PROJECT IDEA NOTE (PIN)

Name of Project: 500 + 500kW Combined Photovoltaic and Wind Power Plant in the Kingdom of 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)/ Voluntary Carbon Units (VCUs) price in US$ or € /ton CO_2e 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

OBJECTIVE OF THE PROJECT *Describe in not more than 5 lines*	Electricity generation in Tonga is dominated by diesel, resulting in high electricity tariffs. Moreover, only 30% of the total population has access to electricity supply. Energy shortage is common in Tonga, which seriously constraints the living standard improvement of local people and harms the socio-economic development of this country. The objective of the proposed project is to utilize the plentiful solar and wind resources in this tropical island state to improve its energy supply and structure. The project is expected to benefit economic and social development in the region, such as providing working opportunities, reducing greenhouse gas emissions through replacing diesel generators as well as improving the skills and building experiences of local workers and engineers for renewable energy industry in Tonga.
PROJECT BACKGROUND AND DESCRIPTION *About ½ page*	The 500 + 500kW combined photovoltaic (PV) and wind power plant scheme has been proposed as an important part of the Tonga Energy Road Map (TERM) 2010-2020. The project will be funded by the Japan Bank for International Cooperation (JBIC). The estimated annual output is 1,659 MWh, which can save about 432,000L diesel per year.
TECHNOLOGY DESCRIPTION AND SOME KEY PARAMETERS	The proposed project contains two complementary parts - a 500kW PV farm and a 500kW wind farm. The PV station has peak electricity generation during daytime and no output at all at night while the wind farm has small output in the daytime but high output at night. Therefore, the combination of these two intermittent renewable energy sources can smooth the power supply and stabilize the grid. Additionally, the wind farm and the solar PV generation facility will share power transmission facilities, reducing the construction costs of the project. Tonga has good solar energy resources. The ground measurement at Popua Solar Farm in Tongatapu shows a global horizontal irradiation sum of 1627.7kWh per square meter per year.[1] To utilize it, this project will build a PV plant, which typically consists of PV array, inverter, boost transformer and electricity grid connecting system. PV array is the key component of the system for converting solar energy into electrical energy. It can be made of silicon or other semiconductor thin films, such as cadmium Telluride. The relatively high price and low photon to electron conversion efficiency are the main barriers for building and operating large PV plant. Unlike other electricity generation technologies, PV array produces direct current (DC) rather than alternating current (AC). So for long-distance AC electrical power transmission, an inverter is indispensable for changing DC to AC. The voltage of the AC from inverters requires to be raised in the boost transformer for reducing the line loss during long-distance transmission. The wind plant consists of a group of wind turbines. As a source of clean energy, there is nearly no pollution on site for electricity generation. However, the unstable wind resources make the electricity supply change with time, which is harmful to the grid. So the low voltage ride-through ability is indispensable to reduce the influence of the voltage dip. The combination of a

[1] Feasibility Study for a 500kW Photovoltaic Plant on Vava'u Island in the Kingdom of Tonga

<table>
<tr><td></td><td>complementary solar farm may be also helpful to alleviate the problem.

Estimated parameters of the PV power plant:

<table>
<tr><td>Description</td><td>Parameter</td></tr>
<tr><td>Type of Power Plant</td><td>Photovoltaic</td></tr>
<tr><td>Installed Capacity</td><td>500 kW</td></tr>
<tr><td>Plant Capacity Factor</td><td>15.9%</td></tr>
<tr><td>Annual Output</td><td>695MWh</td></tr>
<tr><td>Annual output degradation</td><td>1%</td></tr>
</table>

Estimated parameters of the wind power plant:

<table>
<tr><td>Description</td><td>Parameter</td></tr>
<tr><td>Type of Power Plant</td><td>Wind</td></tr>
<tr><td>Installed Capacity</td><td>500 kW</td></tr>
<tr><td>Plant Capacity Factor</td><td>22%</td></tr>
<tr><td>Annual Output</td><td>964MWh</td></tr>
</table>
</td></tr>
<tr><td colspan="2">TYPE OF THE PROJECT</td></tr>
<tr><td>Greenhouse gases targeted
$CO_2/CH_4/N_2O$/HFCs/PFCs/SF_6
(mention what is applicable)</td><td>CO_2</td></tr>
<tr><td>Type of activities
Abatement/CO_2 sequestration</td><td>Abatement</td></tr>
<tr><td>Field of activities
(mention what is applicable)
See annex 1 for examples</td><td>Renewable Energy – wind (1 d)
Renewable Energy – Photovoltaic (1 g)</td></tr>
<tr><td colspan="2">LOCATION OF THE PROJECT</td></tr>
<tr><td>Country</td><td>The Kingdom of Tonga</td></tr>
<tr><td>City/Area</td><td>TBD</td></tr>
<tr><td>Brief description of the location of the project
No more than 3-5 lines</td><td>The Kingdom of Tonga</td></tr>
<tr><td colspan="2">PROJECT PARTICIPANT</td></tr>
<tr><td>Name of the Project Participant</td><td>Tonga Energy Road Map Implementation Unit (TERM-IU)</td></tr>
<tr><td>Role of the Project Participant</td><td>a. Project Operator
b. Owner of the site or project √
c. Owner of the emission reductions
d. Seller of the emission reductions
e. Project advisor/consultant
f. Project investor
Other, please specify: _____</td></tr>
<tr><td>Organizational category</td><td>a. Government
b. Government agency √
c. Municipality
d. Government-owned company
e. Private company
f. Non Governmental Organization
Other, please specify: _____
_____</td></tr>
<tr><td>Contact person</td><td>Siakala Taumoefolau</td></tr>
</table>

