PROJECT IDEA NOTE (PIN)

Name of Project: 500kW Photovoltaic Plant on Vava'u Island 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) 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 throughout Tonga is dominated by imported diesel. Moreover, only 30% of the total population on average has access on electricity. The objective of the project is to utilize solar energy in Vava'u for electricity generation, which will improve Tonga's energy supply and structure. The project is also expected to bring in economic and social development in the region, such as providing work opportunities, reducing greenhouse gas emissions through replacing diesel-based generators as well as training skilled local workers and engineers for renewable energy industry in Tonga.
PROJECT DESCRIPTION AND PROPOSED ACTIVITIES *About ½ page*	The 500kW solar photovoltaic (PV) plant scheme has been proposed as an important part of the Tonga Energy Road Map (TERM). The proposed power plant will be located in Vava'u, the Kingdom of Tonga. Vava'u is an island chain including one large island and 40 small ones around 300km northeast of Tongatapu Island, the largest and most important island in the country. The whole area is 121 km^2 and the population is 15,505 (2008). Although the main island in Vava'u is the second largest island of Tonga, the area and the population only account for 22% and 16% of the total numbers in Tonga, respectively. The proposed project will be constructed by Masdar Company from Abu Dhabi, the United Arab Emirates with a financial grant provided by the Abu Dhabi Fund for Development (ADFD). The project's estimated power generating capacity is 500kW and the expected original annual energy output is 695MWh, saving 180,990L diesel and providing 13.8% of Vava'u's annual electricity supply. The total cost for the project is estimated to be around four million US dollars.
TECHNOLOGY DESCRIPTION AND SOME KEY PARAMETERS	Tonga has plenty of solar resources as an equatorial South Pacific country. Although the data in Vava'u is lacking, ground measurement at the Popua Solar Power Station in Tongatapu shows an annual global horizontal irradiation sun of 1627.7kWh per square meter.[1] To utilize the abundant solar energy, a 500kW PV plant was proposed near the Taumu'aloto Power Station for connecting to its electricity transmission facilities. 3,570 of 1.43m^2 PV modules will be manufactured by the Masdar Company. The PV modules will consist of microcrystalline and amorphous silicon thin films with twin advantages of high electron mobility from the crystalline structure and increased long wavelength absorption from the amorphous structure. 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 changing DC to AC. Since the intermittent PV electricity will take up a large portion of the power supply in Vava'u's grid (13.8%), batteries have to be used for storing energy and smoothing the electricity supply in case of grid collapse. The key parameters of some devices are shown as following[2]:

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

Key parameters of PV array:

Description	Parameter
Manufacturer	Masdar PV GmbH
Model	MPV140-M
Total Number of PV Modules	3570
Nominal Peak Power[3]	90W
Nominal Voltage	72V
Nominal Current	1.27A
Annual Output Degradation	1%

Key parameters of inverter:

Description	Parameter
Manufacturer	SMA
Model	Sunny Tripower 10000TL
Total Number of Inverters	44
Operating Voltage	150-800V
Unit Nominal Power	10.0kW AC

Key parameters of the proposed PV plant:

Description	Parameter
Type of Power Plant	Photovoltaic
Installed Capacity	500 kW
Annual Output	695MWh
Annual output degradation[4]	1%

TYPE OF PROJECT	
Greenhouse gases targeted $CO_2/CH_4/N_2O$/HFCs/PFCs/SF_6 *(mention what is applicable)*	CO_2
Type of activities Abatement/CO_2 sequestration	Abatement
Field of activities *(mention what is applicable)* *See annex 1 for examples*	Renewable Energy – Photovoltaic (1 g)
LOCATION OF THE PROJECT	
Country	The Kingdom of Tonga
City/Area	Neiafu, Vava'u Island
Brief description of the location of the project *No more than 3-5 lines*	The proposed location is close to the Taumu'aloto Power Station near Neiafu, the downtown of the Vava'u Island. A main road (Laifone Road) connects the proposed plant and the harbor for material transportation. The total area of the proposed plant is estimated to be 12,600m^2.
PROJECT PARTICIPANT	
Name of the Project Participant	Tonga Energy Road Map Implementation Unit (TERM-IU)
Role of the Project Participant	a. Project Operator b. **Owner of the site or project** √

[3] http://www.tehnosat.ro/pdf/PVmodules/Masdar_MPV95-100-105-110S_aSi_thin_film.pdf

