Initial Environmental Examination

Project No. 49450-012
March 2018

TON: Renewable Energy Project

Prepared by
Tonga Power Limited &
Ministry for Meteorology, Energy, Information, Disaster Management, Environment, and Climate Change
for
Ministry of Finance and National Planning & Asian Development Bank

TABLE OF CONTENTS

LIST OF ABBREVIATIONS

ADB	-	Asian Development Bank
BESS	-	battery energy storage system
CCP	-	communications and consultation plan (of the project)
CEMP	-	construction environmental management plan (of the contractor)
CLO	-	Community Liaison Officer (of the contractor)
COEP	-	Codes of Environmental Practice
CO_2	-	carbon dioxide
CSS	-	country safeguards system
DOE	-	Department of Environment (within MEIDECC)
EHSG	-	Environmental Health and Safety Guidelines (of the World Bank)
EHSO	-	Environmental Health and Safety Officer (of the contractor)
EIA	-	environmental impact assessment
EMP	-	environmental management plan
ESU	-	Environment Social Unit (in the PMU)
GCF	-	Green Climate Fund
GDP	-	gross domestic product
GFP	-	grievance focal points
GOT	-	Government of Tonga
GRM	-	grievance redress mechanism
HSP	-	health and safety plan (part of CEMP)
IEE	-	initial environmental examination
IPP	-	independent power producer
JICA	-	Japanese International Cooperation Agency
MFNP	-	Ministry of Finance and National Planning
MEIDECC	-	Ministry of Meteorology, Energy, Information, Disaster Management, Environment, Climate Change and Communications
NDC	-	nationally determined contributions (renewable energy targets)
OIREP	-	Outer Island Renewable Energy Project
PCCSP	-	Pacific Climate Change Science Program
PMU	-	Project Management Unit
PPE	-	personal protective equipment
PV	-	photovoltaic
QPR	-	quarterly progress report (of the project)
SHS	-	solar home system
SPS	-	Safeguard Policy Statement 2009
TERM	-	Tonga Energy Road Map 2010 – 2020
TOP	-	Tongan pa'anga (see currency equivalents below)
TPL	-	Tonga Power Limited

MEASURES AND WEIGHTS

m = meter
m^2 = square meter
km = kilometer
km^2 = square kilometer
ha = hectare
MW = megawatt
MWh = megawatt hours

CURRENCY EQUIVALENTS

(as of 15 March 2018)

Currency Unit	=	Tongan pa'anga (TOP)
TOP1.00	=	US$ 0.447
US$1.00	=	TOP 2.179

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., FY2017 ends on 31 December 2017.

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

EXECUTIVE SUMMARY

1. **Background**. Historically, Tonga has almost exclusively relied on the import of diesel for generating its electricity needs. An estimated 13 million liters of diesel were consumed each year to generate over 95% of the grid-supplied electricity. This cost burden (equivalent to approximately 10% of total gross domestic product), along with vulnerability to price fluctuations and increased consciousness of environmental impacts; led to the development of the Tonga Energy Road Map 2010 – 2020 (TERM). This established the Government of Tonga (GOT) targets to generate 50% of all electricity from renewables by 2020.

2. **The project**. The Asian Development Bank (ADB) is supporting the GOT to meet its ambitious renewable energy targets as set out in the TERM. The proposed Tonga Renewable Energy Project (the project) builds on achievements and lessons learned through earlier investments in the renewable energy sector, and provides the necessary scale to transition Tonga to a low carbon future. Increased energy security and resilience, improved balance of payments, and increased energy access and affordability will benefit the people of Tonga.

3. It is estimated that the project will lead to 13,616 tonnes of reduced CO_2 emissions per year, or 340,395 tonnes over the project's 25-year lifespan. Approximately 7 million liters of fuel will be saved per annum. Currently the contribution of renewables to power generation in Tonga is 10%. The project will provide enabling technical solutions (e.g. battery energy storage system (BESS) etc) and capacity building for promoting more private sector investments on renewables, which will help Tonga meet its 50% renewable energy target by 2020 and build momentum to reach 70% by 2030. The impact of the project will be improved energy security and climate resilience through a transformational shift away from the traditional reliance on fossil fuels toward a greater emphasis on climate-resilient renewable energy systems coupled with BESS. The outcome will be increased generation of lower-cost and cleaner energy.

4. The project will provide approximately 1.15 megawatt (MW) of renewable energy capacity in the outer islands, and almost 10.1 MW/22.2 megawatt hours (MWh) of storage (BESS) capacity on Tongatapu and outer islands. The estimated project cost is $53.2 million including counterpart contributions and grants from ADB, Green Climate Fund and Government of Australia. The project has four outputs:

- Output 1: BESS on Tongatapu - installing multiple units of BESS to complement the renewable energy systems;
- Output 2: grid-connected renewable energy generation on 'Eua and Vava'u islands - installing the on-grid solar PV plants coupled with small BESS on 'Eua and Vava'u;
- Output 3: renewable-based hybrid systems and mini-grids on outer-islands - installing mini-grid renewable-based hybrid systems coupled with small-scale BESS in five outer islands; and
- Output 4: capacity building and project management support – (i) capacity development (assessing renewable energy technologies, setting tariffs for power purchase agreements); (ii) capacity development for implementing agencies to manage assets, undertake O&M and improve community engagement; (iii) support to project management in line with international standards and best-practices; and (iv) support to design, procurement and construction supervision as well as development of operation and maintenance manuals.

5. **Institutional arrangements**. The executing agency is the Ministry of Finance and National Planning (MFNP). The project implementing agencies will be Tonga Power Limited (TPL) for and the Ministry of Meteorology, Energy, Information, Disaster Management, Environment, Climate Change and Communications (MEIDECC) – Energy Department.

6. TPL is a government-owned, public enterprise under the oversight of the Ministry of Public Enterprises and the Cabinet. TPL has the concession for, and operates, four independent grids for on-grid electricity services on the main islands of Tongatapu (Tongatapu and Eua) and Vava'u and Ha'apai island groups, where it generates, distributes, and retails electricity, and provides O&M services. The MEIDECC Energy Department is the primary body responsible for policy formulation, as well as for implementation of rural electrification and demand management projects for off-grid electricity services. Both MEIDECC and TPL have significant experience through previous and ongoing projects financed by ADB and World Bank (and others).

7. A project management unit (PMU) established under the Outer Island Renewable Energy Project will continue with additional resources as required to deliver the project. Under the proposed project an environmental and social unit (ESU) will be established within the PMU. The ESU will comprise specialists from the supervision consultant and staff seconded from MEIDECC and/or TPL (or national consultants). The ESU will be responsible for implementing safeguards and ensuring compliance with all project agreements and covenants on behalf of the GOT.

8. **Environmental safeguards**. The project is prepared, and will be implemented, in such a way to comply with the environmental safeguard requirements of Safeguard Policy Statement 2009 (SPS). For screening the potential environmental impacts and the most sensitive components, the project is determined as category B for environment. The project components have been grouped into those proposed for Tongatapu, and those proposed for the outer islands and two initial environmental examinations (IEE) have been prepared. For completeness, the IEE considers the installation of solar plants and wind farms on Tongatapu, that will be financed by other parties and for which the project will provide BESS, as associated facilities. The IEEs also meet the requirements of the country safeguards system including Environmental Impact Assessment (EIA) Act 2003 and EIA Regulations 2010.

9. This IEE covers the works proposed for the islands of 'Eua, Vava'u and Niuafo'ou and four islands in the Ha'apai group. Detailed design for project components will be completed during implementation. This IEE and its environmental management plan (EMP) will be updated at that time. The updated IEE will be formatted as required and lodged with the accompanying fees as an application to the Department of Environment using EIA Regulations Form 3. The contractor awarded the civil works contract will prepare a site-specific construction EMP (CEMP) for each component. The CEMP will be reviewed and cleared by the ESU, and no objection issued by the Engineer before the contractor commences any works (including clearing and grubbing activities).

10. **Project sites**. All project components are located in sites that are modified environments (refer to Table ES.1). The solar farm extension at Vava'u is proposed for a site within an unused coconut plantation. At 'Eua, the extension is on largely cleared land adjacent to the current TPL lease area for the existing solar panel arrays and whilst there will be clearance on the land, the site does not contain significant habitat or ecological values. For the mini-grids proposed at three of the four islands in Ha'apai, the sites are vacant, grassy plots adjacent to the village areas while at Kotu, the site will require clearance of some vegetation including coconut trees, mango trees and pandanus grass. At Niuafo'ou, the solar farm, BESS and back-up generator will be located at the airport.

11. **Environmental impacts**. Pre-construction impacts relate mostly to siting of components, land acquisition and land use change. The project will require 2.71 hectares for the solar farm extensions. This will create land use change, with some land converted from potential residential or agricultural use to energy production. These impacts are outweighed by the higher economic return from renewable energy production, and in the case of the mini-grids, the benefit of increased access to renewable energy and power reliability and availability for village and island economic and social development.

12. Most environmental risks and impacts will occur during the construction stage, these will largely be site-specific, temporary and localized and can be managed and/or mitigated through implementation of measures identified in the project EMP. These risks include noise, dust generation, erosion, siltation and sediment laden run-off, health and safety impacts, traffic issues, and generation of waste materials. There are no identified risks during the operational phase of the solar farm extensions and BESS facilities. For the mini-grids, the key environmental risks are associated with the hybrid systems including noise emissions from the diesel generator, fuel spillage, and visual impact. The siting will maximize the buffer distance between the generator and the closest residences.

13. The project will not cause any significant or lasting adverse environmental impacts during operation. The project will produce significant environmental benefits including the reduction of CO_2 emissions, reduction of diesel fuel imports for 'Eua and Vava'u, reduced risk of groundwater contamination through diesel spills, and increased resilience to economic and climate change shocks through decreased reliance on fossil fuel energy. During decommissioning, the main environmental risks are associated with the end of life cycle for batteries and solar cells. Through careful design, including the choice of materials and design of closed loop maintenance and end of life systems, the project can ensure that there are no legacy waste materials in the future. For the mini-grids, these decisions are critical given that waste materials will be stored on remote islands. The project EMP requires proper handling and storage/disposal of spent batteries to ensure there is no residual environmental impact.

14. **Environmental management plan**. The EMP has been developed to outline the measures that are to be implemented to minimize adverse environmental impacts and serves as a guide for the contractor and the workforce on their roles and responsibilities concerning environmental management on-site and outlines the potential environmental impacts, their mitigation measures, roles and responsibilities and timescales. The project EMP identifies the mitigation measures, environmental monitoring and capacity development that are required to minimize the environmental impacts in the pre-construction, construction and operational phases of the project. The supervision consultant will be tasked to update the EMP based on detailed design and the contractor will be required to prepare the site-specific construction EMP (CEMP), submit the CEMP to the PMU for approval and then be responsible for implementing the approved CEMP. The CEMP will be based on the contractor's construction methodology, will be site-specific and will also cover materials sourcing, transportation, storage and disposal.

15. During the construction period, environmentally responsible construction practices and management of all activities including construction wastes will be essential. Implementation of internationally recognized good construction environmental practices form the basis of the EMP which covers issues such as erosion and sedimentation control, noise and air quality, materials sourcing and spoil management, minimization of land disturbance, and worker and community health and safety.

16. **Consultations and information disclosure**. During the preparation of this report, consultation was held to identify any concerns. No specific environmental issues were raised in community discussions. Local communities and community leaders support the Project, with the main point of discussion on power pricing. For the grid connected components in 'Eua and Vava'u, customers want to see increased renewable energy sources lead to reduced power prices to make a real impact on peoples' lives. In the stand alone mini-grid systems, there was extensive discussion on ability to pay, and the need to ensure that the power supply is reliable. Overwhelmingly, community members want to have the power supply, and believe they will find the resources to pay for their household power consumption.

17. **Grievance redress**. The project will establish a grievance redress mechanism (GRM) for any project implementation issues including safeguards. The GRM will be based on the procedures established under other projects and will include recourse to traditional systems for conflict resolution as required. The PMU and contractor(s) will each maintain a complaints registry that will record the complainant's name and contact details, the nature of the complaint, who received the complaint, action required to resolve the complaint (and at what level) and close-out date. The GRM will be subject to monitoring.

18. **Monitoring and reporting**. Monitoring requirements for the project are set out in the monitoring plan. The monitoring requirements are commensurate with the risks and impacts of the project. There is no need for additional baseline information and monitoring of implementation and effectiveness of the EMP will be based largely on observation.

19. Reporting will include: (i) monthly reporting from the contractor which will include summary of the daily and weekly compliance checks undertaken by the contractor's environmental, health and safety officer including grievances/complaints and any corrective action requests issued by the Engineer; (ii) quarterly progress reporting by the PMU which will include a section on safeguards (including project communications and grievance redress); and (iii) semi-annual safeguards monitoring reports by the PMU which will include summaries of the contractor's monthly reports, results of the regular monitoring (inspections and audits) undertaken by the PMU, results of the GRM, and training and capacity building activities.

20. **Conclusion**. The environmental impacts of the project will be site-specific, localized and largely temporary in nature during the construction phase. The impacts and risks can be readily managed and/or mitigated through implementation of the project EMP. Overall the project will contribute positively to sustainable development through improving capacity of TPL and MEIDECC to properly manage and maintain energy sector assets and by increasing renewable energy capacity and storage and reducing CO_2 emissions and fossil fuel consumption.

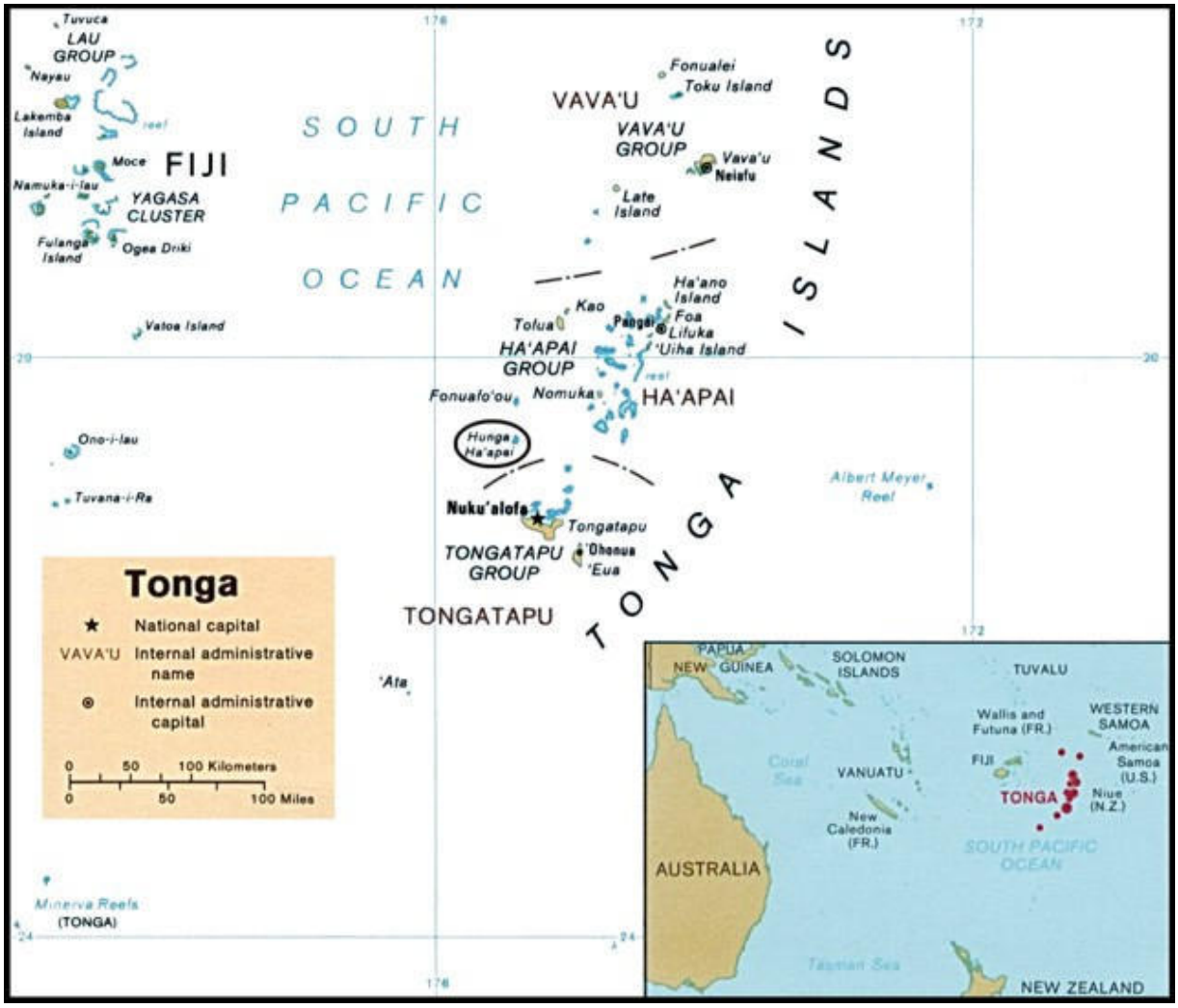
Table ES.1: Summary of Project Components in Outer Islands

Island group	Island	Site/existing use	Component description	Additional capacity		Land requirements (m^2)
				Generation (MW)	Storage (MWh)	
Tongatapu	‘Eua	Adjacent to existing solar farm. Unused agricultural land	Additional solar generation + BESS	0.35	0.9	3,800
Vava’u	Uta Vava’u	Opposite existing power generation and solar farm. Old coconut plantation (unused).	Additional solar generation + BESS	0.3	0.5	12,000
Ha’apai	‘O’ua	Adjacent to village – vacant unused plot	4 x mini-grid systems with solar PV generation, battery storage and small generator	0.25	0.47	1,900
	Tungua	Adjacent to village – vacant unused plot				2,960
	Kotu	Adjacent to village - mango, breadfruit trees and pandanus				2,205
	Mo’unga’one	Adjacent to village – vacant unused plot				1,500
Niua	Niuafo’ou	Land located at the airport	Solar mini-grid and battery storage	0.25	0.40	2,765
TOTAL				**1.15**	**2.27**	**27,130**

A. INTRODUCTION

1. **Background**. The Kingdom of Tonga (Tonga) is a small island developing state consisting of 177 islands with a total area of 748 km^2 (Figure 1.1). Tonga's population is approximately 103,000, of which almost three-quarters live on the island of Tongatapu. Tonga is remote from markets and most resources. In Tonga, 89% of households have access to electricity, increasing to 97% in urban areas. Like many other small Pacific islands, Tonga's electricity production relied almost exclusively on diesel generation. Until recently, over 95% of electricity in Tonga was generated using imported diesel fuel. For example, in 2012 (the latest year with complete figures), an estimated 15 million liters of diesel were consumed to generate electricity at a cost equivalent to approximately 10% of total gross domestic product and 15% of national imports. Until recently, Tonga depended almost entirely on imported diesel (around 90%) to generate its electricity. This led to climate change concerns and created a high dependency on imported fuels, which caused limited electricity consumption due to the high electricity costs.

