

## PROJECT IDEA NOTE (PIN)

Name of Project: Popua 1MW Solar Farm, Tonga

Date submitted: 27 June, 2012

### Description of size and quality expected of a PIN

Basically a PIN will consist of approximately 5-10 pages providing indicative information on:

- the type and size of the project
- its location
- the anticipated total amount of greenhouse gas (GHG) reduction compared to the “business-as-usual” scenario (which will be elaborated in the baseline later on at Project Design Document (PDD) level)
- the suggested crediting life time
- the suggested Certified Emission Reductions (CERs)/Emission Reduction Units (ERUs)/Verified Emission Reduction (VERs) price in US\$ or €/ton CO<sub>2</sub>e reduced
- the financial structuring (indicating which parties are expected to provide the project's financing)
- the project's other socio-economic or environmental effects/benefits

**While every effort should be made to provide as complete and extensive information as possible, it is recognised that full information on every item listed in the template will not be available at all times for every project.**

**A. PROJECT DESCRIPTION, TYPE, LOCATION AND SCHEDULE**

<p><b>OBJECTIVE OF THE PROJECT</b> <i>Describe in not more than 5 lines</i></p>	<p>Energy shortage is quite common in Tonga, which seriously lowers the living standard of local people and harms the socio-economic development of this country.</p> <p>The objective of the proposed project is to utilize solar energy for electricity generation. By providing 1,880MWh of electricity annually, the project will save 423,000USD per year through diminishing consumption of 470,000L diesel. The project is also expected to generate huge economic and social development benefits in the region, such as providing working opportunities, reducing greenhouse gas emission through replacing diesel generators as well as training skilled local workers and engineers for renewable energy industry in Tonga.</p>
<p><b>PROJECT DESCRIPTION AND PROPOSED ACTIVITIES</b> <i>About ½ page</i></p>	<p>The Popua 1MW solar farm has been proposed as an important part of the Tonga Energy Road Map (TERM) 2010-2020. The power plant is located in Popua of Tongatapu, the Kingdom of Tonga. As the first grid-connected photovoltaic (PV) plant in Tonga and the second largest in Oceania, the project will be a milestone for the development of regional renewable energy industry and lead the trend in this field.</p> <p>The project is constructed by Meridian company from New Zealand and 9 million USD of fund has been provided by New Zealand's Ministry of Foreign Affairs &amp; Trade Aid Programme. The electricity generation capacity is 1MW and the original annual energy output is about 1,880MWh, accounting for about 4% of Tongatapu's energy supply and saving 470,000L diesel.<sup>1</sup> The construction cost is 11.8 million USD and the annual O&amp;M cost is around 20,000USD for the first five years.<sup>2</sup></p> <p>On 10<sup>th</sup>, November of 2011, the groundbreaking ceremony for this proposed project was chaired by the acting prime minister, Hon. Samiu Vaipulu.<sup>3</sup> The solar farm is planned to generate electricity in July 2012 and its expected use life is 35 years. In the first five years the farm will be operated by Meridian Energy and then it will be handed over to Tonga Power Limited.<sup>4</sup> As some of the inverter components and other facilities have a use life of only 25 years, they require to be replaced once during the life span of the project.</p>
<p><b>TECHNOLOGY DESCRIPTION AND SOME KEY PARAMETERS</b></p>	<p>Tonga has plenty of solar resources as an equatorial South Pacific country. The ground measurement at the Popua Solar Farm shows global horizontal irradiation of 1627.7kWh per square meter per year.<sup>5</sup> To utilize the abundant solar energy, the Popua Solar Farm is built near the Popua Power Station, the largest diesel power plant, for sharing its electricity transmission facilities. Project will use 5760, 230W polycrystalline silicon PV modules made by SolarWorld. Unlike other electricity generation technologies, PV modules produce direct current (DC) rather than alternating current (AC). So for long-distance AC electrical power transmission, an inverter is indispensable for</p>

