part of the UN compound signature. As per the UNDP Smart Facility vision, all results of this installation will become a showcase to inspire a movement locally and hopefully regionally.

2.3 Site Description

The UNDP Haiti FO premises are located at: 11-13 Rue Pinchinat, Petion-Ville, in the following GPS Coordinates: 18.510281,-72.289142. The compound's aerial location can be seen below in Figure 4. A storage area can be made available on the FO's premises to place the goods during the installation (Please refer to appendix IV). However, space may be limited, and during the pre-bid site visit vendors must assess any security issues linked to the equipment's storage on-site.

Figure 4 - Aerial view of the UNDP Field Office Premises

2.4 Weather on Site

Pétion-Ville, in Haiti, has a tropical climate characterized by distinct wet and dry seasons. The climate is heavily influenced by the Caribbean Sea, bringing substantial rainfall during the wet season.

The rainy season typically extends from June to November, during which the area experiences heavy rainfall, high humidity, and warm temperatures. This period accounts for the majority of the annual precipitation. The dry season lasts from November to May, characterized by lower humidity and higher

temperatures, but significantly less rainfall. Especially during the dry season, dust can be a significant inconvenience for solar PV production, as Haiti is located in a region where dust from the Saharan Desert can be transported.

The lowest minimum temperatures are typically recorded in December and January, while the highest maximum temperatures occur in April and May. The mean monthly temperature ranges from about 24ºC in December to 30ºC in May.

The average wind speed in Pétion-Ville is generally moderate, ranging from 7 to 15 mile per hour (mph) on most days. While full-fledged cyclones are rare, the region can occasionally experience the peripheral effects of tropical storms forming in the Atlantic Ocean. These can bring sudden and sharp increases in wind speeds, along with heavy rainfall. Hence, the system must be able to withstand wind loads of 160 mph of speed.

2.5 Potential Location of PV Panels

The solar panels are suggested to be located on the UNDP FO's roof. The suggested layout for the PV modules is shown in Figure 5.

The solar PV system shall be connected to the main distribution board and the utility, located in the parking area of the building (refer to photo in Annex IV).

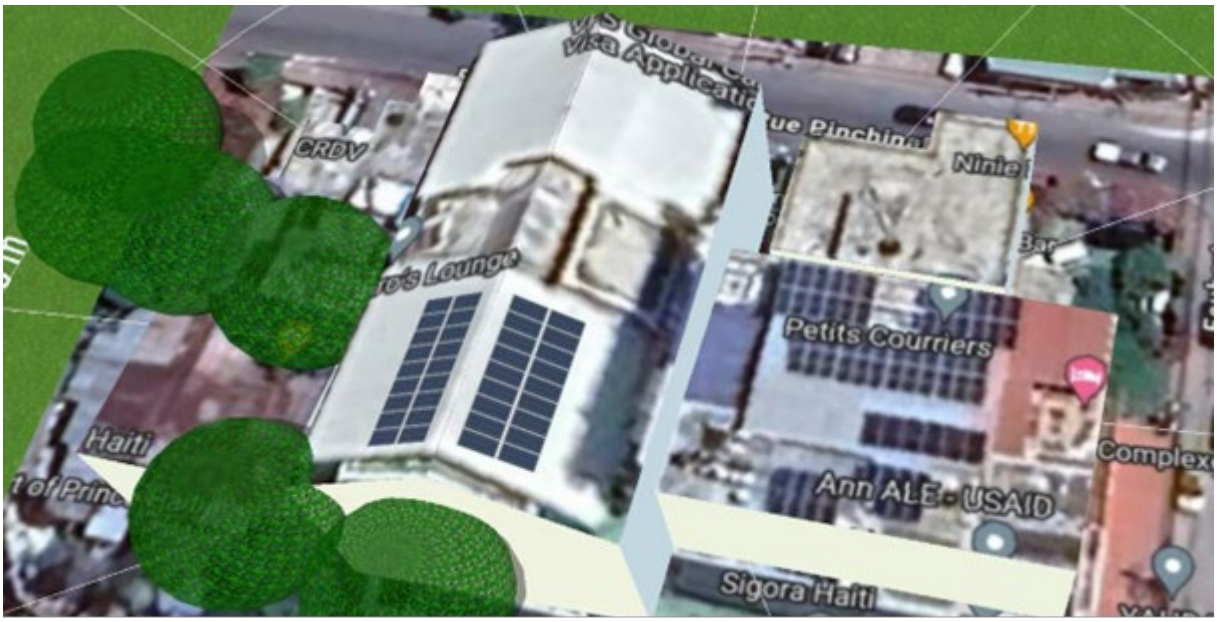

Figure 5 - Proposed Area for PV panels on the UNDP FO rooftop

2.6 Power Supply and Estimated Load Consumption

The Haiti Field Office is primarily powered by the national grid, which suffers from **frequent, unpredictable, and long outages (three outages per day with a duration of three hours each)**, supplemented by three backup generator of 125 kVA, 100kVA, and 45 kVA respectively with the usage being interchangeably between the 125 and 100 kVA generators depending on the demand of the FO using a manual switch. The Server room is mainly fed from the 45 kVA Generator only. Electricity and Diesel Bills were used to estimate the consumption of the grid mainline and the generator. Using the data from the IoT sensors on similar appliances in the main CO, the daily load profile was generated. The load profiles reveal that the average daily load is around 59.12 kWh during weekdays and 57.71 kWh during weekends,

comprising an average of **58.73kWh/day.** Additionally, during the monitoring period, the peak load observed was 3.39 kWh, typically occurring during working hours on weekdays. Based on this data, and accounting for both day-to-day and timestep variability, the facility's annual energy consumption is estimated to be 26,280 kWh. The final load profile used for the simulations is shown in the subsequent pictures.

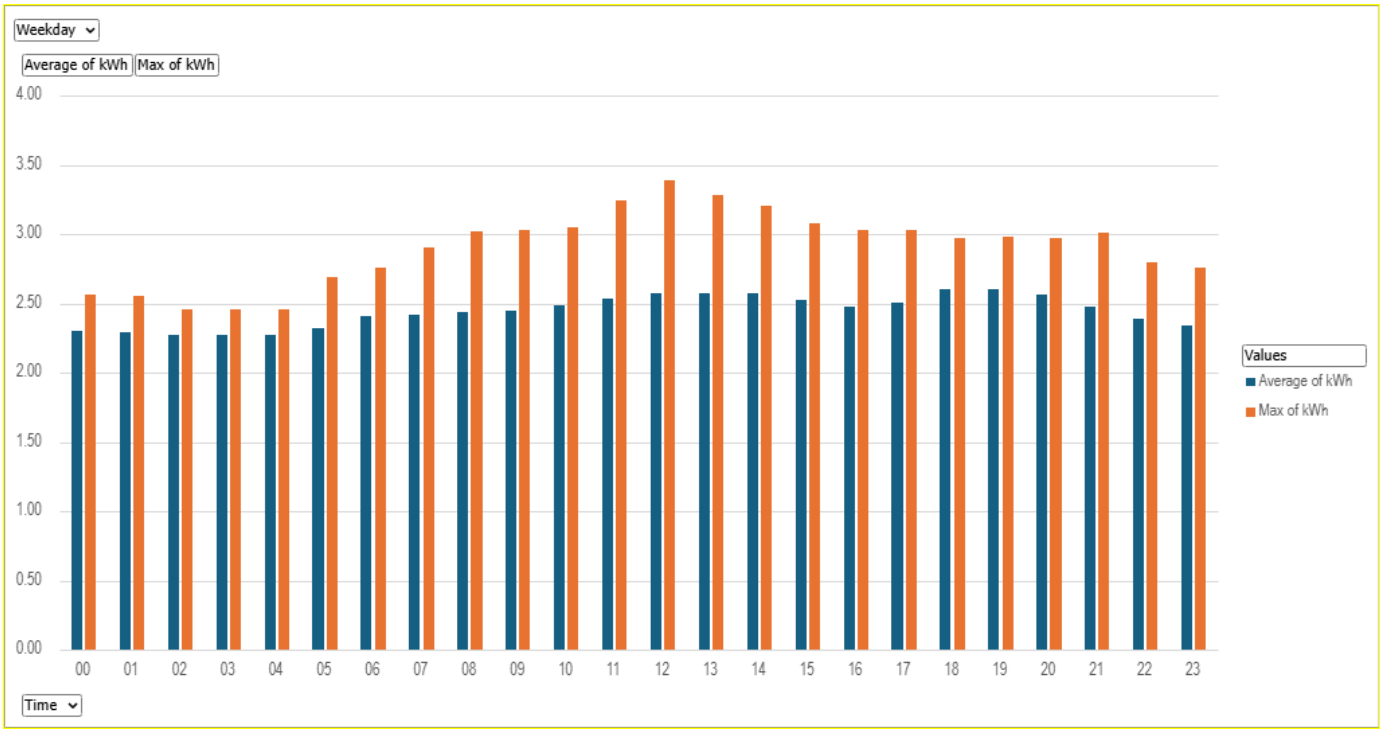

Figure 6 - UNDP Haiti FO Load Profile – Weekdays

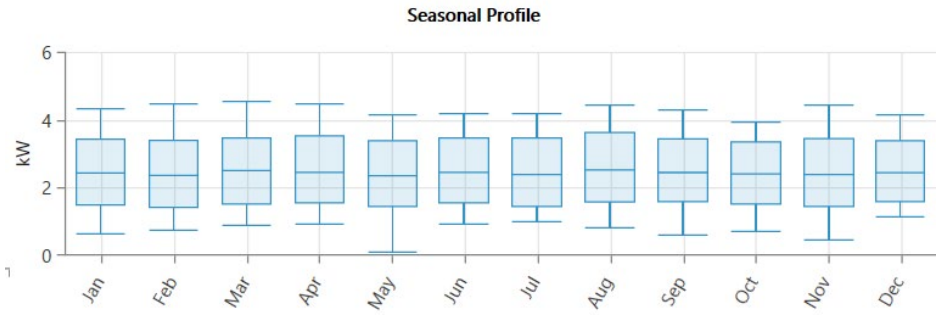

Figure 7 - UNDP Haiti FO Seasonal Profile

Table 1 - Load Profile Metrics used for simulation

Metric	Baseline
Average (kWh/day)	58.73
Average (kW)	2.45
Peak (kW)	3.39

2.7 Connectivity

A survey was completed to understand the options for remote monitoring and control after the installation of the solar hybrid PV system. The download and upload Internet speeds are estimated to be around 5.34Mbps for upload and 34.36Mbps for download. The compound has access to wired (Ethernet) and wireless internet connection.

