This product catalogue is divided into two major parts each providing specifications for the solar home systems and the other for solar lanterns. Part I of the product catalogue provides specifications for solar systems above 10Wp. Part II of the product catalogue provides specifications for solar systems that are below 10Wp which are the consumer products (or low cost lighting solutions).

**PART I. Systems Comprising Solar Modules 10Wp or Greater**

(i) **Certification Requirements**
- Products must have test certificate from a testing and certification organization acceptable to the Fiji Islands and the World Bank stating that the Solar Home System meets or exceeds the specifications given below. Organizations accredited according to ISO 17025 or equivalent standards will be acceptable for issuing the component certifications.
- Solar Modules that are listed in the Clean Energy Council of Australia list of approved and fire tested panels will be acceptable for use. (See [www.cleanenergycouncil.org.au](http://www.cleanenergycouncil.org.au))

Grid Connect components or systems that bear the IECEE PV Quality Certification Mark or Seal will be acceptable for use. IECEE PV Quality Certification covers all photovoltaic components, modules and systems that fall under the scope of IEC International Standards developed by IEC Technical Committee 82: Solar photovoltaic energy systems.
- SHS battery charge controllers and DC fluorescent lamps that have been tested at an accredited testing institute and have a currently valid certification for use in the following World Bank-assisted projects are eligible for use in the Fiji Islands Project, subject to prior clearance by the implementing agent. Examples of projects that use compliant products include:
  - Sri Lanka Energy Services Delivery Project and the Sri Lanka Renewable Energy for Rural Economic Development Project (for list of certified products see: [http://www.energyservices.lk/offgrid/approvedsolar.htm](http://www.energyservices.lk/offgrid/approvedsolar.htm) or write to info@dfccbank.com)

(ii) **Standards**
Standards that are applicable to this project are;
- IEC 61215: 1993 Crystalline Silicon Terrestrial PV Modules – Design Qualification and Type Approval
- IEC 61646: 1996 Thin Film Silicon Terrestrial PV Modules – Design Qualification and Type Approval
- IEEE 1262: 1995 Recommended Practice for Qualification of Photovoltaic Modules
- PNS 06 : 1987, Lead Acid Storage Specifications
- PNS 853: 1993, Portable Valve Regulated Sealed Lead Acid Battery

(iii) Component Specifications
There are five components that have further specifications outlined in Appendix A. These are:
1. PV Modules
2. Batteries
3. Charge Controllers
4. Fluorescent Luminaires
5. DC/AC Sockets
6. Inverters

For specific information on these components, including testing, features and recommended features, please refer to Appendix A.

Installation Specifications
Compliance with relevant Health and Safety regulations is necessary. In addition, the design, installation and commissioning of grid connect or stand-alone PV system is recommended to be carried out under the guidelines of Sustainable Energy Industry Association of the Pacific Islands (SEIAPI) which adopts the following AS/NZS standards.

- AS/NZ 3000 Wiring Rules
- AS 3008 Selection of Cables
- AS/NZS4777 Grid Connection of energy systems by inverters
- AS/NZS 5033 Installation of PV Arrays
- AS 4509 Stand-alone power systems (note some aspects of these standards are relevant to grid connect systems)
- AS 1768 Lightning Protection
- AS/NZS 1170.2 Wind Loads

Solar Module
1. The solar module should either be mounted on a pole or on the roof of the building/house.
2. For pole mounting systems:
   a. The pole shall either be bolted securely to the side of the building with the module being a minimum of 200 mm above the roof or on a stand alone pole.
   b. The base of a stand-alone pole shall either be installed in concrete or in tightly packed earth to a minimum depth of 1.5 metre.
   c. The pole and module support structure shall be constructed of corrosion resistant material with a minimum design life of 10 years. The pole and structure shall be designed to withstand the typical winds experienced at the installation site.
3. For roof mounted systems:
   a. The module support structures shall be constructed of corrosion resistant material with a minimum design life of 10 years. The structure shall be designed to withstand the typical winds experienced at the installation site.
b. The solar module when mounted on the module support structure shall be a minimum of 50mm above the roof.
c. Corrosion resistant nuts and bolts shall be used to mount the module structure on the roof.
d. Any roof penetrations should be waterproof.

