Guyana Energy Agency
Caribbean Efficient and Green Energy Buildings Project (CEGEB Project)

Preparation of Detailed Designs and Technical Specifications for Energy Efficiency Measures and Distributed Solar PVs Systems for Second Batch of Public Buildings in Guyana

Terms of Reference

Introduction and Context

Despite the availability of indigenous renewable energy resources, many Caribbean nations continue to have a heavy dependence on imported fossil fuels which has threatened energy security and led to high electricity prices. The vast majority of power generation capacity in countries such as Guyana, Saint Lucia, and Grenada, consists of heavy fuel oil and diesel-fired power plants. The reliance on expensive imported heavy fuel oil and diesel fuel, together with the inability to take advantage of economies of scale due to the small market sizes of individual island states has resulted in extremely high electricity tariffs in these countries. With the discovery and exploration of natural gas resources in Guyana the development of a gas fired power plant, hydropower and solar power are under way and is expected to reduce the dependency on expensive fossil fuel imports and reduce the electricity prices.

Guyana aims to reduce its carbon emissions by 70% by 2030. Guyana's Low Carbon Development Strategy (LCDS) highlighted three strategic priorities to achieve this emission target: (i) investing in transformational energy infrastructure across the generation and transmission systems; (ii) implementing fiscal incentives and government policies to support the use of renewable energy at the level of households and businesses; and (iii) investing in EE.

Energy surveys of selected buildings conducted by the Guyana Energy Agency (GEA) have indicated major benefits from investments in EE and distributed solar photovoltaic (PV) systems. These interventions can reduce dependency on fossil fuel, lower electricity costs, decrease GHG emissions, and enhance resilience of critical public services. The results from these energy surveys indicate that EE and RE investments are economically viable.

The Government of Guyana has applied for financing from the World Bank (WB) toward the costs of the multi-country Caribbean Efficient and Green Energy Buildings Project (CEGEB Project)[1] with estimated total financing for the activities in Guyana of US$ 38.6 million. This six-year investment Project is scheduled to obtaining approval by the World Bank in November 2024. The implementing agency for the project activities in Guyana is the Guyana Energy Agency (GEA).

The CEGEB Project is designed to address common challenges in the energy sector that countries in the region face and will support investment in EE measures and RE systems, such as distributed solar PV systems installed on rooftops or in public spaces. The EE retrofits will include passive and active EE measures along with improvements in building-control systems. Passive EE

[1] The CEGEB Project also includes St. Lucia and Grenada, in addition to Guyana.

measures will include energy-efficient windows, shading, wall and roof insulation, cool surfaces, etc. Active EE measures will include the replacement of existing inefficient building equipment and appliances, or installation of new energy efficient equipment and appliances, such as lighting systems, air-conditioning equipment, ceiling fans, and refrigerators or freezers using refrigerants with low or no global-warming potential (GWP), where appropriate. Improvements in control systems will include smart controls, sensors, and energy-management systems to meet EE objectives. The Project will also support safe disposal of used equipment and materials.

The GEA plans to use the proceeds from the CEGEB Project to hire a consulting firm (hereafter referred to as the Consultant) to undertake the investment grade audits in the project second batch consisting of 17 public buildings in Guyana and prepare detailed designs, technical specifications, and bidding documents for EE measures (EEMs) and solar PV systems (DPVs) in these buildings.

Objective of the assignment

The objective of this assignment is to define the EEMs and DPVs to be implemented in the selected 17 public buildings in Guyana and prepare the detailed design, technical specifications, and bill of quantities (BOQ) for the bidding documents for implementing the proposed EEMs and DPVs investments. The assignment will also include identification of environmental and social risks associated with the planned implementation and preparation of Environmental and Social Management Plans (ESMPs) in accordance with the Environmental and Social Management Frameworks (ESMFs) and other instruments for the project which have been prepared by the Government of Guyana. The list of the buildings is provided in Annex 1.

The assignment will include a detailed review of the EEMs and DPVs identified in the preliminary surveys already conducted,[2] identification of any additional EEMs, DPVs or other measures that may be appropriate,[3] assessment of the current technical energy performance of the buildings, detailed analysis of the EEMs and DPVs, and analysis of the implementation costs, energy and cost savings, paybacks, IRR and NPV and co-benefits such as improved comfort levels, reduced local pollution, decreased GHG emissions and increased resilience. It will also include the preparation of any needed drawings, detailed costing, and technical specifications, and key implementation steps that will be translated into bidding documents. The assignment will also include the confirmation of compliance with relevant energy norms and standards.

