Initial Environmental Examination

April 2018 (Latest Updated)

TON: Outer Island Renewable Energy Project – Phase 2

Prepared by Ministry of Finance and National Planning, Government of Tonga for the Asian Development Bank.

CURRENCY EQUIVALENTS

(as of 28 March 2017)

Currency Unit	=	Tonga: pa'anga (TOP)
TOP1.00	=	US$ 0.44
US$1.00	=	TOP 2.22

LIST OF ABBREVIATIONS

ADB	-	Asian Development Bank
CFC	-	chlorofluorocarbons
DG	-	Diesel Generator
EA	-	Executing Agency
EIA	-	Environmental Impact Assessment
EMP	-	Environmental Management Plan
EPC	-	Engineering, Procurement and Construction
GoT	-	Government of Tonga
GDP	-	Gross Domestic Product
GFP	-	Grievance Focal Points
GHG	-	Green House Gases
GRC	-	Grievance Redress Committee
GFP	-	Grievance Focal Point
IA	-	Implementing Agency
IEE	-	Initial Environmental Examination
IUCN	-	International Union for Conservation of Nature
MFNP	-	Ministry of Finance and National Planning
MEIDECC	-	Ministry of Environment, Information, Disaster, Energy and Climate Change
PCBs	-	polychlorinated biphenyl
PMC	-	Project Management Consultant
PPTA	-	Project Preparatory Technical Assistance
PV	-	photovoltaic
REA	-	Rapid Environmental Assessment
SHS	-	Solar Home System
SPS	-	Safeguard Policy Statement
TA	-	Technical Assistance
TERM	-	Tonga Energy Road Map
TPL	-	Tonga Power Limited

NOTES

(i) The fiscal year (FY) of the Government of Tonga ends on 31 December. FY before a calendar year denotes the year in which the fiscal year ends, e.g., FY2011 ends on 31 December 2011.

(ii) In this report, "$" refers to US dollars

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A. EXECUTIVE SUMMARY

1. The proposed Outer Islands Renewable Energy Project (the Project) will assist the government of the Kingdom of Tonga (the government) efforts to reducing the country's heavy reliance on imported fossil fuels for power generation. By providing a secure, sustainable and environmentally-sound clean electricity for private and commercial consumers, it will implement 1.25 MWp solar power capacity connected to the existing diesel networks of Tonga's outer islands saving about 1700 tons of carbon dioxide (CO_2) per annum.

2. The scope of the Project is divided into two phases as:

- **Phase 1:** Installation of 0.8 MWp solar power in Tonga's outer islands of Ha'apai, Vava'u and 'Eua; and

- **Phase 2:** Installation of 0.45 MWp solar power in Ha'apai's outer islands of 'Uiha, Nomuka, Ha'ano and Ha'afeva; and Niuatoputapu, as well solar home systems in Niuafo'ou in the northern most part of the Kingdom of Tonga (Tonga).

3. This is the Initial Environmental Examination (IEE) prepared for Phase 2 of the Project. The interventions proposed under Phase 2 of the Project is located in the four outer Islands of Ha'apai and the Niuas. Based on the government's law and ADB's environmental safeguard policy, the Phase 2 interventions are categorized as environmental category B project considering the most sensitive component. This IEE meets the requirements of the Tonga's Environmental Impact Assessment (EIA) Act 2003 and complies with the ADB's Safeguard Policy Statement (SPS) 2009. The scope of this IEE is limited to the sites of the proposed interventions.

4. The IEE for Phase 2 was initially prepared during the project preparation work in the months of June and July 2012. The project is now at bidding stage for Phase 2, and although there are no major changes in the project design or location of components anticipated, this IEE (including the environmental management plan [EMP]) has been updated after detailed design in line with the SPS.

5. The Project will construct and operate five solar power generation units with a total capacity of 430 kWp and will install about 100 Solar Home Systems (SHSs) with a combined capacity of 20 kWp. The solar power generation units will consist as a set of solar photovoltaic (PV) modules, power inverters, switchgear, associated protection, control and monitoring equipments, and associated civil works. The electricity output will be directly fed into the existing distribution network of island electricity committees for further distribution.

6. The project will require about 4500 sq.m (0.45 hectares)[1] land to install 430 kWp capacity over five solar power plant sites. Except for Ha'afeva and Niuatoputapu, the sites proposed for the solar power plants in the Ha'apai Group are open areas of flat topography adjacent to the existing plants with land use being mostly rural (non-residential) and little vegetative cover. There are no sensitive areas on and around these proposed sites. In Ha'afeva and Niuatoputapu, the proposed sites are covered by trees and other vegetative cover. On these two land plots there are about 60 coconut trees and other crops including kasava, banana, and kape. Coastline is between 1 and 2.5 km away from the proposed sites and there is no history of any flooding or water logging. There is no physical infrastructure or archaeological/ religiously important sites in and around the proposed sites. The land available adjacent to existing power plants in 'Uiha, Nomuka, and Ha'ano islands is sufficient to accommodate the proposed solar plant size at these islands and was obtained through negotiated settlement. However for Ha'afeva and Niuatoputapu Power Plants, the additional land required belong

[1] Land requirement is estimated based on assumption that 1 kWp solar power requires about 8 sq.m. area for solar PV installation and space of access and distance between rows of panels.

to the government and will be leased by the Project. Table 1 summarizes the island wise plant size and summary of existing features and proposed interventions.

Table 1: Summary of Existing Features and Proposed Interventions

Feature	Targeted Island					
	Nomuka	**Ha'afeva**	**'Uiha**	**Ha'ano**	**Niuatoputapu**	**Niuafo'ou**
Island Group	Ha'apai	Ha'apai	Ha'apai	Ha'apai	Niuas	Niuas
Total Geographical Area (sq.km.)	7.0	1.8	5.36	6.58	18.0	15.0
Number of Households	127	80	100~	90	155[2]	211 8 villages
Geographical Location	Nomuka is a small island in the southern part of the Ha'apai Group of islands in the Tonga.	Ha'afeva is located 42 km southwest of Pangai in the Ha'apai group of islands.	'Uiha is an island in Lifuka district, in the Ha'apai islands of Tonga	Ha'ano is an island in the Ha'apai islands of Tonga. To the south are the islands of Foa and Lifuka.	Niuatoputapu lies about 240kms (144 miles) north of Vava'u.	(Niuafo'ou is the northernmost island in the Tonga. Almost 350 miles separate Niuafo'ou from Tonga's main island of Tongatapu.
Proposed Interventions	Installation of 70 kWp solar power plant connected to existing grid	Installation of 70 kWp solar power plant connected to existing grid	Installation of 70 kWp solar power plant connected to existing grid	Installation of 70 kWp solar power plant connected to existing grid	Installation of 150 kWp centralized solar power plant and associated distribution system integrated with existing solar home systems	Installation of 100 solar home systems with a total capacity of 20 kWp
Location of proposed sites for interventions	Nomuka Island	Ha'afeve Village	'Uiha Village	Pukotala Village	Hihifo Village	In all 8 villages of Niuafo'ou Island
Ownership of proposed land	Owned by Nomuka Electricity Committee	Owned by government /private parties	Owned by 'Uiha Electricity Committee	Owned by Ha'ano Electricity Committee	Government	Government / Private Land
Land requirement	750 sq.m.	750 sq.m.	750 sq.m.	750 sq.m.	1500 sq.m.	No land requirement
Land use in and around proposed site for solar power plant site	Open land within premises of existing diesel power plant	Open land owned by nobles.	Open land within premises of existing diesel power plant	Open land within premises of existing diesel power plant	Open land with vegetation cover / trees and crops owned by keeper of the	Open land

[2] Source: 2011 Census

Feature	Targeted Island					
	Nomuka	**Ha'afeva**	**'Uiha**	**Ha'ano**	**Niuatoputapu**	**Niuafo'ou**
					land.	
Terrain of proposed site	Plain	Plain	Plain	Plain	Plain	Plain to undulating
Distance from Coastline	1 km	1 km	1 km	1 km	1-2 km	1-2 km

7. The solar power plants will not have any significant long term adverse environmental impacts; in fact the project will create long-term environmental benefits by reducing CO_2 emissions in the order of 1700 tons per year. The main environmental impacts are short-term and will be created during the construction stage. The main environmental impacts will be during site preparation, which will include the cutting of about 60 coconut trees and removal of crops from two of the proposed sites and surrounding areas to prevent shading. There will also be impacts from noise and dust emissions due to increase in traffic for transportation of equipment and construction material as well as operation of construction machineries such as concrete mixer, bulldozer, dump trucks, cranes etc. However these will be short-term (approximately 3-5 days for the smaller sites and up to a month for the larger sites). Impacts associated with the installation of solar home system are mostly related to change in local topography and visual impacts. However, these impacts will not be significant as the size of the SHS is very small and will be installed individually for about 100 households. Operational impact includes management of used batteries. It is proposed that handling and disposal of used batteries will be taken care of by manufacturers. Similarly after decommissioning of the solar plants, solar panels will be dismantled and handled by manufacturers. All these impacts are manageable by implementing mitigation measures proposed in the environmental management plan.

8. Local communities and stakeholders were involved in the process of preparing the IEE through on-site discussions. As the Project will have minor environmental impacts, local communities and community leaders support the Project. They, however, sought assistance in community development such as provision of street lights etc. and support for community cultural events. Details of community issues and project actions are incorporated in the social assessment report. The IEE will be made available at public locations and will be disclosed to a wider audience via the ADB website. The consultation process will be continued and expanded during the project implementation to ensure that stakeholders are fully engaged in the Project and have the opportunity to participate in its development and implementation and understand that there is a process in place for them to air any grievances or complaints.

9. The interventions proposed under Phase 2 of the Project will not cause any significant or lasting adverse environmental impacts during construction, operation and decommissioning. In terms of environmental impacts, the Project will bring about benefits by reducing gaseous emissions (CO_2) through reducing dependence on existing diesel generator (DG) sets which use imported fossil fuels; reduction in noise from DG sets operations; and reduction in land and ground water contamination caused by spills from DG sets and diesel fuel storage areas. Only minor and transient environmental disturbances will be experienced at the project sites during construction and operation, and these can be minimized and managed through implementation of the EMP. Due to the limited and manageable nature of impacts this IEE is adequate to comply with the EIA Act of Tonga and ADB's SPS and therefore further environmental analysis of the Project is not required. Requisite compliance measures (updating and implementation of EMP and monitoring plan) will be included in the project and bid/tender documents.

B. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

10. Environmental assessment of the proposed project has been carried out in compliance with ADB's SPS and the government's legislation and requirements.

1. The Government Environmental Laws and Regulations

11. Some of the important laws relevant to the Project focusing on environmental assessment are summarized in Table 2.

Table 2: Summary of Relevant Environmental Laws and Regulations of Tonga

Environmental Legislation	Year Passed	Objective
Environmental Impact Assessment (EIA) Act 2003	2003	To provide for the application of environmental impact assessment to the planning of development in Tonga.
Environmental Impact Assessment (EIA) Regulations 2010	2010	To regulate major development projects and the applications of notification consistent with the EIA Act 2003.
Waste Management Act 2005	2005	To manage and oversee the function of the Waste Management Board.
Parks and Reserves Act 1976	1976 (amended in 1979 & 1988)	To provide for the establishment of Parks and Reserves Authority and for the establishment, preservation and administration of Parks and Reserves.
Biosafety Act 2009	2009	To regulate living modified organisms and the applications of modern biotechnology consistent with Tonga's obligations and rights under the Convention on Biological Diversity and the Cartegena Protocol.
Ozone Layer Protection Act 2010	2010	To regulate the use of ozone depleting substances and to implement the provisions of the Convention for the Protection of the Ozone Layer and the Protocol on substances that deplete the ozone layer and for related purposes.
Hazardous Wastes and Chemicals Act 2010	2010	To provide for the regulation and proper management of hazardous wastes and chemicals in accordance with accepted international practices and the International Conventions applying to the use, transboundary movement and disposal of hazardous substances and for related purposes.
Renewable Energy Act 2008	2008 (amended in 2010)	To regulate the use of renewable energy in the Kingdom and related matters.
Environment Management Act 2010	2010	To establish the Ministry of Environment & Climate Change to ensure the protection and proper management of the environment and the promotion of sustainable development.