4. Stainless steel nuts and bolts shall be used to attach the module to the module support structures.
5. Fibre washers or some other form of insulator shall be used to separate dissimilar metals such as the aluminium frame of the solar module from a galvanised steel module support structure.
6. The solar modules should face true north and tilted at an angle of approximately 10 degrees from the horizontal plane.

Battery
The battery
1. should be installed in a ventilated battery enclosure (or box) constructed of corrosion resistant material. The enclosure shall also prevent accidental short circuiting of the terminals
2. enclosure shall be position in a well-ventilated location.
3. enclosure should not be exposed to direct sunlight unless it is well insulated.
4. enclosure should not be easily accessible by children.

Controller
The controller
1. should be located close to the battery,
2. shall not be installed directly above the battery enclosure nor in any position where it is exposed to the battery fumes.

Inverter
If the inverter is designed to be installed behind the module (a.c. module) then consideration should be given to adequate ventilation and to the ease of replacement in the event of an inverter failure. If a central inverter (or inverters) is used and the inverter enclosure is not weatherproof (e.g. IP 54 rated) then these should either be located inside the building or in an appropriate weatherproof enclosure. The inverter heat sink must be clear of any obstacles to facilitate cooling of the inverter. The manufacturers recommended clearances must be followed.

System Monitoring
1. The solar home system shall have some form of indication (led lights or meters) for the end-user to be aware of the battery state of charge. Ideally this should be part of the system controller.
2. The system monitoring shall be located in a readily accessible location.

System Wiring and Protection
1. Stranded and flexible insulated copper cable is preferable.
2. All cables must be sized to keep line voltage losses to less than 5% in between the PV module to the battery and between any load to the battery.
3. The current rating of the cable shall be greater than the maximum current that will be carried by that cable.
4. For all wiring installed on a structure:
   a. All exposed wiring must be firmly fastened to the building structure in a neat
      and tidy manner.
   b. Wiring through roofing, walls and other structures must be mechanically
      protected to avoid any damage.
   c. Wiring through roofing must form a water-proof seal.
   d. Where the wiring is through flammable material (e.g. thatched roofs), they
      must be in a conduit.
   e. Adequate fasteners, conduits, bushings and other installation hardware must
      be supplied.

5. Wiring from a solar module installed on a stand-alone pole should be installed:
   a. within the pole or be firmly fastened to the pole in a neat and tidy manner.
   b. in an underground trench between the pole and the building housing the rest of
      the solar home system.

6. Field-installed wiring should preferably be joined using terminal strips or screw
   connectors. Crimping in the field must be avoided. Wire nuts are not allowed. The
   rated current carrying capacity of the joint must not be less than the circuit current
   rating. All connections must be made in junction boxes. Fittings for lights, switches,
   and socket outlets may be used as junction boxes where practical.

7. All wiring shall be colour coded and/or labelled.

8. A fuse should be installed between the battery and controller. The fuse shall be rated
   to protect the smallest diameter cable in the solar home system.

9. All loads (lights, TV, radio etc.) shall be connected to the load terminal on the
   controller NOT directly to the battery.

PART II. Systems Comprising Solar Modules less than 10W_p.

These systems should have IEC62257 certification or equivalent and typically comprise:
   • Separate LED lights, small batteries and small solar modules; or
   • Small modules and LED lights with inbuilt batteries.

The systems may or may not include some small controller.

If the products do not meet the standard requirements as specified for systems greater than
10W_p then the equipment retailers shall provide a statutory declaration that:
   • the equipment they are offering meets the technical performances specified below ;
   and
   • the retailer providing the equipment in the Fiji Islands agrees to provide warranties
     as specified below and provide information to the customer on the expected lifetime
     of the products.

These products are generally known as low cost lighting solutions and the end-users shall
have no misunderstanding that these lighting systems are to provide lighting better than
kerosene lights at a cost less than using kerosene for lighting regularly over a specified period.
(i) Technical Performance

The batteries have a minimum life of 1 year.

The battery shall be able to provide power to the standard number of lights in the system for a minimum of 3 hours per day (after a sunny day).