Scope of Work

The Consultant shall develop a list of EEMs and DPVs for each of the public buildings and prepare the detailed design (including drawings), technical specifications, bills of quantities (BOQs), necessary for preparation of the bidding documents to implement the investment (which will be carried out by another consultant). The GEA will facilitate and support coordination with the building administrations to ensure full and timely access to the facilities for the assessments to be conducted and facilitate sharing of available and relevant documentation of the facilities, including energy bills, with the Consultant. The Consultant is expected to use available documentation and drawings as reference (where drawings are unavailable, the consultant can use or create as-built

[2] GEA has completed surveys and collected inventory and energy consumption data for the buildings and done preliminary analysis of EE measures and PV capacity and feasibility. This will be provided to the consultant.

[3] Such as structural or infrastructure upgrades/replacement (electric systems, piping for HVAC, hot water, etc. that may be deemed necessary to ensure sustainability/longevity of the proposed EE improvements and DPVs.

drawings), but shall confirm completeness and accuracy during site visits, and, to the extent needed, the Consultant should make drawings of current systems.

The Consultant shall report to GEA and through GEA to the WB.

The Consultant shall perform the following tasks:

Task 1: Review of existing energy audits & surveys, and inception report

All public buildings selected for the implementation of EEMs and DPVs have existing energy surveys based on walk-through assessments, preliminary analysis of energy consumption and cost, and economic and financial analyses of the investment. These energy surveys will be shared with the Consultant and will serve as an information basis. In this Task, the Consultant shall review and assess the surveys and the EEMs and DPVs defined and analyzed in these reports, and define the detailed methodology and approach to prepare the investment grade audit reports as necessary to (i) identify any field work for measurements to collect data and develop a measurement plan; (ii) identify EEMs and DPVs to be implemented; (iii) develop the appropriate designs and drawings; (iv) prepare technical specifications and BOQs; (v) develop bidding documents; and (vi) identify E&S risks and prepare ESMPs.

The Consultant shall prepare and submit an Inception Report to GEA and WB describing the review and assessment and the methodology and approach to be utilized.
The inception report shall: (i) summarize the results of the review and assessment of the energy surveys; (ii) identify information to be collected for the buildings during site visits; (iii) define the methodology and approach for site visits and for identifying EEMs and DPVs; (iv) present the plan for site visits, data collection, and field work; (v) provide a detailed work program for the rest of the project, (vi) identify potential issues and problems and approach for addressing these; (vii) list any assistance or action items needed from GEA and/or WB.

The Consultant shall also document in the Inception Report the key parameters and methodology for conducting financial calculations such as payback and IRR following the WB guidelines for economic and financial analyses for similar investments.

Deliverable

Inception Report

Task 2: Site visits, investment grade audits, data collection for EEMs and DPVs; Identification and assessment of EEMs

Site visits and data collection

The Consultant shall conduct site visits to the public buildings and interviews with building users, officials and/or energy managers to collect information and data. The existing surveys can be used as basis for the data collection,[4] and collect additional data as needed. If necessary, measurements will be taken to obtain additional data in accordance with the measurement plan defined in Task 1.

[4] The beneficiaries and administrations are responsible for providing necessary inputs, like copies of invoices and bills of energy consumption, technical design documentation, copies of walk-through surveys, and any other data. Some of the information may be available from the surveys already carried out.

The following information will be documented for each building:

- General building information: square meters and age (including date of any major retrofits), typology and general use of the building,
- Building layout, floorplan, and site plan with the orientation of the building and the surroundings.
- Structural assessment: inspection by a qualified Engineer of structural integrity of roof, ceiling, physical condition of building, and any defects that could affect longevity, utility, safety, or feasibility of EEM installation,
- Environmental inspection: presence of water damage or mold, evidence of wood-destroying insects or other vermin or pest infestation, or presence of asbestos, but not limited to these only,
- Operations: Occupancy rate, occupancy schedules, descriptions of current energy management activities,
- Utility information: Data available about energy consumption and costs for energy services. Review and analysis of the energy bills and data on electric (and fossil fuels if any) energy consumption and water bills (if any) for at least 36 months. The analysis of historical data will consider disruption derived from COVID lockdowns,
- Building envelope: Collect data and information about actual condition of building envelope: e.g., area and composition of external walls, floors, roofs, and windows, building geometry, thermal transmittance and u-values of building elements,
- Energy systems: energy sources, technical characteristics of equipment comprising cooling controls, ventilation, sanitary hot water, air conditioning and lighting systems, among others,
- Inventory of existing systems and electrical equipment: HVAC systems, automatic control systems, lighting, motors, etc.,
- Assessment of the energy performance levels of the existing systems and equipment from equipment ratings and specifications or measurements,
- Other relevant information impacting energy consumption levels, such as operating hours of the institution and energy services, number of users, indoor comfort measurements and occupant surveys (temperatures, humidity), energy consumption related to behavior of the users, thermostat settings etc.,
- Total building's electrical load measurement for at least one week to identify electricity consumption during weekdays and weekends,
- Energy consumption of air conditioning systems and indoor temperatures, at least for 24 hours,
- Output values like airflow, water flow, air and water temperatures of cooling production and distribution central systems,
- Electrical consumption of lighting systems for sample circuits, and lighting level (lux) in sample representative locations.
- Carry out a survey of the status of all electrical and electro-mechanical installations against national wiring regulations in consultation with the relevant governing Electrical Authority: This should include:

- Analyze the capacity of electrical boards,
- Analyze the status of the main wiring,
- Analyze the load demands on the mains of power equipment,
- Verify the existence of protective earth connection and lightning protection where required,
- Diagnose the state of the buildings' electrical installations, proposing necessary improvement measures, including estimated costs,
- Discuss the location for the inverters, DC and AC cables.

Identification and Assessment of EEMs

Based on the analysis of the above information, the Consultant shall develop the energy consumption baseline. The baseline will consider indoor temperatures measured and current equipment installed (consistent with the energy bills). If comfort level in the building is not met and/or active systems do not comply regulations in place, the Consultant will also calculate a normative baseline, considering that indoor temperatures meet comfort levels and equipment installed in compliance with regulations.[5] The energy model should be calibrated with data determined by calculation or measurement, and should provide estimates on the baseline consumption (actual and normative) disaggregated by energy use for cooling, preparation of sanitary hot water, indoor lighting, ventilation, etc.

The Consultant shall then identify the EEMs – including the EEMs that were recommended in the audit reports and any additional EEMs identified by the Consultant. EEMs should include both active and passive measures. All EEMs should be in compliance with local and regional regulations and guidelines such as, for example, the CARICOM Energy Efficiency Building Code, and EE Standards and Labeling, etc.

For each EEM in each building, the Consultant shall update the electricity savings, fuel savings, greenhouse gas emission reductions; cost savings, O&M costs, investment costs, payback, IRR and NPV. The investment costs of EEMs should be determined based, to the best extent possible, on preliminary quotes from contractors, vendors, and installers, or ESCOs. Costs should include breakdown of labor, installation and construction costs, materials and equipment, all indirect costs needed for implementation (pipe accessories, civil construction works, electrical connections, changes in electrical boards, remediation of mold or asbestos, replacement of ceiling or roof elements (if required), etc.). It should also include O&M costs, commissioning costs, and costs of waste management and safe disposal of used equipment and materials.

The consultant shall provide a complete list of all EEMs considered and a list of the recommended EEMs based on the prioritization methodology developed in Task 1 and approved by GEA.

The Consultant shall also prepare a measurement and verification (M&V) plan based on international best practice[6] and develop the related M&V protocols and operational procedures to verify the achieved savings. The M&V Plan shall specify for each EEM the parameters to be

[5] Compare the comfort level/electricity consumption of a building of similar type which meet national/international standard in order to set up baseline.

[6] Such as, for example, the International Performance Measurement and Verification Protocol (IPMVP).

measured, the pre-implementation baseline values for these parameters, the post-implementation measurements, and the methodology for calculation of the achieved energy savings and making any needed adjustments for changes in any baseline parameters.

Deliverables

Detailed Task 2 Report, consisting of an Executive Summary and a separate section for each building, including all data collected in this Task, complete list of EEMs, list of recommended EEMs for implementation, and M&V plan.