Source: Ministry of Environment, Information, Disaster, Energy and Climate Change, Government of Tonga

2. Environmental Assessment Process in Tonga

12. Under the Tongan regulatory framework (the EIA Act 2003 and the EIA Regulations 2010), all development activities must be referred to the Minister of Environment, Information, Disaster and Climate Change (MEIDECC). With this notification, the proponent must complete a Determination of Category of Assessment Form, providing an overview of the proposed development and a number of details in relation to the existing environment and potential environmental impacts and mitigation

measures. The Secretariat and the Minister determine whether the proposed development is a minor or major project, and advises the proponent within 30 days. If it is a major project, the proponent then submits a full Environmental Impact Assessment for review by the Secretariat. The Secretariat makes recommendations to the Environmental Assessment Committee. The Minister receives an assessment report and issues the approval (with or without conditions), a request for further information, or a rejection.

13. Under the EIA Act, a Schedule lists the projects considered as major projects. Electricity Generation Station is listed as one of the major projects however; renewable energy generation projects such as this project has not been clearly stated in this Schedule. This IEE provides the information required for MEIDECC to undertake its assessment process as required under the regulations as Major Project.

3. ADB's Environmental Safeguard Requirements

14. This environmental assessment is carried out in compliance with safeguard 1 of ADB's SPS so as to ensure that potential adverse environmental impacts are identified, avoided where possible and managed or addressed.

15. As per the SPS the objective of Environmental Safeguard is to ensure the environmental soundness and sustainability of projects and to support the integration of environmental considerations into the project decision-making process. To help achieve the desired outcomes, ADB adopts eleven policy principles for guiding the assessment of projects that trigger environmental risks and impacts. ADB categorizes projects into categories A, B, C, and FI according to the significance of likely impacts.

16. Based on the Government's EIA Act and ADB's SPS, the interventions proposed in Phase 2 of the Project is categorized as category B project based on the most sensitive component. Project categorization is carried out using Rapid Environmental Assessment (REA) Checklist (Appendix 3). Category B projects judged to have some adverse impacts, but of lesser degree and/or significance than category A. An initial environmental examination (IEE) is required to determine whether or not significant environmental impacts warranting an EIA are likely. If an EIA is not needed, the IEE is regarded as the final environmental assessment report. Accordingly, this IEE is prepared to meet the requirements of the government as well as ADB's SPS requirements.

4. Institutions

17. The principal national agency charged with environmental protection is the Ministry of Environment, Information, Disaster, Energy and Climate Change (MEIDECC). The role of MEIDECC is to protect the environment and promote sustainable development. The environmental assessment for development projects is also approved by MEIDECC. It is also the agency required to respond to any complaints from the public about environmental issues.

5. Extent of IEE Study

18. The interventions proposed under the Phase 2 of the Project located in the outer Islands of Ha'apai and Niuas. The scope of this IEE is limited to the power plant, mini-grid service lines and solar home systems sites only. The purpose of this IEE is to assess potential environmental, health, safety and social impacts of the proposed interventions.

19. The Phase 2 IEE was initially prepared during the project preparation work in the months of June and July 2012. The project is now at bidding stage for Phase 2, and although there are no major changes in the project design and location of components, this IEE has been updated after detailed design in compliance with the ADB's SPS 2009.

20. This IEE study is conducted based on primary data from field surveys (including consultations) and secondary information collected from various sources. During the site visits the specialists had discussions with various stakeholders including town members and local executive powers for their opinions on the Project. The results of the consultations with village/town members and communities as well as an evaluation of the institutional framework have been incorporated into this assessment.

C. DESCRIPTION OF THE PROJECT

1. Project Background

21. Like other Pacific islands countries, Tonga is highly vulnerable to increasing oil prices, affecting the affordability of food, goods, electricity, and transportation. Its dependency on imported fossil fuels consequently affects the economic growth of the country. The proposed Outer Islands Renewable Energy Project (the Project) will assist the government's efforts to reducing the country's heavy reliance on imported fossil fuels for power generation. By providing a secure, sustainable and environmentally-sound clean electricity for private and commercial consumers, it will implement 1.25 MWp solar power capacity connected to the existing diesel networks of country's outer islands saving yearly about 1700 tons of carbon dioxide (CO_2).

22. A project preparatory technical assistance (PPTA) was provided to the government to help develop the Project in the nine outer islands groups of Ha'apai, Vava'u, 'Eua, and Niuas. It include (i) solar resource assessment, (ii) screening and site selection for one solar plant on each island group, (iii) preparation of conceptual feasibility studies for the selected schemes including all technical, economic, financial, environmental, legal and social considerations, and (iv) capacity strengthening program of executing and implementing agencies, including customers. This report presents the updated findings of the study carried out for Phase 2 interventions in Ha'apai's four outer islands of 'Uiha, Nomuka, Ha'ano and Ha'afeva; and the two Niua islands (Niuatoputapu and Niuafo'ou).

23. The scope of the Project is divided in two phases:

- **Phase 1:** Installation of 0.8 MWp solar power in Tonga's outer islands of Ha'apai, Vava'u and 'Eua; and
- **Phase 2:** Installation of 0.45 MWp solar power in Ha'apai's outer islands of 'Uiha, Nomuka, Ha'ano and Ha'afeva; and the two Niuas namely Niuatoputapu and Niuafo'ou islands.

2. Location of Project

24. All the physical components included in the Phase 2 are located in outer Islands of Ha'apai and Niua Groups of Tonga. Ha'apai Group is located on northern part of Tonga with Ha'apai (Capital) located at about 175 km northeast of the national capital Nuku'alofa. Niuas are northern most islands of Tonga. Ha'apai Group consists of 62 Islands covering a total land area of 110 sq. km. As at the 2011 census the Group had a total population of 6650 and 1268 households. The land use around the proposed sites is rural (non-residential) with flat topography. Ha'apai has high volcanic and low limestone islands. In Ha'apai group the solar plants will be located one each in outer islands of 'Uiha, Nomuka, Ha'ano and Ha'afeva.

25. Niuas, the two volcanic islands of Niuatoputapu and Niuafo'ou are located in the north of the Tonga. Niuatoputapu lies about 240 km (144 miles) north of Vava'u and consist of an area of 18 sq.km whereas Niuafo'ou is the northernmost island in Tonga. Almost 350 miles separate Niuafo'ou from Tonga's main island of Tongatapu; while Samoa (200 miles) and Fiji (300 miles) are a shorter distance away. The proposed solar power plant is located on Niuatoputapu and Solar Home System (SHS) will be installed in eight villages of Niuafo'ou island of Niuas.

26. Figure 1 shows the location map of the project facilities. Detailed maps showing locations of individual plant sites are provided in Appendix 1.

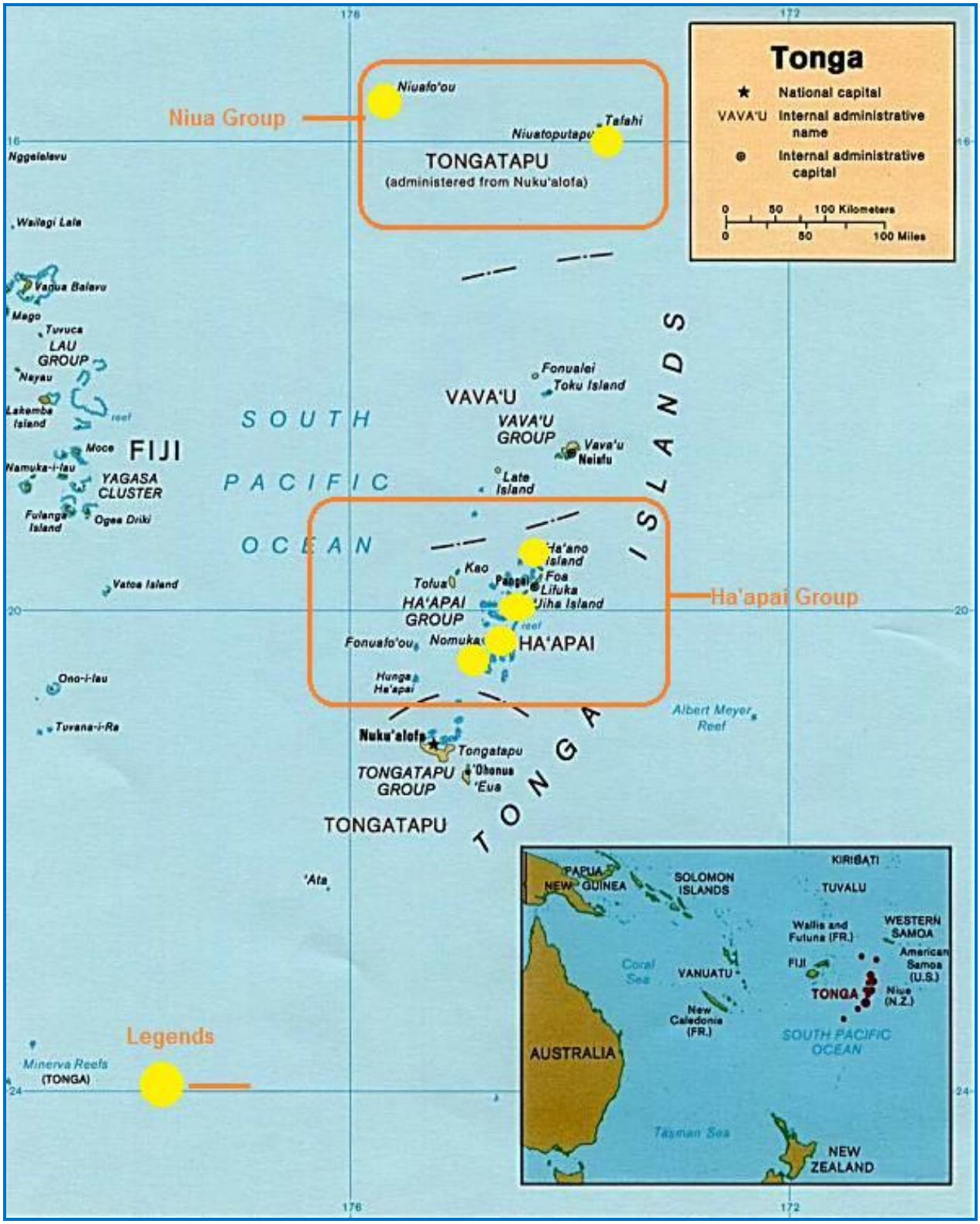


Figure 1: Locations of Project Areas on Country (Tonga) Map[3]

[3] Source: http://www.lib.utexas.edu/maps/islands_oceans_poles/tonga_pol_1989.pdf

3. Project Components and Activities

27. As part of the Project a solar power plant of 70 kWp will be installed each in four of the Ha'apai's outer Islands namely 'Uiha, Nomuka, Ha'ano and Ha'afeva; and a 150 kWp solar power plant will be installed in Niuatoputapu. In Niuafo'ou island a 20 kWp (100 HH) solar home systems (SHS) will be installed.

28. In four outer islands of Ha'apai, solar power plants will be installed adjacent to the existing diesel power generation plants and in Niuatoputapu, the power plant will be installed at new location in Hihifo village. In Niuafo'ou the SHSs will be installed in eight villages across the island.

29. The Project will require about 4500 sq.m (0.45 hectares)[4] land to install 430 kWp capacity over five solar power plant sites. Except for Ha'afeva and Niuatoputapu, the sites proposed for the solar power plants are open areas of flat topography adjacent to the existing plants with land use being mostly rural (non-residential) and little vegetative cover. There are no sensitive areas on and around these proposed sites. In Ha'afeva and Niuatoputapu, the proposed sites are covered by trees and other vegetative cover. The land available adjacent to existing power plants in 'Uiha, Nomuka, and Ha'ano islands is sufficient to accommodate the proposed solar plant size at these islands. However for Ha'afeva and Niuatoputapu Power Plants, additional state owned land will be leased by the Project. Table 3 below summarizes the island wise plant size and summary of existing features and proposed interventions.

Table 3: Summary of Existing Features and Proposed Interventions

Feature	Targeted Island					
	Nomuka	**Ha'afeva**	**'Uiha**	**Ha'ano**	**Niuatoputapu**	**Niuafo'ou**
Island Group	Ha'apai	Ha'apai	Ha'apai	Ha'apai	Niuas	Niuas
Plant Capacity	70 kWp solar power plant	70 kWp solar power plant	70 kWp solar power plant	70 kWp solar power plant	150 kWp centralized solar power plant and associated distribution system integrated with existing solar home systems	100 solar home systems with a total capacity of 20 kWp
Number of Households	127	80	100~	90	155[5]	211 8 villages
Location of proposed sites for interventions	Nomuka Island	Ha'afeve Village	'Uiha Village	Pukotala Village	Hihifo Village	In all 8 villages of Niuafo'ou Island
Land requirement	750 sq.m.	750 sq.m.	750 sq.m.	750 sq.m.	1500 sq.m.	No land requirement

30. The main activities under Phase 2 of the Project are summarized below:

[4] Land requirement is estimated based on assumption that 1 kWp solar power requires about 8 sq.m. area for solar PV installation and space of access and distance between rows of panels.