2.8 Generator

Three generators provide power to the compound. The first one is the main generator 125 kVA Cummins 6BT 220V 60 HZ feeding the load between 7am and 5 pm. The second one is a 2013 100 kVA generator, and the third is a 45 kVA Generator. The 45 kVA generator is mainly used to power the server room. (Refer to annex IV for generator nameplates).

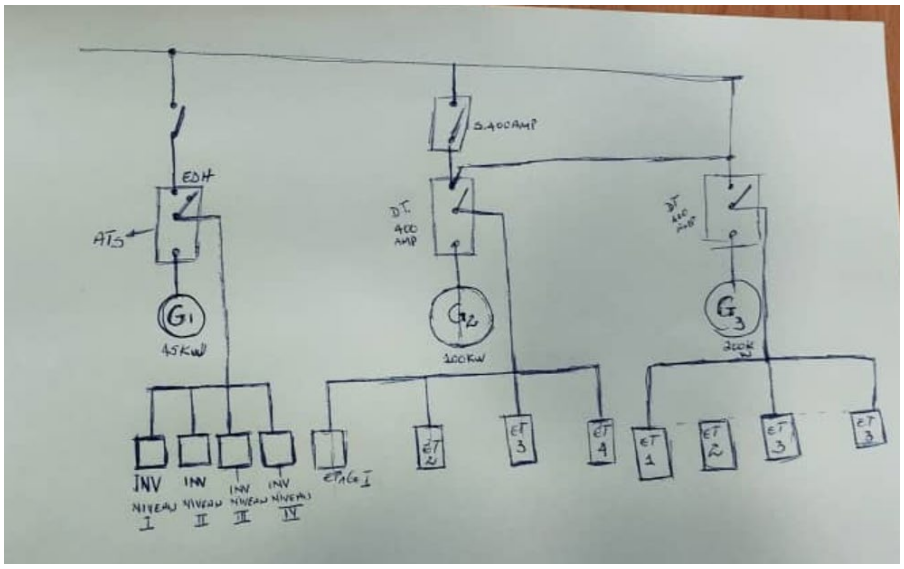

Figure 8 – SLD provided from Landlord

In the SLD above, the server room is located at circuit IV which is fed by the 45 kVA generator (G1).

3. Statement of Work

3.1 Local Partner

In case the vendor is not located within a reasonable distance to allow for a response time within the maximum time specified in Table 2, it must show proof of a formal agreement with a local representative with relevant experience for this project. This agreement is designed for support in the deployment of the solar hybrid PV system with regards to the pre-bid site visit, the after-award site survey, installation, commissioning, training, after-sales services, and maintenance processes[3]. This aligns with the UNDP's mission of developing local capacity.

[3] Please refer to Section 3.7 for vendor's tasks and responsibilities.

In case the vendor is based within a reasonable distance from the FO and can ensure to meet the required response times, a local partner is not necessary.

Please include the following in the offer document:

1. Topics and content to be covered during training.
2. Plan for bi-annual maintenance by the local partner, lasting for 3 years. Include the comprehensive details for procedures to be carried out during the periodic inspections.

In case the vendor partners with a local representative, please include the following in the offer document:

3. Letter signed by both parties, confirming the relationship between vendor and local partner.
4. Profile of the local partner, including documentary evidence of relevant experience and services.
5. Official documentation stating that the Local Partner is a registered business in the country.

Both the vendor and the local partner (if considered) need to agree to the maintenance terms discussed in *section 3.7.1.8,* **and must be aware of the high-quality expectations for the solution, as the system will serve as a showcase at both national and international levels.** This needs to be proved through a signed document stating the mentioned points.

Note that the **vendor is responsible** for the requirements mentioned in **section 3.7.1.8** and not the local partner. As the local partner may be required to go on-site during the O&M phase for corrective maintenance and troubleshooting, it should be based in a strategic location within proximity to the FO.

3.2 After-sales Services and Event Resolution Process

3.2.1 Corrective Maintenance

Corrective Maintenance corresponds to any activity performed to restore the solar PV hybrid system, equipment or component to a functioning state, and occurs after an event (failure) detection on site or by remote monitoring. Events are categorized by response priority depending on the scope of fault and business impact (Table 2). In case of an event, the vendor/local partner shall acknowledge the issue and perform the required activities depending on the identified event priority and timeline.

Table 2 – Event Response Priority

Priority	Scope	Business Impact	Acknowledgement Time	Response Time	Resolution Plan Submission
Critical	System is not operational	The event has extensive financial implications on end-user energy bills.	Within 8 working hours	Within 48 hours in **urban** area Within 72 hours in **rural** area	3 working days
Medium	Partial generation loss (e.g. single inverter failure, single battery rack failure, connectivity loss)	Some financial impact on energy bills and few business units are impacted.	Within 8 working hours	Within 96 hours in **urban** area Within 120 hours in **rural** area	5 working days
Low	Generation loss less than 10% or non-generation related event (e.g., PV panel damage, support equipment failure, monitoring portal issues)	Minium to no financial impact.	Within 16 working hours	Remote troubleshooting or/and site visit	case-dependent

As per best operations & maintenance practice, corrective maintenance process outlines the requirements for Acknowledgment time, Response time, time to submit Resolution Plan, and Resolution time as per

Resolution Plan. These factors will be monitored by UNDP ITM during the O&M period and accounted towards Vendor's key performance indicators (KPIs) and annual performance evaluation.

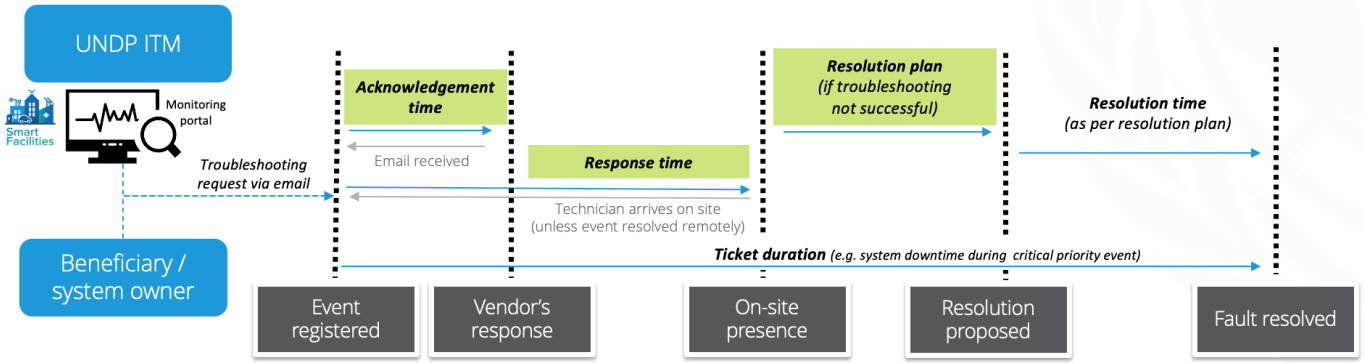

Figure 9 – Event response & resolution process

Event response by Vendor shall always:

1. Include **Acknowledgement email** of incident reporting within the specified acknowledgement time.
2. If an event cannot be solved remotely, provide **on-site presence** by a technician according to response time requirements.
3. If an event is not solved during the site visit, submit **Resolution plan** within the specified time.
4. Commence implementing resolution actions with the timelines and modalities indicated in **Resolution plan**.

Resolution plan shall always include

1. Clear explanation of event and the technical and financial impact for the end-user.
2. Event root-cause analysis.
3. Resolution activities and timelines.
4. Submission of request for procurement of any component's replacement.

3.2.2 Preventive Maintenance

Preventive Maintenance is the core element of after-sales services to a solar PV hybrid system. It comprises bi-annual site visits and physical inspection as well as verification that all the key components of the solar plant are in good working order. This maintenance is carried out at predetermined intervals according to the prescribed maintenance schedule submitted with the offer. The first preventive maintenance visit is carried out at the end of the Stabilization period (6 months after commissioning).

After each preventive maintenance visit, the Vendor is required to submit a Preventive Maintenance report (see template in Appendix III) outlining identified issues and providing Action plan for corrective measures (Figure 10).

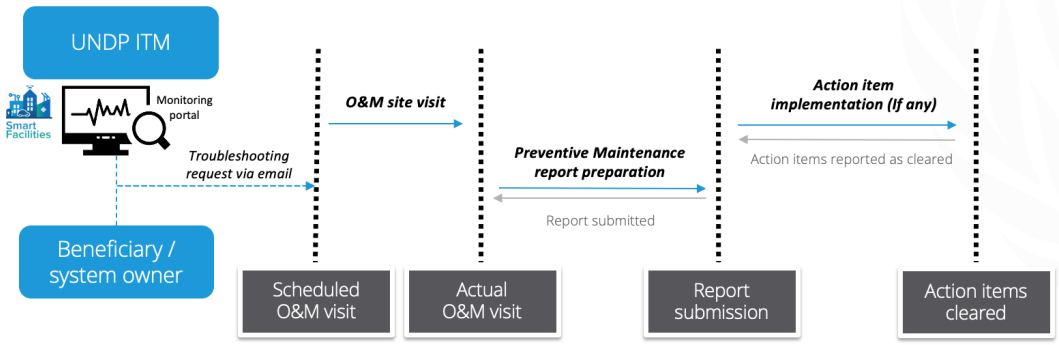

Figure 10 – Preventive maintenance process

The permitted timelines for completion of each activity of the preventive maintenance process are shown in Table 3. The results are accounted towards Vendor O&M schedule attainment KPI (see Section 3.2.3).