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

	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	Polly Dacre
Address	TERM-IU, PO Box 827, Nuku'alofa, Tonga
Telephone/Fax	+676 8494823
E-mail and web address, if any	
Main activities *Describe in not more than 5 lines*	Affordable, accessible, and sustainable electricity is a high priority of the Tongan Government, which is articulated in the Tonga Energy Road Map (TERM). To ensure effective implementation of TERM through strong collaboration with the energy sector stakeholders and collaboration with Tonga's development partners, a Director of TERM - Implementation Unit (IU) has been designated to ensure that the Government's plans for sustainable economic growth come to fruition. For instance, TERM-IU represented Tongan Government to sign Memorandum of Understanding with Masdar for Vava'u's PV project.
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	Masdar
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	Serene Serhan
Address	Masdar City Opposite Presidential Flight Khalifa City A P.O. Box 54115 Abu Dhabi, UAE
Telephone/Fax	+971 2 653 6017 / 800-MASDAR (800-627327)
E-mail and web address, if any	Email: press@masdar.ae
Main activities *Describe in not more than 5 lines*	Masdar is Abu Dhabi's initiative to promote the development, commercialization and deployment of renewable energy technologies and solutions. The company serves as a link between today's fossil fuel economy and the energy economy of the future - developing the "greenprint" for how we will live and work tomorrow.
Summary of the financials *Summarize the financials (total assets, revenues, profit, etc.) in not more than 5 lines*	Masdar is fully owned by the Abu Dhabi Government.[5]
Summary of the relevant experience of the Project Participant *Describe in not more than 5 lines*	Construction of a PV array on Sir Bani Yas Island[6]
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*	September of 2012
Expected first year of CER/ERU/VERs delivery	September of 2013
Project lifetime *Number of years*	25 years
For CDM projects: Expected Crediting Period *7 years twice renewable or 10 years fixed* For JI projects: Period within which ERUs are to be earned *(up to and including 2012)* 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*	The Memorandum of Understanding (MOU) on the project was signed on18th, January of 2012. The feasibility study was finished by Masdar Company on February of 2012.

[5] http://www.masdar.ae/en/Menu/index.aspx?MenuID=42&CatID=12&mnu=Cat
[6] http://www.masdar.ae/en/Menu/index.aspx?MenuID=48&CatID=29&mnu=Cat

finished/feasibility study finished/negotiations phase/contracting phase etc. (mention what is applicable and indicate the documentation)	Major environmental impact assessment was finished by TERM-IU on 12th, April of 2012.
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)*	MOU was signed with the Tongan Government. More contracts will be signed later.
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.____

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): __531_ tCO_2-equivalent Up to and including 2012: __0_ tCO_2-equivalent Up to a period of 10 years: 5312 tCO_2-equivalent Up to a period of 7 years: NA tCO_2-equivalent
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:	CO_2 is the targeted greenhouse gas for emission reductions by the project activity. Tonga is highly dependent on imported fuels to meet its overall energy needs. 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

Year	Emission Reduction (tCO_{2e})
2014	556
2015	550
2016	544
2017	539
2018	534
2019	528
2020	523
2021	518
2022	513
2023	507
Sum	5312

• 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*	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 prices of PV module hinder the large scale application of PV technology. In the absence of the financial aids from VCS, the proposed project cannot be implemented and diesel-based electricity generation would continue. In Vava'u, the grid electricity is entirely supplied by 5 diesel generators in the Taumu'aloto Power Station. Since the annual output of the proposed PV plant is expected to be 695MWh, the baseline scenario would be the same amount of grid electricity generation by Taumu'aloto Power Station.
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)"[7], 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 proposed grid-connected PV plant is only 500kW, the proposed project is additional. Additionally, in the absence of VCS, the proposed project cannot commence due to the high price of PV module and lack of adequate investment in such a small island state. Insufficient skilled workers and engineers for construction, operation and maintenance is another major 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 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.	Tonga is highly dependent on imported fuels to meet its overall energy needs. According to the latest energy balance table for Tonga (2000), 75% of its energy was supplied from imported petroleum products and 25% came 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 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 contribute to the international cooperation for fighting against climate change. In response to the above twin challenges, in 2009 the Tongan Government passed 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).[8]
METHODOLOGY Please choose from the following options:	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

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

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

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	less than 15 MW) where in the baseline all generators use exclusively fuel oil and/or diesel fuel.

C. FINANCE

TOTAL CAPITAL COST ESTIMATION	
Total project costs[9]	Total cost is around 5 million USD. Details will be decided in the future when signing contracts.
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 Name of the organizations, status of financing agreements and finance (in US$ million)	Abu Dhabi Fund for Development (ADFD)
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)	-

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

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 diesel-based power generation, reducing CO_2 emissions significantly, thus mitigating the global warming and its adverse impacts on sea level rise. The construction of the proposed project will bring some environmental impacts. The noise produced during construction process and by heavy vehicle is unavoidable. However, there is no residential area nearby and the disturbance will only last for a short time. Although the proposed location is mostly grass, there are some large trees required to be removed. Other trees surrounding the site need to be trimmed for avoiding potential shading of the PV modules. As a PV plant, light pollution has to be taken into consideration. Fortunately, the population density around the proposed location is low and there are a lot of trees surrounding the location, reducing this problem to a very small extent. As a clean energy project, the proposed PV plant will almost not release any pollutant except some garbage produced by operators. After 25-year operation period, the PV modules 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 eco-social 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 improve the living standard of the local people in Vava'u by providing as much as 13.8% of the power supply of the existing grid in this area. ✓ Improvement of energy structure. Solar Power plant in Vava'u will provide 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 will provide a lot of temporary jobs to 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 apparently increase the income of local people. ✓ Preparation for future development of Tonga's renewable energy industry. Workers and engineers working on the project will get some hands-on training during 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	All the proposed project activities, including both construction and operation processes, comply with related regulations and laws in Tonga. For instance, waste treatment complies with the Public Health Act 1992. The liquid and solid

A brief description of the project's consistency with the environmental strategy and priorities of the Host Country *About ¼ page*	waste has been treated properly in case of 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 emissions 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