[5] Source: 2011 Census

- Installation and commissioning of a grid-connected solar power plant in Nomuka Island of Ha'apai with a capacity of 70 kWp.
- Installation and commissioning of a grid-connected solar power plant in Ha'afeva Island of Ha'apai with a capacity of 70 kWp.
- Installation and commissioning of a grid-connected solar power plant in 'Uiha Island of Ha'apai with a capacity of 70 kWp.
- Installation and commissioning of a grid-connected solar power plant in Ha'ano Island of Ha'apai with a capacity of 70 kWp.
- Installation and commissioning of an off-grid solar power plant with associated distribution system in Niuatoputapu Island of Niua with a capacity of 150 kWp.
- Installation and commissioning of solar home systems (SHS) for about 100 households in Niuafo'ou Island of Niua with a total capacity of 20 kWp.
- Capacity building of executing and implementing agencies, solar electricity committees in planning and customers in managing the electricity services.
- Efficient project management services.

31. The scope of work under physical components comprise of various elements as described in following paragraphs.

32. The Project will construct and operate five solar power generation units with a total capacity of 430 kWp and will install about 100 SHSs with a combined capacity of 20 kWp. The solar power generation units will consist in a set of solar photovoltaic (PV) modules, power inverters, switchgear, associated protection, control and monitoring equipments, and associated civil works. The electricity output will be directly fed into existing distribution network of island electricity committees for further distribution. Table 4 summarizes salient features of a solar power generation unit.

Table 4: Salient Technical Features of a Solar Power Plant

S. No.	Component	Features / Specifications
1.	Solar Panels	
	Number of Panels	Approx. 2500 panels, poly-crystalline, photovoltaic (PV)
	Dimensions of each panel	Rectangular, 2 m by 1 m
	Inclination	15 degrees
	Life Cycle	25 years
2.	Loading Controllers	5 stations
3.	DC-AC Inverters	100 kW, 5 units
4.	Transformers	0.1 MVA (22kV/380V) 5 unit
5.	Batteries	To be define
6.	Wires and other accessories	As per locally available

33. Besides solar power generation units, the Project will install individual solar home systems for about 100 households with a combined capacity of 20 kWp. These individual SHS will be installed at

individual houses in eight villages of Niuafo'ou Island. The SHS will consist in a set of solar photovoltaic (PV) modules, charge controller, luminaries, battery, wire, and accessories.

4. Local Infrastructure Required

34. The local infrastructures required for the Project are the roads, wharves, outer island jetties and the pre-existing energy grid.

35. The roads, wharves and outer island jetties will be needed to transport necessary materials and equipments during construction. It is estimated that maximum 10 trucks will be moving daily for a maximum 3-4 days during peak construction time. Heavy machinery will only be required for construction of the larger new mini-grid on Niuatoputapu which has an adequate wharf, whereas they will not be required for the smaller outer islands of Ha'apai with sufficient small landing jetties.

36. The solar power plant will be connected to the existing grid and will feed it energy. Batteries are to be installed as part of the project to ensure smooth transition from solar plant to grid.

5. Implementation Arrangement and Schedule

37. Existing and newly established institutions will support the project implementation. The government through its Ministry of Finance and National Planning (MFNP) will be the executing agency (EA) of the Project. The Ministry of Environment, Information, Disaster, Energy and Climate Change (MEIDECC), through its Energy Implementation Unit will be the implementing agency (IA) for the Phase 2 projects located in the outer islands of Ha'apai and Niuas. An international team comprising solar energy specialist, field engineer, safeguards specialist, and financial expert has been established as the Project Management Consultant (PMC) to support the EA and IA. The PMC will take over project implementation, and after start up will design and conduct operations and maintenance (O&M), and capacity building of Tonga Power Limited (TPL) staff and members of the island electricity committees to guarantee for at least five years the project sustainability. During project implementation a project steering committee chaired by the MFNP will supervise the project implementation of the Project.

6. Project Benefits and Justification

38. The successful implementation of the 450 kWp solar power generation capacity in Ha'apai and Niuas Islands as part of Outer Island Renewable Energy Project will result in reduction of annual diesel import for power generation equivalent to about 180,000 liters/year by 2018[6]. This will allow at least 100 HH in Ha'apai and Niuas will be supplied with electricity generated from renewable sources, out of them at least 15 HHs are headed by women. Besides this, schools, offices and churches will also be benefited from the Project.

39. In terms of access to solar energy, about 763 consumers in Ha'apai and Niuas will get at least 789 MWh of solar electricity supply every year[7].

40. In addition, a key element of the project will be capacity building including strengthening of staff from island electricity committees in the areas of O&M of solar-diesel hybrid energy systems. The Project will also bring positive impacts by reducing gaseous emissions (CO_2) from running of existing DG sets; reduction in noise from DG sets operations, reduction in land and ground water

[6] With a baseline of 2011 diesel consumption for power generation which is 150 million of liters.

[7] The proposed 450 kWp power plant is expected to generate about 789 MWh of solar electricity annually which will offset about 180000 litres of diesel per annum.

contaminations caused by spill of oil from DG sets. Overall, at a local level the Project will improve socio-economic conditions of the local communities in the targeted areas and at a national level will help improve the national Grass Domestic Product (GDP).

D. DESCRIPTION OF THE ENVIRONMENT

1. Physical Resources

1.1 Physiography, Land use and Demography

41. The Kingdom of Tonga (Tonga) is a group of small islands located in the central South Pacific. It lies between 15º and 23º30' South and 173º and 177º West. Tonga has a combined land and sea area of 720,000 km². It is an archipelago of 172 named islands covering an area of 747 km^2 of which 36 islands (covering an area of 649 km^2) are inhabited. Tonga had a total population of 103,036 (2011 census) compared to 101,991 at the census of 2006, an increase of 1045 people over the 5 years.

42. Tonga consists of four clusters of islands extended over a north-south axis: Tongatapu (260 km^2); 'Eua (87 km^2) in the south; Ha'apai (109 km^2) in the centre; Vava'u (121 km^2) in the north; Niuafo'ou and Niuatoputapu (72 km^2) in the far north. Tonga's archipelago is situated at the subduction zone of the Indian-Australian and the Pacific tectonic plates and within the Ring of Fire where intense seismic activities occur.

43. Within Tonga there is a western line of islands of volcanic origin, steep topography and generally high elevations, and an eastern line of generally low-lying limestone and mixed geology islands. Amongst the western group are Tofua (507 m), Kao (1030 m), Late (519 m), Niuafo'ou (260 m), Niuatoputapu (106 m) and Tafahi (548 m). The eastern group where the majority of the population lives consists of Tongatapu (65 m), 'Eua (312 m) and most of the islands of the Ha'apai and Vava'u groups.

44. Ha'apai Group consists of 62 Islands covering a total land area of 109 km^2. As at the 2011 census the Group had a total population of 6650 and 1268 households. The land use around the proposed sites is rural (non-residential) with flat topography. Ha'apai has high volcanic and low limestone islands.

45. Niuas, the two volcanic islands of Niuatoputapu and Niuafo'ou are located in the north of the Tonga. Niuatoputapu lies about 240 km (144 miles) north of Vava'u and consist of an area of 18 km^2 whereas Niuafo'ou is the northernmost island in Tonga. Almost 350 miles separate Niuafo'ou from Tonga's main island of Tongatapu; while Samoa (200 miles) and Fiji (300 miles) are a shorter distance away.

46. Niuafo'ou is the tip of an underwater volcano, which was created by sub-oceanic eruptions many years ago. The center of the island is dominated by *Vai Lahi*, a large lake measuring some 5 km (3 miles) across and up to 84 m (277 ft.) deep. On the island's south and west, extensive, blackish grey fields of lava bear witness to Niuafo'ou volcanic history.

47. Table 5 present the physiographical features of the islands that form the Project area.

Table 5: Physiographical Features of the Proposed Sites

Feature	Targeted Island					
	Nomuka	**Ha'afeva**	**'Uiha**	**Ha'ano**	**Niuatoputapu**	**Niuafo'ou**
Island Group	Ha'apai	Ha'apai	Ha'apai	Ha'apai	Niuas	Niuas
Total Geographical Area (sq.km.)	7.0	1.8	5.36	6.58	18.0	15.0

Feature	Targeted Island					
	Nomuka	**Ha'afeva**	**'Uiha**	**Ha'ano**	**Niuatoputapu**	**Niuafo'ou**
Geographical Location	Nomuka is a small island in the southern part of the Ha'apai Group of islands in the Tonga.	Ha'afeva is located 42 km southwest of Pangai in the Ha'apai group of islands.	'Uiha is an island in Lifuka district, in the Ha'apai islands of Tonga	Ha'ano is an island in the Ha'apai islands of Tonga. To the south are the islands of Foa and Lifuka.	Niuatoputapu lies about 240kms (144 miles) north of Vava'u.	(Niuafo'ou is the northernmost island in the Tonga. Almost 350 miles separate Niuafo'ou from Tonga's main island of Tongatapu.
Proposed Interventions	Installation of 70 kWp solar power plant connected to existing grid	Installation of 70 kWp solar power plant connected to existing grid	Installation of 70 kWp solar power plant connected to existing grid	Installation of 70 kWp solar power plant connected to existing grid	Installation of 150 kWp centralized solar power plant and associated distribution system integrated with existing solar home systems	Installation of 100 solar home systems with a total capacity of 20 kWp
Location of proposed sites for interventions	Nomuka Island	Ha'afeve Village	'Uiha Village	Pukotala Village	Hihifo Village	In all 8 villages of Niuafo'ou Island
Ownership of proposed land	Owned by Nomuka electricity committee	Owned by Noble	Owned by 'Uiha electricity committee	Owned by Ha'ano electricity committee	Government	Government / Private Land
Land requirement	750 sq.m.	750 sq.m.	750 sq.m.	750 sq.m.	1500 sq.m.	No land requirement
Land use in and around proposed site for solar power plant site	Open land within premises of existing diesel power plant	Open land owned by private parties.	Open land within premises of existing diesel power plant	Open land within premises of existing diesel power plant	Open land with vegetation cover / trees and crops	Open land
Terrain of proposed site	Plain	Plain	Plain	Plain	Plain	Plain to undulating
Distance from Coastline	1 km	1 km	1 km	1 km	1-2 km	1-2 km

1.2 Meteorology and Climate

48. The climate of Tonga is tropical. It lies within the south-east trade wind zone of the South Pacific. Wind speed over its surrounding oceans averages around 12 knots. Strong winds are not common except during tropical cyclone passages in summer (November- April) and gales from eastward migrating high-pressure systems during winter (May-October). Rainfall is moderate, with high relative humidity. Tonga's annual rainfall is defined by two seasons, the Wet and Dry seasons.

49. Temperature variations throughout the country show an increase in daily and seasonal variations with increasing latitude. Mean annual temperatures vary from 27^0C at Niuafo'ou and Niuatoputapu to 24^0C on Tongatapu. Diurnal and seasonal variations can reach as high as 6^0C throughout the island group. During the Hot Wet Season (November-April), the average temperature ranges from 27-29^0C whereas at Dry Cool Season (May-October), the average temperature ranges from 20-24^0C.

50. Tonga has seen an increasing trend in the occurrences of tropical cyclones. There is also evidence that the intensity of cyclones has increased since the 1980's in Tonga. Since the 1960's 4 cyclones have severely affected Tonga. Cyclone Flora in March, 1961 affected Vava'u and Ha'apai districts, Cyclone Isaac in March, 1982 affected Ha'apai and Tongatapu and Cyclone Waka in December, 2001 affected the northern group of Niua and Cyclone Renee in 2010 severely affected Tongatapu, Vava'u and Ha'apai groups. The most recent Cyclone Ian affected the Ha'apai group in 2014. All of these cyclone events caused severe damages to crops and food supply, infrastructures, tourist resorts, the environment, buildings and disrupt essential services and the wellbeing of the people of affected community for a prolonged period of time.