Table 3 – O&M Schedule Attainment

Activity	Completion time	KPI
Site Visit	Completed **within 1 week** of scheduled date	Yes / No
Site Visit Report	Submitted **within 1 week** from site visit	Yes / No
Action items	Items cleared **within 1 month** from site visit report submission	Yes / No

3.2.3 Energy System and Vendor KPIs

This section shows Key Performance Indicators (KPIs), which shall be respected during the O&M period of solar PV hybrid system. The KPIs are divided into energy system and vendor KPIs:

- Solar PV system KPIs, which directly reflect the performance of energy system and are quantitative indicators. They are calculated annually as part of the Annual Performance Report by ITM.
  - ✓ Connectivity [%] – UNDP ITM has launched a Network Monitoring Solutions (NMS) dashboard that continuously checks the inverter's status. The inverter's status is displayed and stored as either online (value = 1) or offline (value = 0) based on real-time monitoring.
  - ✓ Uptime [%] – Total number of hours per year minus the total ticket resolution time for critical priority events (expressed in %).
  - ✓ Specific Yield [kWh/kWp/year] – 1000kWh/kWp/year is set as the minimum by UNDP auditors.
  - ✓ Energy performance index (EPI) [%] – the ratio between Specific Yield and Expected Yield as per Final Design submitted by the Vendor in Step 5.
  - ✓ Energy savings [kWh/year and liters/year], financial savings [$/year], CO_2 savings [tCO2/year] compared to a year before solar PV installation.
- Vendor KPIs, which reflect the performance of the service provided by Vendor during the O&M period and are both quantitative and qualitative indicators. All but the last KPI refer to corrective maintenance as per Section 3.2.1.

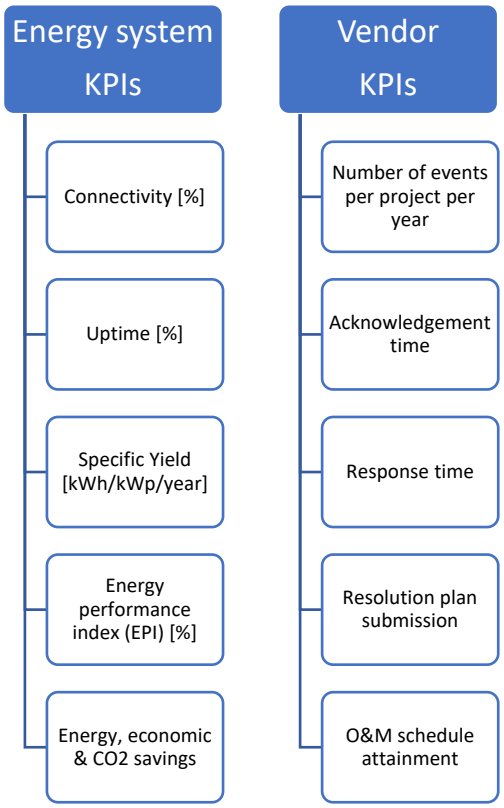

Figure 11 – Key Performance Indicators

3.3 Pre-bid Site Visit

Necessary site information, including photos, has been provided. However, for the preparation and submission of the bid, bidders shall engage with the local partner or defined representative to conduct a Site Visit (without cost to UNDP). The data collected on the pre-bid site visit and the data included in this document shall be considered for the offer preparation and submission.

The Pre-bid Site Visit is scheduled as per the details provided through the system. The visit can be conducted either by the vendor's staff, the local partner, or a third representative. Conducting a pre-bid site visit is **compulsory** for bidding.

Please note that each representative is responsible to follow local and international safety regulations and measures, including the use of appropriate PPE, during this and any future site visits or other activities related to this procurement process. UNDP declines any responsibility in case of accidents or unforeseen events that may result from the lack of safety precautions.

Please note that it is necessary to inform the visitors' credentials to UNDP in advance. As such, the vendors must inform their local partner accordingly.

Please confirm your intention to undertake the Pre-bid Site Visit(s) (without cost to UNDP) **by using the Messaging function in Quantum** or in its defect by sending an email to magdala.dejoie@undp.org. Kindly **provide the following information** for UNDP to make the necessary arrangements for assessment.

1. Name of company and local partner (if applicable):
2. Name of visitor:
3. ID:
4. Contact details (telephone number):

3.3.1 Pre-Bid Site Visit Information

The main purpose of the site visit is to allow for an educated bid, providing bidders with the opportunity to visit the site and take into consideration all necessary site-specific information for the submission of their proposal. Therefore, it shall remain the bidder's responsibility the communication with the local representative (if applicable), to ensure they have the necessary context and guidance to collect all relevant information.

This shall include, at a bare minimum (but not limited to): (i) existing power supply sources and integration; (ii) existing loads, distribution boards, and overall wiring condition; (iii) PV installation area and overall site condition; (iv) available space for technical room and power electronics; (v) internet connectivity for future solar PV system's monitoring.

3.4 Bidders Conference

The **bidders' conference** aims to provide an open exchange between UNDP and vendors, communicate the RFQ process to vendors, answer questions about the RFQ and ultimately ensure that prospective vendors have a clear understanding of the requirements. The conference will be conducted with interested vendors over a video conference, and the vendors' participation is **mandatory** for bidding.

3.5 Health and Safety

General terms and conditions – refer to conduct of UNDP expects its suppliers to adhere to the UN Supplier Code of Conduct found in this link : https://www.un.org/Depts/ptd/about-us/un-supplier-code-conduct.

A Health and Safety official shall be nominated during the execution and installation of the project. The nominated official shall be responsible for ensuring that adequate health and safety measures are respected throughout the project execution.

3.6 Technical Requirements

Compliance with or deviations from the specification shall be clearly stated by the vendor in the below sections (3.6.1 - 3.6.9) and submitted as part of the offer (*Please refer to Appendix 1*). The vendor shall apply good engineering practices and follow the applicable standards in the solar PV system's design. In addition, the vendor shall include technical and performance specifications of the equipment that will be used in the project. The system's electricity supply is expected to operate according to the follow logic/priorities shown in Figure 12, also further specified in section 3.6.7.1.

Figure 12 - System's operation logic

3.6.1 PV Modules

Table 4 - PV Modules Technical Requirements

3.6.1.1	**PV Capacity**	Total PV capacity of **15 kWp**
3.6.1.2	**Module Specifications**	Solar PV panels shall follow the following technical and performance specifications: i. Mono or polycrystalline silicon ii. PV Panels with enough number of cells and energy efficiency ensuring the system offered has the capacity requested iii. Tolerance better than -0/+5% iv. Maximum weigh per module 28 kg (>28kg modules may be accepted as long as the total weight of the structure does not compromise the integrity of the roof). v. Frameless modules are not allowed vi. The encapsulant used for the PV modules should be UV resistant in nature. vii. Junction box with accessible bypass diodes and degree protection of at least IP67 viii. Anti-reflective glass cover ix. Modules must be PID (potential induced degradation) proof, or have passed the IEC 62804 standard test x. Plug connectors must have at least IP65 protection. xi. Double insulation module with cables and connectors
3.6.1.3	**Standards**	i. PV module design and type-approval shall be completed according to **IEC 61215-2** or equivalent. ii. PV module fire performance shall be qualified and classified according to **IEC 61730, UL1703**, or equivalent. iii. Compliant with **IEC 61701** or equivalent. iv. Compliant with **IEC 62716** or equivalent.
3.6.1.4	**Module Efficiency**	Minimum shall be 20%.

3.6.1.5	**Limited Power Warranty**	i. The modules shall be subject to a 10-year limited product warranty or longer. ii. The performance warranty shall ensure that the modules will produce at least 90% of their nominal power after 10 years and 80% of the nominal power after 20 years.
3.6.1.6	**Voltage rating**	Shall be compatible with the battery voltage.
3.6.1.7	**Disconnecting means**	Shall be provided for the PV generator to isolate it from the battery safely when needed.
3.6.1.8	**Labelling**	Each PV Module shall be provided a bar code which must be able to withstand harsh environmental conditions. Bar code scanner leading to datasheet of all the modules containing the following information shall also be provided. The bidder shall provide the following information at the project completion: i. Manufacturer name of both the PV module and the solar cells ii. Type of solar cells: mono/poly-crystalline iii. The PV module brand; model and serial number iv. Rated power, Efficiency, Im, Vm and FF for the module v. Color temperature vi. Clear indication of the connecting inlets and outlets vii. Warranty and Safety warning viii. Other relevant information on traceability of solar cells and modules as per ISO 9000 series.

3.6.2 PV Modules mounting

Table 5 - PV modules mounting technical requirements

3.6.2.1	**General aspects and layout**	In this regard, vendors are requested to provide complete appropriate solution including supply of materials, civil works etc. as part of the proposed solution. On the top of buildings with a pitched roof the modules can be directly mounted on the roof, and enough space must be left for proper module ventilation. Otherwise, the tilt angle and azimuth of the modules are to be optimized to the production in relation to the needs and the local conditions. Shadowing of the PV modules from trees, buildings or any other obstacles should be minimized over the whole day and there shall be no shadows in a period of ± 4h w.r.t. solar noon. Distance between rows shall be designed to minimize shading losses while allowing optimal utilization of the available space. Bidders are requested to provide the solar field layout drawings of their solution coupled to a calculation of the required area (size) for Solar PV Modules in the offered system, as well as provide energy production forecast based on the orientation, tilt, and shadowing effects for Solar PV Modules.

		Any changes to the preliminary design of the mounting structure may be provided following the after-award site survey and the final design shall be approved by UNDP.
3.6.2.2	**Mounting Structure**	As the proposed solution consists of a rooftop mounting structure, the following shall apply: i. The new solar system including panels, racking, connections, and other components shall be designed in accordance with the loading criteria of the 2012 International Building Code and Haitian National Building Code, 2012 edition (herein after referred to as "code"). ii. The mounting structure and its total weight (PV modules and mounting structure) shall not compromise the integrity of the roof, and any damage that may occur because of the installation shall be the responsibility of the vendor. iii. Roof mounted structures shall be designed and customized to withstand local weather and climate, structural loads such as solar panels, wind loads (160 mph, or specify in case of any particular lower wind speed, considering building code or worst average wind speed/hurricane events), seismic loads (dependent on location), etc. iv. The roof mounted structure shall be installed following local and/or international regulations (in accordance with the IBC code), and it shall not include ballasts and other components that may add unnecessary load on the roof. The proposed solution shall minimize the weight on the structure. v. The structural design, when applicable, shall be designed and signed by a licensed engineer. The evaluation shall be in accordance with the IBC code. Detailed drawings shall be provided, indicating total dimensions of the structure. vi. **Structural engineering analysis** should be performed in accordance with ASCE 7 (from IBC code) and site conditions, **with sealed calculations for wind forces, reactions, and attachment design.** vii. The mounting structure and overall solution shall be aesthetically pleasing, use local materials (when possible) that adhere to quality standards and materials that have low embodied energy. viii. Bidders shall assess and confirm if there is easy access to solar panels on top of the roof for regular cleaning and maintenance of the solar panels. ix. The PV layout shall include enough distance between rows to allow for maintenance activities as needed. x. The mounting structure design and installation shall adhere to local standards and / or the International Building Code (IBC). xi. The BoM considered for the structure shall be included in the technical drawings. xii. The structure shall be placed at a minimum safe distance from the edges of the roof, following local standards and in line with manufacturer's recommendations. xiii. Distance between rows, if applicable, shall be designed to minimize shading losses while allowing optimal utilization of the available space.