Figure 1.1: Location of Tonga's island groups in the Pacific



2. **Path to renewable energy**. Tonga has a large potential for renewable energy, most notably from solar, wind and biomass. However, financial, technical and other barriers have constrained the development of renewable energies. In response, the Government of Tonga (GOT) issued the Renewable Energy Act in 2008 and then formulated the Tonga Energy Road Map 2010 – 2020 (TERM).[1] Tonga's nationally determined contributions (NDC) include the following targets:

- by 2020, 50% of all electricity to be generated from renewables; and
- by 2030, 70% of all electricity to be generated from renewables.

3. GOT has been implementing the TERM in a phased manner. The first two phases of TERM are under implementation. When these phases are complete, approximately 27% of Tonga's electricity will be generated from renewable energy. Building on this, the proposed Tonga Renewable Energy Project (the project)–to be funded in part by the Green Climate Fund (GCF)– will be the major force to implement TERM Phase 3, thereby helping Tonga meet its NDC targets.

4. **The project**. It is estimated that the project will lead to 13,616 tonnes of reduced CO_2 emissions per year, or 340,395 tonnes over the project's 25-year lifespan. Approximately 7 million liters of fuel will be saved per annum. The impact of the project will be a transformational shift away from the traditional reliance on fossil fuels toward a greater emphasis on climate-resilient renewable energy systems coupled with battery energy storage system (BESS) and reduced greenhouse gas emissions as well as promotion of more private sector investments into renewable energy development. To achieve this, the project will:

- Install about 10.1 megawatt (MW) /22.2 megawatt hours (MWh) of stand-alone BESS to overcome technical barriers to greater renewable energy integration to the grid and unlock private sector investment into renewable energy development, which will enable installation of about 7.8 MW of grid-connected renewable energy (4 MW solar photovoltaic (PV) and 3.8 MW wind power) generation capacity on Tongatapu to be financed by independent power producers (IPP);[2]
- Install 1.15 MW of renewable energy generation capacity in the outer islands coupled with the associated BESS;
- Install mini-grid systems in the outer islands to bring electricity generated from renewable energy-based hybrid system to consumers;
- Improve capacity of GOT and TPL on (i) developing renewable energy system including BESS; (ii) undertaking operation and maintenance; (iii) setting off-take tariffs for power purchase agreements for private sector funded investments; and (iv) improving both gender and community engagement;

[1] GOT. June 2010. Tonga Energy Road Map 2010 – 2020: A 10-year road map to reduce Tonga's vulnerability to oil price shocks and achieve an increase in quality access to modern energy services in an environmentally sustainable manner.

[2] TPL has successfully sourced, structured and negotiated the first independent power producer for a 2 MW solar PV farm, which is currently in operation. Additional IPP projects in the pipeline include: (i) option for additional 4 MW (2 lots of 2 MW) of IPP solar through the current power purchase agreement; and (ii) the Government of New Zealand (MFAT) has committed NZ$5.0 million to support a 2.2 MW wind IPP project, which both MFAT and TPL have started identifying the IPP. However, both solar and wind IPPs are subject to provision of some form of storage to be gran-financed by development partners like GCF.

- Make a major contribution to Tonga's NDC target of generating 50% of electricity from renewables by 2020 and help Tonga build momentum to reach 70% by 2030. Project-financed generation technologies in the outer islands will directly generate about 3% of additional clean electricity. BESS to be installed under the project will enable an increase in renewable energy generation by about 7.8 MW (4 MW solar PV and 3.8 MW wind power to be funded by the private sector), which will enable Tonga to increase their renewable energy penetration by 24% without negatively affecting the grid;
- Mitigate climate change effects leading to 14,141 tonnes of reduced CO_2 emissions per year, or 340,395 tonnes over the project's 25-year lifespan; and
- Adapt to climate change by incorporating climate proofing into technical design.

5. The estimated project cost is $53.2 million including counterpart contributions and grants from Asian Development Bank (ADB), Green Climate Fund (GCF) and Government of Australia.

6. **Screening and scope of environmental assessment.** The project is prepared, and will be implemented, in such a way to comply with the environmental safeguard requirements of Safeguard Policy Statement 2009 (SPS) and the laws of Tonga. The field investigations confirmed the screening conclusion that the project is category B for environment, based on findings that the project will have site-specific and localized impacts, most of which are construction-related and which can be readily mitigated and managed. The project components have been grouped into those proposed for Tongatapu, and those proposed for the outer islands and two initial environmental examinations (IEE) including environmental management plans (EMP) have been prepared.

7. This IEE covers the components proposed for the outer islands. The IEE was based on technical designs undertaken during the feasibility study and will be updated during detailed design. The fieldwork, consultations and site visits for the IEE were undertaken in April - May 2017. This IEE will be one of the due diligence studies submitted to the GCF Board as a part of Tonga's application for financing to implement the project.

B. ADMINISTRATIVE, POLICY AND LEGAL FRAMEWORK

1. Administrative Framework

8. **Institutional arrangements for the project**. The executing agency is the Ministry of Finance and National Planning (MFNP). The project implementing agencies will be Tonga Power Limited (TPL) for and the Ministry of Meteorology, Energy, Information, Disaster Management, Environment, Climate Change and Communications (MEIDECC) – Energy Department.

9. TPL is a government-owned, public enterprise under the oversight of the Ministry of Public Enterprises and the Cabinet. TPL has the concession for, and operates, four independent grids for on-grid electricity services on the main islands of Tongatapu (Tongatapu and Eua) and Vava'u and Ha'apai island groups, where it generates, distributes, and retails electricity, and provides O&M services. The MEIDECC Energy Department is the primary body responsible for policy formulation, as well as for implementation of rural electrification and demand management projects for off-grid electricity services. Both MEIDECC and TPL have significant experience through previous and ongoing projects financed by ADB and World Bank (and others).

10. The Government of Tonga has also established a high-level Taskforce to implement the TERM. Under the TERM Taskforce, a GCF sub-committee has been established to coordinate and support development of the proposed project. The sub-committee is chaired by MEIDECC and its members include TPL, the MFNP, a representative of the OIREP, and a representative from the ADB Tonga Extended Mission Office. The sub-committee reports directly to the Deputy Prime Minister. If successful and the Project is approved, this sub-Committee will become the Project Steering Committee. With support from a Project Management Unit (PMU) formed within MEIDECC, the Committee will oversee project implementation, facilitate information flows and support coordination.

11. A project management unit (PMU) established under the Outer Island Renewable Energy Project (OIREP)[3] will continue with additional resources as required to deliver the new project. Under the proposed project, an environmental and social unit (ESU) within the PMU will be established. The ESU will comprise specialists from the supervision consultant and staff seconded from MEIDECC and/or TPL. The ESU will be responsible for implementing safeguards and ensuring compliance with all project agreements and covenants on behalf of the GOT.

12. The PMU will work with TPL to implement the works for the on-grid components in 'Eua and Vava'u. For the mini-grid systems, the project will be managed and implemented by the MEIDECC Energy Department. To improve maintenance and therefore overall sustainability, it is recommended that a maintenance contract with TPL be established and overseen by MEIDECC. All components described within this IEE will be handed over to TPL at the end of the project construction phase. Design and supervision consultants will be mobilized through separate contractual arrangements. These consultants, on behalf of the GOT and ADB, will oversee all implementation: procurement, contracting, civil works and maintenance. The PMU will work closely with TPL in the commissioning and capacity building components to ensure the necessary skills are strengthened for long term sustainability.

[3] Outer Island Renewable Energy Project approved by the ADB Board 27 June 2013 for loans and grants to the amount of 17.26 million.

13. **Institutional arrangements for implementing the country safeguards system**. The Department of Environment (DOE) within MEIDECC has the mandate is to ensure the protection and proper management of the environment and the promotion of sustainable development. The vision of the DOE is sustainable development for Tonga's present and future generations through coordinated environmental management and protection, and climate change mitigation and adaptation and its mission is to effectively monitor and sustainably manage lands, natural resources and environment to increase resilience to climate change and geohazard impacts in Tonga.

The DOE administers various programs and supports implementation of the MEIDECC Corporate Plan to meet the GOT national priorities. The DOE's core functions include implementing the Environmental Impact Assessment (EIA) Act 2003 and EIA Regulations 2010 which provide the process and procedures for applying EIA to the planning of development projects. The DOE also provides advice to GOT on environmental and climate change issues and statutes, regional and international obligations.

2. Tongan Country Safeguards System

14. The country safeguard system (CSS) for environment includes several laws and regulations governing protection of the environment, management of resources and establishing the procedure for EIA of development projects. The CSS for environment is summarized in Table 2.1.

Table 2.1: Summary of Environmental Laws and Regulations of Tonga

Legislation	Objective
Environment Management (Litter and Waste Control) Regulations 2016	To provide environment, health, police and waste officers with powers to issue notifications or on the spot fines for poor waste management practices; such as dumping, burning and littering.
Seabed Minerals Act 2014	To provide for the management of Tonga's seabed minerals and the regulation of exploration and mining activities within Tonga's jurisdiction or under Tonga's control outside of national jurisdiction in line with responsibilities under international law
Environment Management Act 2010	To establish the Ministry of Environment (now MEIDECC) to protect and properly manage the environment, and promote sustainable development.
EIA Regulations 2010	Regulations for implementation of EIA Act, delineating major development projects and the processes required for development consent.
Hazardous Wastes and Chemicals Act 2010	To regulate and effectively manage hazardous wastes and chemicals in accordance with accepted international practices and the International Conventions applying to the use, trans-boundary movement and disposal of hazardous substances.
Ozone Layer Protection Act 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.
Biosafety Act 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.
Renewable Energy Act 2008	To regulate the development and use of renewable energy in Tonga.
Waste Management Act 2005	To manage and oversee the function of the Waste Management Board.
EIA Act 2003	To establish and implement environmental impact assessment procedures for developments in Tonga.
Birds & Fish Preservation Act 1988	To protect listed bird and fish species, establish protected areas and describe powers of police and fisheries officers under this Act.
Parks and Reserves Act 1976	To provide for the establishment of Parks and Reserves Authority and for the establishment, preservation and administration of Parks and Reserves.

Source: Tonga Crown Law Site (www.crownlaw.gov.to)

3. Environmental Assessment Process in Tonga

15. The EIA Act contains the schedule identifying 'major projects' for which EIA must be conducted. Developments and activities included in the schedule which could be triggered by the project are identified below.[4]

Scheduled development or activity	Triggered by the project
(i) electricity generating stations	***x***
(k) mining, being an activity that disturbs the surface of the land > 1 hectare	***x***
(l) sand or gravel extraction from any beach within 50 meters of the high tide mark	TBD
(q) removal of trees (incl. mangroves) or natural vegetation of any area > 0.5 hectare	TBD

16. Regarding the above: (i) measures will be included in the project EMP to ensure that any sand or gravel extracted for use as construction materials for the project will not be obtained from an area within 50 meters of the high tide mark; and (ii) during detailed design the area of vegetation removal and type of vegetation to be removed will be confirmed; following which it can be concluded if the project will trigger item (q) of the major projects schedule.

17. Section 9 further defines major projects if any of the following are likely to occur to a significant degree:

i. result in or increase pollution;

ii. result in the occurrence, or increase the chances of occurrence, of natural hazards such as soil erosion, flooding, tidal inundation, or hazardous substances;

iii. result in the introduction of species of types not previously present that might adversely affect the environment and biodiversity;

iv. have features, the environmental effects of which are not certain, and the potential impact of which is such as to warrant further investigation;

v. result in the allocation or depletion of any natural and physical resources in a way or at a rate that will prevent the renewal by natural processes of the resources or will not enable an orderly transition to other materials; or

vi. whether utility services are available and adequate for that activity.

18. The project is not considered a major project by virtue of any of the above.

19. CSS clearance of a development project or activity requires following the steps set out in the EIA Act and the EIA regulations.

20. Submission of Form 1 - Determination of Category of Assessment. This provides an overview of the proposed development along with a description of the existing environment and assessment of identified environmental risks and mitigation measures proposed. The project proponent will also pay the required registration fee. The Minister will determine whether the proposed development is a minor or major project or if additional information is required, and advises the proponent within 30 days.

[4] Renewable energy generation is not identified in the Major Projects Schedule. MEIDECC is in the process of reviewing the EIA legislation and this will include amending the Schedule to be more specific to developments and projects that have been undertaken since 2003 and were not necessarily envisaged when the EIA Act was passed.

21. If it is a minor project, it may be approved (with or without conditions) based on the information provided on Form 1. The DOE advises the proponent of the decision using Form 2: Minor Environmental Impact Assessment.

22. If the development or activity is deemed to be a major project, a 'thorough assessment or environmental impacts' is required as per Form 3: Major Environmental Impact Assessment. The proponent is required to seek advice from the Secretariat of the Environmental Assessment Committee (Secretariat) and DOE Director as to the level and depth of assessment required. The EIA is submitted by the proponent along with the accompanying fee. The Secretariat will review the EIA and prepare a report. The Environmental Assessment Committee reviews the application, EIA, Secretariat report, and any additional relevant reports provided before making its recommendation. The recommendation will state: (a) whether to approve, reject, defer or modify the development application; (b) the reasons for that recommendation; and (c) any conditions that shall be attached to any approval.

4. Tonga's Energy Policy and Laws

23. In response to dependency on fuel imports and the associated environmental costs, the GOT issued the Renewable Energy Act in 2008 and developed the TERM (see footnote 1) to guide the transition to a more sustainable energy sector.

24. The objective of the TERM is to lay out a least-cost approach and implementation plan to reduce Tonga's vulnerability to oil price shocks and achieve an increase in quality access to modern energy services in a financially and environmentally sustainable manner. While on-grid renewable energy is a major component of the TERM, it requires assessment of the full range of opportunities to determine the least-cost combination of interventions to achieve the objective. These include: (i) improvements in petroleum supply chain to reduce the price and price fluctuation of imported petroleum products; (ii) efficiency of conversion of petroleum to electricity (i.e. increases in efficiency and reduced losses at TPL); (iii) efficiency of conversion of electricity into consumer electricity services (demand-side management; and (iv) replacing a portion of current or future grid-based generation with renewable energy. In addition, the TERM includes recommendations for a new approach to meeting the needs of consumers too remote to be connected to a grid-based supply.

25. The Renewable Energy Act applies to the production, storage or distribution of any form of energy derived from a renewable source and: (i) provides a legal framework to promote the utilization of renewable energy in Tonga[5]; (ii) creates the Renewable Energy Authority and empowers the Authority to regulate all matters relating to renewable energy; promotes the implementation of commercially sustainable renewable energy-based electrification services by encouraging economically efficient investment in the use of and infrastructure to provide electrification services; and (iv) promotes access to renewable energy services to the extent that it is reasonably and commercially practicable to provide such services by people resident in the remote areas of Tonga.

[5] The Act seeks to do this through: (i) researching and developing opportunities of renewable energy (RE); (ii) encouraging commercially sustainable RE technology for both grid connected and stand-alone power supply systems; (iii) regulating the technical and safety standards for RE technologies; (iv) regulating the licensing of persons involved in the design, research, installation and management of RE projects; (v) regulating RE operators; (vi) regulating the feed-in tariffs for RE-generated electricity; and (vii) supporting the engagement of the private sector in RE projects.

26. With support from the World Bank and Secretariat of Pacific Community – Energy Division, the GOT is preparing a National Energy Bill. The aim of the Bill is to create further institutional, regulatory and policy reforms and lead to streamlined policy and decision making. The objectives of the Bill are:

- to create a centralized oversight function on energy matters within the MEIDECC;
- to legalize the mandate of the Energy Department (within MEIDECC);
- to transition and centralize the function of energy-related regulators; and
- to ensure harmonization and coordination of any initiative, while retaining flexibility to adapt to evolving priorities within the energy sector.

27. **Codes of environmental practice**. Through the World Bank supported New Renewable Electricity Generation and Electricity Infrastructure in Tonga program Codes of Environmental Practice (COEP) for the energy sector have been developed. The COEP, and accompanying guidelines, identify good practice in undertaking safeguards due diligence and developing supporting documentation for the clearance process under the CSS. Both documents were developed to help stakeholders to understand and navigate through the approvals process relating to land and the environment and were commissioned under the auspices of the TERM.[6] The COEP have been integrated into the project impact assessment and identification of mitigation measures tracked through to the project's EMP. Appendix 1 provides the list of the COEP.

5. ADB Environmental Safeguard Requirements

28. The ADB's SPS includes three safeguards: environment, involuntary resettlement, and indigenous people. The SPS has the objectives to (i) avoid adverse impacts of projects on the environment and affected people; (ii) where possible; minimize, mitigate, and/or compensate for adverse project impacts on the environment and affected people when avoidance is not possible; and (iii) help borrowers/clients to strengthen their safeguard systems and develop the capacity to manage environmental and social risks.

29. SPS safeguard requirements 1: environment involves due diligence commencing with screening, scoping and addressing environmental concerns, if any, of a proposed activity from the initial stages of project preparation. The SPS requires that due diligence commence with a screening of project activities and impacts to categorize the project (A, B or C) to determine the level of environmental assessment required to address the potential impacts. The project will create short-term, small-scale, but nevertheless potential adverse environmental impacts, which are site-specific, most if not all impacts are manageable for which mitigation measures are identified in the EMP.