51. Ha'apai has semi-tropical climate with mean monthly maximum and minimum temperatures are 25.5^0C and 23.5^0C, respectively. Average annual rainfall is 1619 mm, which is not usually sufficient to support plant growth during the dry season and frequent droughts occur in the period June - August. Soil erosion occurs as a result of high intensity rainfall (including hurricanes) during the wet season from November to March. Niuas also has semi-tropical climate with mean monthly maximum and minimum temperatures are 26^0C and 20^0C, respectively. Average annual rainfall in Niuas is 1610 mm.

52. A climate risk profile for Tonga[8] indicates that the main impacts of climate change are expected to be high sea levels, extreme winds, and extreme high air and water temperatures. Best estimates of long-term, systematic changes in the average climate for Tonga indicate that sea level is likely to have increased by 36 centimeters and the frequency of severe short sea level rise resulting from storm surge (2.2 meters above mean sea level) will increase from a one in 580-year event to a one in 5-year event by 2050. The project will provide solar PV plants with resilience to climate change through compact and preassembled systems resistant to marine environments.

1.3 Geology, Soils and Mineral Resources

53. The soils of Tonga are derived from a mixture of volcanic ash and coral. Because island groups are isolated from each other, and are physically and economically different, the country is described in four parts. Most of the islands of Tonga have a soil layer overlying coral limestone. While soils vary from island to island, they are mainly derived from volcanic ash (andesitic tephra) deposited by a series of volcanic eruptions from emergent volcanoes such as Tofua and Kao and from submarine volcanoes to the west. Other soils include coral and lagoon sands and mud. Among the 63 islands of Ha'apai group, 43 are coral islands, with very low topography and coraline soils. Ha'apai has high volcanic and low limestone islands or atolls. Niuas are volcanic islands. Niuafo'ou is the tip of an underwater volcano, which was created by sub-oceanic eruptions many years ago. To the south and west of the island, extensive, blackish grey fields of lava bear witness to its volcanic history.

1.4 Water Resources

54. The freshwater resources of Tonga consist of groundwater in the form of freshwater lenses. Freshwater lenses form on top of seawater in many of the islands due to the difference in density of the two fluids. The interface, or boundary, between the two fluids forms a transition zone. Within the transition zone the water salinity increases from that of freshwater to that of seawater over a number of metres. Surface water resources are only evident on some of the high volcanic and mixed geology islands in the form of springs and lakes. Crater lakes exist on the islands of Niuafo'ou and Tofua. It is

[8] Climate Profile of Tonga prepared by ADB in 2008

reported that the former lake has been used in dry periods as a source of potable water. Surface water is collected from cave systems on the island of 'Eua and used for potable water supply.

55. Rainwater harvesting systems are a complementary freshwater resource, and an essential source of potable water on many of the islands. On the Ha'apai group they are the only source of freshwater. On most parts of the main islands of the Ha'apai group the depth from the surface to water table is higher being in the order of 5 to 8 m in many places and greater than 15 m in elevated parts of the islands. The center of the Niuafo'ou Island is dominated by *Vai Lahi*, a large lake measuring some 5 km (3 miles) across and up to 84 m (277 ft.) deep.

2. Ecological Resources

2.1 Flora and Fauna

56. Tonga's flora and fauna is limited in diversity. There is a wide variety of vegetation types throughout the islands of Tonga. Indigenous vegetation includes a variety of rootcrops, fruit trees such as mangoes, tava, and a variety of citrus, and native vegetables and grasses. In the settled areas of the four Island Groups, much of the native vegetation has been cleared for coconut plantations, home gardens, villages, and commercial crops. A significant percentage of the country is now under coconut and Panicum grassland.

57. The major marine ecosystems in Tonga are: algal and seagrass beds; fringing and lagoon reefs; rocky coasts; beaches; open lagoons; marine lakes; marine caves and a submarine trench. The reefs and lagoons are the prime fishery for subsistence supplies. The natural vegetation pattern shows secondary fallow vegetation in all island groups of Ha'apai. All islands have a cover of coconuts, and few other trees.

58. Knowledge of Tonga's terrestrial fauna is limited with most past researches and investigations concentrated on agricultural-related fauna. Tonga's Stocktaking report (2004) reviewed the terrestrial fauna in terms of vertebrates and invertebrates. Invertebrates are mostly agricultural pests widely found throughout the Pacific and tropical environments and include beetles, moths, flies and worms which prominence relate more to their destructive impact on agriculture as oppose to being biologically rare and unique.

59. Of vertebrates, other than the domesticated ones of low conservation significance, birds have the highest diversity. Watling reported 74 species (Watling, 2001) 51 of which are resident breeding species, 22 native land birds, 23 sea bird species, and 6 introduced. The remaining 23 species are migrant or vagrants of which are 6 shore birds, 13 seabirds and 3 land and wetland species (ibid.). Endemism is low with only one (Hengahenga or Tonga whistler; Pachycephala jacquinoti) species, while the Niuafo'ou megapode (Megapodius pritchardii) is known to also exist in Vanuatu. The megapode is listed by the IUCN as an endangered species.

60. Other fauna species are hepterofauna of which some 20 species are reported, two species of fruit bats (Pteropus tonganus and P samoensus), rodents and cats.

2.2 Forests and Protected Areas

61. Tonga's protected area network consists of national parks, terrestrial and marine parks and reserve protected areas. Under the Parks and Reserves Act of 1976, five marine parks have been designated on Tongatapu. The parks cover 250 hectares of coral reef, which is 10% of Tonga's total coral system. None of the other island groups have marine parks although surveys have been conducted with this intention in mind. Table 6 present the overview of the protected area system in Tonga and corresponding IUCN category. IUCN categorization system is provided in Appendix 4.

Table 6: Overview of Protected Area System in Tonga

PA category/type	No.	Surface area, (ha)	Corresponding IUCN category	Management authority
Marine Protected Areas, protected seascape/ marine reserves	8	1,003,729	IV-VI	MEIDECC
Managed resource terrestrial protected areas	6	2,100	II, V,VI	Forestry & MEIDECC
Managed resource protected areas/special management areas (SMA) – community based.	6	9256.5	VI	Fisheries
Strict Nature Reserve (SMAs – community based)	6	1,104.5	IA	Fisheries

Source: Data provided by MEIDECC.

3. Socio-economic Conditions

3.1 Demography

62. The population of Tonga is 106,036 distributed over 36 of its 172 islands. Since 2006 the average annual population growth has been 0.2%, and is not expected to increase. Due to steady migration (urban drift) to the capital of Nuku'alofa, with a population growth of 0.8%. In Ha'apai the annual growth rate is recorded -2.6% during this period. The official poverty line in Tonga has been established at $2586 per person per year in 2009. According to the Bureau of Statistics, 22% of people in Tonga are viewed as living below the poverty line. Table 7 present the demographic details of each targeted island.

Table 7: Island-wise Detail of Demographic Features

Feature	Targeted Island					
	Nomuka	**Ha'afeva**	**'Uiha**	**Ha'ano**	**Niuatoputapu**	**Niuafo'ou**
Island Group	Ha'apai	Ha'apai	Ha'apai	Ha'apai	Niuas	Niuas
Total Geographical Area (sq.km.)	7.0	1.8	5.36	6.58	18.0	15.0
Total Population	477	270	415	419	758	523
Number of Households	127	80	100~	90	155[9]	211 8 villages
Households without power connnection	17 (13%)	7 (9%)	No record	20	No record	22 (11%)

63. In the consultation process, households were asked to comment on level of power supply and fairness of pricing for a range of utility services including electricity. Most of the people agreed that the level of electricity supply they are getting from existing system is satisfactory as there are not many blackouts reported by the public.

[9] Source: 2011 Census

3.2 *Economic Development*

64. The economy of Tonga is largely based in agriculture and fisheries. Subsistence agriculture plays an important role for many families. In addition, remittances sent from relatives working abroad play a significant part in the Tongan economy as a whole, and in the economy of individual households. The global financial crisis in recent times has impacted on this economic flow, increasing the level of hardship experienced by many families in Tonga. The agriculture sector is the main contributor, in terms of GDP, to the economy of Tonga from 2000–2009. This is closely followed by public administration and services. If we aggregate the data to the sectoral level then the services sector is revealed to be the highest contributor to the GDP. This indicates a gradual diversification from the agricultural sector to the services sector. During the consultation it is reported that about 15-20% of their monthly income goes to the electricity consumption. Life in Tonga revolves around strong values of family and the Church, and has a well developed historic and contemporary national identity.

3.3 Historical and Cultural Values

65. The proposed project sites and the surrounding areas are for mainly agricultural and non-residential land use, and have no important historical or cultural sites. There are no records of archeological findings in the project areas.

E. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

1. Impacts and Mitigation Measures Due to Pre-construction Activities

1.1 Physical Environment

66. The proposed sites of the power plants are open land except in Ha'afeva and Niuatoputapu where the proposed sites are covered by modified vegetation.The project facilities do not encroach any of the environmentally sensitive areas. Also there are no sites of any archaeological importance in and around the project facilities. Therefore, impacts associated with project siting on physical environment are negligible.

67. Minor impacts on topography and visual impacts are expected due to installation of the solar power plants. However, these impacts are permanent, and these impacts were minimized by careful site selection to avoid inhabited areas.

68. The equipments to be procured and installed by the Project will comply with international standards for noise as well as escape of polluting materials. The Project will use compact and preassembled systems to minimize the impacts. Therefore, no adverse impacts due to the Project design are anticipated. To ensure that all the environmental mitigation measures are implemented, the EMP will be included in the bidding documents.

69. Climate risk profile for Tonga indicates that the main impacts of climate change are expected to be high sea levels, extreme winds, and extreme high air and water temperatures. Best estimates of long-term, systematic changes in the average climate for Tonga indicate that sea level is likely to have increased by 36 centimeters and the frequency of severe short sea level rise resulting from storm surge (2.2 meters above mean sea level) will increase from a one in 580-year event to a one in 5-year event by 2050. The project will provide solar PV plants with resilience to climate change through compact and preassembled systems resistant to marine environments.

1.2 Biological Environment

70. The project will need cutting of about 60 coconut trees from the proposed sites. The loss of trees will be compensated by planting additional trees as per government requirements. Although

Tonga has a large protected area network, none of these areas is located in the impact area of sites proposed for the interventions (solar power plants and SHSs) under Phase 2 of the Project in outer islands of Ha'apai and Niua Groups. Therefore there will not be any impacts on the fauna.

1.3 Social Environment

71. The project will require about 0.45 Ha of land. The proposed land is state owned and Nobles where applicable have given consent for it to be leased by the Project as per national regulations. To ensure the livelihood of affected people due to loss of crops, there is possibility that the keeper of the land will be employed by the project. Therefore, there will be no relocation issues.

2. Impacts and Mitigation Measures Due to Construction Activities

2.1 Physical Environment

72. Impacts on topography due to installation of solar plant and SHS at individual household will be insignificant. The PV panel will be visible on ground for solar plant and individual houses. This small change in topography will be visible in the habitation. This change will be permanent. In installation phase there will be no impact on soil quality of the area.

73. Visual impacts are anticipated due to storage and haulage construction material and movement of equipments and machineries. This will be minimized by the selection of suitable storage areas for materials or plant with minimum visibility from residences and roads with screening where necessary.

74. Impacts on water resources are not anticipated as there are no water bodies around the Project sites. Wastewater generated during construction will be managed by constructing temporary collection tanks.

75. The Project will involve only minor civil works such as clearing of site, earth work and foundation for panels. Mechanical and electrical works will take place at various locations within a large project sites. The site preparation will involve only minor leveling, and thus will not significantly change the drainage pattern. The transportation of construction materials and project equipment will require about 10 truck trips per day during the working period of 8 hours. It will mean there is more traffic, particularly heavy traffic, on the road than usual. The distance from the wharf to the proposed site is generally short so few roads will be affected by this. Traffic level will return to normal after the construction of the solar plant is completed. Considering the nature and scope of the construction works and the ecological insensitivity of the Project site, it is certain that only minor and manageable environmental disturbances will be created during construction, with minimum impact on nearby communities and the natural environment. Environmental disturbances during construction will be small and transient, such as dust, noise, incremental traffic loads on the roads, and gaseous emissions created by trucks and heavy construction equipment.