<sup>1</sup> <http://www.mic.gov.to/press-releases/3118-groundbreaking-ceremony-for-new-photovoltaic-popua-solar-farm>

<sup>2</sup> <http://pidp.eastwestcenter.org/pireport/2011/November/11-15-11.htm>

<sup>3</sup> Construction activities can be tracked on Facebook: [www.facebook.com/popuasolarfarm](http://www.facebook.com/popuasolarfarm)

<sup>4</sup> <http://www.meridianenergy.co.nz/assets/PDF/What-we-do/Our-projects/Popua-project/Popua-Fact-Sheet-English.pdf>

<sup>5</sup> Feasibility Study for a 500kW Photovoltaic Plant on Vava'u Island in the Kingdom of Tonga

	changing DC to AC. Then the voltage of AC requires to be raised by transformers for transmission to cities. The key parameters of some devices are shown as following:																				
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<b>TYPE OF PROJECT</b>																					
Greenhouse gases targeted CO <sub>2</sub> /CH <sub>4</sub> /N <sub>2</sub> O/HFCs/PFCs/SF <sub>6</sub> <i>(mention what is applicable)</i>	CO <sub>2</sub>																				
Type of activities Abatement/CO <sub>2</sub> sequestration	Abatement																				
Field of activities <i>(mention what is applicable)</i> <i>See annex 1 for examples</i>	Renewable Energy – Photovoltaic (1 g)																				
<b>LOCATION OF THE PROJECT</b>																					
Country	The Kingdom of Tonga																				
City/Area	Popua, Tongatapu																				
Brief description of the location of the project <i>No more than 3-5 lines</i>	The Popua Solar Farm will occupy approximately 2.5 hectares of land near the Popua Power Station, including a field leased by Tonga Power Limited from the Maritime Polytechnic Institute. <sup>8</sup>																				
<b>PROJECT PARTICIPANT</b>																					
Name of the Project Participant	Tonga Power Limited																				
Role of the Project Participant	<ul style="list-style-type: none"> <li>a. <b>Project Operator</b>✓</li> <li>b. Owner of the site or project</li> <li>c. Owner of the emission reductions</li> <li>d. Seller of the emission reductions</li> <li>e. Project advisor/consultant</li> <li>f. Project investor</li> </ul>																				

<sup>6</sup> <http://www.solarworld-usa.com/system-designers/~media/Global/PDFs/datasheets/sunmodule-solar-panel-230-poly-ds.pdf>

<sup>7</sup> Final On-grid Report Renewable Energy Supply to the Four Island Grids in Tonga April 2010

<sup>8</sup> Major Environmental Impact Assessment Popua 1MW Solar Farm

	Other, please specify: _____
Organizational category	<ul style="list-style-type: none"> <li>a. Government</li> <li>b. Government agency</li> <li>c. Municipality</li> <li>d. <b>Government-owned company</b> ✓</li> <li>e. Private company</li> <li>f. Non Governmental Organization</li> </ul> Other, please specify: _____
Contact person	Tsutomu Nakao II
Address	Tonga Power Limited (TPL) PO Box 429 Nuku'alofa, Tonga
Telephone/Fax	+676 28-525
E-mail and web address, if any	t2nakao@kalianet.to
Main activities <i>Describe in not more than 5 lines</i>	Director
Summary of the financials <i>Summarize the financials (total assets, revenues, profit, etc.) in not more than 5 lines</i>	The company is 100% owned by the Tongan Government.
Summary of the relevant experience of the Project Participant <i>Describe in not more than 5 lines</i>	No related experience yet since Popua Solar Farm is the first grid-connected renewable energy power station in Tonga <sup>9</sup> .
<b>PROJECT PARTICIPANT</b>	
Name of the Project Participant	Meridian Energy
Role of the Project Participant	<ul style="list-style-type: none"> <li>a. <b>Project Operator</b> ✓</li> <li>b. Owner of the site or project</li> <li>c. Owner of the emission reductions</li> <li>d. Seller of the emission reductions</li> <li>e. Project advisor/consultant</li> <li>f. Project investor</li> </ul> Other, please specify: _____
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Contact person	Murray Hill
Address	Meridian Energy PO Box 2128 Christchurch, New Zealand