30. ADB's SPS applies pollution prevention and control technologies and guidelines consistent with international best practices as reflected in internationally recognized standards such as the World Bank Group's Environmental Health and Safety Guidelines (EHSG). The EHSG provide the context of international best practice and contribute to establishing targets for environmental performance.

[6] World Bank. 2016. COEP: Managing Environmental and Social Impacts and Guidelines for Land Acquisition Approvals, Environmental Permits and Building Permits.

C. DESCRIPTION OF THE PROJECT

1. Project Rationale

31. Tonga is highly dependent on diesel for energy and electricity generation. Tonga has an ambitious national target to achieve 50% renewable energy generation by 2020 and an additional target in its NDC to have 70% of electricity generated from renewable sources by 2030. Tonga's current installed generation and storage capacity is shown in Table 3.1. Overall installed capacity is 20.2 MW, of which 3.7 MW (or 18%) is solar PV. There is an additional 1.2 MW of BESS.

Table 3.1: Status of Generation and Storage Capacities in Tonga

Island group	Island	Grid Status	Description	Conventional capacity (MW)	RE Capacity (MW)	BESS Capacity (MW)
Tongatapu	Tongatapu	TPL grid (11 kV)	Popua Power Station 6 x 1.4 MW + 2 x 2.8 MW diesel	14		
			Popua (Maama Mai) PV plant		1.3	0.5
			Vaini solar plant		1	0.5
			Distributed PV +1 x 11 kW wind ~ 30 sites		0.5	
Tongatapu	Eua	TPL grid (medium voltage)	Power station 2 x 186 kW diesel	0.37		
			PV Plant (no storage)		0.2	
Vava'u	Utu Vava'u	TPL grid (medium voltage)	Taumu'aloto power station	1.87		
			2 x 600 kW, 1 x 300 kW and			
			2 x 186 kW diesel			
			La'a Lahi solar facility		0.42	0.2
			PV and VRLA batteries			
Ha'apai	Nomuka	Non-TPL grid (6.6 kV)	Power station	0.92 kW	0.7	
			1 x 37 kW and 1 x 55 kW gensets			
Ha'apai	Ha'afeva	Non-TPL grid (6.6 kV)	Power station	0.64 kW	0.7	
			1 x 3 7kW and 1 x 27 kW gensets			
Ha'apai	Ha'ano	Non-TPL grid (6.6 kV)	Power station	0.64 kW	0.7	
			1 x 37 kW and 1 x 27 kW gensets			
Ha'apai	Uiha	Non-TPL grid (6.6 kV)	Power station	0.92 kW	0.7	
			1 x 37 kW and 1 x 55 kW gensets			
Ha'apai	Other	Off-grid	Household generators and SHS	Very low	Negligible	
Niua	Niuafo'ou	Off-grid	Small SHS + 32 small portable gensets (2.5 kW)			
TOTAL				**16.55**	**3.7**	**1.2**

Key: BESS = battery energy storage system; kV = kilovolt; kW = kilowatt; MW = megawatt; PV = Photovoltaic; RE = renewable energy; SHS = solar home system; TPL = Tonga Power Limited; VRLA = valve-regulated lead-acid

Source: Government of Tonga and Tonga Power Limited (2017)

32. Most installed capacity--conventional, solar and BESS--is on Tongatapu, the main island and main grid. The other capacity is on separate mini-grids or household systems across many islands. The generation of electricity from solar PV is limited by: (i) the fact that solar PV electricity is not always available when needed (especially after sunset, despite battery storage); and (ii) the distribution of generators across the islands cannot always perfectly match the demand on the islands. Hence, in 2017, only about 11% of electricity consumption was being met by renewables.

33. For Tonga, electricity consumption in 2012 was 52.4 GWh. The Feasibility Report concludes the most realistic scenario is that consumption will increase to 66 GWh by 2020 and 107 GWh by 2030.[7]

[7] This estimate is based on ongoing projects and energy efficiency measures including (i) BESS under the proposed project; (ii) distribution network upgrades under the Tonga Village Network Upgrade Project on Tongatapau and OIREP on Ha'apai, 'Eua and Vava'u; (iii) Others (e.g. smart meter installation, Interconnection Upgrades and Energy Efficiency Programmes for residential and commercial customers, etc).

34. The proposed project will provide the means for Tonga to reduce its vulnerability to increasing oil prices, reduce its carbon emissions, improve its resilience to climate change and pricing shocks, and provide secure, sustainable and environmentally-sound clean electricity for private and commercial consumers.

35. The Project is a continuation of earlier work to achieve the renewable energy targets of the Government of Tonga. It is the third phase of investment, with the first two phases as outlined below:

- Phase 1, 2014 – 2019. The OIREP supported by several international partners. OIREP outcomes are: (i) optimized use of on-grid and off-grid generation systems, and (ii) increased consumer access to electricity generated by solar power. OIREP outputs include: (i) the construction and installation of solar power systems with a total capacity of 1.32 MW on nine outer islands, (ii) the transfer of operation and maintenance knowledge, and (iii) rehabilitation of the existing grid network near the solar power generation systems on the islands of 'Eua and Vava'u;
- Phase 2: 2017 – 2019. Initial expansion through the most financially attractive projects, with a total investment of $10 – 15 million. This includes one solar farm to be funded and built by an IPP, and one wind farm to be funded by the Japan International Cooperation Agency (JICA);

36. The third phase is to help Tonga meet renewable energy targets in its largest demand center (Tongatapu) and on some of the outer islands not covered through the OIREP. The proposed project is central to phase 3.

37. **Battery energy storage systems.** Energy storage is a rapidly evolving field. The Feasibility Study determined that battery storage is the least cost storage solution amongst several considered storage options. The proposed BESS systems can be grouped into two groups with different characteristics and technical issues; (i) integral (associated) BESS (to be funded by GCF) to be connected to the solar PV and wind farms (to be funded by IPPs) for providing grid-stability and instantaneous response; and (ii) stand-alone BESS (one unit for grid-stability and two units for load-shifting). However, the technology to be deployed at the site (i.e. battery type) will be left to the contractors to propose based on specifications in the bidding documents.

38. **O&M contracts in the outer islands.** As part of government's community service obligation, a long-term operations and maintenance (O&M) contract is expected to be made between GOT and TPL for those outer islands to be funded under the project. This will ensure the long-term sustainability of the assets financed in the outer islands. Under the contract, TPL will train local communities for daily O&M as well as post-disaster repair and maintenance.

2. Overview of Project Components in Outer Islands

39. The project components in Vava'u and 'Eua are on-grid renewable energy components, increasing the generation of power through solar energy, and implementing improvements in both short and long term energy storage solutions. Improving the way energy is stored provides a range of options to buffer the changing peak demand periods in a day, as well as systemic ways to store power for use in periods of low generation (e.g. high cloud, night, or low wind conditions). The proposals for Vava'u and 'Eua will be managed by TPL with asset maintenance and replacement integrated with the TPL operations.

40. The mini-grid systems are part of ongoing efforts for rural electrification in Tonga, providing energy security and the associated socio-economic opportunities to isolated communities. Previously, the islands have received assistance through solar home systems (SHS), but these provide limited power for lights and some charging of portable electronic devices and phones. There have been some issues of poor maintenance leading to unreliability of the installed SHS.

41. Through an AusAID assistance scheme in Ha'apai group commissioned between 2002 and 2003, the outer islands of Ha'afeva, Nomuka, 'Uiha and Ha'ano (with a total of about 450 households) were electrified. These mini-grids use diesel generation, with power distributed to households using underground cabling. The systems are managed by community committees, formally established and supervised by the Department of Co-operatives and Credit Unions, with members trained in mini-grid operations, basic maintenance and financial management.

3. Location of Components

42. The project components are located in 'Eua (Tongatapu group), 'Uta Vava'u (the main island of the Vava'u group), Niuafo'ou (one of the two islands in the Niua group in the far north), and four islands--'O'ua, Kotu, Tungua, and Mo'unga'one--in the northern Ha'apai group. Figure 3.1 shows the location of 'Eua, Figure 3.2 shows the project islands in Ha'apai group, Figure 3.3 shows Uta Vava'u and Figure 3.4 is a map of Niuafo'ou island. Aerial photos showing the locations of the sites on the islands are provided in Figures 3.5 – Figure 3.11.

Figure 3.1: Location of Project Island – 'Eua – within Tongatapu Group

Figure 3.2: Location of Project Islands within Northern Ha'apai Group

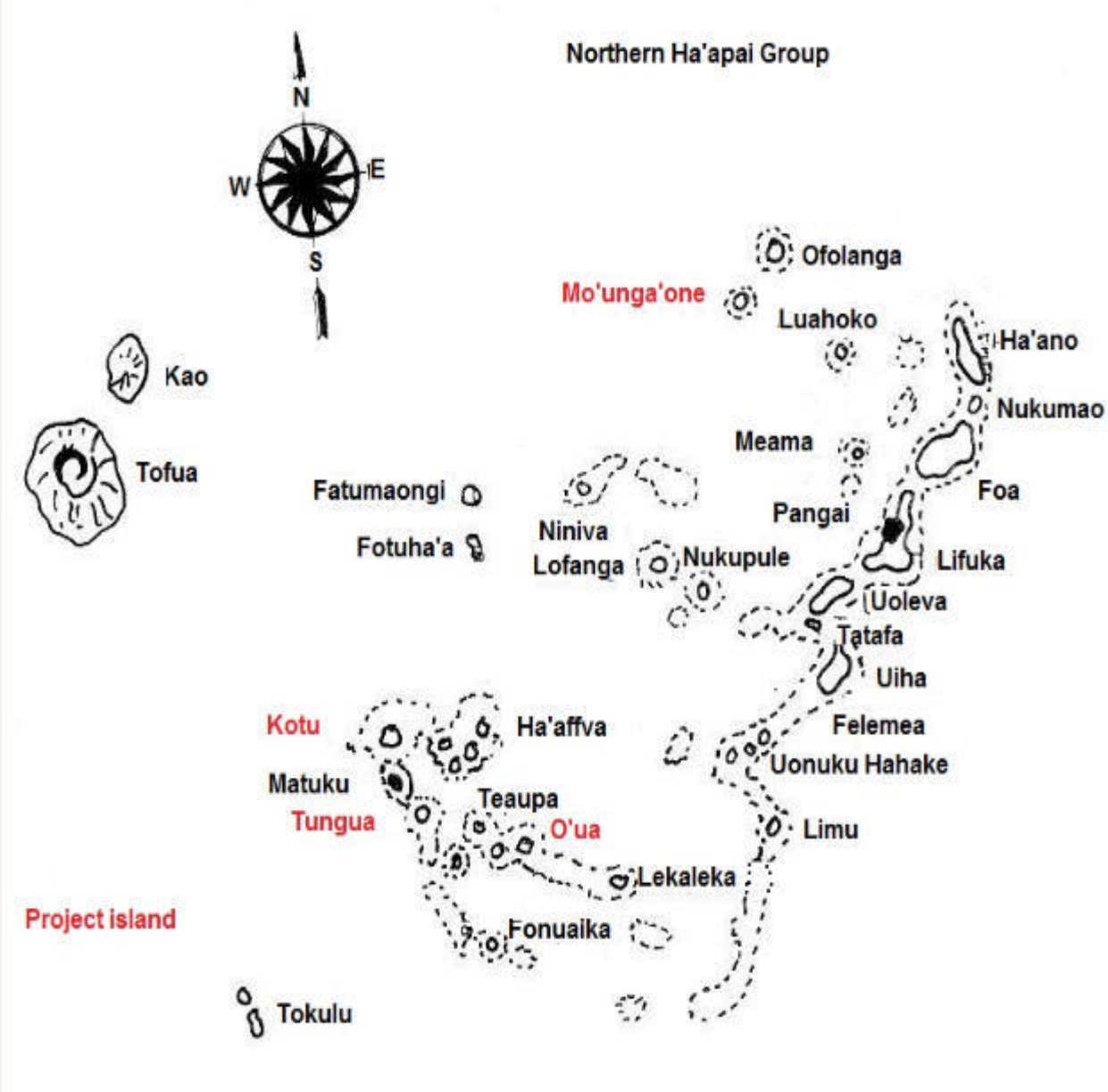


Figure 3.3: Location of Project Island – Uta Vava'u - in Vava'u Group

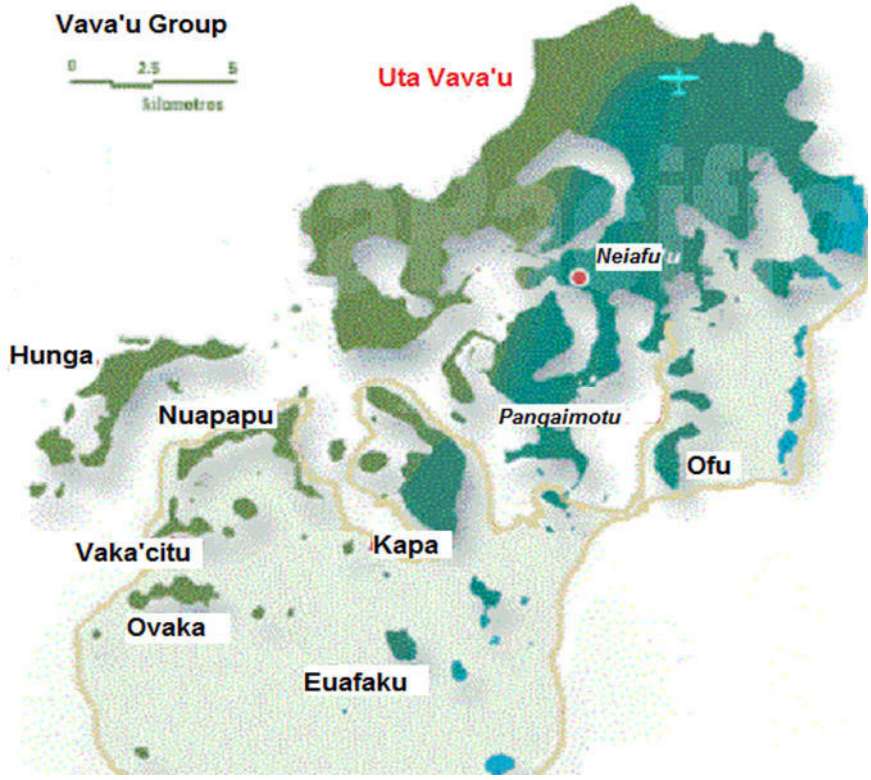
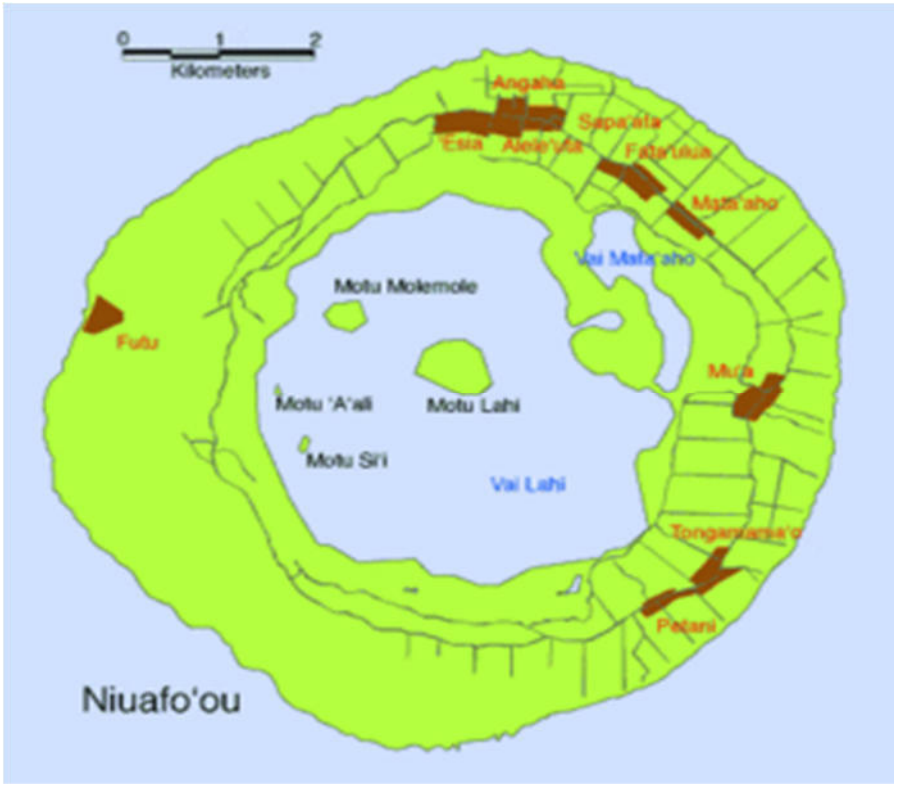


Figure 3.4: Map of Niuafo'o Island



43. ‘Eua is an island in the Tongatapu group, located approximately 17.5 km southeast of Tongatapu. The existing solar farm is in Ohonua village and was co-located with the ‘Eua power plant. The proposed site in ‘Eua includes an area within the existing TPL lease and an area on the adjacent lot which will require a lease agreement (see Figure 3.5).

44. Vava’u is an island group in northern Tonga with a total land area of 121 km^2. On the main island of the group—Uta Vava’u—the existing solar farm and generation center is in the village of Kameli on the outskirts of Neiafu. Land to the north and south have existing buildings and uses in place. The area to the west, immediately adjacent to the solar facility, is an existing water extraction area supplying groundwater for the island’s water supply. The land to the east across the public road is owned by the King and is currently an unused coconut plantation with some use for grazing. It was agreed that this site is the preferred option for the extension of the solar facility (Figure 3.6).

45. The four mini-grid systems proposed for Ha’apai are on ‘O’ua, Tungua, Kotu and Mo’unga’one. The selected sites are technically feasible and minimize social and environmental impacts. The solar panels and back-up diesel generators will be constructed on existing cleared and vacant sites in each village, exception for at Kotu where the site includes some existing vegetation such as mango and breadfruit trees and pandanus grass. Refer to Figures 3.7 – 3.10.