76. The impacts associated with civil works activities will be controlled by adapting suitable mitigation measures such as:

- Selection of construction techniques and machinery seeking to minimize ground disturbance and noise vibrations.
- Proper maintenance and operation of construction equipment.
- Existing roads and tracks used for construction and maintenance access to the line / site wherever possible to minimize increase in airborne dust particles.
- Soil excavated from foundation footings disposed of at designated places.
- Fuel and other hazardous materials securely stored above high flood level.

- Construction activities only undertaken during the day and local communities informed of the construction schedule.
- Protect /preserve topsoil and reinstate after construction completed.
- Safe handling and disposal of phased out equipments.
- Contractor to arrange for health and safety training sessions.
- Implementation of effective environmental monitoring and reporting system using checklist of all contractual environmental requirements
- Appropriate contact clauses to ensure satisfactory implementation of contractual environmental mitigation measures.

2.2 Biological Environment

77. Clearing of land by cutting of about 60 trees and trimming of some trees on surrounding areas will have some adverse impacts on the environment. Cuttings of trees will be compensated by planting additional trees. Necessary budget will be provided for planting trees. Cutting and planting of trees will be done in coordination with local offices of the Lands and Surveys Department, and Forestry Department. No impacts on fauna are anticipated due to contraction activities. Following mitigation measures will be implemented by the contractor -

- Marking of trees to be removed prior to clearance, and strict control on clearing activities to ensure minimal clearance.
- Trees that can survive pruning to comply should be pruned instead of cutting.
- Contractor to ensure that there is no illegal felling of trees by the construction workers.
- Planting of trees in coordination with local forest authorities.

3.3 Social Environment

78. The construction will require not more than 50 workers, who will reside outside the Project sites. No groundwater will be tapped at the Project site as these sites have low groundwater potential. The water required for construction (concrete mixing) and consumption will be brought in from outside sources. Domestic wastewater generated by the construction workers would not be more than 10 cubic meters per day per site and will be treated either in a small centralized package treatment plant or by individual septic tanks, one for each toilet.

79. The nature of the construction works indicates that no toxic or hazardous materials will be used, apart from fuel oils for vehicles, which will be properly stored. Construction wastes will be sorted out by the contractors for recycling. The residual wastes will be properly handled by the relevant municipal units for waste disposal.

80. Following additional mitigation measures will be implemented to ensure health and safety of local communities and construction workers.

- Construction activities only undertaken during the day and local communities informed of the construction schedule.
- Installation of site drainage, erosion and runoff controls where necessary.
- Installation of security fencing.
- Construction workforce facilities to include proper sanitation, water supply and waste disposal facilities.
- Protect /preserve topsoil and reinstate after construction completed.
- Contract provisions specifying minimum requirements for workers camps.

- Provide protection gears.
- Contractor to prepare and implement a health and safety plan including safety manual.
- Contractor to arrange for health and safety training sessions.

81. Since there are no cultural resources near the project sites, there will be no impacts on physical cultural resources through the implementation of the Phase 2 components.

3. Impacts and Mitigation Measures from Operation

2.1 Unlike thermal power plants, the operation of the solar power plant will have negligible environmental impact on the site during operation. There will be no waste products, no requirements for cooling, no moving parts, no noise, and no impact on flora and fauna.

3.1 Physical Environment

82. After construction, the project impacts will diminish. After construction, traffic to and from the existing diesel generation unit sites will reduce to present levels. The solar facilities contribution to noise in the vicinity will be undetectable and definitely insignificant compared to that of the adjacent diesel generators.

83. The possible impact could be visual with the addition of the solar panel arrays and installation of SHS on the site, including the possibility of some glare from the panels, even though they are designed to absorb the incident solar radiation. The arrays will be less than 3 m high at their peak and will be on a fixed 20 degree angle facing due north. The proposed sites for the arrays are kept away from the residential areas, therefore impacts from glare and the visual impact from the proposed power plants and SHSs will be insignificant.

84. The water to be used for washing of the solar panels will be taken from outside sources. Provision of adequate drainage facilities will control impacts due to wastewater generated by washing of solar panels.

85. Ha'apai and Niuas are vulnerable to the tropical cyclones and hurricanes. To mitigate these impacts, the foundations and racking system will be designed to withstand powerful cyclones and hurricanes, which will limit the probability of generation unavailability as well as reducing any potential hazard of panels being lifted up and blown onto adjacent properties.

86. During operation phase battery of SHS will have to be replaced after 3- 5 years. This battery contains heavy metal lead and sulphuric acid. If the batteries are discarded in the surroundings, then there will be soil contamination with lead and sulphuric acid in the area. To mitigate these impacts the replaced batteries will be stored in leak proof battery collection system and will be sent to manufacturers for recycling and further management.

87. The Project will use transformers of forced-oil and forced-air-cool designs, which do not use polychlorinated biphenyl (PCB). Therefore, there will be no PCB disposal problem.

3.2 Biological Environment

88. No significant impacts anticipated on biological environment due to operation of solar power plants. Minor impacts on fauna species such as birds, bats etc. due to reflection and glare form solar panels are possible but the presence of birds in the targeted areas is very rare therefore no impacts on fauna due to glare. Wastewater generated from cleaning of solar panels will be collected for sediment removal before discharging to the water bodies, therefore impact on aquatic life is not expected.

3.3 Social Environment

89. Only about 10-15 staff will operate the Project facilities. Domestic wastes generated by this small number of people could be readily handled by conventional practices.

90. Contractors' emergency response plan including occupational health and safety plan approved by supervision consultant will be adopted to handle emergency situation during the operation period. Workers will be trained to deal with the emergency situations.

4. Impacts and Mitigation due to Decommissioning

91. The Project's solar PV panels are expected to have an economic life of 25 years. The suppliers will accept the decommissioned solar PV panels for recycling based on the thin-film technologies and their update. Dismantling of the PV panels will be handled by suppliers that offer the best price for used PV panels in the future. Similarly, the project will require the use of batteries which will need proper disposal and recycling of the lead and the acid that is contained in the batteries after 10 years of operation. To control these possible impacts, it is proposed the disposal of the batteries will be handled by suppliers.

5. Cumulative Impacts

92. The solar power plants proposed under the Project will be located adjacent to the existing diesel generation power stations which consist of diesel generators and diesel storage tanks. While the facilities will result in a number of new solar array structures, these will be no higher than 3 m and visual impact on neighbouring properties will be limited by providing adequate fencing along the plant boundaries.

93. Presently, there is no future development or expansion plan either of existing diesel power plants or any other infrastructure by government. Therefore, there will be no cumulative environmental effects of constructing an additional solar plant in each of six targeted islands.

F. ANALYSIS OF ALTERNATIVES

94. With and without project alternative were analyzed and it is found that the Tonga would continue to pay heavy price for diesel import which will affect the overall economic development of country and the Islands. Implementation of Project will bring positive economic, social and environmental benefits. Economic benefits will be from the reduction in import of diesel for power generation. Social benefits will be from sustainable electricity supply to the consumers and environmental benefits will be from reduction in emission from DG sets by reducing diesel transport, storage, spills and emissions; reduction in noise levels from DG sets being currently operated by power station. Also as part of capacity building of local technicians in implementation and operation of solar and other renewable energy projects, future projects will be benefit from the learning from the construction and operation of the site.

95. Alternative sites were considered, but the proposed sites in Ha'apai and Niuatopotapu were considered the best locations for the solar power plants as these are adjacent to the existing generation diesel power generation plants, easy access to distribution network, providing existing facilities (network, access roads), security and operational workforce that will reduce capital and operating costs. The land has low environmental or residential value, given the existing power generation operations and leases in place. The Project's technical team is reviewing the technical aspects and conceptual designs of potential PV panels and battery suppliers and the best configurations that would meet desired locational requirements will be selected.

G. CONSULTATIONS AND INFORMATION DISCLOSURE

1. Stakeholder / Community Consultations

96. As part of environmental assessment, stakeholders and community consultations were carried out during field visits. The details of such consultation carried out during reconnaissance field visits are presented in Table 8 and Table 9. Also, in total 27 officials from various agencies, i.e., the Tonga Power Limited, Office of the Governor of targeted islands, town officers from islands, Department of Lands and Surveys, etc., were consulted during the fact-finding visits. The consultations included both discussions with stakeholders and discussions with village/district level authorities.

97. Consultation will continue at next stages i.e. after finalization of detailed design and before start of the civil works construction as well as at implementation stage.

Table 8: List of Stakeholders / Communities Consulted during Field Visits to targeted Islands in Ha'apai and Niua Groups

Sl. No.	Name	Designation and Organization	Remarks
NUKU'ALOFA			
1.	John van Bribk	Chief Executive, Tonga Power Limited, Nuku'alofa	
2.	Lano Fonua	Liaison Officer, Tonga Power Limited, Nuku'alofa	
3.	Seini Fotu	Conservation Officer -Biodiversity, Department of Environment, Ministry of Environment and Climate Change, Government of Tonga, Nuku'alofa	
4.	Richard 'Atelea Kantoke	GIS Specialist, GIS Unit, Ministry of Lands, Surveys and Natural Resources, Government of Tonga, Nuku'alofa	
5.	Makameone	Senior GIS Technician, GIS Unit, Ministry of Lands, Surveys and Natural Resources, Government of Tonga, Nuku'alofa	
6.	Warrick Dea	Land Registration Officer, Ministry of Lands, Surveys, and Natural Resource, Government of Tonga, Nuku'alofa	
HA'APAI GROUP			
7.	Viliami Latu	Representative, Governor's Office, Ha'apai	
8.	Samuela Fakatou	Sub-treasurer, Finance Department, Ha'apai	
9.	Simote Mahe	Lands Officer, Department of Lands and Survey, Ha'apai	
10.	Taufa Vaka	Manager, Tonga Power Limited, Ha'apai	
11.	Taniela Latu'ila	Technician, Ha'apai Power Station, Tonga Power Limited, Ha'apai	
12.		District Officer, Fao Island	
13.	Women Groups (3)	Ha'apai Island and Fao Island	
14	'Otolose Pau'u	In-charge of Nomuka Electricity Committee, Nomuka Island	

15.	Fonia Kanongata'a	In-charge of Ha'afeva Electricity Committee, Ha'afeva Island	
16.	'Alekisanita Leao	In-charge of 'Uiha Electricity Committee, 'Uiha Island	
17.	Smith Tutu'ila	Retired Technician, 'Uiha Electricity Committee, 'Uiha Island	
18.	Tai Siope	In-charge of Ha'ano Electricity Committee, Haano Island	
NIUAS GROUP			
19.		Government Representative, Niuatoputapu Island	5 persons
20.		Government Representative, Niuafo'ou Island	4 persons

Table 9: Summary of Stakeholder/ Community Consultation Undertaken During Visits of Sample Sites

Date / Venue / No. of participants	Issues discussed / remarks[10]
29 June 2012/ Government Office cum School Complex, Niuatoputopu Island / 30	Information about existing power generation system, status of land proposed for power plant, presence of environmental sensitive areas on and around the proposed site, existing capacity of electricity committee in managing environmental issues were assessed. It is informed by Government representative that the land proposed for solar power plant belongs to the Government (King). Project proponent can take this land on lease for the power plant. Local community leaders informed that there are no environmental sensitive areas in and around the proposed site and land use is agricultural. Local people (keeper of the land) growing seasonal crops on the proposed land without any formal lease. Chairmen of the existing electricity committee informed that there is a need of capacity building in managing the solar home systems.
30 June 2012/ Hihifo Church Complex, Niuafo'ou Island / Government representative and women groups' groups (45 participants from various agenices)	Discussions were held together with technical and social team to inform communities about the proposed project and understand their concerns, if any. Communities were informed about the benefits both socio-economic as well as environmental benefits of the project. All the participants consulted fully support the project. Women groups recommended need for the street lights and other community facilities. Present of environmental sensitive areas were discussed with the Agriculture Officer of the Niuafo'ou Island and he informed that there are no such area on the Island.
6 July 2012/ Ministry of Lands. Surveys, and Natural Resources /02	Details of the land use in and around the sites proposed for the Solar Power Plants in nine outer islands were obtained including land maps and lease arrangement of the existing diesel power plants were discussed. Requirements for land for new solar power plants and procedure to acquire land were discussed. Land Registration Officer informed that all land should be leased by the project proponent as per exiting law. Detailed procedure for the land acquisition / leasing was collected from the officer.
16 April 2012/ then Ministry of Environment and	Scope of proposed project, national policy and regulatory framework as well as requirements for permits and EIA approval were discussed with officials from MECC.