<sup>9</sup> <http://www.meridianenergy.co.nz/assets/PDF/What-we-do/Our-projects/Popua-project/Popua-Fact-Sheet-English.pdf>

Telephone/Fax	+64 43827449
E-mail and web address, if any	
Main activities <i>Describe in not more than 5 lines</i>	Meridian Energy Limited has renewable energy-based electricity generation projects in New Zealand and other countries. The company develops future power generation and retail electricity as well as offshore renewable energy and innovative energy products and services.
Summary of the financials <i>Summarize the financials (total assets, revenues, profit, etc.) in not more than 5 lines</i>	Meridian Energy is a government owned company. <sup>10</sup>
Summary of the relevant experience of the Project Participant <i>Describe in not more than 5 lines</i>	CalRENEW-1 solar farm has been built in Mendota, California of USA. <sup>11</sup>
<i>Please insert information for additional Project Participants as necessary.</i>	
<b>EXPECTED SCHEDULE</b>	
Project start date <i>Year in which the plant/project activity will be operational</i>	June 2012
Expected first year of CER/ERU/VERs delivery	2013
Project lifetime <i>Number of years</i>	35 years
For CDM projects: Expected Crediting Period <i>7 years twice renewable or 10 years fixed</i>  For JI projects: Period within which ERUs are to be earned ( <i>up to and including 2012</i> )  For VCS projects: Expected Crediting Period <i>10 years twice renewable or 20 years with a maximum of 100 years</i>	VCS: 10 years twice renewable
Current status or phase of the project <i>Identification and pre-selection phase/opportunity study finished/pre-feasibility study finished/feasibility study finished/negotiations phase/contracting phase etc. (mention what is applicable and indicate the documentation)</i>	Environmental impact assessment was finished on 8 <sup>th</sup> , February of 2011.  A groundbreaking ceremony was held on 10 <sup>th</sup> , November of 2011.

<sup>10</sup> <http://www.meridianenergy.co.nz/company/about-us/>

<sup>11</sup> <http://www.meridianenergy.co.nz/what-we-do/our-power-stations/solar/calrenew-1/>

<p>Current status of acceptance of the Host Country  <i>Letter of No Objection/Endorsement is available; Letter of No Objection/Endorsement is under discussion or available; Letter of Approval is under discussion or available (mention what is applicable)</i></p>	<p>N/A</p>
<p>The position of the Host Country with regard to the Kyoto Protocol</p>	<p>Has the Host Country ratified/acceded to the Kyoto Protocol?  <u>Yes, 2008</u>                  Has the Host Country established a CDM Designated National Authority?    <u>No. VCS project does not require the approval from Designated National Authority in the host country.</u></p>