46. On Niuafo’ou (see Figures 3.4 and 3.11), the solar panels and generator will be constructed on land located at the airport. The electricity will be distributed to the villages via two long feeders. One feeder will extend from the solar plant east to Esia, while the other feeder line will extend south from the solar plant to the furthest village at Petani.

Figure 3.5: Existing Solar Farm and Proposed Expansion Site on ‘Eua

Figure 3.6: Existing Solar Farm and Proposed Expansion Site on Vava'u

Figure 3.7: Proposed Solar PV Site for Mini-Grid on O'ua (Ha'apai)

Figure 3.8: Proposed Solar PV Site for Mini-Grid on Tungua (Ha'apai)

Figure 3.9: Proposed Solar PV Site for Mini-Grid on Kotu (Ha'apai)

Figure 3.10: Proposed Sites for Mini-Grid on Mo'unga'one (Ha'apai)

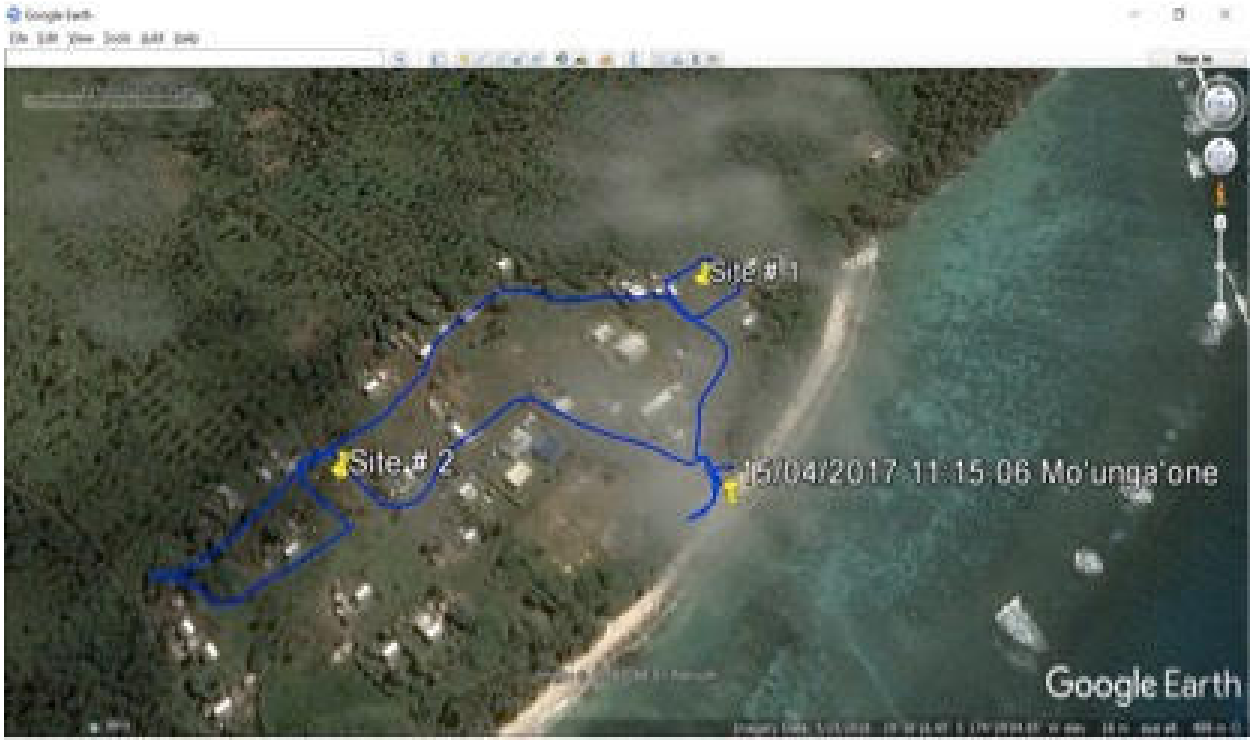


Figure 3.11: Proposed Site within Airport Land on Niuafo'o

4. Detail of Project Components

47. **Increasing on-grid renewable energy on 'Eua**. There is an existing solar facility in 'Eua, located at 'Ohonua village. This plant has a 200KW capacity, and was constructed under Phase I of OIREP. Under the proposed project energy generation from solar power will be tripled by installing additional infrastructure to generate a further 400kW from solar energy. Based on the design of the original 200 kw installation, the extension of the solar panels will consist of approximately 2,000 poly-crystalline PV panels; each panel of 2m x 1m dimension. The panels will be mounted on arrays with a 15^{o} inclination.

48. The installation of a BESS of 500 kWh of storage will further improve the performance of the renewable energy inputs into the grid. The BESS will also assist in the management of fluctuations in renewable energy power supply and the maintenance of energy stability during peak power demand. To simplify site placement and associated works, the BESS units will be housed in containerized modules. The housing will include the required temperature control, fire protection and features to prioritize site safety and ensure battery life is maximized. Additional underground cabling and connection works will be required.

49. **Increasing on-grid renewable energy in Vava'u**. Vava'u currently has a solar farm of 0.42 MW supplying approximately 13.8% of Vava'u's annual electricity supply. The facility was constructed in 2013 with funds from the United Arab Emirates and was the second solar facility in Tonga. The solar farm is located next to the TPL power station at Kameli on the outskirts of Neiafu. The new facility, requiring an additional 12,000 m^2 of land, will generate a further 500 kW of energy. In addition, a BESS facility will be housed at the Vava'u site to provide energy storage of 1.1 MW and 1.5 MWh batteries.

50. The inclusion of a BESS is critical to improve the performance of renewable energy inputs into the Vava'u grid. It will assist in the management of fluctuations in renewable energy power supply, and the maintenance of energy stability, including times of peak power demand. A 'best available technology' approach will be used to select high capacity batteries, likely to be lithium ion or sodium sulphur technology. The BESS units will be housed in containerized modules, which simplify site placement and associated works. The housing will include the required temperature control, fire protection, and safety features to prioritize site safety and ensure battery life is maximized. Additional cabling and connection works will be required. All connection cabling will be underground.

51. **Mini-grid systems in Ha'apai**. The mini-grid systems will bring electrification to four islands in the Ha'apai group. The design will be based on best available technology and lessons learned from the installation of mini-grid systems in the four islands of Nomuka, Ha'afeva, 'Uiha and Ha'ano (under the DFAT financed program). While most households on 'O'ua, Tungua, Kotu and Mo'unga'one have existing SHS, there are issues of energy reliability and SHS maintenance. The mini-grids proposed under the project provide a more robust system of collective power generation and distribution. The component will consist of solar panels for power generation, a BESS to provide energy storage, and a back-up diesel generator to ensure power supply is reliable and consistent. The works will include distribution lines to bring the electricity to households. Underground lines will reduce the visual impact of the development, and improve resilience to cyclones and extreme weather events.

52. **Mini-grid system in Niuafo'ou**. In Niuafo'ou, a mini-grid system will be constructed on vacant land at the airport. The mini-grid will extend from the centralized solar plant and distribute energy to the villages via two long feeder lines. One feeder will extend from the solar plant east to Esia and the other feeder will extend south from the plant to Petani. All cables will be underground to improve disaster resilience and minimize visual impact.

5. Project Construction, Operation and Decommissioning

53. **Construction and installation activities**. Construction and installation of project components will include the following activities:

- Minor vegetation clearance for the solar farm extensions in 'Eua and Vava'u
- Site preparations works including leveling, compaction, and filling where required.
- Site drainage measures, erosion and run-off controls. It is important that the facilities are protected from erosion and that the sites themselves do not create run-off or siltation affecting neighboring properties.
- Security fencing around solar facility extensions and mini-grid systems.
- Installation of PV mounting system and PV panels.
- Installation of BESS facilities housed in modular containers at each site.
- Associated connection works into the grid in Vava'u and 'Eua, requiring a mixture of overhead lines and trenches for underground cabling.
- Site landscaping where required to minimize erosion and stabilize the new development sites.
- Construction of new mini-grid systems in five remote island locations, including the installation of solar panels, battery storage facilities, and back-up diesel generators.
- Construction of feeder and distribution lines from the mini-grids. All cabling will be underground for improved resilience to cyclones and reduction of visual impact.
- Commissioning of all equipment.

54. The workforce required would be small and would not necessitate construction of a camp. Workers can be accommodated in existing guesthouses, local government/island council buildings or on the boat transporting the materials and plant to the sites. It is expected that works will be undertaken at each site over a period of between 2 and 4 months.

55. **Operation**. During the operational phase, the increased solar generation facilities and the BESS will work in an integrated system to supply the maximum amount of energy from renewable sources in Vava'u and 'Eua. By providing power to consumers from renewable sources, it is expected that costs will decrease, with associated economic benefits for the communities. The operations will require a focus on optimizing renewable energy and storage efficiencies to maximize benefits to end users. There are no environmental impacts predicted for the operational phase of the solar and BESS facilities. The operation of the mini-grids will require trained local people to undertake basic operational tasks, including fueling the back-up generator. The challenge of regular and timely maintenance is a critical sustainability issue to be addressed and resolved by the project.

56. **Decommissioning**. The expected lifespan of the project components is 25 years. As required, it is likely that the assets will be renewed and upgraded as they reach the end of their operational life. The key issue at the end of life cycle is the management of the waste materials. With the significant surge in production and operation of these technologies on a global scale, it is predicted that the recyclability of materials will improve in the coming two decades. Whilst lead acid batteries are economically recyclable now, the recycling and disposal options for lithium ion batteries are in the early stages of development. The recycling of PV modules is also in the early stages at a global level, given that there are limited volumes of redundant panels to underpin viable recycling businesses.

57. **Implementation schedule**. The following is the processing and implementation proposed for the project:

- GCF Board approval July 2018
- ADB Board approval Q1 2019
- Bidding documents and tendering Q2 2019
- Contract award: Q1 2020
- Construction: Q1 2021
- Testing/commissioning: Q2 2021

D. DESCRIPTION OF EXISTING ENVIRONMENT (BASELINE CONDITIONS)

1. Physical Environment

58. **Island location, topography, geology and soils**. Tonga is a group of small islands located in the central South Pacific. Located between 15º and 23º30º south, and 173º and 177º west; Tonga consists of four clusters of islands extending over a north-south axis: Tongatapu (347 km^2) in the south; Ha'apai (109 km^2) in the centre; Vava'u (121 km^2) in the north; and Niua (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. The Tongan Ridge which separates the relatively shallow north-east trending Lau Basin from the very deep and narrow north-east trending Tongan Trench. Both the Tongan ridge and trench turn north-westwards at their northern end to form a convex arc facing the Samoan chain of islands to the north. Tonga is comprised of a mixture of island types; in the west islands are generally of volcanic origin with associated steep topography and high elevations and in the east, the islands are more typically low-lying atolls formed with uplifted coral limestone with deep-pile sediment of volcanic origin.

59. The island of 'Eua lies 40 km south-east of the main island of Tongatapu, but it's physiography is very different. The island was shaped by the Tongan plate rubbing against the Pacific plate, causing the uplift of 'Eua and the deep 7 km Tonga trench. The landscape is undulating with hills up to 312 m above sea level. 'Eua has a base of coral, and features many caves and sinkholes. Its soil is volcanic from depositions of nearby eruptions tens of thousands of years ago. 'Eua has the only river in Tonga, which drains into the harbor near the capital, 'Ohonua. 'Eua also has extensive natural and plantation forests, particularly on the hilly eastern side. 'Eua has a land area of 87 km^2.

60. Uta Vava'u is the main island in the Vava'u group. The island is a raised coral island with a maximum elevation of 213m and a terraced landscape formation. The coral limestone is overlaid with volcanic soils up to 9 m in depth.

61. Ha'apai group consists of 62 islands with a combined land area of 109 km^2. The Ha' apai group includes islands formed by sedimentary tuffs, at times interbedded with pyroclastic coral debris and an eastern zone of coral islets. The four project islands are in Lulunga District (Tungua, 'O'ua and Kotu) and Lifuka District (Mo'unga'one). Tungua in the south-west has an elevation of approximately 19 m above sea level, 'O'ua is a low-lying atoll located southeast of Tungua, Kotu is elevated at approximately 18 m above sea level and Mo'unga'one has an elevation of 21 m above sea level.

62. Niuafo'ou is the most northerly island in Tonga, located 574 km north of Tongatapu island. Niuafo'ou was created by sub-oceanic volcanic eruptions and is located at the tip of this active underwater volcano. The land area of 49 km^2 includes a volcanic peak at a height of 285 m. It is an active volcanic rim island, with two crater lakes dominating the landscape; the largest lake--Vai Lahi--is 4 km wide, 84 m deep and 23 m above sea level. The coastline is rocky and steep with beaches characterized by stony black sand. There are extensive black and grey lava fields in the south and west of the island. The geology comprises beach deposits (boulders, cobbles, gravel and sand), cone deposits and lava flows interbedded with ash, recent lava flows and recent pyroclastic deposits (surge-like deposits and cinder/tuff cones).

63. **Climate**. The climate of Tonga is categorized as sub-tropical. The climate is influenced by the trade winds of the South Pacific, and characterized by a hot humid wet season (November to April) and a slightly cooler season (May to October). Approximately 60% of the rain falls in the wet season (November to April), but the dry season also experiences occasional heavy rain.

64. Tonga's prevailing winds blow from the east and the southeast at an average of 12 knots. Its location in the south-west Pacific makes Tonga vulnerable to cyclones from November to April each year, and gale force winds from eastward migrating high pressure systems from May to October.

65. Temperatures in Tonga change from season to season and are strongly tied to changes in the surrounding ocean temperature. Mean annual temperatures vary from 27^0C at Niuafo'ou in the north to 24^0C on Tongatapu in the south. Diurnal and seasonal variations can reach as high as 6^0C throughout the island group. During the wet season (November – April), the average temperature ranges from 27–29^0C, whereas the dry season (May – October), averages temperature from 20–24^0C. The larger differences occur in the south, with about 5ºC difference between the warmest month (February) and coolest month (July) at Nuku'alofa.

66. Tonga's climate varies considerably from year to year due to the El Niño Southern Oscillation. This is a natural climate pattern that occurs across the tropical Pacific Ocean and affects weather around the world. There are two extreme phases of the El Niño Southern Oscillation: El Niño and La Niña. There is also a neutral phase.

67. Tropical cyclones affect Tonga between November and April. In the 41-year period between 1969 and 2010, 71 tropical cyclones passed within 400 km of Nuku'alofa, an average of one to two cyclones per season. The number of cyclones varies widely from year to year, with none in some seasons but up to five in others. Over the period 1969–2010 cyclones occurred more frequently in El Niño years.

68. Vava'u has mean monthly average temperatures ranging from 22^0C in the cooler dry season and 28.3^0C in the wet season. The average annual rainfall is 2,222 mm, with the climate conducive to a productive agricultural sector. There are dry periods usually for 1-2 months sometime between June and September. On average, once in seven years, Vava'u can experience drought.

69. 'Eua has a semi-tropical climate with mean maximum temperature of 27^0C with a mean minimum of 24^0C. Due to its higher elevation, 'Eua has slightly higher and better distributed rainfall than Tongatapu, and is known for being less affected by drought.

70. Ha'apai has mean monthly minimum and maximum temperatures of 23.5^0C and 25.5^0C respectively. The average annual rainfall is 1,619 mm but there can be prolonged dry periods between June and August and frequent droughts.

71. Niuafo'ou averages a monthly maximum temperature of 26^0C and minimum of 20^0C, with an average rainfall of 1,610 mm. Both the islands in the Niua Group are vulnerable to water shortages, especially during El Nino events.

72. **Climate change**. Scientists from the Pacific Climate Change Science Program (PCCSP) have evaluated 24 models from around the world and found that 18 best represent the climate of the western tropical Pacific region. These 18 models have been used to develop climate projections for Tonga. The climate projections for Tonga are based on three IPCC emissions scenarios: low (B1), medium (A1B) and high (A2), for time periods around 2030, 2055 and 2090.

73. Climate projections for Tonga include:[8]

- Temperatures will continue to increase - projections for all emissions scenarios indicate that the annual average air temperature and sea surface temperature will increase in the future in Tonga. By 2030, under a high emissions scenario, this increase in temperature is projected to be in the range of 0.3–1.1°C;
- More very hot days - increases in average temperatures will also result in a rise in the number of hot days and warm nights and a decline in cooler weather;
- Changing rainfall patterns - projections generally suggest a decrease in dry season rainfall and an increase in wet season rainfall over the course of the 21st century. Wet season increases are consistent with the expected intensification of the South Pacific Convergence Zone. Drought projections are inconsistent across Tonga. More extreme rainfall days Model projections show extreme rainfall days are likely to occur more often;
- Less frequent but more intense tropical cyclones - on a global scale, the projections indicate there is likely to be a decrease in the number of tropical cyclones by the end of the 21st century. But there is likely to be an increase in the average maximum wind speed of cyclones by between 2% and 11% and an increase in rainfall intensity of about 20% within 100 km of the cyclone center. In the Tonga region, projections tend to show a decrease in the frequency of tropical cyclones by the late 21st century and an increase in the proportion of the more intense storms;
- Sea level will continue to rise - sea level is expected to continue to rise and by 2030, under a high emissions scenario, the increase is projected to be in the range of 3-17 cm. The sea-level rise combined with natural year-to-year changes will increase the impact of storm surges and coastal flooding; and
- Ocean acidification will continue - under all three emissions scenarios (low, medium and high) the acidity level of sea waters in the Tonga region will continue to increase over the 21st century, with the greatest change under the high emissions scenario. The impact of increased acidification on the health of reef ecosystems is likely to be compounded by other stressors including coral bleaching, storm damage and fishing pressure.

74. **Water resources**. The water resources of Tonga consist mostly of groundwater stored in fresh water lenses. Due to the differential in salinity, fresh water forms on top of the sea water, with a transition zone of varying salinity for several meters between the two fluids. This resource is vulnerable to salinization from over-extraction, and to pollution from human activities.