Task 3 – **Develop Indicative model, design of the DPVs systems for each building and support preparation of the bidding documents for proposed DPVs investment**

Based on the results of Task 2, the consultant will:

- ✓ Assess the roof, its capacity, age, technical drawings, access, and safety. The consultant shall justify with a FEA (finite element analysis)[7] as necessary the bearing capacity of the roofs, but it may also use the technical specifications of the roof, if available. Technical requirement for an FEA is provided in Annex 3.
- ✓ Provide the area available for solar PV modules in m^2 and consider a high efficiency PV module (not less than 21.5%) for the conversion to kWp. The consultant shall explain the area considered versus the available for the PV modules and refrain from providing only kWp.
- ✓ Model each solar DG system, using PVsyst and provide P50 and P90 yield values. The consultant shall analyze the solar resource and make sure that the source used is of good quality. All solar systems, including those for grid connections, must be designed to use most of the available area for energy generation considering not less than 25% of DC/AC oversizing.
- ✓ The AC capacity should be sized based on i) the load, which should be analyzed for 1 year based on the bills (except for the COVID affected periods (2020-2021) and measured for at least a full week for each building, if possible, and ii) the contracted AC capacity or available AC capacity as provided by the utility (the rating of the breakers shall be reported). The consultant shall also report the maximum AC and DC capacities that can be deployed in each building (respecting the minimum of 25% DC/AC oversizing).
- ✓ Identify in each building and discuss with the owner/responsible the location for the PV modules, the inverters, the DC cables, the AC cables, the main switch board or similar for grid connection. The location of the meter(s) should also be included. The accesses to the roofs must be reported.
- ✓ Carports should also be considered, characterized and described.
- ✓ Provide for the solar PV systems: indicative layout, single line diagrams and configuration of each solar DG system including the main equipment.
- ✓ Provide cost estimates for the solar PV systems assuming local prices and also international ones. For each building, the Consultant shall define the electricity savings, fuel savings, GHG savings, cost savings, O&M costs, investment needs, payback, IRR and NPV.

[7] See the TOR of the FEA to be respected in a separate document. The FEA shall only be done, if clearly required based on a visual inspection or analysis of technical drawings.

- ✓ Prepare a draft report on the proposed DPVs, including results of economic and financial analyses to the OECS Commission for approval.
- ✓ After the approval of the proposed DPV investments, prepare technical documentation (design, technical specifications and bill of quantities (BOQs) for the bidding documents for the procurement of goods, services and works required to implement the proposed DPVs investments. Refrain from over specifying as the contracts will be EPC, so consider minimums to be generated and delivered.

Deliverables

- Task 3.1: Draft report specifying the proposed DPVs.
- Task 3.2: Detailed design (including the appropriate architectural, mechanical, and electrical drawings (in DWG and PDF formats) technical specifications, bills of quantities needed for preparation of the bidding documents for each EEM.

Task 4. Detailed design of EEMs, technical specifications, and bills of quantities

Following approval by the GEA of the proposed EEMs in Task 2, the Consultant shall prepare the detailed designs (including the appropriate architectural, mechanical, and electrical drawings) technical specifications, bills of quantities and bidding documents for each EEM in each building.

Specifically, this task includes (but is not limited to) the following activities:

For each of the selected EEMs, prepare the technical design documentation, including technical descriptions, design calculations, lay-outs and drawings, detailed technical specifications and priced bill of quantities (BoQs). For technical requirements and specifications that will be linked to new materials or equipment not included in country-specific norms or standards, the Consultant shall follow relevant recognized international norms and codes. The technical design shall also take into account relevant regulations in Guyana on health, environmental protection and safety, any existing environmental management plans for public buildings and facilities, and the environmental and social management framework for the project (ESMF) provided by the GEA. The technical design documentation shall be certified by the Consultant according to relevant provisions in the Law on Construction of Guyana.

Discuss and agree the draft design documentation with GEA, WB and other stakeholders and revise as needed. The detailed design documentation should at least include:

- ✓ Architectural drawings (plans, sections, facades, technical details).
- ✓ Remediation or structural correction plans (mold, pests, roof elements) if required; Installation drawings (schemes, details, units, specifications)
- ✓ Structural drawings (when needed).
- ✓ Technical specifications.
- ✓ Bills of quantities for work to be implemented,
- ✓ Calculations.

In case approval from local authorities/state expertise for the reconstruction/building retrofits in accordance with local legislation is needed, provide technical support in the approval process if required.