**B. METHODOLOGY AND ADDITIONALITY**

<p><b>ESTIMATE OF GREENHOUSE GASES ABATED/ CO<sub>2</sub> SEQUESTERED</b>  <i>In metric tons of CO<sub>2</sub>-equivalent, please attach calculations</i></p>	<p>Expected average annual emission reduction(if varies annually, provide schedule): <u>1,437</u> tCO<sub>2</sub>-equivalent                  Up to and including 2012: <u>0</u> tCO<sub>2</sub>-equivalent                  Up to a period of 10 years: 14,375 tCO<sub>2</sub>-equivalent                  Up to a period of 7 years: <u>NA</u> tCO<sub>2</sub>-equivalent</p> <table border="1" data-bbox="808 1012 1240 1495"> <thead> <tr> <th>Year</th> <th>Emission Reduction (tCO<sub>2e</sub>)</th> </tr> </thead> <tbody> <tr><td>2013</td><td>1504</td></tr> <tr><td>2014</td><td>1488</td></tr> <tr><td>2015</td><td>1474</td></tr> <tr><td>2016</td><td>1459</td></tr> <tr><td>2017</td><td>1444</td></tr> <tr><td>2018</td><td>1430</td></tr> <tr><td>2019</td><td>1415</td></tr> <tr><td>2020</td><td>1401</td></tr> <tr><td>2021</td><td>1387</td></tr> <tr><td>2022</td><td>1373</td></tr> <tr><td>Total</td><td>14375</td></tr> </tbody> </table>	Year	Emission Reduction (tCO <sub>2e</sub> )	2013	1504	2014	1488	2015	1474	2016	1459	2017	1444	2018	1430	2019	1415	2020	1401	2021	1387	2022	1373	Total	14375
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<p><b>BASELINE SCENARIO</b>                  CDM/JI/VCS projects must result in GHG emissions being lower than “business-as-usual” in the Host Country. At the PIN stage questions to be answered are at least:</p> <ul style="list-style-type: none"> <li>Which emissions are being reduced by the proposed CDM/JI/VCS project?</li> </ul>	<p>CO<sub>2</sub> is the targeted emission reductions by the project activity.</p> <p>Tonga is highly dependent on imported fuels to meet its overall energy requirements. According to the latest energy balance table for Tonga (2000), 75% of its energy was supplied from imported petroleum products and 25% was coming from biomass and off-grid solar cells. All grid-supplied electricity, which accounts for over 98% of electricity used in Tonga, is generated using imported diesel fuel.</p> <p>Like other small island states in the South Pacific, Tonga’s electricity supply is dominated by diesel generators. Although the country has great ambitions on renewable energy industry, the high price of PV module hinders the large scale</p>																								

<ul style="list-style-type: none"> <li>What would the future look like without the proposed CDM/JI/VCS project?</li> </ul> <p>About ¼ - ½ page</p>	<p>application of PV technology.</p> <p>In the absence of the financial support from VCS, the project cannot be implemented and diesel would be continued to use for electricity generation, resulting in high greenhouse gas emission. Since the annual output of Popua Solar Farm is 1880MWh, the baseline scenario would be 1880MWh of grid electricity generation by diesel generators.</p>
<p><b>ADDITIONALITY</b> Please explain which additionality arguments apply to the project:</p> <p>(i) there is no regulation or incentive scheme in place covering the project (ii) the project is financially weak or not the least cost option (iii) country risk, new technology for country, other barriers (iv) other</p>	<p>As per “Information on additionality (Attachment A to Appendix B of 4/CMP.1 Annex II)”<sup>12</sup>, a grid-connected PV plant with an installed capacity up to 15MW should be automatically defined as additional in the absence of further documentation of barriers. Since the installed capacity of the grid-connected PV plant is only 1MW, the project is additional.</p> <p>Additionally, in the absence of VCS, the project will lose its durability due to its relatively high O&amp;M price. Although the Government of New Zealand provided enough funding for construction, the Tonga Power Limited will take over the solar farm after the first five years of operation. Furthermore, many facilities, such as inverters and module mounting system, have to be refurbished during the project’s expected use life of 35 years.<sup>13</sup> Insufficient skilled workers and engineers for construction, operation and maintenance is another major barrier.</p>
<p><b>SECTOR BACKGROUND</b> Please describe the laws, regulations, policies and strategies of the Host Country that are of central relevance to the proposed project, as well as any other major trends in the relevant sector.</p> <p>Please in particular explain if the project is running under a public incentive scheme (e.g. preferential tariffs, grants, Official Development Assistance) or is required by law. If the project is already in operation, please describe if CDM/JI/VCS revenues were considered in project planning.</p>	<p>Imported diesel plays a dominant role in Tonga’s electricity supply system. Unfortunately, the price of diesel is high and unstable, seriously harming the social and economical development of Tonga. Another important issue is climate change. As a small island state, Tonga is particularly vulnerable to sea level rise caused by global warming. Therefore, the country has a strong aspiration to play an important role in the international cooperation for fighting against climate change.</p> <p>In response to the above twin challenges, in 2009 the Tongan Government ratified the Tonga Energy Road Map (TERM) 2010-2020 with an ambitious target of achieving 50% electricity from renewable sources by 2012. This plan represents a clear direction and indication from the Government that reducing the vulnerability of the country to future oil price shocks is a key objective to enhance energy security for the Kingdom. To support the TERM, the Tonga Energy Road Map Implementation Project (TERM IP) was approved to provide technical assistance to strengthen the legal and regulatory framework of the energy sector in Tonga, such as establishing and implementing the Tonga Green Incentive Fund (TGIF).<sup>14</sup></p>
<p><b>METHODOLOGY</b> Please choose from the following options:</p> <p>For CDM/VCS projects:</p> <p>(i) project is covered by an existing Approved CDM/VCS Methodology or Approved CDM/VCS Small-Scale Methodology</p>	<p>AMS-I.F. – Renewable electricity generation for captive use and mini-grid</p> <p>The proposed project will supply electricity to a mini grid system (The sum of installed capacities of all generators connected to the mini-grid is equal to or less than 15 MW) where in the baseline all generators use exclusively fuel oil and/or diesel fuel.</p>