Address	TERM-IU, PO Box 827, Nuku'alofa, Tonga
Telephone/Fax	+676 8494823
E-mail and web address, if any	staumoefolau@consult.gov.to
Main activities *Describe in not more than 5 lines*	Project Administrator, TERM-IU
Summary of the financials *Summarize the financials (total assets, revenues, profit, etc.) in not more than 5 lines*	Not Applicable as Government Entity
Summary of the relevant experience of the Project Participant *Describe in not more than 5 lines*	Not Applicable as Government Entity
PROJECT PARTICIPANT	
Name of the Project Participant	TBD
Role of the Project Participant	a. Project Operator b. Owner of the site or project c. Owner of the emission reductions d. Seller of the emission reductions e. Project advisor/consultant f. Project investor Other, please specify: _____
Organizational category	a. Government b. Government agency c. Municipality d. Government-owned company e. Private company f. Non Governmental Organization Other, please specify: _____
Contact person	
Address	
Telephone/Fax	
E-mail and web address, if any	
Main activities *Describe in not more than 5 lines*	
Summary of the financials *Summarize the financials (total assets, revenues, profit, etc.) in not more than 5 lines*	
Summary of the relevant experience of the Project Participant *Describe in not more than 5 lines*	
Please insert information for additional Project Participants as necessary.	
EXPECTED SCHEDULE	
Earliest project start date *Year in which the plant/project activity will be operational*	Estimated in 2013
Expected first year of CER/ERU/VERs delivery	Estimated in 2014
Project lifetime	25 years

Number of years	
For CDM projects: Expected Crediting Period *7 years twice renewable or 10 years fixed* For VCS projects: Expected Crediting Period *10 years twice renewable or 20 years with a maximum of 100 years*	VCS: 10 years twice renewable
Current status or phase of the project *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)*	
Current status of acceptance of the Host Country *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)*	
The position of the Host Country with regard to the Kyoto Protocol	Has the Host Country ratified/acceded to the Kyoto Protocol? _____Yes, 2008._____ Has the Host Country established a CDM Designated National Authority? __No. VCS project does not require the approval from Designated National Authority in the host country.___

B. METHODOLOGY AND ADDITIONALITY

ESTIMATE OF GREENHOUSE GASES ABATED/ CO_2 SEQUESTERED *In metric tons of CO_2-equivalent, please attach calculations*	Expected average annual emission reduction(if varies annually, provide schedule): __1302_ tCO_2-equivalent Up to and including 2012: __0_ tCO_2-equivalent Up to a period of 10 years: 13024 tCO_2-equivalent Up to a period of 7 years: NA tCO_2-equivalent

Year	Emission Reduction (tCO_{2e})
2014	1327
2015	1321
2016	1316

	2017: 1310 2018: 1305 2019: 1299 2020: 1294 2021: 1289 2022: 1284 2023: 1279 Total: 13024
BASELINE SCENARIO 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: • Which emissions are being reduced by the proposed CDM/JI/VCS project? • What would the future look like without the proposed CDM/JI/VCS project? *About ¼ - ½ page*	CO_2 is the targeted emission reductions by the project activity. Tonga is highly dependent on imported fossil 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 PV. All grid-supplied electricity, which accounts for over 98% of electricity used in Tonga, is generated using imported diesel fuel. 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 wind turbine and PV module hinders the large scale application of wind and PV technology. In the absence of the financial aids from VCS, the proposed 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 the proposed plants is 1,659MWh, the baseline scenario would be 1,659MWh of grid electricity generation by diesel generators.
ADDITIONALITY Please explain which additionality arguments apply to the project: (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	As per "Information on additionality (Attachment A to Appendix B of 4/CMP.1 Annex II)"[2], a grid-connected solar 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 proposed grid-connected solar PV plant is only 500kW, the proposed project is additional. In the absence of VCS, the proposed wind farm project cannot commence due to the high prices of wind turbine and lack of adequate investment in such a small island state. Lack of skilled workers and engineers for construction, operation and maintenance is another unavoidable barrier.
SECTOR BACKGROUND 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. Please in particular explain if the project is running under a public incentive scheme (e.g. preferential tariffs, grants, Official	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. Unfortunately, the fluctuation of crude oil price seriously harms 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. The more populated and economically developed coastal area is eroded. Therefore, the country has a strong aspiration to contribute to the international cooperation for fighting against climate change.