Deliverables
Task Report specifying the EEMs and related detailed design (including the appropriate architectural, mechanical, and electrical drawings (in DWG and PDF formats) technical specifications, bills of quantities as needed for preparation of the bidding documents for each EEM.

Task 5: Identify environmental and social risks and prepare Environmental and Social Management Plans (ESMPs)

In this Task, the Consultant shall:

- ✓ **Identify environmental and social risks associated with the implementation of the EEMs:** Identify environmental and social risks associated with each of the EEMs, including presence and quantity of any hazardous materials (such as, but not limited to, asbestos and mercury containing light bulbs) that would have to be removed as part of the implementation.
- ✓ **Prepare site specific Environmental and Social Management Plans (ESMPs):** Prepare site-specific environmental and social management plans (ESMPs)/ any other guidance as per the ESMF and submit them to GEA. The ESMPs shall include specifications and bills of quantities for removal, packaging, transport and disposal/interim storage of any relevant hazardous materials, personal safety equipment and monitoring requirements and estimate of costs for the measures. This will also include the locations where the hazardous materials can be disposed and the interim storage location for the mercury containing light bulbs as per the ESMF and country legislation.
- ✓ **Provide support to the GEA to carry out public consultations on audit and ESMPs.** GEA will organize site-specific public consultations to describe the mitigation, monitoring, and institutional measures to be taken during sub-project implementation and operation to eliminate adverse environmental and social risks and impacts. The consultations will also present on the specific actions and resources needed to implement these measures and the grievance system in place to stakeholders. The consultant will provide materials and support needed for the consultation and update the ESMP considering the inputs from the consultation.

Deliverables

- Report on environmental and social risks covering each building site.
- ESMP for each building site.
- Reporting on consultations undertaken during subproject preparation and implementation.

<u>Services to be provided to the Consultant</u>
The GEA will provide the Consultant with the preliminary energy surveys already conducted and introductions to the respective building administrators.

The Consultant will be responsible for all other arrangements to ensure coordination with the respective buildings' administrations and all relevant entities.
It will be the responsibility of the consultant, when site visits are carried out, to ensure that all safety precautions are taken.

Qualifications
The Consultant should be a firm with relevant international (experience outside the country where the firm is based) project experience. Relevant technical experience would include programs related to EE measures and DPVs in buildings (especially public buildings), such as conducting of energy audits in buildings, development of detailed designs, technical specifications and BOQs, implementation of building EE programs, etc.

The Consultant must propose a team capable of successfully carrying out all aspects of the TOR with local/international in-depth experience in executing similar assignments. The Consultant shall demonstrate the capability to mobilize enough skilled staff for carrying out the project activities within the allocated time. The exact composition of the team will be left to each firm to propose (see specifications in Annex 2) but key skills and credentials are expected to include:

Timeframe and implementation arrangements
The estimated time frame is expected to be 6 months from the day of the contract signing. Expenditure on logistics, including international travel, is to be included in the proposed costs.
The Consultant will provide all necessary equipment or resources for the activities.

Deliverables and timeline
The proposed timeline is outlined below.

	Deliverables	**Delivery Date**
1	Inception Report	1 month from signing the contract
2	Task 2- Draft report on Site visits, data collection for EEMs and DPVs; Identification and assessment of EEMs	2 months after signing the contract
3	Task 3.1- Draft report on Develop Indicative model, design of DPVs systems	3 months after signing the contract
4	Task 3.2 - Report on detailed design, technical specification & BOQ of DPVs systems	5 months after signing the contract
5	Task 4. Detailed design of EEMs, technical specifications, and bills of quantities	5 months after signing the contract
6	Task 5. Report on environmental and social risks and ESMPs	5 months after signing the contract
7	Approval of all Reports	6 months after signing the contract
8	Update Reports from Consultant (identifying challenges, risks and progress)	Bi-weekly

Annex 1: List of Public Buildings, Second Batch

#	Building Name	Electricity Consumption (kWh/year)
1	Buxton Post Office	*7,717*
2	Call and Business Center for Persons with Disability	*78,355*
3	Cotton Tree Health Center	*22,572*
4	De Willem Secondary School	*18,757*
5	East Ruimveldt Secondary School	19,884
6	EPA Whim Office	*29,958*
7	Experiment Health Center	*9,043*
8	Guyana Lands and Survey's, Crane Office	*20,035*
9	Government Technical Institute	90,309
10	Guyana Rice Development Board	*111,469*
11	Leonora Technical and Vocational Training Center	94,460
12	Mahaicony Technical and Vocational Training Center	48,890
13	Ministry of Human Services and Social Security	*45,234*
14	New Amsterdam Technical Institute	216,517
15	Sophia Training Center	34,386
16	St Winefride Secondary School	22,644
17	Vryman Erven Training Center	15,611