75. In some of the island groups, there are surface water resources. This includes ‘Eua, where surface water from the cave systems is collected over a large run-off area, and distributed as a potable water supply to households and businesses. Despite the Tonga Water Board investing in filtration infrastructure, the water supply is often heavily dis-colored. The water quality remains vulnerable to incompatible land uses such as land clearance and pig farming.

[8] PCCSP. 2011. International Climate Change Initiative. Volume 2 - Climate Change in the Pacific: Scientific Assessment and New Research, and Web-based Climate Projections Tool – Pacific Climate Futures (available at www.pacificclimatefutures.net)

76. In Vava'u, the water table depth is approximately 5-8 m, with the depth from surface to the water table being up to 15 m in areas of higher elevations. Ground water is the main water supply for Vava'u. The water supply tends to have some quality issues, with many households choosing rain water as their main source of potable water. In several villages, rainwater storage is the only option.

77. The four islands in Ha'apai rely exclusively on catchment and storage of rainwater. This makes them extremely vulnerable to drought, which is experienced frequently in Ha'apai, particularly from June to August. Kotu has an underground water supply, although water pumped from this fresh water lens is untreated and vulnerable to contamination.[9]

78. There is a crater lake on Niuafo'ou, but this water is not potable. Some villages use the lake water for non-potable uses such as washing, with other villages using groundwater wells to access the fresh water lens. This groundwater is high in calcium and has an unpleasant taste and households rely on rainwater for potable water.

2. Biological Environment

79. **Terrestrial flora**. Tonga's flora is limited in diversity, particularly in populated areas where extensive land clearance occurred for settlement and agriculture. Many plants and trees are common throughout the pacific and include hibiscus, frangipani, bird of paradise, mango, breadfruit, acacia, coconut, pandanus and banana. Twelve plant species, including the orchid *Acanthophippium splendidum, Podocarpus pallidus* a species of conifer and *Aglaia heterotricha* species of the Meliaceae family, are endemic to Tonga. Non-endemic flora includes *Ficus obliqua (*small-leaved fig in Moraceae family), orchid *Spathoglottis plicata,* and the Joannis palm (*Veitchia joannis)*.

80. None of the proposed sites contain any areas of habitat value or vegetation of conservation of significance (refer to Plates 4.1- 4.6).

81. The site on 'Eua is within the existing TPL lease site and except for a small area on the eastern side is already cleared. The adjacent land is covered with regrowth including grasses, weeds, acacia, mango and coconut trees and the clearing of the project area will not have a significant impact on habitat. The vegetation is not of conservation significance.

82. The site identified for the expansion of solar facilities on Uta Vava'u was established in earlier years as a coconut plantation. There are approximately 100 mature coconut trees planted on the site, but the plantation has been non-productive for many years. The understory is grasses, small shrubs, and weeds; there is intermittent cattle grazing on the site.

83. For the islands in the Ha'apai group, the sites are in village areas where the land has already been cleared. The exception is Kotu, where the site at the southern end of the village is only half cleared land with an unused small shed structure, and the other half will require land clearance. The vegetation includes papaya, coconut and breadfruit trees, and pandanus grass; none of which is ecological significance.

84. At Niuafo'ou, the selected site is on the airport land, which has already been cleared.

[9] GOT & Sustainable Livelihoods Alleviating the Poor Inc. 2014. Luluunga District Water Supply Report. Available at ttps://www.worldpulse.com/sites/default/files/post/6610/34865/post_document/0b16de0dfc1f6f5fbbe68a73b2ddf05d/lulunga_water_supply_edited.pdf

Plates 4.1a and b: Coconut plantation, other trees and understory at Uta Vava'u site

Plates 4.2a and b: Cleared and non-cleared parts of proposed site at 'Eua

Plate 4.3: proposed site at O'ua (Ha'apai group)

Plate 4.4: proposed site at Tungua (Ha'apai group)

Plate 4.5: proposed site at Kotu (Ha'apai group)

Plate 4.6: proposed site at Mo'unga'one (Ha'apai)

85. **Fauna**. With the loss of habitat over a long historical period, there are no specific terrestrial species in Tonga that are known to be rare or endangered. The highest diversity is found in bird species. Other fauna includes 20 species of skinks/lizards, ten species of butterfly, two species of jumping spider—*Iona nigrovittata* (genus Salticidae) and *Sobasina magna*—that are endemic to Tonga, two fruit bats including Pacific or insular flying fox (*Pteropus tonganus)*[10] and *Pteropus samoensus*, Pacific or Polynesian sheath-tailed bat (*Emballonura semicaudata*), and the common northern palm squirrel (*Funambulus pennantii*) a species of rodent in the family Sciuridae.

86. The most comprehensive study of birds in Tonga was undertaken in 2001, which reported a total of 74 species.[11] Of these species, 51 are resident breeding species and include 22 native land birds, 23 sea bird species, and six introduced bird species. The other 23 species were identified as migrant or vagrant (including six shore birds, 13 seabirds and three land-wetland species). Endemism is low, with one species Hengahenga or Tongan whistler (*Pachycephala jacquinoti*) being endemic to Tonga and another the Polynesian megapode (*Megapodius pritchardii*) is known to also exist in Vanuatu.

87. There is no evidence of significant vertebrate or invertebrate species at the 'Eua site. Due to its long history as tax allotments (farming parcels) the ecology is highly disturbed and modified.

88. The Tongan whistler is endemic in Vava'u, but its habitat requires primary or mature secondary forest, neither of which occur at the proposed site. Being a highly disturbed land parcel, with a coconut tree plantation, grasses and weeds, there are no habitat trees available to this species. The level of site disturbance has resulted in a site with limited conservation values. There was no evidence of any species of significance in the preliminary site survey.

89. The settled islands of the Ha'apai group are largely cleared due to settlement and agricultural activities. However, there are some important stands of coastal vegetation, mangroves and older trees of significance. None of these areas will be impacted by the developments. Important habitat areas such as mangroves or bird nesting sites will not be impacted by the developments, which will occur within or at the edge of the villages.

90. As an isolated island with a relatively sparse population and intact forest, Niuafo'ou provides some important areas of habitat. There are a documented 17 breeding species of birds.[12] The Polynesian megapode (*Megapodius pritchardii*) is listed as endangered by the IUCN.[13] Its natural habitat is tropical moist lowland forests and on Niuafo'ou it is most common in the central caldera (crater lake) area. The major threats to these birds are habitat loss, hunting and egg collection (both of which are part of local tradition). The mini-grid system will be constructed on the cleared land at the airport site and will not create any impacts on these populations. The feeder lines will be buried underground, which mitigates further disturbance to bird populations.

---

[10] Geographically this is the most widespread flying fox in the Pacific.

[11] Watling, D. 2003. A Guide to the Birds of Fiji and Western Polynesia; and 1982. The Birds of Fiji, Samoa and Tonga.

[12] Including Audubon's Shearwater (*Puffinus iherminieri*), Pacific black duck (*Anas superciliosa*), banded rail (*Rallus phillippensis*), Spotless Crake (*Porzana tabuensis*), Purple Swamphen (*Porphyrio porphyria*), barn owl (*Tyto alba*), red-vented Bulbul (*Pycnonotus cafer*), Polynesian starling (*Aplonis tabuensis nesiotes*), jungle Myna (*Acridotheres fuscus*), blue-crowned lorikeet (*Vini australis*), white-tailed tropicbird (*Phaethon lepturus*), Pacific reef-heron (*Egretta sacra*) and Pacific pigeon (*Ducula pacifica*).

[13] Goth and Vogel. 1999. *Notes on Breeding and Conservation of Birds on Niuafo'ou Island* in Pacific Conservation Biology 5(2) 103 – 114. Available at http://www.publish.csiro.au/pc/PC990103

91. **Forests and protected areas**. Tonga has a system of terrestrial and marine protected areas with 15.9% of land and 1.5% of its marine territory designated as protected.[14] There are eight Special Marine Management Areas established to improve sustainability of fishing and management of coral reef areas, with a further six proposed under the ADB financed Climate Resilience Sector Project. Table 4.1 shows the existing network of protected areas in Tonga.

Table 4.1: Protected Areas in Tonga

Type of Protected Area	Management Authority	IUCN Category	No.	Area (ha)
Marine protected area	MEIDECC	IV - VI	8	1,003,729
National parks, managed protected area – terrestrial	MAFFF, MEIDECC	II, V, VI	6	2,100
Managed resource / special management area – community based	MAFFF	VI	6	9,256.5
Strict nature reserve / special management area – community based	MAFFF	IA	6	1,104.5

Source: MEIDECC (reported in OIREP Phase I: IEE for 'Eua Solar Plant)

92. The 'Eua National Park of 449 ha on the east coast of the island which protects Lokupo Beach and an 800 m width swathe of tropical rainforest. The proposed site is on the opposite side of the island. The Mount Talau National Park in Vava'u (reaching 131 m above sea level) is habitat for the rare banded lizard (*Brachylophus fasciata*) known locally as Fokai, as well as the Tongan whistler (*Pachycephala jacquinoti*) and the flying fox (*Pteropus tonganus*). The proposed site is located on the outskirts Neiafu and the National Park is on the western promontory.

Figure 4.1: Protected Areas viz Project Sites on 'Eua and Vava'u

[14] SPREP. Pacific Island Protected Area Program. Available at http://www. http://pipap.sprep.org/country/to

3. Socio-economic Environment

93. **Population and demography**. The preliminary data published from the 2016 Tonga census records a total population of 100,745 distributed over the 36 inhabited islands. The 2016 population had decreased slightly compared with 103,036 recorded in the 2011 census.[15] The population decrease is largely due to ongoing emigration to New Zealand, Australia, and the USA.[16]

94. The census information for the project islands is provided in Table 4.1. The table shows that each of the project islands experienced a population decrease between 2011 and 2016. The decrease is particularly severe on the four islands in Ha'apai (19% - 31.5%).

Table 4.1: Population of Islands with Proposed Development Sites

Island	Population		Intercensal change (%)	Males		Females		Households	
	2016 Census	2011 Census		2011	2016	2011	2016	2011	2016
Vava'u	13,740	14,922	-7.9	7,559	6,872	7,363	6,868	2,834	2,742
'Eua	4,950	5,016	-1.3	2,514	2,489	2,502	2,461	870	885
'O'ua	116	144	-19.4	83	69	61	47	28	25
Tungua	187	232	-19.4	121	94	111	93	43	37
Kotu	129	178	-27.5	91	65	87	64	36	30
Mo'unga'one	63	92	-31.5	37	31	55	32	20	15
Niuafo'ou	493	523	-5.7	277	264	246	229	114	101

Source: Tonga National Population and Housing Census 2016

95. Average household size across the project islands is 5.1 people and ranging from 4.2 people/household on Mo'unga'one to 5.6 people/household on 'Eua. The male to female ratio is balanced at roughly 50:50 with the exceptions of O'ua (males = 59%), Niuafo'ou (males = 54%) and Mo'unga'one (males = 49%).

96. Some 22.5% of Tongans live below the national poverty line. Tonga's impoverished communities are primarily in rural areas on the outer islands. The main island of Tongatapu has the highest GDP per capita, but the citizens of the farther islands of 'Eau, Ha'apai, Niua and Vava'u struggle to find work. The higher poverty rates on these islands are due to a lack of access to goods, transportation and marketing opportunities.

97. **Health**. The Ministry of Health provides health services to this population through four hospitals, 14 Health Centers and 34 Maternal and Child Health Clinics. While in general, Tonga has high standards of education and health, statistics for infant mortality rate also show that for every 1,000 babies born, 14 die before their first birthday. Tonga has experienced high mortality rates due to non-communicable diseases; the diseases of the circulatory system, neoplasms, endocrine, nutritional and metabolic, diseases of respiratory system are the most common causes of death. These diseases are usually included in the five leading causes of mortality and are responsible for more than 50% of the total annual deaths. Tonga is on the heavier end of the obesity statistics for the Pacific Islands with 69% of the adult population being obese. The current prevalence of Type 2 diabetes in Tonga is 18%. The prevalence of diabetes has doubled since 1973. In addition, almost another estimated 20% of the population has lesser degrees of glucose intolerance.

[15] GOT Statistics Department. 2017. Tonga National Population and Housing Census 2016. Preliminary Results.

[16] There are approximately 100,000 Tongans living overseas.

98. **General economy**. The economy is vulnerable, with limited local opportunities, a steady outflow of skilled persons moving overseas for opportunities, and a dependence (70%) on rural livelihoods of agriculture and fisheries, where access to markets can be limited.[17] In the outer islands, particularly isolated small islands such as the target islands in Ha'apai and Niuafo'ou; economic vulnerabilities are greater due to distance to markets and strong reliance on subsistence agriculture and fishing. Climate change risks such as increased droughts or changes in fishery stocks, will disproportionately impact communities on these remote islands.

99. Subsistence agriculture plays an important role for many families, contributing to food production for the family, as well as additional income. Production focuses on a range of traditional root crops such as yams, taro, sweet potato and cassava. There has been commercial production with a focus on squash pumpkin for export. However, considerable effort has been made to diversify into higher-value export crops, notably vanilla and watermelon. Issues of quality control, disease management and market demand fluctuations make growth in this sector challenging.

100. Remittances sent from relatives working abroad also play a significant role in the Tongan economy, and in the economy of individual households. Recent global economic downturns have significantly impacted on this economic flow, increasing the level of hardship experienced by many families in Tonga.

101. **'Eua**. Being a larger island and closer to the capital, 'Eua has a greater range of economic activities compared with more remote outer islands. Activities include agriculture, fisheries, handicrafts, forestry and tourism. With the regular ferry services, artisans can easily access markets in Tongatapu where many products of 'Eua (fruits, dyes for tapa cloth etc) are in high demand. 'Eua also has a growing tourism market with visitors to the caves, national park, diving and whale watching activities.

102. There is a piped water supply in the main villages of 'Eua but many people use rain water tanks due to high sedimentation and color in the surface water collection scheme. The island is connected to an electricity grid powered mainly by diesel and recently supplemented by solar energy through the construction of the TPL-operated solar farm in November 2016. There is access to two mobile networks in the town center, although reception can be poor in the outlying areas.

103. **Vava'u**. The group of islands is a well-established tourism market. Neiafu is the trading and administrative center of the island group. Also at Neifau is the Port of Refuge, a deep-water harbor on the south coast of the island. There is an airport which now receives international flights from Fiji on a regular basis. Neiafu has an established infrastructure that includes restaurants, hotels, tour and guide businesses and these economic opportunities together with government and local business (including traditional activities of fishing, agriculture and handicrafts) create the economic backbone of Neiafu and Uta Vava'u.

104. There is a piped water supply but many people rely on water tanks for their potable water supply. Poor water supply (including lack of or broken storage tanks and no piped water to elevated areas), lack of waste services, poor sanitation, unclean environment, poor road conditions and lack of street lights are identified as priority development issues.[18]

[17] IFAD. Rural Poverty in Tonga. Available at http://www.ruralpovertyportal.org/country/home/tags/tonga

[18] GOT - Ministry of Internal Affairs. 2015. Neiafu Community Development Plan. Available at https://media.wix.com/ugd/6d6824_e0e9fb86f7ea4b33921c2013f1a0d1f2.pdf

105. **'O'ua**. Like many islands in Ha'apai, the people of 'O'ua identify water storage as a critical issue, particularly given Ha'apai's vulnerability to drought. In 2014 in 'O'ua 65 rain water storage tanks were recorded for 25 households as families had prioritized this household need.[19] There is no clinic on the island; patients travel by a 45-minute boat-trip to the main island of Pangai to seek medical attention. Households derive seasonal income from sea cucumber harvesting and selling; harvesting is restricted due to conservation concerns and is only permitted for people of 'O'ua. Approximately 30 people from the island participate in the Australian seasonal visa programme, travelling to work in the fruit picking seasons and providing remittances to their families.

106. **Tungua**. The households on this island do not have access to piped water supply or electricity, apart from those with SHS. There is access to the TCC mobile network, although reception can be poor. Livelihoods of people in Tungua are predominantly fishing and handicrafts (pandanus mat weaving). People of Tungua have not participated in the Australian seasonal worker programme. Critical issues identified include lack of water (broken or damaged storage tanks), poor sanitation, limited access to electricity and coastal erosion.[20]

107. **Kotu**. A few households on the island have SHS. There is an underground water supply, with untreated water pumped from the freshwater lens which is vulnerable to contamination.[21] There is access to the TCC mobile network, although reception can be poor. There is no health clinic on the island and patients need travel to Pangai by a 45-minute boat trip. Critical issues for the community are identified as lack of water, lack of navigational facility/safety equipment, lack of flush toilet facilities, lack/damaged solar power and poor telecommunications.[22]

108. The livelihoods in Kotu are predominantly fishing, handicrafts (pandanus mat weaving), and kava production. Kotu is known in Tonga for its high-quality kava, grown on a neighboring uninhabited island. Men produce powdered kava to sell to other islands and to Tongatapu, providing one of the main income sources for some families on the island. The island is also known for building fishing boats which are sold to fishers from other islands in the Ha'apai group.

109. **Mo'unga'one**. In January 2014, this island was devastated by Cyclone Ian; the National Emergency Management Office assessment found that of 26 houses, 20 were destroyed, four sustained major damage and two houses incurred minor damage.[23] There is no piped water supply with people relying on rainwater and no electricity aside from SHS. There is access to the TCC mobile network, although reception can be poor. Similar to other small islands of the Ha'apai group, there is no health clinic and patients travel by boat to Pangai. Livelihoods in Mo'unga'one are predominantly fishing and handicrafts, with pandanus mat weaving an important source of income generated by women in the village. There are no community members who have travelled under the seasonal worker visas to Australia.