		xiv. Ballasted-only systems are not allowed due to the high risk of cascading failure modes. All mounting structures shall have positive mechanical attachments to the building structure. xv. Self-tapping screws for structural connections shall not be accepted. xvi. Penetrations through existing elements shall not have an adverse effect on the existing building structure. xvii. If top-down clamps are required, clamps that hold modules individually or independently shall be used. xviii. Bolt hardware shall be vibration-resistant and appropriate for the environment and workforce. xix. The material of the structure/rails/clamps shall be anodized aluminum 6005 T6 with anodized coating, galvanized mild steel with selected coating thickness for protection against corrosion given local environmental conditions, stainless steel 304, or of equivalent quality xx. All fasteners and washers shall be of stainless-steel grade SS 304 & SS 316 with property class A2-50 and A2-70 respectively, conforming to relevant ISO standard and must sustain the adverse climatic conditions to ensure the life of the structure for 25 years. xxi. The vendor should guarantee that the solar installation should not cause any water leakage or any damage to the roof which might incur during the installation phase as well as later after the solar system is commissioned and fully functioning.
3.6.2.3	**Design requirements**	The vendor shall submit the detailed design calculations and drawings for the foundation, mounting structure, bill of materials and their specifications/ standards for approval. The documentation should specify installation details of the PV modules and the support structures with appropriate diagram and drawings.
3.6.2.4	**Lifespan**	Mounting structure should last at least the lifespan of project (25+ years).
3.6.2.5	**Installation**	The design and installation should respect and meet the recommendations specified by the solar panels' installation guideline.

3.6.3 Power electronics

Table 6 - Power electronics technical requirements

3.6.3.1	**Features**	The system must include a smart inverter and controller to control the solar PV output, battery charging and discharging and the output of external power sources (grid/generator). Additionally, power electronics and BOS devices should include protection and power quality devices that counter problems like power back flow to the generator due to solar production.
3.6.3.2	**Inverter Specifications**	For solar hybrid PV systems, the following system setup are allowed i. AC-coupled system with solar PV inverters, MPPT/Charge Controllers, and battery inverters. ii. DC-coupled system with hybrid inverters.

		The solution should be integrated with diesel generators and must control the switching on and off the generators. Their design should be based on the requirements specified below:
		<u>Solar inverters with:</u> i. Inclusive of at least 2 maximum power point tracker (MPPT) compatible with the PV modules' layout and total voltage rating, maximizing the PV production. ii. The inverter maximum output capacity shall not apply any limitation to other power sources. iii. The inverter shall be compatible with the PV module's layout, accounting for possible local temperature variations. iv. Inverter EU efficiency: 95% (on-grid). v. Temperature-dependent smart cooling is required (the speed of the fans shall be controlled by temperature) vi. Solar inverters shall provide **IP 65** or better
		<u>Battery inverters with:</u> i. Minimum rated output capacity of 10 kW and a maximum peak capacity (for 3 seconds) of at least 15 kW ii. 1-phase/2-phase with the AC output voltage of 220 V(L-N), 220(L1-L2) and 60Hz (to be confirmed by bidder during pre-bid site visit) iii. Compatible with Li-Ion battery system. Please note that we expect the battery system to be used daily and therefore the charging and discharging cycle will also happen daily.
3.6.3.3	**General Specifications for all power electronics**	i. Operating Temperature: 0 to 50°C ii. 1-phase 220V/2-phase 220V (to be confirmed during pre-bid site visit) iii. Frequency 60 Hz iv. Total Harmonic Distortion: Less than 3% at 100% load v. The inverter front panel and/or the control unit shall feature an LCD/LED display to indicate the primary system components and their on/off status. It is preferable to have 3 independent inverters to make the 3-phase output. However, other suitable configurations may also be acceptable.
3.6.3.4	**Standards for all power electronics**	Regarding quality assurance, power electronics must follow these certifications, or equivalent ones (if equivalent, specify in Appendix I). Proof of compliance shall be presented along with the technical offer, as previously specified. i. Design: **IEC 62093** or equivalent

		ii. CE-conformity **LVD 2014/35/EC**, including at least the following harmonized standards: a. Safety for converters: **IEC 62109-1 and IEC 62109-2** jointly, or EN 60335-1 (in case of small power electronics), or equivalent iii. Safety for Battery Chargers: **EN 60335-2-29** iv. CE-conformity **EMC 2014/30/EU**, including at least the following harmonized standards: a. **IEC 61000-3-3** or **IEC 61000-3-11** b. **IEC 61000-3-2** or **IEC 61000-3-12** v. EMC conformity Emissions limits: Either **EN 61000-6-3, 61000-6-4**, or **EN 55014-1** (according to size of equipment and application) vi. EMC conformity Immunity limits: Either **EN 61000-6-1, 61000-6-2** or **EN 55014-2** (according to size of equipment and application) (if any equivalent standard, specify in the Appendix I)
3.6.3.5	**Safety for all power electronics**	i. **All power electronics** stored in the technical room shall provide **IP 54** or better, or they shall be installed inside an IP54 container/cabinet. **Solar inverters shall be IP65 or better** ii. A circuit breaker of appropriate voltage and current rating shall be provided at the output to isolate the inverters from grid in case of faults iii. It shall provide protection against the following type of faults, among others: a. DC/AC over current and over voltage b. DC reverse polarity c. DC earth fault d. AC under voltage e. AC under frequency/over frequency f. Over temperature g. Lightning surges
3.6.3.6	**Warranties**	The expected operating lifetime of the battery charge controller and inverter shall be of at least 10 years and the warranty period of 5 years.
3.6.3.7	**Market Experience**	Inverter and power electronics manufacturers must have a minimum of seven (7) years of continuous operation in the manufacturing of PV and battery inverters as of the proposal submission date. The experience must be in the design, production, and supply of inverters similar to those required by this procurement process.

3.6.4 Battery

Table 7 - Battery technical requirements

3.6.4.1	**Battery Capacity**	Rated capacity of 60kWh at 1C.

3.6.4.2	**Battery Type**	Lithium-ion batteries.
3.6.4.3	**Features**	The set of batteries in the Hybrid Energy System shall include these technical and performance specifications: i. Number of guaranteed cycles at 80% DOD > 5000 cycles ii. Operating temperature 0-40°C iii. Protection against deep discharge, overcharge iv. Charge balancing between cells v. Batteries should be installed in a climate-controlled environment. vi. Temperature should be kept at optimum operating conditions. Note: Factory assembles standard modules are preferred above the single units assembled on site.
3.6.4.4	**Standards**	Regarding quality and safety assurance, they must follow these certifications, showing proof of compliance along with the technical offer, as structure previously specified. i. UL 1973 ii. UN 38.3 (or equivalent). iii. Must be stored in an IP 54 cabinet/container, or provide IP54 protection
3.6.4.5	**Labelling**	The bidder shall provide the following information for each battery at the project completion: i. Manufacturer ii. Serial number iii. Number of series and parallels iv. Rated capacity (Ah @1C and @C100) v. Rated voltage vi. Manufacturing date vii. Clear indication of the connecting inlets and outlets viii. Charge strategy ix. Safety warning
3.6.4.6	**Warranty**	The expected lifetime of the battery shall be 10 years, and the warranty period shall be 5 years.
3.6.4.7	**Manufacturing**	The manufacturing date of the batteries shall be no more than 6 months prior to the installation of batteries to the system. Should the installation be delayed, the batteries shall be charged and cycled as per the manufacturer recommendation, at the expense of the vendor (not to use CO or client energy supply, considering cost of electricity especially for large batteries). The batteries shall not be cycled more than twice before installation (total 18 months of age maximum before installation)

3.6.5 Technical Room

Table 8 - Technical room requirements

3.6.5.1	**Specifications**	The PV inverters can be installed in a new technical room being built on the rooftop of the building (see photo in annex IV), and it must be in a well-ventilated area that is shielded from direct sunlight and rain. The landlord is building a new room on the roof which can be used to house the inverter and BOS components. It is the vendor responsibility to ensure the room is sealed from rain and lockable for security. It shall remain the bidders' responsibility to guarantee that any civil works or interventions on an existing structure for the power electronics installation (such as drilling in existing wall for inverter fixation, or cabling connections) will not compromise the integrity of the structure. Any damage to the existing structure that may occur as a result of this installation shall be the responsibility of the vendor.
3.6.5.2	**Features**	In case the features are not available in the existing technical room, they shall be included as part of the proposal: i. Smoke detection and alarm ii. Fire extinguisher iii. Climate control and protective device iv. Conditions: Tropical Environments v. Operating Temperature: Desert/Tropical (-10°C/+50°C) vi. Internal temperature shall be regulated for optimal performance of equipment vii. Ensure that the product conforms to appropriate and applicable European, American, Japanese or Australian standards with regards to: Safety for Electrical Appliance, Electrical Standards, Building Standards, Container Internal Environment, General Ventilation and Cooling Standards for such facility, Offer to clearly reflect cost of this element (technical room features) including overall system cost improvement and/or increment related to this option.

3.6.6 Online monitoring system

Table 9 - Monitoring requirements

3.6.6.1	**Connectivity requirements**	Internet connectivity will be available at the site. i. Vendor shall provide LAN internet (wired) connection from the closest ethernet port to the inverters. ii. Based on the distance from the inverter to the closest ethernet port communication protocol shall be Ethernet (Cat5/Cat6 up to 100m).