<sup>12</sup> [https://cdm.unfccc.int/Reference/Guidclarif/ssc/methSSC\\_guid05.pdf](https://cdm.unfccc.int/Reference/Guidclarif/ssc/methSSC_guid05.pdf)

<sup>13</sup> Major Environmental Impact Assessment Popua 1MW Solar Farm

<sup>14</sup> Final On-grid Report Renewable Energy Supply to the Four Island Grids in Tonga April 2010

(iii) projects needs modification of existing Approved CDM/VCS Methodology	
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**C. FINANCE**

<b>TOTAL CAPITAL COST ESTIMATION</b>			
Total project costs <sup>15</sup>	Item	Total (US dollars)	Percentage
	Total Installed Cost	11,800,000	94.4%
	Annual O&M Cost (lifetime: 35 years)	20,000	5.6%
	Total Project requirements	12,500,000	100%
<b>SOURCES OF FINANCE TO BE SOUGHT OR ALREADY IDENTIFIED</b>			
Equity Name of the organizations, status of financing agreements and finance (in US\$ million)	Around two million US dollars.		
Debt – Long-term / Grant Name of the organizations, status of financing agreements and finance (in US\$ million)	9 million USD from New Zealand's Ministry of Foreign Affairs & Trade Aid Programme		
Debt – Short term Name of the organizations, status of financing agreements and finance (in US\$ million)	N/A		
Carbon finance advance payments sought from the buyer. (US\$ million and a brief clarification, not more than 5 lines)	TBD		
<b>SOURCES OF CARBON FINANCE</b> Name of carbon financiers that you are contacting (if any)	TBD		
<b>INDICATIVE CER/ERU/VER PRICE PER tCO<sub>2</sub>e</b> <i>Price is subject to negotiation. Please indicate VER or CER preference if known.</i>	TBD		
<b>TOTAL EMISSION REDUCTION PURCHASE AGREEMENT (ERPA) VALUE</b>			
A period until 2012 (end of the first commitment period)			
A period of 10 years			
A period of 7 years			

<sup>15</sup> <http://pidp.eastwestcenter.org/pireport/2011/November/11-15-11.htm>