[19] GOT & Sustainable Livelihoods Alleviating the Poor Inc. 2014. Luluunga District Water Supply Report. Available at https://www.worldpulse.com/sites/default/files/post/6610/34865/post_document/0b16de0dfc1f6f5fbbe68a73b2ddf05d/lulunga_water_supply_edited.pdf

[20] GOT - Ministry of Internal Affairs. 2014. Tungua Community Development Plan. Available at https://media.wix.com/ugd/6d6824_16a1b47f0f55436dbd1bf1c03df63dcd.pdf

[21] GOT & Sustainable Livelihoods Alleviating the Poor Inc. Ibid

[22] GOT - Ministry of Internal Affairs. 2014. Kotu Community Development Plan. Available at https://media.wix.com/ugd/6d6824_d5683e6a74434c95a9e068d007237e09.pdf

[23] Aho, L. 2014. Situation Report No. 4 Regarding TC Ian in Ha'apai. Available at http://mic.gov.to/tc-ian-in-haapai

110. **Niuafo'ou**. There are eight small villages located in the north and east of the island. The villages have basic infrastructure including four primary schools and one high school (located in Mu'a), a post office, telecommunications station, and an airport in Angahā. Links to other islands and the capital are limited to fortnightly flights and monthly ships transporting goods and passengers. There is some access to communication services through mobile phones. Electricity is limited to SHS; 169 systems were installed and 40 systems were rehabilitated (replacement of batteries and charge regulators) by NZAid in 2006. Some 129 SHS are reported to be in poor condition.[24] Fishing, weaving, and remittances are the most common source of income. Mats, including ta'ovala (traditional mat worn around the waist), woven by local women bring in the most income.

111. **Historic and cultural sites and resources**. The proposed project activities are not expected to have any impacts on historic sites, or cultural resources as sites have been previously cleared and/or used. Consultations confirm that there are no known sites or resources of historic or cultural value at the sites. Should excavation for BESS housing platform or footing for solar panels or mini-grid systems result in accidental discovery of an artefact or site, chance find procedures (established in the EMP) will be implemented.

[24] ADB. 2016. OIREP - Phase 2 Off-grid Site Visit Report. Manila, Philippines

E. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

1. Design and Pre-construction Impacts

112. **Climate change considerations**. The climate risk profile for Tonga indicates sea level rise, extreme wind events, more intense cyclones and increased air and water temperatures. The solar and BESS facilities in Vava'u and 'Eua and the Ha'apai island mini-grids are located away from the coastal zone and will not be impacted by sea level rise. Construction for, and installation of. the solar panel arrays and BESS facilities will be undertaken in accordance with Tonga's Building Code and Standards to ensure they will withstand strong wind. Feeder lines for the mini-grids will be installed underground, like previously installed mini-grids, to increase resilience to cyclones and strong wind.

113. **Environmental management system and environmentally responsible procurement**. Throughout the project, for implementation of environmental safeguards to be effective, a robust environmental management and monitoring system will need to be established. The PMU will ensure that the EMP is updated, as required, based on detailed design and incorporated into the bid documents. The bid documents will also specify other environmental management requirements such as: (i) requirements to comply with applicable standards and the COEP; (ii) the contractor designating a full-time environmental, health and safety officer (EHSO) and deputy EHSO and recruiting a community liaison officer (CLO) from the local community and the reporting/communication lines and channels; (iii) the monitoring and reporting requirements; and (iv) delivery of induction, training and awareness sessions for workers and the community. Prior to works commencing at each site, the contractor will prepare and submit a site-specific construction EMP (CEMP) to the PMU, the CEMP will be based on the project EMP and detail the construction methodology and program to be undertaken at each site, identify the risks associated with that construction methodology and detail mitigation measures to avoid or reduce the risks. The PMU-ESU will review and clear the CEMP and advise the supervising engineer that the CEMP may be approved and no objection to commencement of works given.

114. Once works commence, the EHSO will conduct monitoring of compliance of activities with the approved CEMP and the PMU-ESU will undertake inspections and audits of the effectiveness of the contractor's implementation of the approved CEMP. Given the logistical challenges and cost of transport to outer islands, the ESU may need to delegate regular inspection and auditing to team members either on-site (engineer or site supervisor) or who are required to frequently travel to the sites. The ESU will devise the checklist to be used for the inspections and audits and will consolidate the inspection/audit findings along with summaries of the contractor's monthly reporting. ADB will undertake review missions which will report on, inter alia, overall implementation of environmental safeguard requirements.

115. As early as practicable after commencement, the project will establish a grievance redress mechanism (GRM) to address concerns and resolve complaints and issues raised on any aspect of project implementation (refer also Section G 3). Safeguards concerns will be addressed through the GRM. The CEMP will outline how the contractor will implement the relevant elements of the GRM and how and when they will provide information about construction activities and timing to the community.

116. The contractor will be expected to provide information about the works, impacts and mitigation/control measures to the community in a timely and effective manner. The contractor's liaison and communication with the community, managed by the CLO, will be guided by the project's communications and consultation plan (CCP).

117. Workers and sub-contractors will be inducted to the site and this will include awareness and training on the provisions and requirements of the CEMP and how it is to be implemented.

118. Procurement of consultants and equipment and plant for the project will comply with the prohibited investment activities list in the SPS. The COEP (footnote 5 and Appendix 1) will apply during detailed design, construction and operation and have been referenced as mitigation measures where applicable and tracked through to the EMP.

119. In Niuafo'ou, with the main construction works at the airport site, coordination with Tonga Airports Limited will be crucial to ensure the activities have no impact on airport operations. COEP 17 will apply.

120. **Materials and plant import and/or local sourcing**. Most of the plant and construction materials will be imported to Tonga and transported by boat to the project sites. Imported plant, equipment and materials and the vessels that import them will be subject to clearance procedures under the Quarantine Act and Quarantine Regulations and may require issue of phytosanitary certificates from Quarantine and Quality Management Division of MAFF. Should any materials be sourced locally (i.e. sand or aggregate), the contractor must seek approval (including obtaining any permit or consent required) from the relevant government agency and agreement from, including payment of royalties to, the land/resource owner. Any sand or aggregate extraction required for the project will only be undertaken in accordance with an extraction plan reviewed and cleared by the PMU-ESU and engineer/site supervisor. Vehicles transporting loose materials, from an extraction area to the project site, will be covered and secured with tarpaulin to prevent dust or spillage.

121. **Landscape and visual impacts**. Landscape impacts will be insignificant, given the highly disturbed and modified environments/landscapes the sites will occupy. The site selection process has sought to minimize visual impacts as far as possible by selecting sites that are either remote or sites that are adjacent to already modified environments with similar activities or uses. COEP 1 (section 2.4) and COEP 14 will apply.

122. At the proposed Vava'u site, the solar farm expansion and installation of the BESS facility will create insignificant impacts as the site is adjacent to the existing solar facility and whilst the solar panel arrays will be increased in number, grouping them together in one location will reduce the overall impact. In 'Eua, the construction of the solar facility and installation of the BESS is sited next to the existing TPL solar farm. If vegetation/trees along the boundary can be retained or re-vegetated following clearance and installation of the panels, any visual impacts, including through views from the road, will be insignificant. In Ha'apai, the installation of the mini-grids will create a visual impact. Whilst existing SHS mean that solar panels are a common sight, grouping together solar panels for a collective power generation scheme will result in a larger area of panels and therefore a greater visual impact. The impact is somewhat mitigated through already changed land use due to village activities and uses and the impact will be further mitigated through site boundary planting. The visual impact in Niuafo'ou will be negligible given the site is within the airport and visual impacts of land clearance and construction of buildings etc has already occurred.

123. **Ecological impacts**. Land clearance and tree removal at the sites do not constitute an ecological impact as the trees are productive, have largely been planted rather than naturally occurring, and none provide habitat for endemic or threatened fauna. The Vava'u site will remove approximately 100 mature coconut trees. These trees do not have significant conservation or habitat value, and as such any impact will be minor. In 'Eua, land clearance is minor and will not create conservation or habitat impacts. The planting will mitigate the loss of vegetation.

124. The sites for the mini-grids on the four islands are located within or near villages. Three of the identified sites are on already cleared land. On Kotu the site includes fruit trees and pandanus grass; there will be no ecological impacts through removal of these trees or grasses. To off-set any ecological impacts, the boundaries of sites will be re-vegetated with tree species determined by the PMU. COEP 8 will apply.

125. **Socio-economic impacts**. During the design and pre-construction phase, socio-economic impacts include land clearance and land use change. The total areas required across the seven outer island project sites is 2.7 ha; 3,800 m^2 in 'Eua, 12,000 m^2 in Vava'u, 8,565 m^2 in the four Ha'apai islands and 2,765 m^2 in Niuafo'ou. The access to the land at all sites and the removal of coconut trees at Vava'u, productive trees at 'Eua and the unused small shed structure and productive trees on Kotu will be compensated as per the resettlement plan prepared for the project and application of COEP 3.

126. The acquisition or lease of land for the project and conversion from coconut plantation and fruit/productive trees and vacant/unutilized land to energy generation/production will be a land use change. At some sites, there will be negligible land use impact where the current land uses are neither unique nor high-yielding and at other sites changing from vacant land to a productive use that in turn can improve other uses is a positive impact.

2. Construction Impacts on Physical Environment

127. **Construction activities**. The construction activities at the seven sites include vehicle movements (haulage of materials and plant), land clearance, site layout and establishment of laydown areas, small-scale earthworks for ground leveling, foundation and platform construction/establishment and installation of the facilities and mini-grid infrastructure. Impacts from such activities during the construction phase will be inevitable, the impacts are anticipated to be site-specific, intermittent, localized and largely temporary in nature. In most, if not all, cases such impacts can be mitigated and/or managed.

128. **Air quality**. Air quality conditions at the sites and immediately surrounding areas during construction activities are expected to be temporarily reduced through dust and particulates generated from equipment/vehicle movements and work activities. Fugitive dust emissions will be generated during earthworks, footing and platform excavation, movement of fill and materials around the site, and transport of materials, plant and equipment to and from the sites, especially along unsealed roads. Impacts will be sporadic, temporary/short-lived and subject to the existing weather conditions prevailing at the time.

129. Dust prevention and controls applicable to construction activities are provided in the EMP. The implementation of best practices, mitigation and management measures will greatly reduce potential impacts. Air quality impacts will be managed according to the requirements of COEP 5 (section 6.7). Measures to be included in the CEMP are:

- Reduce the speed of all vehicles entering and working within the site to reduce potential dust;
- Trucks carrying material should be covered with a tarpaulin so that any material will not be spilled during transportation between the project site and boat anchorage area or local material source;
- A water truck will spray the site and local roads as required according to a water spraying schedule on days there is no rain;
- Regular cleaning (washing) of construction vehicles in a dedicated location to reduce dust on site;
- Anti-dust breathing facemasks are to be used by all staff working in high dust areas;
- All machinery, equipment and all vehicles used should be well maintained and emission level should be kept low;
- Cover storage and handling areas, where practicable; and
- Minimize stockpile heights and contain stockpiles with perimeter wind break fencing (or at least covers).

130. **Earthworks and stockpiles**. Earthworks to level the ground and create suitable platforms or footings will be relatively small-scale and provided the works are managed any impacts created will be of minor significance. Earthworks and stockpiles will be managed as per the requirements of COEP 5 (section 6.3). Measures to be included in the CEMP are:

- Topsoil will be preserved and reinstated at the end of the construction period.;
- Earth excavated for footings and facility platforms will be stockpiled at designated areas within the site and re-used if possible;
- Stockpile material that cannot be re-used will be distributed around the site and levelled, excess material will be removed to a designated off-site area approved by the engineer/site supervisor (with permission of local government and/or land owner);
- Bare ground at the site will be seeded/sowed with appropriate species of grasses, particularly under the solar panel arrays, to minimize erosion; and
- Vehicles transporting loose materials will be covered and secured with tarpaulin to prevent dust or spillage.

131. **Erosion and stormwater run-off**. If not correctly managed, site drainage and stormwater run-off can create localized and short-term impacts during high rainfall events (including contamination of adjacent properties and/or water courses and channels through suspended sediments, plastics and construction contaminants entering the surrounding environment). Drainage, erosion and stormwater run-off will be managed as per the requirements of COEP 5 (section 6.5). Measures to be included in the CEMP are:

- The CEMP will include a drainage and erosion control plan which will identify existing stormwater flow paths across the site and potential erosion and stormwater run-off routes and measures to mitigate and control the flow. The plan will identify where drainage, diversion channels and collection tanks will be installed and how frequently they will be cleared and where any material cleared from the drains/channels will be removed to and disposed of;

- To prevent run-off or water from adjacent land shedding onto the site and creating erosion or siltation, bunds or swales/diversion channels will be installed where required along the site boundary;
- Any wastewater generated during construction will be managed through the construction of temporary collection tanks;
- Cover/stabilize all exposed surfaces and excavated materials during construction;
- Implementing effective construction site drainage such that runoff is directed to sediment traps before discharge to the environment;
- All waste-water should not be directed to nor spilled onto any natural water course or body;
- Close construction supervision to ensure the above measures are implemented; and
- Provisions of stop work during periods of heavy rainfall.

132. **Waste and waste management**. Construction activities will generate waste that will need to be stored and disposed of by the contractor. Waste will be managed as per the requirements of COEP 11 and standard industry practice. General construction waste and hazardous substances waste are dealt with separately. Measures to be included in the CEMP to ensure proper on site waste management include:

- The site will be kept in a tidy and hygienic condition. Covered rubbish and waste receptacles will be provided on site; as far as is practicable waste will be segregated (organic, plastic/tin and paper/cardboard for potential reuse or recycling);
- The contractor will discuss disposal and reuse/recycling options with the Waste Authority Ltd and GIO Recycling and include any agreed arrangements in the site-specific CEMP;
- No on-site burning of waste, especially plastics, will be permitted;
- Waste wood will be cut to appropriate lengths and given away as fencing materials or firewood;
- Remaining organic materials are to be neatly stockpiled and/or buried (if acceptable and approved by the engineer/site supervisor) and allowed to decompose over time;
- Waste that cannot be reused will be stored on site in appropriate bins, and removed off-site by the contractor to a designated/approved disposal site; and
- Final disposal in Vava'u will be at the Kalaka landfill and in 'Eua at the Angaha landfill. In Ha'apai and Niuafo'ou, where there are no landfills (only informal dump sites), unless otherwise agreed, waste will be transported to Tongatapu for safe disposal at the Tapuhia landfill.

133. **Storage, use and disposal of hazardous substances**. Use of hazardous substances during construction, such as oils, lubricants and petrochemicals can cause significant impacts if uncontrolled or if waste is not disposed of correctly. Hazardous substances will be managed as per the requirements of COEP 12 and standard industry practice. Measures to be included in the CEMP to ensure proper storage, use and disposal of hazardous substances include:

- Hydrocarbon and toxic material will be stored in adequately protected site/s consistent with national and local regulations and codes of practice to prevent soil and water contamination or harm to people;
- Fuel, oil and hazardous substances must be secured safely at designated areas on site. The area for fuel and oil storage will be concreted and bunded for 110% capacity of the largest volume container stored on site;
- Store hazardous substances above possible flood level;
- All hazardous substances will be stored in a lockable unit within which all substances will be clearly labelled as to what they are, what their use is, and that they are harmful/poisonous;
- An appropriate spill kit/spill containment materials will be kept on site and designated workers will be trained in its use;
- Refueling of vehicles and plant to be undertaken on concrete pads adjacent to the bunded fuel and oil storage area;
- Ensure that safe storage of fuel, other hazardous substances and bulk materials are agreed by DOE and follow internationally recognized good practice;
- Segregate hazardous wastes (oily wastes, used batteries, fuel drums etc) and ensure that storage, transport and disposal shall not cause pollution and shall be undertaken consistent with national regulations and COEP 12;
- Regularly check containers for leakage and undertake necessary repair or replacement;
- Discharge of oil contaminated water shall be prohibited; and
- Used oil and other toxic and hazardous materials shall be disposed of off-site at a facility authorized by the DOE.

134. **Water resources**. Impacts on water resources are not anticipated, as there are no water bodies near the project sites and any spills that could potentially contaminate groundwater will be managed as per the above. COEP 9 will be reviewed for applicability and recommended practices, where relevant, will be identified in the CEMP.

3. Construction Impacts on Ecological Environment

135. There are no nesting birds within the sites. There are no terrestrial protected species or protected areas within or adjacent to the project areas of influence. Overall, terrestrial habitat and resource impacts will be minor.

136. **Vegetation removal**. Minor land clearance will be required at the Vava'u, 'Eua and Kotu sites. Prior to land clearance works, the area to be cleared, trees to be removed and trees to be retained (along site boundaries) will be shown on a site plan and marked on the ground by the contractor (trees to be retained will be identified with hi-vis tape), and approved by the engineer/site supervisor. This control ensures that clearance is strictly within the lease boundaries and that any unnecessary clearance and tree removal is avoided.

137. **Impact of workers on flora and fauna**. Workers from other areas in Tonga and foreign workers may not understand the potential impact on flora and fauna local to the sites and in the wider area. The CEMP will include provisions stating that:

- Workers are not permitted to cut any trees (including mangroves) other than for site clearance purposes and other than those marked on the approved plan;
- Workers will be informed about the tree protection/retention and replanting requirements;
- Workers will be instructed that hunting, capture or killing of any birds or other fauna is prohibited, and sanctions (including possible removal from site) will be imposed on any worker who does not comply; and
- Workers will be instructed that diving for sea cucumbers and hunting, capture or killing of turtles, dolphins and other marine fauna is prohibited and sanctions (including possible removal from site) will be imposed on any worker who does not comply.

4. Construction Impacts on Socio-economic Environment

138. **Noise**. Construction noise will be intermittent and will vary depending on the type of machinery and activity. Noise at the site will be generated by earthworks, site clearing, construction of footings and platforms for panel arrays, BESS and mini-grid facilities. Transient noise will be generated by trucks hauling materials and plant to and from the project site. Based on the type of equipment to be used on site, noise levels generated from the construction footprint are expected to range 70 - 90 dB(A). The magnitude of impacts will depend upon specific types of equipment to be used, the construction methods employed and the scheduling of the work. This will be short-term and intermittent during the construction period.