3.6.6.2	**Online monitoring requirements**	A local and online monitoring system shall be a user-friendly dashboard that shows **real-time** power consumption, indicating which sources are used to provide the required power (solar PV, battery, grid and generator). The monitoring portal shall display the following information in **real-time**: i. Solar PV system DC input (kW). ii. Solar PV system AC output (kW). iii. Site electricity consumption - AC loads (kW). iv. Grid import (kW). v. Generator power output (kW). vi. Battery state of charge (SOC, %). vii. Battery charge/discharge power (kW). viii. Battery temperature (C°). ix. Technical room temperature sensor (C°). In addition, the monitoring portal should hold the information about i. List of existing and newly installed equipment (solar PV system, inverter, charge controller, battery) ii. Alarms, Fault and System Diagnostics with time stamped event logging The information in the portal shall be presented in English.
3.6.6.3	**Historic data requirements & retention**	An online monitoring system shall be provided to track the system operation and performance for at least the last three (3) years. It must include the following parameters on (at least) an **hourly** basis: i. Solar PV system DC input (kW). ii. Solar PV system AC output (kW). iii. Site electricity consumption - AC loads (kWh). iv. Energy imported from the grid (kWh). v. Generator energy production (kWh). vi. Energy charged and discharged from the battery (kWh). vii. Technical room temperature sensor (C°). viii. The monitoring system should also include the configuration and alert records. Performance data for the entire period shall be available for download in csv and/or xlsx format for the last three (3) years. In case the native monitoring portal does not provide these options, the vendor is responsible for providing a solution.
3.6.6.4	**Local data logging solution**	Embedded or external data logger shall be provided for data retention of at least 30 days, following the loss of connectivity. System performance data (as per 3.6.6.3) shall be automatically uploaded to the online monitoring portal when connectivity resumes.

3.6.6.5	**Connectivity monitoring**	Whenever LAN internet connection is used, vendor shall provide the following network information in the commissioning checklist • Network name: • Network owner/responsible (e.g. UNDP): • Firewall & router provider (e.g. Cisco Meraki) • Inverter/device name (as seen by network): • MAC address: • IP address:

3.6.7 Smart power management

Table 10 - Smart power management requirements

3.6.7.1	**System's operation logic**	The hybrid energy solution shall include Smart Power Management that allows the working system to supply electricity according to the following logic/priorities: 1st : Solar PV 2nd : Battery 3rd : Electricity Grid 4th : Generator

3.6.7.2	**Details**	The Smart Power Management should provide the following capabilities: i. **Connection with Local Electrical Distribution Panel**: The solar PV systems shall be connected to the main distribution board of the facility. If the main distribution board is not in good condition, does not exist, or needs upgrading, any installation/upgrade activities will also be the responsibility of the awarded vendors. ii. **Prevent Inverter Failure Disruption:** Integration with the grid and generator shall not take part within the power electronics, but at the distribution board. The failure of an inverter shall not disrupt grid and generator supply. iii. **Interconnection with Grid and Generators:** The system shall be designed to interconnect with the facility's grid and generators. iv. **Integrated Operation of Solar PV, Grid, Generators, and Batteries:** The solar PV hybrid system shall enable solar PV, grid, generators, and batteries to operate as a single, integrated, intelligent, and automated energy supply system for the facility. This includes the automatic start and shutdown of generator(s). v. **Dynamic Intelligent Management:** The systems shall provide dynamic and intelligent management for the overall PV system, batteries, grid, and generators, ensuring optimal energy supply. vi. **Internet-Based Monitoring:** The solar hybrid PV system must include online monitoring to track performance, availability, and status. vii. **Protection Against Power Backflow:** The system must ensure protection against power backflow to the generator due to solar production, safeguarding generators from reverse current. viii. **Minimum Human Intervention:** The solar system must function seamlessly, providing a stable and reliable power source with minimal human interaction. The batteries should be capable of self-starting if a critical state of charge (SOC) is reached.
3.6.7.3	**ATS for generator**	Currently the switching between generators is being done manually. As a part of this project, an ATS needs to be installed in order make the switching between diesel generators automatic and controlled by the battery inverters or the SCADA.
3.6.7.4	**Changeover switch**	A changeover switch shall be included to be able to bypass PV.
3.6.7.5	**Power requirements**	The system should not vary the power factor of the load. It shall not vary the reactive power intake form the grid and it shall not increase the peak consumption from the grid.

3.6.8 Wiring and safety

Table 11 - Wiring and safety requirements

3.6.8.1	**Details**	Cables needs to be sized according to the required local applicable standards, or otherwise to EU applied standards, with the following considerations: i. Appropriate sizing of all cable lengths and dimensions shall respect a 2% maximum voltage drop with reference to the maximum permissible current passing through the cable. The voltage drop shall be considered separately to AC and DC sides (i.e. max output of inverter or 125% rating of circuit breaker directly installed at the inverter output. The cable between the inverter and circuit breaker shall respect the maximum voltage drop at the maximum inverter output). ii. Cables installed outdoors must be able to handle high UV radiation, high temperatures, and must be weather resistant. Alternatively, they can be installed in cable trays that ensure they are protected from the elements. iii. Bi-metallic lugs and connectors shall be used for connecting aluminum to copper iv. Solar cables shall be aesthetically tied to Module Mounting Structure using UV resistant cable-ties suitable for outdoor application v. Overcurrent protection for the strings, PV generator, battery and inverter shall be included. vi. Overvoltage surge and lightning protection on the AC and the DC side is required vii. Protection against electric shock on the AC and DC side is also required viii. Circuit Breaker of appropriate voltage and current rating shall be provided at the output to isolate the inverters from grid in case of faults ix. Diesel generator shall be protected from back feeding. x. Cable installation shall be as per IEC 60502 or equivalent xi. All components shall be installed in accordance with local and international standards and the manufacturer installation guide. Manufacturer recommendations are considered requirements. xii. All electrical panels and distribution boards, in case required, must be made of electrostatically coated stainless or galvanized steel. Any component made of steel shall be electrostatically galvanized. Uncoated steel shall not be accepted. Combiner boxes and cabinets can be made of PVC or equivalent material only if placed indoors. They shall be equipped with DIN rails sufficient for the internal components. xiii. All conduits, electrical panels and combiner boxes shall not be crammed with equipment and/or cables, respecting the maximum fill rate specified by NEC: a. Conduits shall have a maximum filling rate of 53% for one conductor, 31% for two, and 40% for 3 or more conductors,

		of the internal cross-sectional area of the conduit. Multicore cables are considered one conductor for this requirement. b. Distribution boards, electrical panels and combiner boxes shall have adequate spacing to prevent overheating and electrical faults, and never more than 40% of the cross sectional area for wiring, and 75% including all other components and equipment.
3.6.8.2	**Trenches**	Trench depth for wiring installations must comply with local standards. In the absence of local standards, the following shall apply: i. Areas with no vehicles or heavy pedestrian activities: minimum cable depth of 30cm ii. Asphalt/pavements with heavy pedestrian activities: minimum cable depth of 30cm iii. Asphalt/pavements with limited vehicle activity: minimum cable depth of 45cm iv. Roads with frequent vehicle traffic or dirt roads: minimum cable depth of 60 cm AC and DC cables shall be in separate trenches. If communication cables are installed in the same trench as a power cable, as per the common requirements in international and local standards, they shall be sufficiently spaced apart and insulated to eliminate magnetic interference.
3.6.8.3	**Grounding**	i. All components of the system must be properly grounded ii. AC and DC components must be grounded separately. iii. All work must be carried out in conformance to international and local codes and electricity standards. iv. The devices must be installed in accordance with the grounding device manufacturer's specified instructions. v. Earth rods/electrodes shall be made of copper bonded steel or galvanized steel of sufficient cross section to carry the fault current and withstand corrosion.
3.6.8.4	**Firefighter's switch**	Solar arrays shall be equipped with a remotely controlled DC disconnect switch. If there's no need for this switch to be remotely controlled, the reason why shall be included, along with the proposed solution.

3.6.9 Warranty of the system

Table 12 - Warranty requirements

3.6.9.1	**Details**	Warranty certification/documentation for the solar PV hybrid energy system main components including summary overview of warranty arrangements (technical and logistical) shall be included in the system documentation. An overview of available warranty extension options for the main components shall be provided.

		Any cost associated with warranty replacements during the warranty period will be borne by the supplier. Any cost associated with the maintenance and technical support for the energy system during maintenance subscription will be borne by the supplier.
3.6.9.2	**Length**	The warranty for the complete system shall be at least 18 months from date of commissioning. This means that, for 18 months after the commissioning, the vendor is responsible for resolving any functionality issues with the complete system, without any financial liability on UNDP.

3.7 Tasks and Responsibilities

The overall tasks and responsibilities of the provider are indicated below in Table 13.

Table 13 - Mandatory tasks and Responsibilities

3.7.1.1	**Risk Assessment, Avoidance and Mitigation Plan**	A mandatory risk assessment must be conducted and presented along with the technical offer, including as minimum features: i. All potential risks that the project might incur, in each step of the project. ii. The probability of incurrence and severity of the identified risks (e.g.: risk matrix). iii. The risk tolerance for the identified risks. iv. Proactive and reactive responses for risks surpassing the defined threshold of severity and/or probability. v. A mitigation plan for the risks identified as most severe or likely to happen (e.g., in case the final timeline is not respected due to external factors). This risk assessment must include all major phases of the project, i.e., procurement, shipment and transportation of goods, installation of the system, training of the end-users and monitoring of the active system.
3.7.1.2	**After-award Site Survey**	The awarded vendor shall carry out an **After-award Site Survey** to exhaustively consider all aspects that can adversely affect the implementation of the project and information for the final project's design, including required materials/equipment and time frames. There should not be any extra costs after the site visit, and if any extra costs may occur after the contract award, these shall be taken individually by UNDP to assess their applicability and justification. A final **Site Survey Report** shall be submitted following minimum criteria and guidelines specified by UNDP in the subsequent sections.
3.7.1.3	**Final Technical Design**	The awarded vendor will be responsible for drafting the final system design, considering findings from the site survey in the previous step. The design shall include, at a minimum, the information outlined in the following section. **The design must be approved by ITM before proceeding, shipment must not be initiated before design has been approved.**
3.7.1.4	**Shipment of material**	Shipment is to be provided for all the components of the system, following all procedures and documentation specified in this document. It is recommended to perform check and verification of the good functioning of the System Solution, and all the equipment involved before shipping the container (ideally 2 weeks before shipment).