[2] https://cdm.unfccc.int/Reference/Guidclarif/ssc/methSSC_guid05.pdf

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.	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 the 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).[3]
METHODOLOGY Please choose from the following options: For CDM/VCS projects: (i) project is covered by an existing Approved CDM/VCS Methodology or Approved CDM/VCS Small-Scale Methodology (iii) projects needs modification of existing Approved CDM/VCS Methodology	AMS-I.F. – Renewable electricity generation for captive use and mini-grid 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.

C. FINANCE

TOTAL CAPITAL COST ESTIMATE	
Total project costs[4]	PV power plant: Wind power plant:

Item	Total (US dollars)	Percentage
Total Installed Cost	3,570,000	96%
Annual O&M Cost (lifetime: 25 years)	5,913	4%
Total Project requirements	3,720,000	100%

[3] Final On-grid Report Renewable Energy Supply to the Four Island Grids in Tonga April 2010
[4] Final On-grid Report Renewable Energy Supply to the Four Island Grids in Tonga April 2010

	<table><tr><td>Item</td><td>Total (US dollars)</td><td>Percentage</td></tr><tr><td>Total Installed Cost</td><td>1,532,500</td><td>58.5%</td></tr><tr><td>Annual O&M Cost (lifetime: 25 years)</td><td>43,460</td><td>41.5%</td></tr><tr><td>Total Project requirements</td><td>2,619,000</td><td>100%</td></tr></table>
SOURCES OF FINANCE TO BE SOUGHT OR ALREADY IDENTIFIED	
Equity Name of the organizations, status of financing agreements and finance (in US$ million)	TBD
Debt – Long-term / Grant Name of the organizations, status of financing agreements and finance (in US$ million)	Japan Bank for International Cooperation (JBIC)
Debt – Short term Name of the organizations, status of financing agreements and finance (in US$ million)	TBD
Carbon finance advance payments sought from the buyer. (US$ million and a brief clarification, not more than 5 lines)	TBD
SOURCES OF CARBON FINANCE Name of carbon financiers that you are contacting (if any)	TBD
INDICATIVE CER/ERU/VER PRICE PER tCO_2e *Price is subject to negotiation. Please indicate VER or CER preference if known.*	TBD
TOTAL EMISSION REDUCTION PURCHASE AGREEMENT (ERPA) VALUE	
A period until 2012 (end of the first commitment period)	
A period of 10 years	
A period of 7 years	

D. EXPECTED ENVIRONMENTAL AND SOCIAL INFLUENCES

ENVIRONMENTAL IMPACTS E.g. impacts on local air, water and other pollution.	The proposed project will displace the power generation of diesel and reduce CO_2 emission significantly, thus mitigating the global warming and its adverse impacts on sea level rise. 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. As a combined PV and wind plant, light pollution has to be taken into consideration. Fortunately, the population density around the location is not large and there are a lot of trees around, reducing this problem to a very small extent. In addition, no migrating birds have been found in the proposed project

	field till now. Therefore, the proposed project is not located on the passage of migrating birds, and the construction will not influence the migration of birds. As a clean energy project, the proposed PV and wind plant will almost not release any pollutant except some garbage produced by operators. After the operation period, the PV modules and wind turbines will be recycled thus no industrial waste will be left in Tonga.
SOCIO-ECONOMIC IMPACTS	
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. *About ¼ page*	Plenty of social and economic benefits will be offered to local communities as following: ✓ More access to electricity. Since only 30% of the total population in Tonga has access on electricity, the proposed project will obviously improve the living standard of natives in Tonga. ✓ Improvement of energy structure. The combined PV and wind power plant provides an alternative to traditional diesel generator, reducing the high cost for fuels as well as air pollution and greenhouse gas emission. ✓ More working opportunities: To build such a large project provides a lot of temporary jobs to natives, such as construction workers, professional 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 apparently increase the income of local people. ✓ Preparation for future 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.
ENVIRONMENTAL STRATEGY/ PRIORITIES OF THE HOST COUNTRY A brief description of the project's consistency with the environmental strategy and priorities of the Host Country *About ¼ page*	All the proposed project activities, including both construction and operation processes, will comply with related regulations and laws in Tonga. For instance, waste treatment will meet 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 obey the Parks and Reserves Act and the Birds and Fish Preservation Act. No land from national reserves and parks or protected species' habitats has been used in the proposed project. The emission reduction of air pollutants and carbon dioxide due to the PV plant project will be helpful for the execution of the TERM 2012-2020.

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_2O removal
8. HFC23 Destruction
9. SF6 Recovery
10. Transportation
   9a. Fuel switch
   9b. Modal switch
11. Others