139. Noise will be managed as per the requirements of COEP 5 (section 6.4) and good practice construction methods such as using well-maintained machinery and vehicles equipped with silencers will ensure impacts can be managed to acceptable levels. Measures to be included in the CEMP to control and manage noise include:

- Machinery and vehicles will be maintained regularly, with attention to silencers and mufflers, to keep construction noise levels to minimum. Machinery to be equipped with silencers as far as practicable;
- Protective devices (ear plugs or ear muffs) will be provided to the workers operating equipment/machinery or in-high noise generating activities;
- For project sites close to sensitive receivers, such as the villages in Ha'apai group, noise barrier/baffle to be installed around the site (can be used a security fence/wall post-construction);
- Advance notification to neighboring residences and uses (including signage) announcing work activities, especially when work is being undertaken outside normal working hours; and
- Scheduling construction, including noisiest, activities to normal working hours (8am – 5pm) Monday to Saturday. Earlier and/or later hours to be agreed locally. No work will be undertaken on Sundays.

140. **Transportation and traffic**. The project will generate traffic movements (including heavy vehicles not common in the outer islands) in the haulage and transportation of materials, equipment and plant to and from landing sites to the project sites. Construction traffic generation will create risks for pedestrians and other vehicles.

141. The CEMP will meet the requirements of COEP 7 and include a traffic management plan detailing haulage routes, on-site requirements and outlining traffic control and safety (including pedestrian) measures as required.

142. **Health and safety risks – workers**. Construction activities of any type and scale include risks to the workers. These risks include, among others, exposure to dust and hazardous materials that may be present in construction materials and project components and physical hazards associated with erecting scaffolding and buildings, working at heights or in confined spaces, and the use of heavy equipment. Health and safety will be managed as per the requirements of the EHSG and COEP 6. Measures to be included in the CEMP to reduce and manage health and safety risks include:

- The contractor will prepare a health and safety plan (HSP) as part of the CEMP. The HSP will establish: (i) activity/job safety procedures and protocols; (ii) plan for HSP training and "toolbox" sessions for workers; (iii) first aid facilities (on-site and in vehicles), personal protective equipment (PPE) and medical evacuations; (iv) routine safety and accident prevention measures; (v) emergency response and preparedness; (vi) accidental environmental instance (e.g. spill) procedures highlighting the sizes and types of impacts that may occur, and the resources (onsite and/or offsite) that will be required to handle and treat the spill; and (vii) accident, near-miss and emergency registry, monitoring and reporting;
- The HSP will cover both occupational health and safety (OH&S) and community health and safety. The HSP will be appropriate to the nature and scope of activities and meet the requirements of good engineering practice, national laws and regulations and the EHSG;
- Before construction commences the contractor/s will conduct training for all workers on environmental safety and environmental hygiene. The contractor will instruct workers in health and safety matters as required by the HSP, good engineering practice and national regulations;
- The contractor will designate one full-time staff as EHSO to implement the HSP;
- The contractor will engage an approved service provider to deliver a program of communicable diseases (including HIV/AIDS/STI) awareness and prevention training to workers and the community;
- Conduct regular meetings to maintain awareness levels of health and safety issues and requirements;
- Ensure that first aid kits and facilities, including access to trained medical personnel, is available on site and arrangements in place to ensure medical attention (including evacuation as necessary) of workers who have suffered an accident or sudden illness;
- Ensure adequate spill response kits are provided, accessible and that designated key staff are trained in their use;

- Workers will be trained in use of any special equipment or machinery. Workers will be instructed in use of safety equipment (harness etc) for working at heights or on scaffolding;
- Observe working hours and official holidays as set out in national law and regulations;
- Excavated trenches must be effectively marked with approved safety signage and/or barrier tape to prevent any accidents;
- Workers, at no cost to themselves, shall be provided (before they start work) with appropriate PPE suitable for the tasks and activities they will undertake. PPE will include safety boots, helmets, gloves, protective clothes, goggles, and ear protection. Instructions on their use around the construction site will be delivered as part of the safety introduction procedures and site agents/foremen will follow up to see that the safety equipment is used and not sold on;
- Provision of potable water supply and sanitary toilet and ablution facilities at the site;
- Child and/or trafficked labor will be strictly prohibited for any activities associated with the project; and
- All measures related to workers' safety and health protection should be free of charge to workers. The HSP, also covering include community health and safety, is to be submitted by the contractor before construction commences and approved by PMU-ESU.

143. **Health and safety risks – community**. The construction activities will create health and safety impacts on the adjacent community related to noise, dust and traffic (dealt with above) and other risks and impacts such as communicable diseases associated with the influx of temporary construction labor.

- The contractor's HSP will address community impacts and management measures in addition to worker health and safety. The HSP will be appropriate to the nature and scope of activities, meet the requirements of good engineering practice and national law and regulations and comply with the EHSG;
- The HSP will include agreement on consultation requirements, establishment and monitoring of acceptable practices to protect community safety, links to the complaints management system for duration of the works (in accordance with the GRM) and system for reporting of accidents and incidents. The PMU will ensure these actions are enforced;
- The contractor will coordinate directly with the grievance focal point(s) (GFP) appointed for the project;
- Before construction commences the contractor/s will conduct training for all workers on environmental safety, environmental hygiene including delivery of the HIV/AIDS/STIs awareness and prevention training and the code of conduct (see sub-section below);
- The contractor, following the requirements of the project's CCP, will inform the community of the works (likely impacts and control and mitigation measures), including the timeframe through information brochures and/or community meetings;

- Tongan minimum wage requirements to be observed, if local staff are required for the assessments. There should be proper enforcement of the labor laws at the work place;
- Child and/or trafficked labor will be strictly prohibited for any activities associated with the project;
- Children will be prohibited from entering the sites (including worker's accommodation, works area/construction zone) and prohibited from playing on any equipment or machinery;
- All advisory and warning signage will be clear, secured on fences, gates and signboards and be posted in Tongan, the language of the main nationality of workers and repeated in English;
- The contractor will implement the traffic management plan which will include traffic control and pedestrian safety measures; and
- The contractor will clearly fence off and post warning signs at the site to prevent the public from entering during the construction period.

144. **Potential for social conflict and influx of project-induced labor**. The construction at each site will require small workforce for between 2 and 4 months. While the contractor will be encouraged to maximize, as far as possible, local labor to reduce potential for conflict and to provide work and income opportunities, skilled national laborers (with certification) in all trade areas are short in the outer islands, therefore it is likely the contractor(s) will need to recruit from overseas. The contractor will be encouraged to provide on-the-job training of local laborers in certain trade areas which would be an enhancement and additional benefit of the project.

145. It is possible that bringing in workers from outside of Tonga, especially to the remote and isolated outer islands, could create social conflict. The contractors may propose laborers from overseas, but local labor will be preferred. The contractor will be required to adopt good management practices to ensure that impacts associated with works/activities, presence of workers, and a storage/maintenance area are minimized. Measures will be implemented to avoid or reduce potential conflict between: (i) local and foreign workers; (ii) workers and the contractor; and (iii) workers and community/public. At Vava'u the site is in Neiafu the main town and the project sites on the four Ha'apai islands are adjacent to villages and therefore interaction between the public and workers will occur and will need to be managed.

146. The contractor will be required to recruit a CLO from within the local community. The CLO will work closely with the ESHO and the PMU-ESU to ensure construction workers adhere to the agreed protocols and workers and adjacent community participate in programs, including HIV/AIDS/STI awareness and prevention, gender, and community consultations. The following measures will be included in the CEMP to manage or mitigate potential conflict or social impacts arising from influx of workers:

- Implementation of the project's CCP;
- Recruitment of a CLO from within the local community;
- Ensure that community and stakeholders are aware of the GRM and how to access the GRM;

- PMU-ESU and CLO to facilitate agreement of protocols--code of social conduct--between the contractor and community leaders. The protocols will govern workers' conduct while at work and in communities, behavior around women and children, restrictions on alcohol consumption, prohibitions (with sanctions for non-compliance) on workers hunting or fishing, implementation of awareness programs, implementation of the GRM and handling of complaints, hiring of local labor, and implementation of the HSP;
- The contractor will engage/recruit an approved service provider to deliver the HIV/AIDS/STI awareness and prevention program to workers and community;
- Workers' access to portable toilets and associated sanitation facilities will be provided at the site(s).
- The contractor will erect notice boards and distribute information pamphlets regarding the scope and schedule of construction, as well as certain construction activities causing disruptions or access restrictions;
- All notice boards and signage to be written in English and Tongan;
- For unskilled activities and labor, every effort to hire local people (including women) for these positions should be a priority:
- Accidental damage to utilities will be minimized by (i) obtaining plans from the public utilities identifying locations of pipelines, conduits and power cables and (ii) consultation with staff on the location of utilities prior to commencing excavation operations.

147. **Impacts on physical cultural resources**. As noted in Section D 3, there are no cultural or physical cultural heritage sites or resources associated with the proposed sites. Nevertheless, the EMP includes a protocol for accidental or chance finds to ensure protection of unforeseen physical cultural resources. If there is a chance-find of cultural resources during the construction process, construction must immediately cease, and the engineer/ site supervisor informed. If for example an artifact or unmarked grave is discovered, the contractor (through the CLO) and engineer/site supervisor will consult the appropriate community leaders and members, and collectively determine the most appropriate way to treat the discovery with respect. The PMU will be informed of the discovery and the requisite way it will be/has been dealt with. COEP 4 will apply.

5. Operation Impacts on Physical Environment

148. Unlike diesel generation plants, solar power plants have negligible environmental impacts during operation. There are no noise, dust or gaseous emissions, and no waste materials generated. For the mini-grid components in Ha'apai, there will be some minor impacts experienced given the proximity of the facilities to each of the villages. Some visual impact, including glare from the panels, may be experienced. However, with the existing SHS and solar street lighting, solar panels are now a commonplace sight in the villages, and there were no concerns expressed in relation to this issue.

149. Refilling of the diesel generator must be taken with care to avoid spillage. Construction stage measures can be implemented to control and mange this activity.

150. TPL and MEIDECC will apply the relevant COEP including;

6. Operation Impacts on Ecological Environment

151. To date there are no attempts in peer reviewed scientific literature that attempt to quantify the impact of PV solar farms on birds purely from an ecological perspective. One study examined habitat use by birds at PV solar installations versus adjacent habitats to assess whether PV installations at airports increase the risk of aircraft bird strike. The main attractant for birds was the potential for solar arrays to be used as nesting grounds; however, this claim was not supported with evidence and further, airport management tends to focus on measures to detract birds to avoid or minimize bird-strike potential.[25] The potential collision risk for flying animals is lower for solar farms than it is for wind farms. The potential risk of barrier effects and habitat loss could occur in large-scale solar PV development, simply because of the land area they require and the necessary surface area required to harvest sunlight. The average size of the seven sites is 3,857 m^2 and the Vava'u site is the largest (12,000 m^2), none of the sites will create bird or bat habitat impacts or barrier effects given already highly modified environments. The conclusion is there will be limited, if any, avifauna impacts are anticipated due to operation of solar PV sites.

152. The risk of soil and water contamination from fuel spillage at the mini-grids must be managed carefully to avoid environmental degradation. Measures are included in the operation stage part of the EMP table.

7. Operation Impacts on Socio-Economic Environment

153. **Noise**. The operation of the mini-grid back-up diesel generators has a potential to create impacts. This includes noise emissions and the potential for contamination of soil through fuel spillage. For noise emissions, the siting of the generator within the site will be determined in the final detailed design. It should be placed to minimize impact for nearby residences. The housing of the generators will also reduce the noise. The generator will be used at times of low solar outputs. At night, this needs to be restricted to reduce noise to acceptable night levels. In special circumstances, such as a funeral or a village function, this can be waived, but standard operating times will be in place. Given that the mini-grids are a community asset, the community members should have a say on the operating times.

154. **On-site staff**. There are expected to be no adverse impacts during the operational phase of the projects in Vava'u and 'Eua. Minimal additional staff will be required, with the small number of on-site staff producing low volumes of domestic and liquid waste. TPL already have a high standard of workplace health and safety, which includes sound house-keeping practices on all sites. Bins are provided for waste, and materials that can be recycled are neatly stockpiled before sale.

155. **Access to improved and reliable energy sources**. In both Vava'u and 'Eua, where the developments are on-grid, a clear message from the consultations was that people are looking for renewable energy to generate a reduction in the cost of power. To date, the solar developments in 'Eua and Vava'u are not perceived as having brought benefit (through cost savings) to the people. It is important as TPL reaches renewable energy targets, that it communicate cost saving results from renewable energy, to ensure that people continue to show strong support for renewable energy initiatives.

[25] Harrison. C et al. 2016. Evidence Review of the Impact of Solar Farms on Birds, Bats and General Ecology. Manchester Metropolitan University, U.K.

156. Messages about savings can be communicated regularly through bills to consumers, and directly to MEIDECC - Energy Department to ensure that progress towards energy targets can be clearly mapped and communicated.

157. In the four islands of Ha'apai, the current power sources are SHS to provide basic lighting and device charging facility to homes, as well as two-stroke or petrol generator sets that are used for village functions, or to power individual activities such as operating a washing machine. Many homes do not have generators, and borrow them from time to time from neighbors or a local church. The fuel costs must be borne by the user. At consultation meetings, there was a high level of dissatisfaction expressed, with power supply options being unreliable and failing to meet the needs of the people. As such, the installation of the mini-grids will be a benefit to communities, providing lifestyle improvements, and improving economic opportunities.

158. **Ability to pay**. A potential impact is unsustainable financial obligations for people. Historically, many households have struggled to pay the monthly fee of TOP13/month, which is charged to cover the costs of maintaining the SHS. There is a concern that this inability to pay will continue for the larger obligation under a higher power consumption model. However, the feedback from community meetings is that TOP13 is too expensive given the limited output of power and service unreliability. A strong demand was expressed for improved power supply, with many families able to access goods such as white goods if they had the power supply. The use of petrol or two-stroke generators and their associated high costs, demonstrates that households can find the funds for energy, and they look forward to accessing a reliable and more cost-effective means to do so. A consideration in this regard is use of 'pay as you go' meters which provide households with autonomy in the way they consume and pay for electricity.

159. For the mini-grid systems in Ha'apai and Niuafo'ou, affordability is a key issue for the communities. Whilst there is a strong demand for the opportunities of electrification, there is also some concern about ability to pay. Pre-paid meters will be an important mitigation strategy, as they provide consumers with direct and tangible incentives to minimize consumption. One risk is that in a village with a small number of consumers the economy of scale in providing the power becomes compromised. The MEIDECC – Energy Department and the PMU will play an important role in awareness raising, as well as in modeling tariffs that are acceptable to communities.

160. **Poverty reduction potential**. As a small island economy and lower middle-income country, Tonga is geographically isolated and has limited human resources. Its economy is dependent on imports, but exports are low. Like other Pacific island countries, it is highly vulnerable to external economic shocks as well as natural disasters. Tonga has mostly experienced low and volatile growth, and its economy is dominated by the service sector and by the public sector. High levels of remittances are necessary to boost the economy and household revenue.

161. About 23% of Tonga's population are considered to live in poverty.[26] Tonga did not meet its Millennium Development Goals targets for poverty. Although there is no absolute poverty in Tonga, due in part to a high level of remittances and subsistence farming and fishing, there is a high level of income disparity. Notably, per capita revenue on Tongatapu is approximately 15% above the national GDP per capita, while on outer islands it is approximately 40% below the national average.[27]

[26] Asian Development Bank - ERCD. 2016. Basic 2016 Statistics. Manila, Philippines (p. 2)

[27] Government of Tonga. 2015. Millennium Development Goals Final Report. Nuku'alofa

162. Further, households headed by women account for 24.6% of those falling below the basic needs poverty line and 29.5% of children living in households headed by women fall below the basic needs poverty line.[28]

163. The poor who live in the outer islands (O'ua with 36 customers, Tungua with 53 customers, Kotu with 43 customers, and Mo'unga'one with 22 customers) currently access the electricity generated from SHS for limited periods during the day. Existing SHS are in varying states of disrepair. Any 'alternating current' power on these islands is generated from household fossil-fuel generators. Existing and new customers in the outer islands will be able to enjoy the project benefits described below.

164. **Project socio-economic benefits**. The positive socio-economic impacts of the project include:

- Improved access to and reliability of power supply will help local businesses, especially in the outer islands;
- Downward pressure on tariffs will support business activity, including household income generation and small local businesses. It is noted that some residential supply is subsidized, but this does not apply to electricity supply to enterprises and businesses;
- Reduced expenditure on fuel imports will reduce pressure on the national budget, releasing funds for other economic investments;
- Increased national energy security creates a better environment for business development;
- Entrepreneurial opportunities relate to renewable energy;
- Improved and clean energy supply benefits to the tourism sector;
- Improved reliability of power supply on some grids will support household income generating activities;
- Improved affordability of power supply will reduce household expenditure on energy, releasing income for other essentials such as education and food;
- Notably, on outer islands, increased access to electricity will result in significant social benefits: including improved education, income generation at household levels, reduced household expenditure on kerosene, lowered fire risk from kerosene lighting, and reduced fuel wood consumption; and
- Improved lighting means more time for community meetings, meaning improved conflict resolution. It is observed that afternoon/night time meetings tend to involve majority of the community members to discuss issues and come to a consensus.

8. Decommissioning Impacts

165. **Effects on physical resources**. The project's solar PV panels are expected to have an economic life of 25 years. It is projected that the panels will be replaced as they reach the end of their life, utilizing the same infrastructure for the mounting of new panels.

[28] Government of Tonga. 2015. Tonga Strategic Development Framework 2015–2025. Nuku'alofa (p.30)

166. Decommissioned solar PV panels will be exported for recycling, based on the most economically viable option for the freight. One way of ensuring that recycling can be undertaken is to include the safe recycling of the decommissioned panels in the contract for supply of new panels. If there is not a recycling market for the solar panels, they will need to be disposed of safely. At the time of decommissioning, TPL and MEIDECC will need to research the best available option in consultation with the industry.