If lead-acid batteries are used, the system shall include some form of over discharge protection.

An LED indicator should show when the battery is being charged.

These small lights shall have a light output better than that of a small kerosene lamp. The lamp shall have light output greater than 10 lux at 1m distance.

Torch style lighting is not allowed. The beam angle of the LED should be a minimum of 60 degrees. The light could include a diffuser to achieve this minimum beam angle.

(ii) Warranty

Solar Module shall have a 12 month warranty on the electrical output of the solar module.

The lights shall have a minimum 12 month warranty.

Pico-Hydro System

The catalogue for the financial/guarantee parts of the project would be limited to a maximum 5KW hydro system with the following:

Turbine

The turbine has guards, balanced, interior access, shut off valve, air access, and exhaust and has efficiencies of at least 30% at converting the hydraulic power to electrical power at the unit’s rated power.

Coconut oil Fuel (CNO)

The catalogue for the financial/guarantee parts of the project would be limited to the following:

1.0 Coconut oil mill – Capacity is limited to a maximum of 300Litres/Hour and may comprise of one or more of the following equipments:
   - Copra solar dryer - Properly designed copra shelves with transparent covers to allow maximum sun heat and light to pass through for best drying
   - Copra cutter - Can be either powered by electric motor or engine
   - Coconut oil expeller - Can be either powered by electric motor or engine
   - Coconut oil filter - With metallic strainer
   - Coconut oil pressure filter - Can be manually or powered pressure
   - Coconut oil storage/mixing tank - Plastic or stainless steel
   - CNO biofuel filling pump - Should comply with the Fiji Petroleum Standard
2.0 Dual fuel generator
Capacity is limited to a maximum of 100KVA and manufactured to either run on pure coconut oil or renewable diesel. Renewable diesel is a mixer of diesel and pure coconut oil with additives to enhance performance.

3.0 Dual fuel kit
Kit can be either manually operated or automatic. Heating source for the kit can be either electrical, engine oil, water from cooling system or exhaust from the engine.

Wind Turbines
The catalogue for the financial/guarantee parts of the project would be limited to the following:
- Should have IEC 61400, ISO, API or equivalent certification
- Less than 5 kW for grid connected systems and less than 100 kW for off-grid applications

Bio Gas
The catalogue for the financial/guarantee parts of the project would be limited to a maximum of 20 cubic metres with the following:
- Fixed dome, compact or floating drum type digesters

Energy Efficiency
The catalogue for the financial/guarantee parts of the project would be limited to the following:

Luminaires
Luminaires used must be either Fluorescent or LED. Refer to Appendix for details on Fluorescent Luminaires. The use of LED luminaires is allowed for area lighting, task lighting, and for use as night lights.

Power Factor Correction
Capacitors and other electrical components installed to reduce electricity losses.

Solar Water Heaters
Can be direct (open loop) or indirect (closed loop), passive or active systems
Should have AS/NZS 2712:2007 certification or equivalent
Plumbing should comply with Fiji Building Code and endorsed by a Licensed Plumber
Appendix A

PV Module

Modules certified in accordance with IEC 61215, IEC 61646 or IEEE Specification 1262-1995 and must be manufactured in an ISO 9000 accredited manufacturing facility, will be accepted. A Manufacturer’s Self Compliance Certificate will be accepted in lieu of the above certifications, if PV modules of differing sizes are made by the same manufacturer and use the same production processes, construction methods, materials and quality control procedures as a previously certified module.

Battery Storage

Batteries must be certified to equivalent standards applicable for the proposed battery type. These standards are:

i. IEC 61427 (Ed. 2). For a flat plate battery, after it has gone through 3 test sequences according to IEC Standard 61427 IEC:2001 Ed.2 "Secondary Cells and Batteries for Solar Photovoltaic Energy Systems - General Requirements and Methods of Test” (a test sequence is defined as going through one complete procedure defined in paragraphs 6.4.1, 6.4.2 and 6.4.3 of IEC 61427), the battery should yet retain at least 80 percent of its initial C10 capacity (according to end-of-test condition as defined in paragraph 6.4.4. Similarly, for tubular plate battery, after it has went through 8 test sequences as defined above, the battery should yet retain at least 80 percent of its initial C10 capacity according to test procedures given in draft IEC Standard 61427 standard.