		The contractor shall be responsible to ensure the shipping timeline and overall installation timeline of the battery will comply with the battery's manufacturer recommendations, ensuring there won't be any issues with the battery warranty as a consequence of the shipping timeline.
3.7.1.5	**Installation of the Solution**	i. Civil Works and Site Preparation: implementation and/or technical guidance shall be provided by the vendor. ii. The safety of all components remains part of vendor's responsibility during civil works and installation phase, up until commissioning and official hand-over of the system. iii. Earth and lightning protection. iv. All necessary components of the system must be properly grounded v. Anti-theft protection of the whole system (at least two numbers of anti-theft fasteners of stainless steel on two diagonally opposite corners for each module shall be provided) vi. Solar hybrid PV system mounting and installation. vii. The engagement and involvement of local or regional partner in order to enhance solar PV system deployment and after-sales services. viii. Connection to the national grid and all necessary related licenses and documentation The installation should follow the guidelines of IEC 63049.
3.7.1.6	**Commissioning, UAT and Training**	**Training** The content of the training must include topics such as: i. Smart appliance usage to prevent equipment misuse. ii. Awareness of energy consumption and electricity costs. iii. Basic operation and functionality of the main components of the solar hybrid system. iv. Emergency response scenarios, including the proper use of fire extinguishers. v. PV panel cleaning with demonstration. vi. PV panel cleaning schedule (to be done by end users outside preventive maintenance visits) with frequency reflecting local climate conditions. **User Acceptance Testing** i. UAT shall be developed in collaboration with ITM UNDP, following a template and guidelines that will be provided by ITM UNDP (as per Appendix II) ii. UAT results shall be captured in Online Monitoring System (3.6.6) (requires online monitoring portal to be set up prior commissioning tests). iii. User inspection will be performed during commissioning by ITM and the FO Focal point. **Commissioning** i. Complete the UNDP Commissioning checklist. ii. As-built diagrams must be provided. iii. If there have been any changes to the technical documentation, the updated documents should also be provided. iv. A representative from the supplier's own staff/team must be present on-site during commissioning of the system.

3.7.1.7	**Stabilization of the System**	i. The awarded vendor must remain at the disposal of the beneficiary for at least six (6) months after system commissioning to assist in answering any technical or other related questions, called *stabilization period*. ii. Maintenance agreement starts with the 1st preventive maintenance visit, once the 6-months stabilization period is finalized.
3.7.1.8	**Maintenance of the system**	i. Mandatory after-sales services including: a. Maintenance (preventive and corrective) b. Technical support (onsite and remote) c. Continuous availability of the online monitoring system ii. The engagement and involvement of local partner is mandatory for the Solar hybrid PV system after-sales services. iii. Vendor shall provide helpdesk's and local partner's contact information and procedures for escalation procedures. iv. Solar hybrid PV system implementation and after-sales technical support is required, inclusive of appropriate escalation measures. v. Solar hybrid PV system maintenance is required, inclusive of appropriate escalation measures. vi. Preventive maintenance shall include: a. Cleaning of PV panels, inverter cooling system, and other equipment in order to guarantee maximum system efficiency b. Technical room visual inspection and cleaning. c. General system checks and verifications (assessment of the structure status; assessment of the technical room status; cable connections check and securing, etc.) d. Preventive maintenance shall be done in compliance to UNDP's Maintenance Report guidelines (as per Appendix III) vii. Corrective maintenance shall include: a. System troubleshooting in case of loss of production, inclusive of necessary corrective visits for system's troubleshoot diagnosis. b. Parameters adjustment and small changes in operational logic. viii. Annual System Performance reports a. Vendor shall complete Annual System Performance report and present it to System owner & beneficiaries (as per provided template). iv. Refresher training a. Local/regional partner shall provide a refresher training with the 2nd, 4th and 6th preventive maintenance visit after Year 1,2,3. b. The training session shall cover the same content about troubleshooting as during commissioning. In addition, local/regional partner shall present the results of Annual Performance report. Local partner should inform system owners & end users about the visit time & date at least 2 weeks in advance.

3.8 Timelines

3.8.1 Tasks and deliverables

The overall deliverables and their respective deadline after Purchase Order (PO) signature are indicated below in Table 14. The tasks are to be performed within the proposed timeline. An overview of the general timeline including all deliverables can be found below this section, in Figure 13.

Table 14 - Tasks and responsibilities timeline

No	Tasks and Deliverables	Deadline
3.8.1.1	**Signature of the contract**	PO
3.8.1.2	**After-award Site Survey Report**	PO + 1 month
	Overview site details for a through survey.	
3.8.1.3	**Final Technical Design**	PO + 2 months
	Single line diagram with endorsement letter from manufacturer	
3.8.1.4	**Pre-assembled technical solution tested and ready to be shipped**	PO + 4 months
3.8.1.5	**Transportation and delivery**	PO + 8 months
3.8.1.6	**Installation of the Solution**	PO + 11 months
	Solar hybrid PV system mounting and installation.	
3.8.1.7	**Commissioning, UAT, Training**	PO + 12 months
	Complete UNDP Commissioning check list. User Acceptance Testing (UAT). Solar hybrid PV system training to UNDP Field office representatives.	
3.8.1.8	**Stabilization of the system**	UAT + 6 months
	The maintenance agreement will start after the stabilization period of six months. First preventive maintenance visit.	
3.8.1.9	**Maintenance of the system**	UAT + 42 months
	After-sales services including maintenance (preventive and corrective). Technical support (onsite and/or remote) including continues online monitoring.	

3.8.2 Documentation

After award of contract and formalization of purchase order (PO), the supplier shall deliver all the documents listed in Table 15 by e-mail to UNDP ITM (itm.green.energy@undp.org). An overview of the general timeline including all documentation can be found below this section, in Figure 13.

Table 15 - Documents after award of contract

No	Document	Description	Deadline for delivery
3.8.2.1	**Project Plan Report**	Complete report specifying all the steps that will be carried out to perform the project (from Site Survey to After sales services) with the corresponding timeline and who will be responsible of each step (vendor, local partner or both).	PO + 1 week

3.8.2.2	**After-award Site survey Report**	i. Overview of the sites' details ii. Solar PV Module installation location details (assessment, measurements; photos, etc.). iii. Consideration and assessment for suitable Solar PV Modules mounting system (so it does not compromise the integrity of the roof). iv. Battery bank location details (measurements; photos, etc.). If outdoor, appropriate weatherproof enclosure. v. Technical room information and final proposal, including any necessary civil works to existing structure (ensuring that any necessary interventions such as drilling in existing wall for inverter fixation, or cabling connections will not compromise the integrity of the structure) vi. Diesel Generator location details vii. Electric distribution panel and wiring overview details (grounding, measurements; photos etc.). viii. Assessment and documentation of any shading objects, including photos. ix. Gather current energy consumption profile provided by the client (local grid and diesel generator, estimate overview of daily use patterns, appliances and load profile). x. Assessment and confirmation of the grid quality, along with assessment of phase loads balancing to avoid future integration issues with the PV system. xi. Assessment and confirmation of connectivity availability. xii. Specific civil work requirements	PO + 1 month
3.8.2.3	**Design report including system design drawings**	i. Site specific Solar PV Solution inclusive of appropriate sizing and optimization of related components e.g., Solar PV Modules; Batteries; inverter(s) inclusive of surge load capacity. ii. Confirmation of energy production forecast based on the load assessment, orientation, tilt, and shadowing effects for Solar PV Modules. iii. Appropriate sizing of all cable lengths and dimensions shall respect a 2% maximum voltage drop with reference to the maximum current passing through the cable. iv. Energy system components and wiring diagram for proposed solution. (Diagrammatical representation of the technical solution). v. Offer including Bill of Material (BoM) and technical datasheets for the main components. vi. Project delivery plan (including complete summary overview of entire project). vii. Endorsement letter certifying/proving the design from the (inverter and monitoring solution) manufacturer.	PO + 2 months

		viii. ISO9001 and ISO14001 certificates for manufacturers of main components (batteries, charge controllers, inverters and panels), if necessary. ix. Confirmation of the suitability of the solution (considering a detailed assessment of the loads). x. Draft of checklists/procedures that supplier will follow for UAT and commissioning. **Note: The design must be approved by ITM before proceeding, shipment must not be initiated before design has been approved.**	
3.8.2.4	**Bill of materials**	Complete list of materials grouped in assemblies	2 weeks before shipment of materials
3.8.2.5	**Shipping documents**	i. Invoice ii. Packing list iii. Bill of lading iv. v. Insurance	ASAP after dispatch, minimum 3 weeks before arrival at destination port
3.8.2.6	**Warranty documents**	Warranty certification/documentation for the Solar hybrid PV system main components, including summary overview of warranty arrangements (technical and logistical). i. Overview of available warranty extension options for main components. ii. Cost associated with warranty replacements during the warranty period will be borne by the supplier. iii. Cost associated with the maintenance and technical support for the installed system during maintenance subscription will be borne by the supplier.	If not already sent with original offer: After dispatch, minimum 3 weeks before arrival at destination port
3.8.2.7	**Testing procedure**	List of tests that will be carried out and respective pass/fail criteria	Latest 4 weeks before testing
3.8.2.8	**Installation and commissioning report**	i. Solar hybrid PV system Commissioning Report. ii. Installation and commissioning activities, as-built drawings	Max. 4 weeks after testing
3.8.2.9	**User acceptance testing report and proof of performance to UNDP**	Results of the individual tests and system performance test as outlined in the testing procedure; sign off by vendor, UNDP ITM and system user; any deviations and pending tasks need to be recorded.	1 week after testing
3.8.2.10	**Training manual/guide**	i. On-Site Solar hybrid PV system Training Guide provided in **French**. ii. Provide manuals in **French**. iii. Include training videos	With training
3.8.2.11	**O&M Manual and**	i. Solar hybrid PV system Maintenance and Troubleshooting Essentials Guide for Field Office (day-to-day operations) in **French**.	With training

	troubleshooting guide	ii. Description of correct operation and maintenance of the system provided in **French**. Troubleshooting in case of errors. iii. Preventive and corrective maintenance logs.	
3.8.2.12	**O&M schedule**	Schedule of preventive maintenance visits including tentative dates	With training
3.8.2.13	**Service level agreement (SLA)**	Agreement between UNDP, vendor, and system owner, defining the scope of the included maintenance (corrective and preventive) and technical support (on-site and remote).	With commissioning
3.8.2.14	**Maintenance reports**	Solar hybrid PV system Preventive Maintenance Report (as per Appendix III)	1 week after maintenance visit
3.8.2.15	**Photo and video documentation**	Documentation of system installation, commissioning, and testing, such as: i. Civil works during installation ii. Concrete foundation tests and procedures. iii. Training of local staff iv. Overview of the installed system v. Solar panels' location vi. Monitoring portal records for commissioning tests	During installation, training, commissioning, and testing