[10] Queries raised by people were answered to their satisfaction and it was assured that their concerns will be addressed in the process of project design.

Date / Venue / No. of participants	Issues discussed / remarks[10]
Climate Change /02	

98. Local communities and community leaders are well aware of and fully support the proposed Project, as the installation of solar power plants and SHSs will bring benefits to the Islands in terms of improved and sustainable electricity supply, improve the overall economy situation by saving in cost of imported diesel and some employment opportunities. Appendix 2 shows the photographic record of the consultations undertaken during preparation of the IEE.

99. Further consultations were again held in the proposed communities in 2016 for detailed design to confirm that communities remained fully aware and were committed to the project and again communities and community leaders fully supported the proposed project.

2. Information Disclosure

100. All environmental documents are subject to public disclosure, and therefore will be made available to the public. The IEE will be disclosed on ADB's website upon receipt as per ADB's New Public Communications Policy (PCP) 2011. The EA through IA will ensure that meaningful public consultations continue employing the community consultation plan particularly with project affected persons.

H. GRIEVANCE REDRESS MECHANISM

1. Grievance Redress Mechanism

101. In order to receive and facilitate the resolution of affected peoples' concerns, complaints, and grievances about the project's environmental performance an Environmental Grievance Redress Mechanism (GRM) is proposed for the project. When and where the need arises, this mechanism will be used for addressing any complaints that may arise during the implementation and operation of the Project. The grievance mechanism is scaled to the risks and adverse impacts of the Project. It addresses affected people's concerns and complaints promptly, using an understandable and transparent process that is gender responsive, culturally appropriate, and readily accessible to all segments of the affected people at no costs and without retribution. The mechanism is not impeding access to the Tonga's judicial or administrative remedies. EA through IA will appropriately inform the affected people about the mechanism before start of commencement of any civil works.

2. Grievance Focal Points, Complaints Reporting, Recording and Monitoring

102. The process for solving environmental complaints that may arise in the Project is the Grievance Redress Mechanism, which will be established at project level, the process is described below:

103. Environment complaints will be received through the Grievance Focal Point (GFP), these will be designated personnel from within the community who will be responsible for receiving the environmental complaints. The Contractor will record the complaint in the onsite Environmental Complaints Register (ECR) in the presence of the GFP.

104. The GFP will discuss the complaint with the Contractor and have it resolved.

105. If the Contractor does not resolve the complaint within one week, then the GFP will bring the complaint to the attention of the PMC Safeguard Specialist. The PMC Safeguard Specialist will then be responsible for coordinating with the Contractor in solving the issue.

106. If the Complaint is not resolved within 2 weeks the GFP will present the complaint to the Grievance Redress Committee (GRC). The GRC will be comprised of designated officials from the following organizations: Contractor's Environment Specialist, PMC Safeguard Specialist, GFP, Island Level representative, and a representative from IA.

107. The GRC will have to resolve the complaint within a period of 2 weeks and the resolved complaint will have to be communicated back to the community. The Contractor will then record the complaint as resolved and closed in the Environmental Complaints Register.

108. In parallel to the ECR placed with the Contractor, each GFP will maintain a record of the complaints received and will follow up on their rapid resolution.

109. EA through IA will also keep track of the status of all complaints through the Monthly Environmental Monitoring Report submitted by the Contractor to the PMC, and will ensure that they are resolved in a timely manner. Figure 2 shows that Grievance Redress Mechanism.

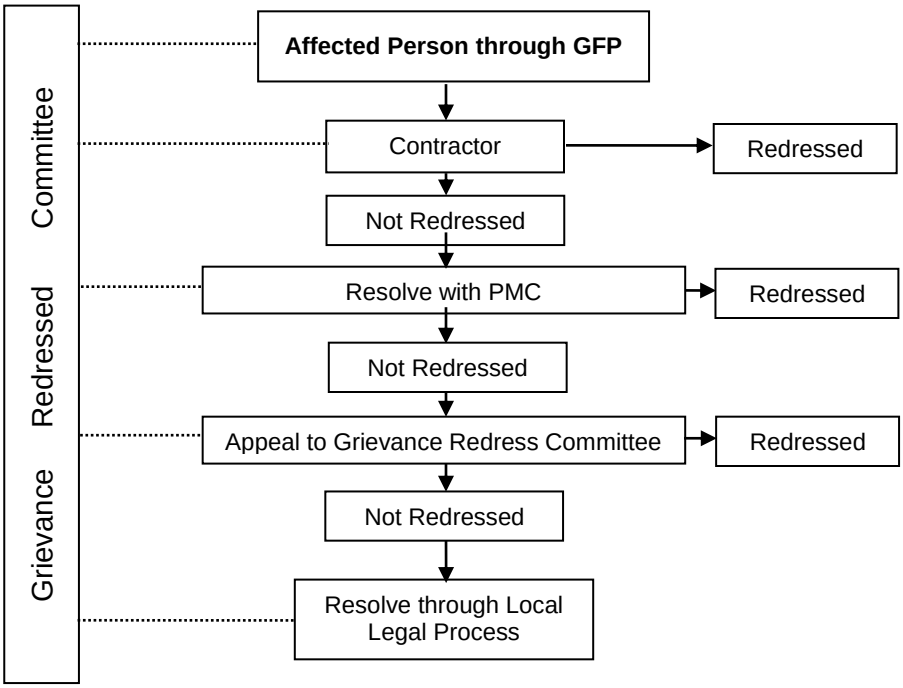


Figure 2: Grievance Redress Mechanism

I. ENVIRONMENTAL MANAGEMENT PLAN

1. Mitigation Measures

110. The major adverse effects of construction stage are change in topography, visual impacts, increased traffic, ground disturbance and health and safety of workers. The environmental effects during operation are minor. If the increased traffic causes an issue with local residents, a scheduled time for shipments to and from the wharf can be created. The preferred foundation design of floating concrete pads is being proposed because it uses local materials and limits the ground disturbance. Provisions of adequate health and safety measures will control adverse health impacts and will ensure safety of the workers and communities. To minimize climate change impacts, the project will provide solar PV plants with resilience to climate change through compact and preassembled systems resistant to marine environments.

111. The cutting of trees and clearing of the top soil will have a definite impact on the vegetative site in appearance and habitat. The Project will attempt to limit the amount of organic material removed from the site, limiting the construction environmental impact. Any organic material removed from the surface will remain on site and be placed in the southeast corner of the property. Used batteries will be sent to authorize dealers for disposal. An environmental management plan showing the stage-wise potential impacts and proposed mitigation measures and responsible agency has been prepared in a matrix form and presented Table 10.

2. Monitoring and Reporting

112. Throughout implementation of the Project, the government and ADB will monitor the implementation progress and impacts of the Project. Overall, the EMP will be implemented by the executing agency through project implementation. In consultation with executing agency and ADB, the implementing agency will establish a system for preparing quarterly reports on safeguards performance monitoring, issues resolution, and corrective action plans.

113. The EMP will be part of the overall project monitoring and supervision, and will be implemented by the project management consultant (PMC) with oversight from the implementing agency. Progress on the preparation and implementation of an EMP will be included in the periodic project progress reports. Specific monitoring activities defined in the IEE and EMP will be carried out by engineering, procurement and construction (EPC) contractor and supervised by PMC and monitored by implementing agency. The executing agency will submit semi-annual environmental monitoring reports on EMP implementation for ADB's review.

114. In general, the overall extent of monitoring activities, including their scope and periodicity, should be commensurate with the project's risks and impacts. The implementing agency with the support from PMC is required to implement safeguard measures and relevant safeguard plans, as provided in the Project agreement.

115. Table 11 provides the environmental monitoring plan outlining parameters and frequency of monitoring.

Table 10: Environmental Management Plan

Project activity /stage	Potential impact	Proposed mitigation measure	Mitigation Cost	Institutional responsibility	Implementation schedule
A. Pre-construction					
Location	Encroachment into precious ecological and protected areas	Careful site selection to avoid encroachment of ecological sensitive areas including protected areas and areas of historical and cultural importance.	Project Cost	EA, IA through PMC	Detailed design
	Topography and visual impacts	Careful selection of site away from inhabited areas.	Project Cost	EA, IA through PMC	Detailed design
Project design	Negligence of environmental mitigation measures	Ensure that EMP is included in the bidding documents	Project cost	EA, IA through PMC	Tendering process
Climate Change	Risk of climate change	Provided solar PV plants with resilience to climate change through compact and preassembled systems resistant to marine environments.	Project cost	EA, IA through PMC	Detailed design
Equipment design and selection	Release of toxic chemicals and gases in receptors (air, water, land)	PCBs should not be used in transformers and other project facilities or equipment.	Project Cost	EA, IA through PMC	Tendering process
Involuntary resettlement or land acquisition	Social inequities	Compensation paid for temporary/ permanent loss of productive land as per entitlement framework and its process, if necessary.	Project Cost	EA, IA through PMC	Prior to commencement of civil work
Site clearing	Cutting of trees about 60 coconut trees and removal of vegetative cover	Compensatory afforestation as per government policies.	To be included in EPC Contractor cost.	EPC Contractor & PMC	Preparation of site prior to civil work
B. Construction					
Installation of Solar Panels and Storage of construction material and movement of vehicles	Topography and visual impacts	Selection of suitable storage areas for materials or plant with minimum visibility from residences and roads with screening where necessary.	To be included in EPC Contractor cost.	EPC Contractor & PMC	During civil work construction
Construction debris and wastewater	Pollution of water bodies due to disposal of waste	Provision of adequate drainage system including controlled collection and	To be included in	EPC Contractor & PMC	During civil work construction

Project activity /stage	Potential impact	Proposed mitigation measure	Mitigation Cost	Institutional responsibility	Implementation schedule
	material into water bodies.	preliminary treatment of wastewater.	EPC Contractor cost.		
Movement and operation of construction equipments	Noise generated from operation and movement of trucks and cranes	- Construction techniques and machinery selection seeking to minimize ground disturbance. - Machines noise level not more than 85 dB(A) at avg. 8 hr	To be included in EPC Contractor cost.	EPC Contractor (preparation and implementation) PMC (approval)	During land clearing and civil work construction
	Visual impacts from storage and haulage of construction material	Selection of suitable storage areas for materials or plant with minimum visibility from residences and roads with screening where necessary.	To be included in EPC Contractor cost.	EPC Contractor (preparation and implementation) PMC (approval)	During land clearing and civil work construction
Transportation of equipments and construction material.	Dust and particulate emission from movement of construction vehicles transporting equipments and construction material.	- Truck wheels cleaning - Road cleaning and watering	To be included in EPC Contractor cost.	EPC Contractor	During land clearing and civil work construction
Cutting of trees and clearing / trimming of trees and vegetative cover	Loss of trees and vegetative covers	- Removal of only those trees which are necessary. - Transplanting of trees if this is possible. - Prohibiting illegal feeling of trees by construction workers for domestic uses.	To be included in EPC Contractor cost.	EPC Contractor	During land clearing and civil work construction
Occupational Health and Safety	Impacts on workers health due to working with trucks and piling cranes, building construction, high voltage work, as well as safety of the community	- Provide Safety Manual - Provide Safety Plan - Supervision and Inspection - Protection gears - Installation of security fencing at solar plant sites and community safety signs and temporary barriers on mini grid trenching and routing.	To be included in EPC Contractor cost.	EPC Contractor (preparation and implementation) PMC (approval)	During land clearing and civil work construction
C. Operation and Maintenance					
Reflection and glare from Solar arrays	Visual impacts and glare	Design of solar arrays to absorb incident solar radiation. Proper orientation of arrays.	To be included in EPC Contractor	EPC Contractor	During operation and maintenance

Project activity /stage	Potential impact	Proposed mitigation measure	Mitigation Cost	Institutional responsibility	Implementation schedule
			O&M cost.		
Cleaning of Solar Panels	Wastewater Generated from cleaning of solar panels	Provision and cleaning of adequate drainage system.	To be included in EPC Contractor O&M cost.	EPC Contractor	During operation and maintenance
Natural Disasters	Damage from hurricanes and cyclones.	Design of foundations and racking system to withstand powerful cyclones and hurricanes, which will reduce any potential hazard of panels being lifted up and blown onto adjacent properties.	To be included in EPC Contractor O&M cost.	EPC Contractor	During operation and maintenance
Health and Safety	Health hazards in the event of accidents (cyclones, hurricanes) and emergency	Emergency Response Plan Health and Safety Plan	O&M Cost	EPC Contractor	Emergency during operation and maintenance
Disposal and management of batteries	Impacts from used batteries and panels	Adequate storage and handling system.	O&M Cost	EPC Contractor	During operation and maintenance
D. Decommissioning					
Dismantling of PV panels	Impacts from disposal of PV panels and batteries.	Contract agreements with PV panel suppliers for dismantling and disposal of panels and batteries.	Maintenance cost	EA & IA	Post operation

Table 11: Environmental Monitoring Plan

Environmental Features	Aspect to be Monitored	Time and Frequency of Monitoring	Location	Monitoring Cost	Responsible party (Implementation/ Supervision)
Construction stage					
Noise	Noise levels in dB(A)	At the start of concerned activities. At least 3 times during construction period.	- Project site - Front main road	2000*3 =6000	EPC Contractor & PMC
Air	Emission of dust and particulate matter	At the start of concerned activities. At least 3 times during construction period.	- Project site - Front main road	3000*3=9000	EPC Contractor & PMC

Environmental Features	Aspect to be Monitored	Time and Frequency of Monitoring	Location	Monitoring Cost	Responsible party (Implementation/ Supervision)
Physical Works Progress	As specified in contractors' plan	Project site Monthly	Project Site	Project Cost	EPC Contractor & PMC
Occupational Health and Safety	As specified in project OHS plan prepared by Contractor	Project site Weekly	Project Site	Project Cost	EPC Contractor & PMC
Operation Stage					
Occupational Health and Safety	As specified in project OHS plan prepared by Contractor	Project site Weekly	Project Site	Project Cost	EPC Contractor & PMC

Note: This monitoring plan is prepared for one site. Same monitoring plan will be implemented on other solar power plant sites.