ii. The maximum permissible self-discharge rate is 10% of rated capacity per month at 25°C

Charge Controller

i. The charge controller set points must be factory preset with the set points applicable to the specified battery characteristics to prevent battery over-charge (high-voltage-disconnect and reconnect set points) or over-discharge (low-voltage-disconnect and reconnect set points). It is recommended that circuitry to allow periodic equalizing charging of the battery be provided. Control set points for charging, discharging and other functions must be sufficiently stable to insure proper operation of the device over the range of anticipated ambient temperatures where the device will be installed.

ii. The charge controller must be capable of handling 125% of the array’s rated short circuit current and 125% of the array’s open circuit voltage (with battery removed) for a duration of one hour.

iii. The low voltage disconnect must be capable of handling at least 150% of the maximum expected continuous load (assuming all end use devices are on simultaneously).

iv. Maximum current draw of the controller, when no LED’s are lit should not exceed 10mA.

v. Controller should include the following protective features:
   a) Battery overcharges and over-discharge protection
   b) Reverse polarity of module or battery
   c) Internal shorts in charge controller.
   d) Lightning induced transients when use in lightning-prone areas is expected.
   e) Nighttime discharge of the battery due to reverse current through the array.
vi. The model number, serial number, rated voltages and currents, should be noted on the charge controller case.

**Fluorescent Luminaire**

i. Each fluorescent luminaire should have its own inverter (electronic ballast).

ii. The inverter electrical efficiency must be greater than 80% from 11.0 to 13.3V when using the fluorescent lamp specified by the luminaire supplier.

iii. Luminous efficacy should be at least 35 Lumens/Rated Watt (rated voltage times rated current of the lamp and not the rating of tube), at nominal voltage.

iv. The minimum operating voltage when the tube will strike (start) should be at least 85% of the rated input voltage when using the fluorescent lamp specified by the luminaire supplier.

v. Maximum continuous operating voltage without damage to the inverter circuit must be at least 125% of the rated voltage.

vi. The minimum operating frequency should be greater than 20 kHz.

vii. The electrical waveform at the fluorescent lamp terminals must be symmetrical in time to within 10 percent (i.e., 60%/40% waveform maximum difference in symmetry over the voltage range of 11.0 to 12.5Vdc at an ambient temperature of 25°C)

viii. Tolerance limits of the waveform test criteria at minimum operational frequency of 20 kHz must be a crest factor ranging between 1.3 to 2. The direct current components of the lamp operating current may not exceed 2% of the r.m.s.

ix. The input connections to the inverter should prevent the application of voltage with reverse polarity, or the inverter should be protected against damage when the rated voltage is applied with reverse polarity.

x. The inverter should be protected against damage by the application of voltage under open circuit conditions (e.g., when the light bulb is removed or has failed). The maximum input current draw under open circuit conditions should be no more than 200mA.

xi. The electronic ballast/lamp combination should withstand 5000 switching cycles, each cycle consisting of 60 seconds on and 150 seconds off.

xii. The lifetime of the tube must exceed 2000 hours when operating at rated voltage. At the end of 2000 hours, luminous efficacy should be at least 25 lumens/rated Watt.

xiii. Inverter / luminaire must be marked with the manufacturer’s model number, rated voltage, wattage and date of manufacture/batch number.

a. Manufacturer name and model

b. Serial number

c. Input and output voltage and rated power

d. Battery and load connection points and polarity

**DC/AC Socket**

i. A 12/24V DC, 240V AC and/or lower voltage socket outlet for a radio/cassette player, TV or similar appliance must be rated to carry the maximum expected DC/AC current. The outlet must be protected from reversing the polarity of the voltage applied to the appliance.

**Inverters**
Should be of the pure sine wave type, allow reliable outdoor and indoor installation, ensure maximum energy harvest from your array under any conditions, have less potential interference with communication, radio and consumer electronics, excellent thermal performance and meets UL-1741 certification or similar acceptable to the World Bank.