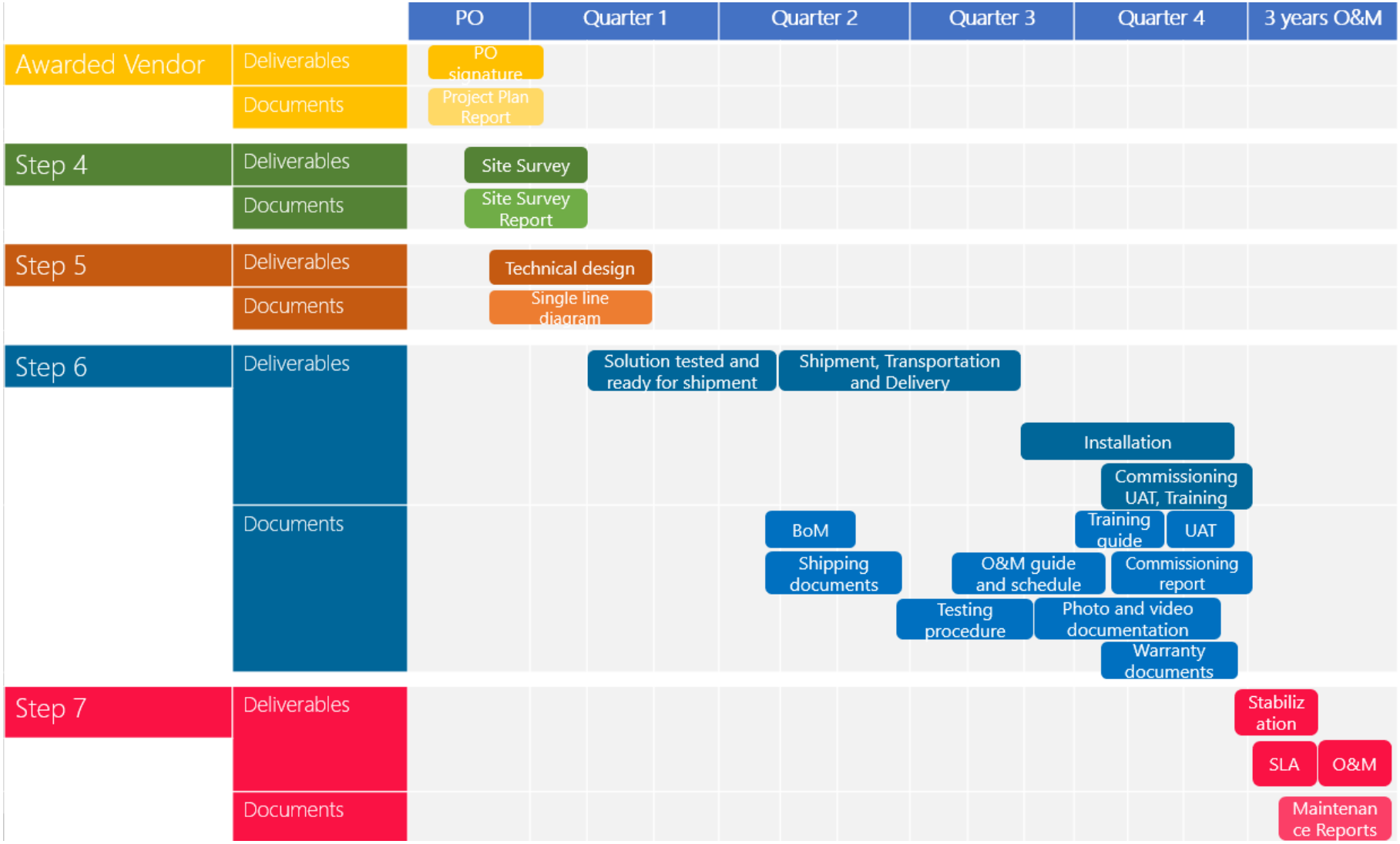

Figure 13 - Documents and Deliverables Timeline

4. Price and Delivery Schedule Forms

The Financial Proposal shall be provided in an excel format, using the template provided in the Price Schedule. Bidders shall make an offer for all the items.

5. Communications Management Plan

This section sets the communication framework for the life of the solar PV installation process. The overall desirable outcome is to keep all parties well informed in a timely fashion to avoid disruption and possible misaligned expectations.

	Communication Activity	Description	Frequency	Format/Channel	Deliverable	Responsible	Accountable	Consulted	Informed
1	Installation Plan	GET shares installation plan template to all stakeholders	As needed	SharePoint	Installation Plan	Vendor	Vendor	UNDP GET	UNDP GET
2	Kickoff Meeting	Meeting of stakeholders	Once before project start	videoconference	Minutes of the meeting	UNDP GET	UNDP GET	Vendor, CO	CO
3	After-award Site survey	Coordination of vendor visit	After project offer	e-mail	Site Survey Report	Vendor	Vendor	UNDP	UNDP
4	Final System Design	Confirmation of detail	As needed	e-mail, phone	Design, letter from manufacturers	Vendor	Vendor	UNDP GET	UNDP
5	Shipping	Shipment of goods	As per provided timeline	e-mail	Invoice, Packing list, Bill of lading, Insurance	Vendor	Vendor	UNDP	UNDP
6	Customs clearance	Clearance of good at the CO	As needed	In person, e-mail	Clearance confirmation	CO	CO	Vendor	UNDP GET
7	Installation	General	As needed	e-mail, phone	General questions and change requests	Vendor	Vendor	UNDP	UNDP
8	Invoice Payment	Receipting and disbursement	As per agreed plan	e-mail, phone	Invoice, payment confirmation	UNDP GET	UNDP GET	Vendor	CO
9	Commissioning	Schedule for training, UAT, etc.	End of each installation	e-mail	Signed UAT, checklist, etc.	Vendor, UNDP GET	Vendor	UNDP	UNDP
10	System Inauguration					UNDP	CO	-	
11	System Maintenance	Bi-annual/quarterly and general support	As needed	e-mail, phone	Maintenance report	UNDP GET, Vendor	Vendor	CO	-

Installation phase: - Please note that during the installation phase, it is requested that all stakeholders are included in all email exchanges. The GET provides project management support, nevertheless direct communication between the Vendor and the FO is advised. In case of delayed response time or in case of arisen problems, GET will step in to enhance communication flow.

5.1 Project Team Contact Details

Name	Designation	E-mail	Phone #
Katiana Macius	End user	TBA	TBA
ITM GET (GET)	Project Manager	itm.green.energy@undp.org	+45 45 33 61 14
<<Vendor name>> (Vendor)	Solution provider	Vendor's email TBA	TBA

5.2 Communications Conduct:

Meetings: - Ad-hoc project meetings will be convened whenever there is need for in-depth discussions that cannot be achieved through e-mail or telephone communication. A record of the meeting proceedings will be kept, particularly action points and agreed decisions.

Email: - E-mail communication is considered an official record in UNDP, and this applies for solar PV installation projects as well. Most issues and information with clear cut intents will be communicated through e-mail to the relevant parties. To keep all informed and for audit trail purposes, all parties should be copied as suitable, and the same thread used as much as possible. All circumstances that may impact on delivery timelines should be proactively communicated by the concerned party to allow for timely resolution.

Informal Communications: - For successful and timely project implement, informal communication is a necessary ingredient especially in solar PV projects. Given the nature of the projects, interaction between the parties, informal communication will form a sizable chunk of overall communication in this project. However, caution needs to be exercised to avoid negative consequences at a later stage. All communication that commits either part/stakeholder should be formally documented and communicated accordingly.

6. Appendix I: Compliance Response Form		Understood	Understood with reservations	Comments	
6.1 Introduction					
1	**Introduction**	☐	☐		
1.1	**Sustainable Development Goals**	☐	☐		
1.2	**Smart UN Facilities**	☐	☐		
1.3	**7-Step Green Energy Process**	☐	☐		
6.2 Project Description					
2	**Project Description**	☐	☐		
2.1	**Project Objectives**	☐	☐		
2.2	**Project High Level Requirements**	☐	☐		
2.3	**Description of Site**	☐	☐		
2.4	**Weather on Site**	☐	☐		
2.5	**Potential Location of PV Panels**	☐	☐		
2.6	**Estimated Load Consumption**	☐	☐		
2.7	**Connectivity**	☐	☐		
2.8	**Generator**	☐	☐		
3.1	**Local Partner**	☐	☐		
3.2	**After-sales Services and Event Response time**	☐	☐		
3.2.1	**Corrective Maintenance**	☐	☐		
3.2.2	**Preventive Maintenance**	☐	☐		
3.2.3	**Energy System and Vendor KPIs**	☐	☐		
3.3	**Pre-bid Site Visit**	☐	☐		
3.4	**Bidders Conference**	☐	☐		
3.5	**Health and Safety**	☐	☐		
3.6 Technical Requirements		**Compliant**	**Deviations**	**Comments**	**Reference**
3.6.1 PV Modules					
3.6.1.1	**PV Capacity**	☐	☐		
3.6.1.2	**Module Specifications**	☐	☐		
3.6.1.3	**Standards**	☐	☐		
3.6.1.4	**Module Efficiency**	☐	☐		
3.6.1.5	**Limited Power Warranty**	☐	☐		
3.6.1.6	**Voltage rating**	☐	☐		
3.6.1.7	**Disconnecting means**	☐	☐		
3.6.1.8	**Labelling**	☐	☐		
3.6.2 PV Modules mounting					
3.6.2.1	**General aspects and layout**	☐	☐		

3.6.2.2	**Mounting Structure**	☐	☐		
3.6.2.3	**Design requirements**	☐	☐		
3.6.2.4	**Lifespan**	☐	☐		
3.6.2.5	**Standards**	☐	☐		
3.6.3 Power Electronics		**Compliant**	**Deviations**	**Comments**	**Reference**
3.6.3.1	**Features**	☐	☐		
3.6.3.2	**Inverter Specifications**	☐	☐		
3.6.3.3	**General Specifications**	☐	☐		
3.6.3.4	**Standards**	☐	☐		
3.6.3.5	**Safety**	☐	☐		
3.6.3.6	**Warranties**	☐	☐		
3.6.3.7	**Market Experience**	☐	☐		
3.6.4 Battery					
3.6.4.1	**Battery Capacity**	☐	☐		
3.6.4.2	**Battery Type**	☐	☐		
3.6.4.3	**Features**	☐	☐		
3.6.4.4	**Standards**	☐	☐		
3.6.4.5	**Labelling**	☐	☐		
3.6.4.6	**Warranty Maintenance**	☐	☐		
3.6.5 Technical Room					
3.6.5.1	**Specifications**	☐	☐		
3.6.5.2	**Features**	☐	☐		
3.6.6 Online monitoring system					
3.6.6.1	**Connectivity Requirements**	☐	☐		
3.6.6.2	**Monitoring and Management Overview**	☐	☐		
3.6.6.3	**Historic data requirements & retention**	☐	☐		
3.6.6.4	**Local data logging solution**	☐	☐		
3.6.6.5	**Connectivity Monitoring**	☐	☐		
3.6.7 Smart power management					
3.6.7.1	**System's operation logic**	☐	☐		
3.6.7.2	**Details**	☐	☐		
3.6.7.3	**ATS for Generator**	☐	☐		
3.6.7.4	**Changeover Switch**	☐	☐		
3.6.7.5	**Reactive power requirements**	☐	☐		
3.6.8 Wiring and safety					
3.6.8.1	**Details**	☐	☐		
3.6.8.2	**Trenches**	☐	☐		
3.6.8.3	**Grounding**	☐	☐		
3.6.8.5	**Firefighter's switch**	☐	☐		