3. Implementation Arrangement

116. The main institutions that will be involved in environmental management activities are the Ministry of Finance and National Planning (MFNP) as the executing agency (EA) of the Project, the Ministry of Environment, Information, Disaster, Energy and Climate Change (MEIDECC) through its Energy Implementation Unit as implementing agency (IA), project management consultant (PMC), and EPC contractor. The IEE will be submitted to MEIDECC for review and approval as per the EIA Act.

117. EA has overall responsibility for all aspects of the Project. IA through support of PMC will be responsible for day to day management of technical aspects of the Project. PMC will be responsible to update EMP followed by design phase and he will also be responsible to approving contractors' management plan, emergency plan, and occupational health and safety plan as well as to ensure on-ground implementation of the environmental management plan. PMC will provide training to IA staff on managing the environmental issued associated with project. EA will ensure the environmental management and monitoring budgets are available and utilized as necessary for timely implementation of EMP. Cost of capacity building is included in the capacity building component of the Project.

118. The Contractor will be required to have one staff with experience in environmental management. This staff will be responsible for preparing plans such as emergency preparedness plan; occupational health and safety plan, energy day to day implementation of EMP.

4. Environmental Management Budget and Resources

119. The cost of all compensation and rehabilitations works will be an integrated part of the overall Project cost, which will be borne by the Project. The preliminary estimated cost of the environmental management including implementation and monitoring is US$ 80,000 as detailed in Table 10 and Table 11.

J. CONCLUSION AND RECOMMENDATION

120. The environmental impacts associated with proposed installation of 450 kWpeak solar power plants have been assessed and described in the previous sections of this document. The findings establish that the project sites are not located in a sensitive ecosystem, and have no historical and cultural value. This nature of the project site coupled with the clean nature of solar power generation ensures that the Project will not cause any significant, lasting environmental impacts during construction, operation and decommissioning. Only minor and transient environmental disturbances would be experienced at the project sites during construction and operation, and they will be minimized through implementation of the EMP. The EMP will be updated in case of any change in project design followed by detailed design stage. It is then recommended that the Project be considered environmentally feasible, and that this IEE is adequate to justify environmental and social feasibility of the Project. There is no need for further analysis and this environmental assessment of the Project is considered complete.

121. It is concluded that the Project has no further environmental issues to follow up, and the adequate measures listed in IEE and EMP, when implemented, will fully comply with ADB's SPS 2009 and Government requirements.

APPENDIX 1: LOCATIONS MAPS OF PROJECT SITES

Figure 1a: Location of Nomuka Solar Power Plant on the Island Map

Map 1a: Map of Nomuka Island showing the proposed site

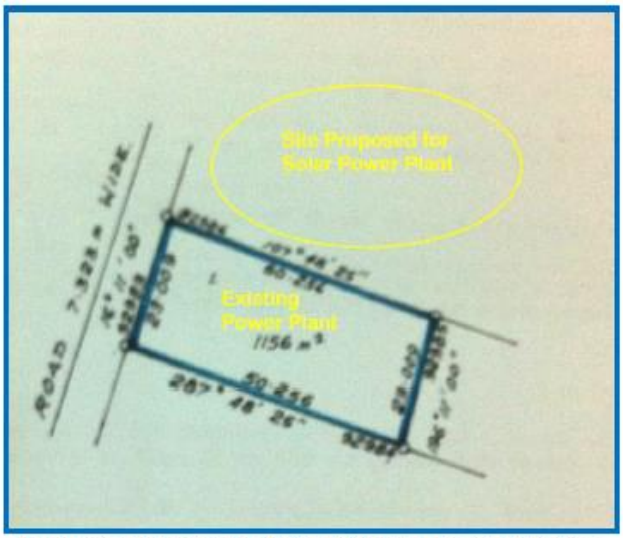


Image 1a: Location of the Proposed site for Solar Power Plant

Image 2a: View of Proposed site from beside existing Generation Plant

Figure 1b: Location of Ha'afeva Solar Power Plant on the Island Map

Map 1b: Map of Ha'afeva Island showing the proposed site

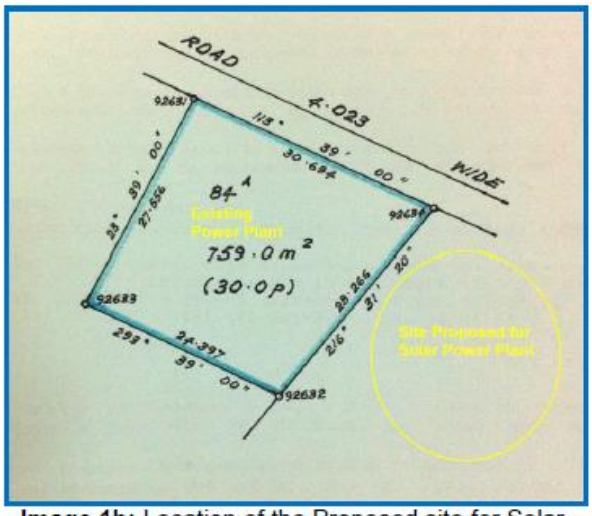


Image 1b: Location of the Proposed site for Solar Power Plant

Image 2b: View of Proposed site beside existing Generation Plant

Figure 1c: Location of ‘Uiha Solar Power Plant on the Island Map

Map 1c: Map of ‘Uiha Island showing the proposed site

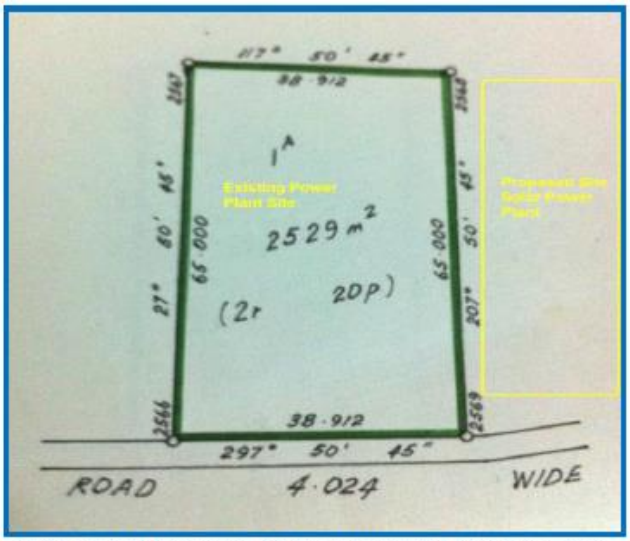


Image 1c: Location of the Proposed site for Solar Power Plant

Image 2c: View of Proposed site from existing Generation Plant

Figure 1d: Location of Ha'ano Solar Power Plant on the Island Map

Map 1d: Map of Ha'ano Island showing the proposed site

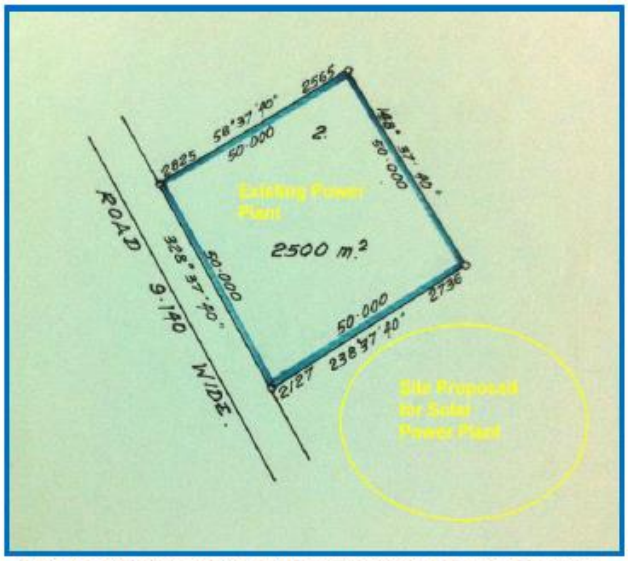
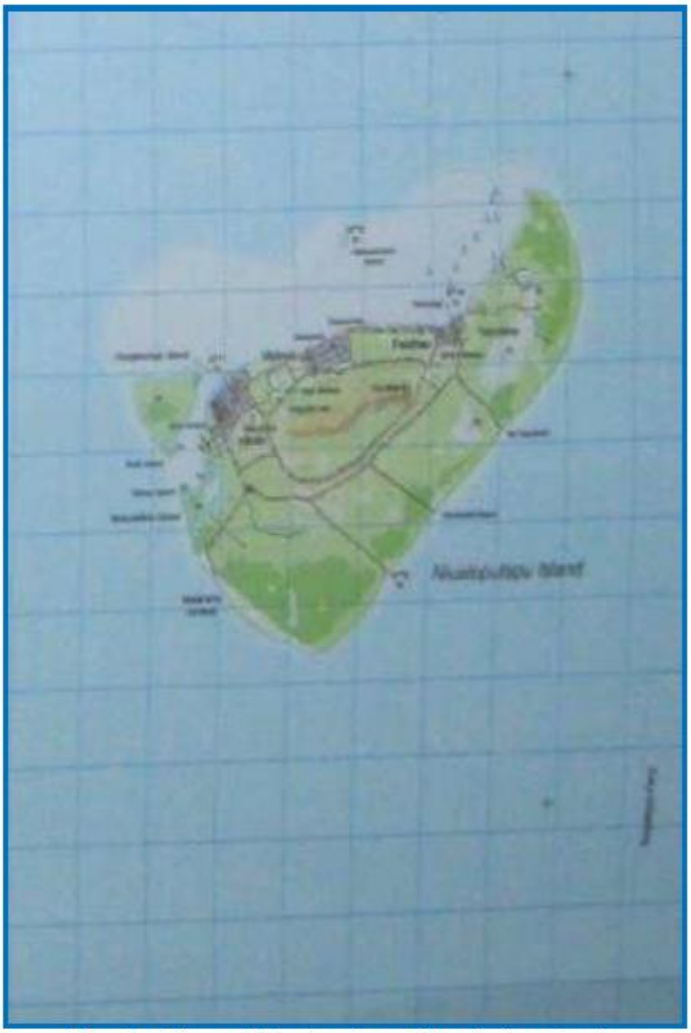