Annex 2: Expected qualifications and expertise

The following key expertise and specialists are expected to be included in the team (to be evaluated as part of the technical proposal):

Key Expert 1: Energy Efficiency Specialist/Project Manager

The expert has specific experience of 10+ years in similar international EE assessments, energy audits, and EE in buildings. He/she has been project manager of similar international projects involving EE assessments and/or conducting energy audits, developing energy baselines, assessing EEMs in buildings, project commissioning etc. The expert has a university degree in engineering in the relevant field, energy economics, energy management, or similar field, and solid experience in the identification and assessment of EEMs in buildings and performance of energy audits. Experience in similar countries is an advantage. Fluency in English required.

Key Expert 2: Solar PV specialist

Solar PVs engineer with 10 years of experience in similar international investment activities for solar PVs system. University degree in civil/electrical engineering, energy management, or equivalent. Prior experience in preparation of design, construction and bidding documents. Strong knowledge of international and national standards and norms on renewable energy efficiency and building codes. Fluency in English required.

Key Expert 3: Energy Economist.

The expert has a university degree in energy or environmental economics or similar and at least 5 years of experience in preparation of feasibility study analysis, cash flow analysis, IRR/NPV/payback calculations of a variety of EE measures in building environments and with experience in economic or financial analysis for WB projects. Fluency in English required.

Key Expert 4: Environmental and Social Expert.

University degree in environmental engineering or equivalent with at least 5 years of experience in hazardous material inventories in buildings, in particular asbestos, and experience with international requirements for proper asbestos and mercury containing CFLs removal, handling and possible treatment options, including costs. Some expertise in social issues, social risk management and stakeholder consultations will be a plus. Knowledge of international best practices, and development of simplified, low-cost options. Fluency in English required.

ANNEX 3: Terms of Reference for the Finite Elements Analysis (FEA)

Scope of work
Rooftops at the 17 building to be used to install PV rooftops includes:

#	Building Name
1	Buxton Post Office
2	Call and Business Center for Persons with Disability
3	Cotton Tree Health Center
4	De Willem Secondary School
5	East Ruimveldt Secondary School
6	EPA Whim Office
7	Experiment Health Center
8	Guyana Lands and Survey's, Crane Office
9	Government Technical Institute
10	Guyana Rice Development Board
11	Leonora Technical and Vocational Training Center
12	Mahaicony Technical and Vocational Training Center
13	Ministry of Human Services and Social Security
14	New Amsterdam Technical Institute
15	Sophia Training Center
16	St Winefride Secondary School
17	Vryman Erven Training Center

One of the concerns that need to be addressed is the structural capacity of the rooftops to withstand the PV modules plus structures as well as during installation for safety reasons. The finite element analysis (FEA) for the roof shall include:

a) The design criteria for the roofs.

b) Specifications for the roof materials used.

c) The design criteria for the PV systems: the roof shall be simulated full of PV modules along the longest dimension. The nodes for the FEA should not be spaced more than 1 meter.

d) A list of live loads: environmental loads such as worst-case wind conditions perpendicular to the roof and 50 and 100 years data to be used. In addition, seismic criteria, and any other special loads should be considered in the analysis:

   1. PV modules plus supporting structures of around 30 kg/m2.
   2. Humans during installation at 150 kg/m2.

e) Deflection values of structural elements and the PV systems under several live loads and wind directions as defined above. A graph with the deflection of the roof should be presented with a resolution not more than 1 meter.

f) Vertical and lateral load analysis for:

   1. PV modules plus supporting structures of around 30 kg/m2.

2. Humans during installation at 150 kg/m2.

g) Dynamic and vibration analyses with and without the PV system.

h) Computer analysis and design results with reports for all the cases mentioned above and a set of recommendations if applicable.

i) For the case that an analysis proves a roof being incapable for solar usage a solution may be given to re-enforce the roof.

j) Please specify the software to be used for the finite elements analysis (FEA) on the proposal.