3.6.9 Warranty of the system					
3.6.9.1	**Details**	☐	☐		
3.6.9.2	**Length**	☐	☐		
3.7 Tasks and Responsibilities		**Compliant**	**Deviations**	**Comments**	**Reference**
3.7.1.1	**Risk Assessment, Avoidance and Mitigation Plan**	☐	☐		
3.7.1.2	**After-award Site Survey**	☐	☐		
3.7.1.3	**Final Technical Design**	☐	☐		
3.7.1.4	**Shipment of material**	☐	☐		
3.7.1.5	**Installation of the Solution**	☐	☐		
3.7.1.6	**Commissioning, UAT and Training**	☐	☐		
3.7.1.7	**Stabilization of the System**	☐	☐		
3.7.1.8	**Maintenance of the system**	☐	☐		
3.8 Timelines and Deliverables					
3.8.1.1	**Signature of the contract**	☐	☐		
3.8.1.2	**After-award Site Survey**	☐	☐		
3.8.1.3	**Final Technical Design**	☐	☐		
3.8.1.4	**Pre-assembled technical solution tested and ready to be shipped**	☐	☐		
3.8.1.5	**Transportation**	☐	☐		
3.8.1.6	**Installation of the Solution**	☐	☐		
3.8.1.7	**Commissioning, UAT, Training**	☐	☐		
3.8.1.8	**Stabilization of the system**	☐	☐		
3.8.1.9	**Maintenance of the system**	☐	☐		
3.8.2 Documentation					
3.8.2.1	**Project Plan Report**	☐	☐		
3.8.2.2	**After-award Site survey Report**	☐	☐		
3.8.2.3	**Design report including system design drawings**	☐	☐		
3.8.2.4	**Bill of materials**	☐	☐		
3.8.2.5	**Shipping documents**	☐	☐		
3.8.2.6	**Warranty documents**	☐	☐		
3.8.2.7	**Testing procedure**	☐	☐		
3.8.2.8	**Installation and commissioning report**	☐	☐		
3.8.2.9	**User acceptance testing report and proof of performance to UNDP**	☐	☐		
3.8.2.10	**Training manual/guide**	☐	☐		
3.8.2.11	**O&M Manual and troubleshooting guide**	☐	☐		
3.8.2.12	**O&M schedule**	☐	☐		

3.8.2.13	**After sales service agreement including maintenance (corrective and preventive) and technical support (on-site and remote)**	☐	☐		
3.8.2.14	**Maintenance reports**	☐	☐		
3.8.2.15	**Photo and video documentation**	☐	☐		

7. Appendix II: User Acceptance Test (UAT) and Commissioning checklist

8. Appendix III: Preventive Maintenance Checklist

9. Appendix IV: UNDP FO Petion-Ville photos

Figure 14 - Storage Area suggested by FO for equipment

Figure 15 - Areal view and orientation of FO

Figure 16 - Proposed Technical room location to be built by landlord

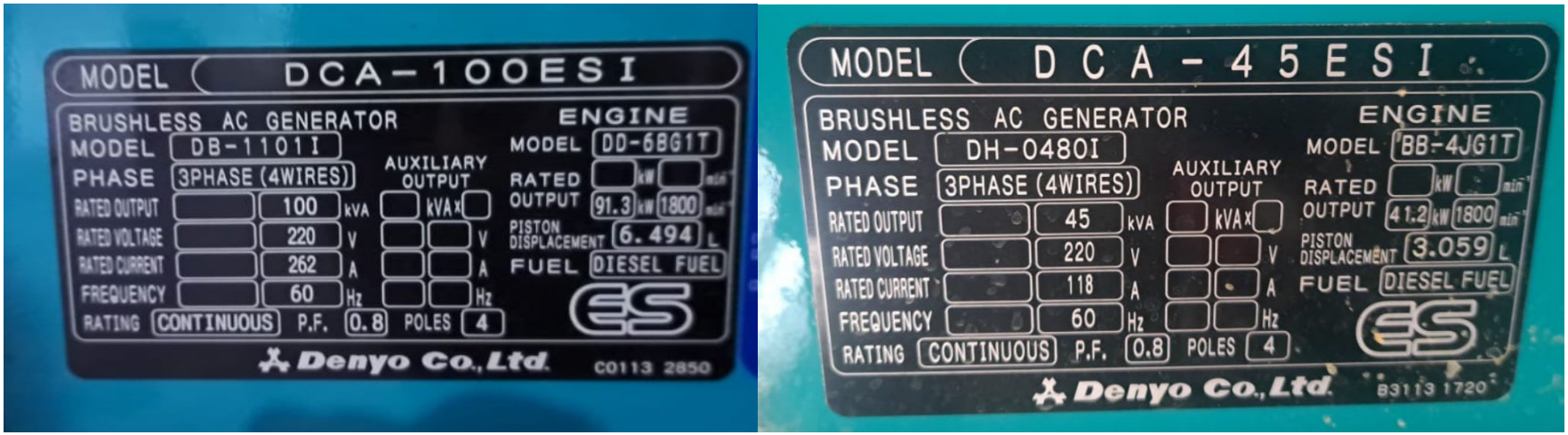

Figure 17 - Generator Nameplate for the 100 kVA and 45 kVA Denyo Generators

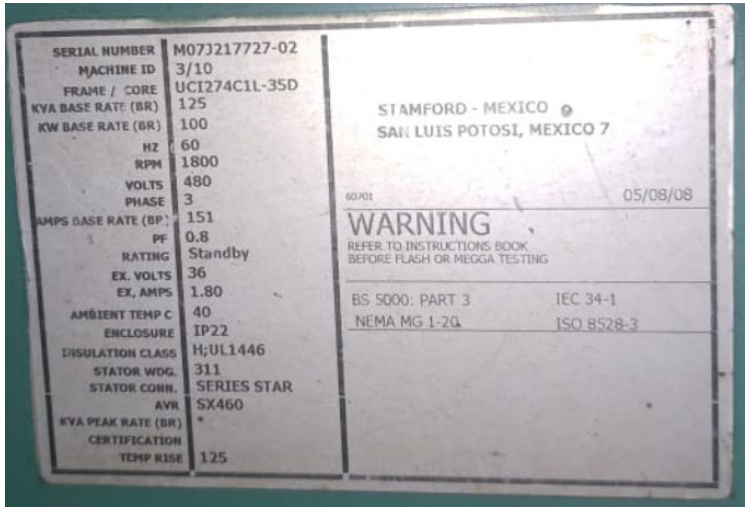

Figure 18 - 100 kVA Cummin Nameplate

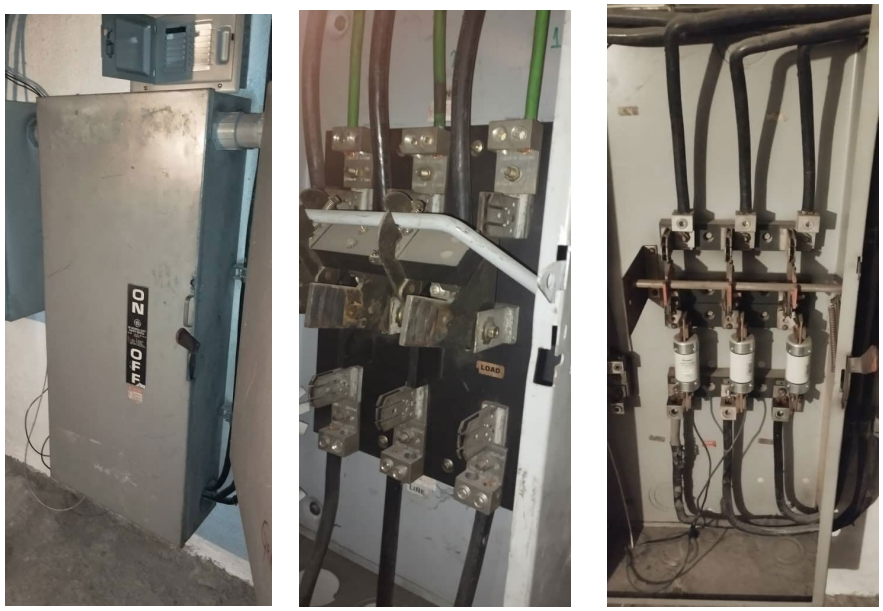

Figure 19 - Main Disconnect switch

Who we are
UNDP ITM/SIS

Our Vision

Creating Smart Facilities to build local capacity and inspire a movement.

Our Mission

To support and guide Country Offices in leveraging technology for efficient delivery on the organization's mandate.

The Information and Technology Management unit is the leader in digital transformation, so UNDP can be agile and effective in its global delivery.

UNDP ITM is headquartered in New York and UN City Copenhagen Denmark, a smart facility which hosts 9 UN agencies and is built with a high focus on sustainability. Our combined efforts provide standardized practices for UNDP country offices to achieve the Sustainable Development Goals and incite other local and international entities to follow our lead.

To illustrate our work, in the wake of the 2014 West Africa Ebola outbreak, country offices in Guinea, Sierra Leone and Liberia could not rely on the grid to meet their energy requirements and diesel shortages restricted access to a sufficient power supply. In order to address this, UNDP ITM leveraged its experience in implementing smart facilities to roll out solar solutions in the affected countries.

Following this outbreak, UNDP ITM has aided the installation of solar panel systems in over 13 countries worldwide.

We look forward to implementing the Smart Facilities concept even further.

United Nations Development Programme
Information & Technology Management
Smart Infrastructure Services

UN City
Marmovej 51,
2100 Copenhagen
Denmark

www.undp.org