**D. EXPECTED ENVIRONMENTAL AND SOCIAL INFLUENCES**

<p><b>ENVIRONMENTAL IMPACTS</b> E.g. impacts on local air, water and other pollution.</p>	<p>The project will displace the diesel fired power generation and reduce CO<sub>2</sub> emission significantly, thus mitigating the global warming and its adverse impacts of sea level rise.</p> <p>The construction of the project will bring some environmental impacts. The noise produced during construction is the main environmental issue concerned. Increased traffic is another problem that may influence the regular transport of local people. However, this area is not populated and the disturbance will only last for a short period. Although the location is mostly grass, there are some trees and scrub required to be removed, especially coconut trees because their fruits may destroy PV modules when falling. Some trees surrounding the site need to be trimmed to avoid potential shading to the PV modules. Lagoon and mangroves will not be affected by the coastal project. As a PV plant, light pollution has to be taken into consideration. Fortunately, the population density around the location is low and there are a lot of trees around, reducing the impacts of this problem.</p> <p>As a clean energy project, the proposed PV plant will almost not release any pollutant except some garbage produced by operators. After the 35-year operation period, the PV modules will be recycled thus no industrial waste will be left in Tonga.</p>
<p><b>SOCIO-ECONOMIC IMPACTS</b></p>	
<p>What social and economic effects can be attributed to the project and which would not have occurred in a comparable situation without that project? Indicate the communities and the number of people that will benefit from this project. <i>About ¼ page</i></p>	<p>Plenty of eco-social benefits will be offered to local communities, including:</p> <ul style="list-style-type: none"> <li>✓ Greater access to electricity. Since only 30% of the total population in Tonga has access to electricity, the project will improve the living standard of local people in Tongatapu by providing as much as 4% total power supply to the existing grid in this area.</li> <li>✓ Improvement of energy structure. The proposed Solar Power Plant in Popua will provide an alternative to traditional diesel-based power generation, reducing the high cost for fuels as well as air pollution and greenhouse gas emissions.</li> <li>✓ More work opportunities. During the construction of such a large project, a lot of temporary jobs will be created for the local people, such as construction workers, vehicle drivers and masons. After construction, the solar power plant still requires local workers and engineers for maintenance. The short-term and long-term effects will include income increase among the local people.</li> <li>✓ Paving the way for further development of Tonga's renewable energy industry. Skilled workers and engineers will be trained for the construction and operation of the solar plant. As a result, the country will have higher potential in renewable energy area due to its enlarged talent pool.</li> <li>✓ A milestone for the development of renewable energy industry in the South Pacific region. As the first grid-connected renewable energy power station in Tonga and the second largest PV station in Oceania, the success of the Popua Solar Farm will significantly raise the confidence of investors. As a result, more investment will</li> </ul>

	<p>flow to this region and strongly support the development of regional renewable energy industry.</p>
<p><b>ENVIRONMENTAL STRATEGY/ PRIORITIES OF THE HOST COUNTRY</b> A brief description of the project's consistency with the environmental strategy and priorities of the Host Country <i>About ¼ page</i></p>	<p>All the proposed project activities, including construction and operation processes, comply with the related regulations and laws in Tonga. For instance, waste treatment follows the Public Health Act 1992. The liquid and solid waste has been treated properly to avoid water and soil contamination. The expropriation and construction also comply with the Parks and Reserves Act and the Birds and Fish Preservation Act. No land from national reserves and parks or protected species' habitats will be used in the proposed project. The emission reduction of air pollutants and carbon dioxide due to the PV plant project will contribute to the implementation of the TERM 2012-2020.</p>

## ANNEX I - Technologies

1. Renewables
  - 1a. Biomass
  - 1b. Biogas
  - 1c. Bagasse
  - 1d. Wind
  - 1e. Hydro
  - 1f. Geothermal
  - 1g. Photovoltaic
  - 1h. Solar Thermal
2. Fossil Fuel Switch
3. Energy Efficiency
  - 3a. Cement Efficiency Improvement
  - 3b. Construction material
  - 3c. District heating
  - 3d. Steel Gas Recovery
  - 3e. Other Energy Efficiency
4. Waste Management
  - 4a. Landfill Gas recovery/utilization
  - 4b. Composting
  - 4c. Recycling
  - 4d. Biodigestor
  - 4e. Wastewater Management
5. Coalmine/Coalbed Methane
6. Oil and Gas Sector
  - 6a. Flared Gas Reduction
  - 6b. Reduction of technical losses in distribution system
7. N<sub>2</sub>O removal
8. HFC23 Destruction
9. SF<sub>6</sub> Recovery
10. Transportation
  - 9a. Fuel switch
  - 9b. Modal switch
11. Others