- Inverters and power conditioners that are listed in the Clean Energy Council of Australia list of approved inverters may be acceptable for use. (See www.cleanenergycouncil.org.au)
- GC Inverters that have received (as a minimum) an EC Declaration of Conformity stating compliance to IEC 62109 and/or VDE-AR-N-4104 may be used - See (http://www.solaraccreditation.com.au/products/inverters.html#sthash.71rTg82M.dpuf)

**Electrical Wiring/Components**

For all 240volt AC system, it should comply with the AS/NZS 3000:2007 Wiring Rules and for the Line distribution, it should comply with the Fiji Electricity Authority Standard Overhead Line Design and Construction Manual.
<table>
<thead>
<tr>
<th>Equipment</th>
<th>To be Eligible</th>
<th>Units</th>
<th>KW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar</td>
<td>All relevant equipments in a solar photovoltaic system</td>
<td>Include the whole system as one unit</td>
<td>Take the KW rating of the solar panels</td>
</tr>
<tr>
<td>Pico-Hydro</td>
<td>DC/AC output turbine including electrical wiring, plumbing and civil works of</td>
<td>Include the whole system as one unit</td>
<td>Take the KW rating of the generator</td>
</tr>
<tr>
<td></td>
<td>the catchment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coconut oil</td>
<td>Equipment is to be part of the CNO fuel production facility</td>
<td>Include the whole system as one unit</td>
<td>Take the KW capacity of the whole production facility (=KWh/month ÷</td>
</tr>
<tr>
<td>mill</td>
<td></td>
<td></td>
<td>(CF x Period) where CF is 5÷24 and period is 8760÷12</td>
</tr>
<tr>
<td>Dual fuel</td>
<td>One of the fuel to be used should be mixer/product or pure CNO</td>
<td>Take a generator as 1 unit</td>
<td>Take the KW rating of the generator</td>
</tr>
<tr>
<td>generator</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dual fuel kit</td>
<td>One of the fuel to be used should be pure CNO</td>
<td>Take a generator as 1 unit</td>
<td>Take the KW rating of the generator</td>
</tr>
<tr>
<td>Wind</td>
<td>Complete system up to 5KW for grid connect and 100KW for stand-alone</td>
<td>Include the whole system as one unit</td>
<td>Take the KW rating of the generator</td>
</tr>
<tr>
<td>Biogas</td>
<td>Complete system with dome capacity up to 20m³</td>
<td>Include the whole system as one unit</td>
<td>Use the ratio of 500 feedstock equals 3.5KW</td>
</tr>
<tr>
<td>Luminaires</td>
<td>Any energy efficient fluorescent or LED light</td>
<td>Include the whole system as one unit</td>
<td>Add the total KW savings of each light</td>
</tr>
<tr>
<td>Power Factor</td>
<td>Replacement or new electrical parts to reduce electrical losses</td>
<td>Take 1 FEA meter as one unit</td>
<td>Calculate the KW from the KWh reduced after the correction</td>
</tr>
<tr>
<td>Correction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solar water</td>
<td>All relevant components of a system</td>
<td>Include the whole system as one unit</td>
<td>Use the rated KW savings or calculate the KW from the KWh reduced</td>
</tr>
<tr>
<td>heater</td>
<td></td>
<td></td>
<td>after the installation</td>
</tr>
</tbody>
</table>

**NOTE:**

- Lending is calculated on number of loans approved
- For all systems, if only addition or replacement equipment is bought to be connected to an existing system, then no increase in KW will be recorded unless if the additional equipment increases the KW of the existing system (For example if a bigger inverter is added to an existing solar PV system, the KW remains the same but the KWh for the first 3 years and the savings per week will increase).
- CO2 calculations for solar that is less than 10W is based on kerosene; therefore 1KW is equal to 2692.3Kg of CO2 per year. The rest is based on diesel so 1KW is equal to 1431.8Kg of CO2 per year
- Number of people provided with access to electricity is obtained by multiplying the number of units by 4; households in Fiji have an estimated 4 people per household.
- Village, settlement or more than 9 units in the same location are classified under community electricity connections