Image 1d: Location of the Proposed Solar Power Plant

Image 2d: View of Proposed site from Existing Generation Plant

Figure 1e: Location of Niuatoputapu Solar Power Plant on the Island Map



Map 1e: Map of Niuatoputapu Island showing the proposed site

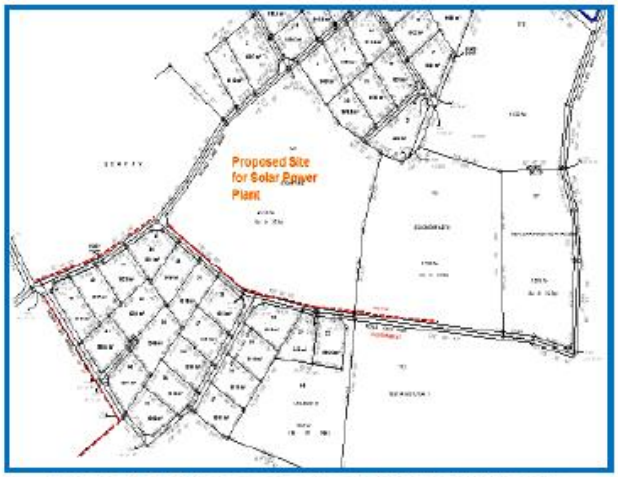
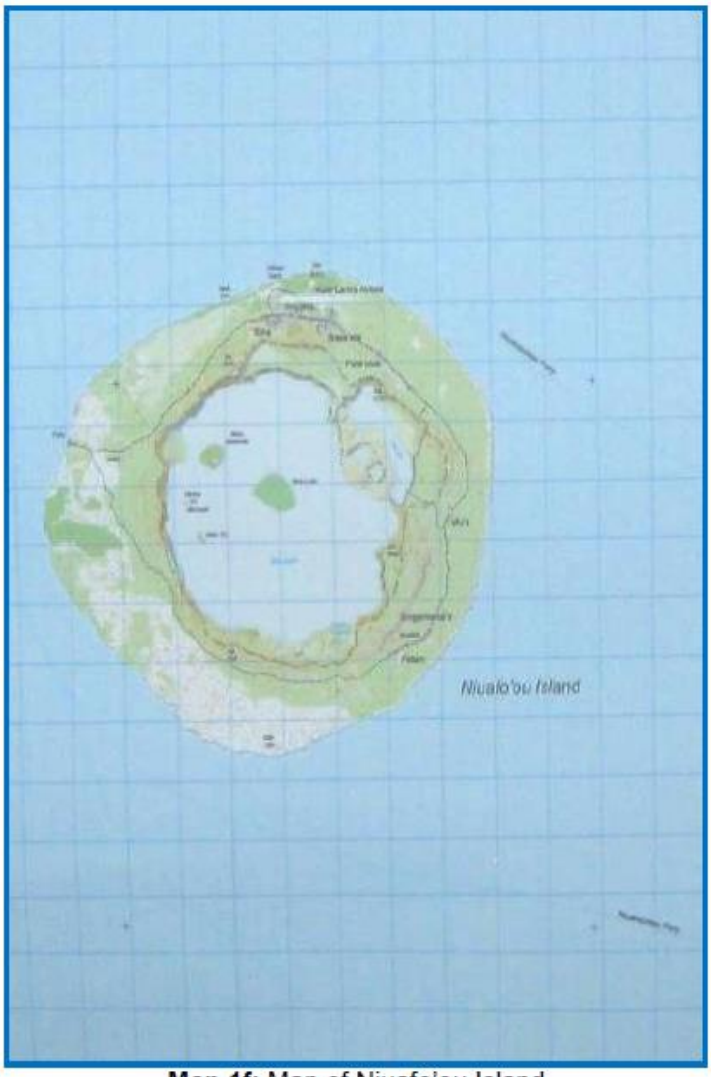


Image 1e: Proposed site on Hihifo town map (Niuatoputapu Solar Power Plant

Image 2e: View of Proposed site from TPL Generation Plant

Figure 1f: Location of Niuafo'ou Solar Home System on the Island Map



Map 1f: Map of Niuafo'ou Island

Image 1f: Typical Solar Home Systems in Niuafo'ou installed with the support of NZAID

Image 2f: Solar Panels Installed for Telecommunication Centre in Niuafo'ou

APPENDIX 2: PHOTOGRAPHS (FIELD AND CONSULTATIONS)

A. Photographs (site and consultations)

Photo 1: Existing Diesel Generation Station at Ha'afeva

Photo 2: Existing Diesel Generators at Ha'afeva Power Plant

Photo 3: On-site discussion with Power Plant Technicians. Ha'afeva Island

Photo 4: Consultation meeting with Government Representatives and Community Groups, Ha'afeva Island, Ha'apai

Photo 5: Consultation with women group in Ha'afeva Island, Ha'apai

Photo 6: Consultation Meeting with Government Representatives and women group in 'Uiha Island, Ha'apai

Photo 7: Consultation Meeting with Government Representatives and women group in Ha'ano Island, Ha'apai

Photo 8: Consultation Meeting with Government Representatives and women group in Niuatoputapu Island

Photo 9: On-site discussion with Town Officer and Government Representative, Niuatoputapu Island

Photo 10: Consultation meeting with officials from Meteorological Centre, Hihifo, Niuatoputopu Island

Photo 11: Discussion with Town Officers in Niuafo'ou Island

Photo 12: Consultation Meeting with women group in 'Niuafo'ou Island

APPENDIX 3: REA CHECKLLIST

SOLAR ENERGY

Rapid Environmental Assessment (REA) Checklist

Instructions:

(i) The project team completes this checklist to support the environmental classification of a project. It is to be attached to the environmental categorization form and submitted to Environment and Safeguards Division (RSES) for endorsement by Director, RSES and for approval by the Chief Compliance Officer.

(ii) This checklist focuses on environmental issues and concerns. To ensure that social dimensions are adequately considered, refer also to ADB's (a) checklists on involuntary resettlement and Indigenous Peoples; (b) poverty reduction handbook; (c) staff guide to consultation and participation; and (d) gender checklists.

(iii) Answer the questions assuming the "without mitigation" case. The purpose is to identify potential impacts. Use the "remarks" section to discuss any anticipated mitigation measures.

Country/Project Title: Kingdom of Tonga / Outer Island Renewable Energy Project – Phase 2 (450 KWpeak Solar Power Generation in Outer Islands of Ha'apai and Niuas)

Sector Division: PARD

Screening Questions	Yes	No	Remarks
A. Project Siting Is the Project area adjacent to or within any of the following environmentally sensitive areas?			The proposed sites are located adjacent to the existing diesel power generation units at Nomuka, Ha'afeva, 'Uiha and Ha'ano islands of Ha'apai and a new plant site in Niuatoputapu. The project will be implemented on a combined land area of 0.45 hectares which in non-residential land. There are no environmental sensitive areas reported in the project area.
▪ Physical cultural heritage site		X	
▪ Located in or near to legally protected area		X	
▪ Located in or near to special habitats for biodiversity (modified or natural habitats)		X	
▪ Wetland		X	Coastline if about 1-2 km away from the proposed site.
▪ Mangrove		X	Mangroves along the coastline which is about 2 km away from the proposed site.

Screening Questions	Yes	No	Remarks
▪ Estuarine		X	
▪ Offshore (marine)		X	Coastline if about 2 km away from the proposed site.
B. Potential Environmental Impacts Will the Project cause…			
▪ large scale land disturbance and land use impacts specially due to diversion of productive lands?	X		Possible. The project will change land use because of installation of solar panels on 0.45 hectares of land which currently has coconut trees and vegetative cover.
▪ involuntary resettlement of people? (physical displacement and/or economic displacement)		X	
▪ disproportionate impacts on the poor, women and children, Indigenous Peoples or other vulnerable groups?		X	
▪ noise, vibration and dust from construction activities?	X		Minor short-term impact due to noise generated from construction activities is expected. Suitable mitigation measures are included in the EMP.
▪ an increase in local traffic during construction?	X		Expected. Transportation of construction equipments and construction material will increase the local traffic during construction. Mitigation measures are included in EMP.
▪ environmental disturbances such as soil erosion, land contamination, water quality deterioration, air pollution, noise and vibrations during construction phase?	X		Short-term disturbance due to noise from construction activities.
• aesthetic degradation and property value loss due to establishment of plant and ancillary facilities?		X	
▪ changes in flow regimes of the water intake from surface water or underground wells due to abstraction for cooling purposes?		X	
▪ pollution of water bodies and aquatic ecosystem from wastewater treatment plant, from cooling towers, and wash-water during operation?		X	Not expected. Wastewater generated will be collected and disposed off after preliminary treatment.
▪ a threat to bird or bat life from colliding with the project facilities and/or being burned by concentrated solar rays?		X	
▪ industrial liquid (dielectric fluids, cleaning agents, and solvents) and solid wastes (lubricating oils, compressor oils, and hydraulic fluids) generated during construction and operations likely to pollute land and water resources?		X	

Screening Questions	Yes	No	Remarks
▪ Soil/water contamination due to use of hazardous materials or disposal of broken or damaged solar cells (photovoltaic technologies contain small amounts of cadmium, selenium and arsenic) during installation, operation and decommissioning?		X	Possible. Waste generated during construction will be handled of carefully.
▪ noise disturbance during operation due to the proximity of settlements or other features?		X	
▪ visual impacts due to reflection from solar collector arrays resulting in glint or glare?		X	Not expected. Solar panels will be installed with a tilt angel to avoid glare and reflection.
▪ large population influx during project construction and operation that causes increased burden on social infrastructure and services (such as water supply and sanitation systems)?		X	Small scale construction.
▪ social conflicts between local laborers and those from outside the area?		X	Small scale construction. Local labour employment.
▪ risks and vulnerabilities related to occupational health and safety due to physical, chemical, biological, and radiological hazards during construction, installation, operation, and decommission?		X	
▪ risks to community health and safety due to the transport, storage, and use and/or disposal of materials and wastes such as explosives, fuel and other chemicals during construction, and operation?		X	
▪ community safety risks due to both accidental and natural causes, especially where the structural elements or components of the project are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning?		X	Controlled access will be provided.

Climate Change and Disaster Risk Questions The following questions are not for environmental categorization purposes. However, the questions are included in this checklist to help the project team identify the potential climate and disaster risks of the project.	Yes	No	Remarks
▪ Is the Project area subject to hazards such as earthquakes, floods, landslides, tropical cyclone winds, storm surges, tsunami or volcanic eruptions and climate changes (see Appendix I)?		X	
▪ Could changes in precipitation, temperature, salinity, or extreme events over the Project lifespan affect its sustainability or cost?	X		Change in solar radiation will affect the operation of the solar power plant.

▪ Are there any demographic or socio-economic aspects of the Project area that are already vulnerable (e.g. high incidence of marginalized populations, rural-urban migrants, illegal settlements, ethnic minorities, women or children)?		X	
▪ Could the Project potentially increase the climate or disaster vulnerability of the surrounding area (e.g., increasing traffic or housing in areas that will be more prone to flooding, by encouraging settlement in earthquake zones)?	X		

APPENDIX 4: SUMMARY OF IUCN PROTECTED AREAS CATEGORIES SYSTEM

IUCN Category	Categorization System[11]
IA - Strictly Protected Areas	Category IA are strictly protected areas set aside to protect biodiversity and also possibly geological/geomorphical features, where human visitation, use and impacts are strictly controlled and limited to ensure protection of the conservation values
IB - Protected Areas	Category IB protected areas are usually large unmodified or slightly modified areas, retaining their natural character and influence without permanent or significant human habitation, which are protected and managed so as to preserve their natural condition.
II - National Parks	Category II protected areas are large natural or near natural areas set aside to protect large-scale ecological processes, along with the complement of species and ecosystems characteristic of the area, which also provide a foundation for environmentally and culturally compatible, spiritual, scientific, educational, recreational, and visitor opportunities.
III-Natural Monument or Feature	Category III protected areas are set aside to protect a specific natural monument, which can be a landform, sea mount, submarine cavern, geological feature such as a cave or even a living feature such as an ancient grove. They are generally quite small protected areas and often have high visitor value.
IV - Habitat/ Species Management Area	Category IV protected areas aim to protect particular species or habitats and management reflects this priority. Many Category IV protected areas will need regular, active interventions to address the requirements of particular species or to maintain habitats, but this is not a requirement of the category.
V Protected Landscape/ Seascape	A protected area where the interaction of people and nature over time has produced an area of distinct charcter with significant, ecological, biological, cultural and scenic value: and where safeguarding the integrity of this interaction is vital to protecting and sustaining the area and its associated nature conservation and other values.
VI Protected area with sustainable use of natural resources	Category VI protected areas conserve ecosystems and habitats together with associated cultural values and traditional natural resource management systems. They are generally large, with most of the area in a natural condition, where a proportion is under sustainable natural resource management and where low-level non-industrial use of natural resources compatible with nature conservation is seen as one of the main aims of the area

[11] Source: UNCN (http://www.iucn.org/about/work/programmes/pa/pa_products/wcpa_categories/)