167. Lead acid batteries are simple to recycle, with local recycling company, GIO Recycling, already packing and exporting batteries off-shore. The experience to date in the outer islands is that often the lead from faulty batteries is re-used for fishing line weights, with the plastic housing and acid discarded carelessly. Using newer batteries will prevent this, as they are sealed units with gel rather than liquids and more likely to remain intact during the storage before they can be taken off-island. COEP 15 includes a procedure for decommissioning faulty batteries, with this process continually reinforced in all trainings and engagements with communities. The recycling of lithium ion batteries is more complex, as the global market for the recycling is under-developed. Although lithium is 100% recyclable, it is currently not economically feasible to recycle lithium batteries due to lack of standardization in battery chemistry and housing. However, the demand for lithium batteries is increasing rapidly, particularly with the growing market in energy storage. It is hoped that by the stage of decommissioning there will be a practical recycling solution for lithium ion batteries. The recommendation included in the EMP is for the procurement package for replacement batteries to include the recycling / safe disposal of old batteries.

168. Storage of decommissioned batteries will be necessary whilst building a reasonable stockpile for recycling and/or disposal. It is critical that TPL and off-grid communities store old batteries safely without any risk of hazardous waste materials spilling into the environment. All batteries must be stored neatly in a purpose-built storage area with a concrete floor and roof, or in a self-contained module such as a shipping container. This needs to be incorporated into the detailed design of the mini-grids to ensure that appropriate storage is made easy.

169. For management and mitigation measures, the EMP table includes reference to relevant COEP including COEP 5, COEP15, COEP19 and COEP 20.

9. Cumulative Impacts

21. The proposed project is part of an integrated program for replacing diesel generation with renewable energy sources over time. As outlined in the TERM, this is important in terms of energy security, economic resilience, and environmental sustainability. Increasing the capacity of solar energy generation along with increasing storage through BESS will make a significant contribution to achieving the aim and objectives of the TERM. With the proposed project combined with existing renewable energy infrastructure in place or in the pipeline, Tonga will meet its NDC. Cumulatively this is of substantial environmental, economic and social benefit to Tonga.

22. For the outer island components in Ha'apai and Niuafo'ou, the proposed mini-grids are an expansion of the existing four mini-grids in Ha'apai. This step-by-step approach to rural electrification allows MEIDECC to continue to improve the lives of remote communities, but in a way that lessons learned can be built upon, with improvements to the way tariffs and maintenance are managed. As these projects and investments continue to roll out, the cumulative impact is overwhelmingly positive including increased number and range of livelihood opportunities, and improved health, education and lifestyles, particularly for women. All of which can contribute to halting, if not reversing, emigration from outer islands to the capital and even elsewhere in Pacific region.

F. ANALYSIS OF ALTERNATIVES

170. In designing the outer island components of the project, alternatives including sites and technologies have been considered.

171. **Site selection**. For the expansion of solar generation and installation of BESS facilities for on-grid systems ('Eua and Vava'u) co-locating with existing facilities is the best option from a technical and environmental point of view. In selecting sites for the mini-grids, MEIDECC analyzed islands where the systems would be technically feasible, and the communities were interested in increasing access to power. There are still many remote islands where this technology would be feasible. However, it is important to undertake the roll-out over time, ensuring that best available technologies are utilized, and that tariff and maintenance systems are developed that underpin the sustainability of the initiatives. Various options for site development were considered with reasons for selection amounting to; land availability including factors such as topography, access, size, ownership, use and proximity to existing generation sites.

172. The 'with and without project' alternatives were assessed. For the on-grid components, it makes sense to expand the renewable energy components and improve energy efficiencies through battery storage. The developments are minor in scale, but continue to build on the efforts to reach the renewable energy targets. If these components were not added, Tonga would not realize the associated savings in diesel use, which is compounded in outer islands due to the additional cost of delivering fuel to 'Eua and Vava'u. The reduction in CO_2 emissions would not be made, resulting in less environmental gain.

173. **The 'no project' option**. In assessing the 'no project' alternative for the mini-grid components, the loss is not so focused on emission reductions given the small scale of the energy supply. However, of all the project components, the mini-grids will have a significant poverty reduction benefit. By continuing to strive for sustainable and reliable energy supply for remote islands, the GOT is improving living conditions and assisting communities to remain intact in the trend of migration to larger centers in Tonga or abroad. By including remote electrification as a project component, the project broadens its focus to improve environmental and socio-economic performance of the energy sector.

174. Without the increased investment in renewable energy infrastructure, Tonga would continue to pay a high price for diesel imports, and be vulnerable to price fluctuations and the impacts on GDP. This lack of economic resilience ultimately affects the customers and increases pressures on poor and vulnerable households, whilst reducing economic investment opportunities. As a small island developing state, Tonga is particularly vulnerable to natural disaster, climate change, and economic shocks. Diversifying sources of energy increases Tonga's resilience and capacity to adapt to a changing world. If this investment does not occur, the environmental, economic and social costs are high.

G. INFORMATION DISCLOSURE, CONSULTATIONS AND GREIVANCE REDRESS

1. Information Disclosure

175. Most project documents, including safeguards due diligence and monitoring reports, are subject to public disclosure and therefore will be made available to the public. Project documents, including this IEE, will be disclosed on ADB's website and locally as per the ADB Public Communications Policy 2011 and relevant laws of Tonga.

2. Stakeholder and Community Consultations

176. **Consultation during project preparation**. As part of the environmental and social assessments, consultations with stakeholders and potential beneficiaries were undertaken. The list of people met is included in Appendix 3. In total 79 stakeholders were consulted (including 53 men and 26 women) during the field work in the outer islands, as shown in Table 7.1.

Table 7.1: Summary of Community Consultations

Location	Date	No. of participants		
		Total	Male	Female
Vava'u	30-Mar-17	5	3	2
Vava'u	30-Mar-17	39	27	12
O'ua	04-Apr-17	13	6	7
Tungua	05-Apr-17	9	9	0
Kotu	06-Apr-17	13	8	5
Total		79	53	26

Source: Project consultations (2017)

177. The consultations did not raise any specific environmental concerns about the project. Key issues raised during the public meetings in Vava'u included: (i) strong opinion that investment in renewable energy results in a cost reduction for power producers and this should be passed on to the consumers. People support renewable energy but are looking for it to make a real difference in their lives; they have not felt the benefits to date; (ii) the existing solar farm has not created any issues and extending at the same site was viewed as practical and low impact; (iii) strong support for renewable energy and leadership for climate change was expressed; and (iv) support for the project but the need for tariff reductions to improve day-to-day living and the business economy of Vava'u was emphasised.

178. Key points raised in the Kotu community meeting included: (i) the community generally support the project and are very keen to see the improvements that energy will bring; (ii) a lot of emphasis on the requirement for power to improve livelihoods – lights for weaving and handicrafts at night, kava grinding, and freezers to preserve fish. There is also some work in boat building and repairs, and having reliable power would strengthen this opportunity; (iii) there was a lot of discussion about the capacity to pay and the need for caution to make sure that people can afford the bills. Other people mentioned already high costs in keeping generator sets running; (iv) support for 'pay as you go' meters to assist households manage power consumption and costs; (v) dissatisfaction with current SHS as not enough power and unreliable.

179. Many people expressed that they were willing to pay, but not when it the system does not meet their needs; and (vi) overall the meeting agreed that they could manage to pay and the benefits will be significant.

180. At the O'ua community meeting similar points raised in the Kotu meeting (i), (iii), (iv) and (v) were expressed. In addition the meeting: (i) registered enthusiasm for the benefits of power and renewable energy specifically; (ii) raised some concern that they were agreeing to something when they did not know the costs; (iii) spoke about having the courage to make a big difference now so that future generations would look back on this time and know that the right decisions were made.

181. Key issues raised in the Tungua community meeting also echoed those of Kotu and O'ua. In addition, it was noted there is dissatisfaction with current SHS as insufficient and unreliable power. Problems with maintenance were noted and that people did not want to pay for something that is not working. The monthly bill of TOP13 continues to be a problem for some households.

182. **Consultation during implementation**. Consultation will be ongoing throughout the project and will be guided by the project's CCP. Communities will be informed prior to any civil works commencing and information about the GRM will be provided. Consultation will be critical in setting sustainable tariffs for the mini-grids, and working closely with communities to ensure they have the necessary support for budgeting and management of power. In addition to meeting the requirements of the ADB Public Communication Policy 2011 and SPS, the CCP will address COEP 2.

3. Grievance Redress Mechanism

183. During project implementation, it is possible that people may have concerns with the project's environmental performance. People may perceive negative impacts during the construction or operational phase, and have a right to have their complaint fairly heard and acted on. Many issues can be resolved effectively through timely communication, inquiry, and mitigation measures. It is an ADB requirement to establish a GRM and for the GRM to function throughout a project. The GRM should be designed to efficiently receive and facilitate the resolution of affected peoples' concerns and grievances about any aspect of the project including any project-level social and environmental issues within a reasonable timeframe. The GRM should (i) be easily accessible and free from repercussions for those making a complaint; (ii) be scaled to the risks and impacts of the project; and (iii) be sensitive to culture and gender and reflect local traditions for conflict resolution as much as possible.

184. The GRM established for the project will address complaints promptly, using an understandable and transparent process that is gender responsive, culturally appropriate, and readily accessible to all segments of the community. The process will not incur costs or retributions, and will not impede access to Tonga's judicial or administrative remedies.

185. **Grievance coordination**. Grievance focal points (GFP) will be established in the communities around the sites to coordinate and help address complaints and concerns arising from any project component. The contact details for GFP, PMU and contractor's CLO will be clearly communicated to persons potentially affected by the project. The GFP will be assisted and supported by the CLO and PMU-ESU; both will maintain a register of complaints (CLO – site/contractor registry, PMU – project registry to compile all site registers), keep track of their status and record in reports.

186. The PMU and CLO will track complaints received, actions taken and the status of resolution (including close-out), reporting regularly to the executing agency and ADB and through the ESU bi-annual reporting process.

187. All communications with the complainant will be documented and whether preemptive action can or has been taken to avoid community concerns in the future. Complaint forms will be distributed to the GFPs to facilitate recording of complaints; however, complaints to be addressed through the GRM may be written or verbal.

188. The GRM register (at both site and project levels) will include: name of complainant (and contact details), date of complaint, nature of complaint, person receiving the complaint, whether the complaint made is verbal or written, other people consulted, action taken or to be taken and date by which action is required, response of complainant to action (and whether/what further action required) and close-out date.

189. Post-project, the GRM will revert to existing systems. For environmental related matters, a complainant can seek resolution of a grievance through directly triggering the environmental complaint and investigation mechanism within MEIDECC. The complaint will be referred immediately to the CEO - MEIDECC. After assessing the nature of the complaint, it is delegated to a relevant staff member to investigate and report on the complaint and follow-up action taken. TPL also has a complaint system, with all complaints and resolutions documented and reported to the TPL Board.

190. **Grievance procedures**. Complainants will be informed that they can ask any questions or discuss grievances with the CLO, GFP or district/town office representative by phone or in person; or to project staff visiting the area. Once a grievance is received, depending on the nature of the complaint, the GFP or CLO is encouraged to discuss the issue with the contractor, ESU or PMU, as often minor issues/grievances can be remedied with immediate action.

191. If the question/grievance is not satisfactorily resolved within one week, and was initially registered verbally, the grievance should be prepared in writing (using the assistance of local community leader, church or school if necessary). The complainant will also be informed that national and international project staff can assist them with writing a grievance if necessary. Written complaints can be sent or delivered to the GFP where they will be recorded in the registry alongside the initial verbal complaint. The GFP or CLO may discuss with PMU depending on the nature of the grievance, and will have one week to deliver a resolution to the complainant. During this time, TPL staff and ESU members can assist the GFP with investigation and further consultation if required. If a satisfactory response cannot be provided, the complainant may raise the issue to the PMU and receive a response within seven days.

192. A complainant also has the right to take the dispute to the Minster - MEIDECC, who will also have one week to respond. If the situation is not resolvable, or the complainant does not accept the decision, depending on the nature of the complaint, they may have recourse to a court (Land Court for e.g.). All court costs (preparation and representation) will be paid for by the project; regardless of the outcome. Table 7.2 outlines the main steps in the grievance resolution process.

Table 7.2: Grievance Resolution Process

GRM respondent	Steps/required activities	Timeframe
CLO/GFP –or village/district officer	Verbally responds to questions and or complaints and records in site register. In agreement with PMU or contractor, suggests action to address the complaint. Depending on nature of grievance, may represent complainant in direct discussions with PMU or contractor. If no response within 1 week, or response is unsatisfactory, complaint raised to next level. If initially complaint was verbal, is recorded on form or letter by complainant (incl. any action to date)	ASAP 1 week
District/Town GFP	Attempts to resolve complaint. If complaint is not resolved in one week, it is passed by the GFP to the PMU.	1 week
PMU	Acknowledges the written complaint, ESU records in project GRM registry and PMU attempts to resolve it with complainant. Depending on the nature of the complaint, the ESU will work closely with the implementing/executing agency, contractor or TPL to resolve the issue. If a satisfactory solution is not reached, the PMU refers it to Minster - MEIDECC.	1 week
Minster - MEIDECC	Consults with other Minsters, the GFP and PMU in the resolution of complaints. The Minister makes a decision and notifies complainant within 1 week. If the decision is still unacceptable to the complainant, they may take it before the Court (Land Court or other relevant court), with all costs paid for by the project.	1 week
Court	The court hears the case and makes a final decision that is binding on all parties.	Court procedural timeframes

H. ENVIRONMENTAL MANAGEMENT PLAN

1. Introduction

193. The EMP provides the framework for addressing the environmental impacts of a project. It outlines the key environmental mitigation, management and monitoring activities that will be undertaken by TPL, MEIDECC and the PMU to avoid or reduce and/or manage environmental impacts. The general purpose of the EMP is to:

- encourage good management practices through planning and commitment to environmental safeguards;
- provide rational and practical environmental and social guidelines that will assist in avoiding or minimizing adverse environmental impacts;
- outline the institutional arrangements for the environmental management requirements throughout the project;
- provide for compliance with applicable laws, regulations, standards and guidelines for the protection of the environment;
- provide for adoption of best practice in impact mitigation;
- describe the safeguards monitoring and reporting procedures for the project; and
- outline the requirements for training and awareness-raising for environmental obligations and compliance.

194. The EMP includes actions required for: (i) pre-construction (detailed design and contractor procurement requirements); (ii) construction; and (iii) operational and decommissioning phases of the project. The project's EMP is presented as a matrix defining impacts and mitigation measures needed to prevent or reduce effects and outlining the monitoring actions to track compliance and effectiveness of the mitigation measures.

195. The outline EMP (Table 8.1) has been developed to identify the measures that are to be implemented to minimize or manage adverse environmental impacts. The EMP includes the potential environmental impacts and their mitigation measures identified in Section 5, as well as roles and responsibilities and timescales for implementation. The EMP serves as a guide for the contractor in the development of their CEMP, and the workforce on their roles and responsibilities concerning environmental management on site.

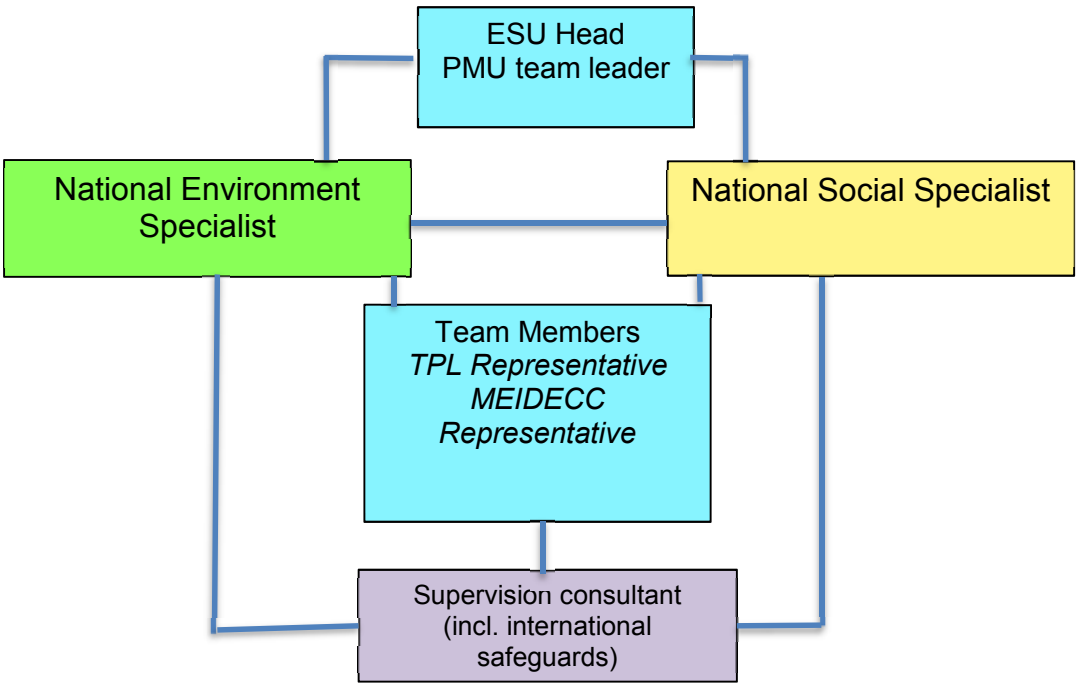
196. The requirements identified for pre-construction mostly relate to PMU requirements in respect of EMP updating and incorporation into bid documents, obtaining government approvals and clearances, and contractor requirements in respect of preparation of the CEMP, induction to the site and implementation of the CEMP. The construction phase includes: i) site clearance and preparation and, ii) works related to construction and installation of the renewable energy infrastructure. All construction activities are covered included in the outline EMP. Operation and decommissioning requirements will be under the purview of TPL and MEIDECC and include waste management during maintenance, replacement and disposal of batteries and health and safety. The management measures in these latter project phases rely heavily upon COEP requirements as reflecting standard and good industry practice.

2. Institutional Arrangements for Environmental Management

197. **Project oversight**. The executing agency for the project is the MFNP and the project's implementing agencies are MEIDECC – Energy Department and TPL. A project steering committee will be established to provide overall coordination and administrative oversight during the project's implementation. The MEIDECC – DOE will be the lead agency for ensuring environmental compliance with legislation and issuance of clearances and permits for the project. Overall the executing agency and implementing agencies are responsible for compliance with the project agreements (covenants and assurances) on behalf of the GOT.

198. **Project management**. The PMU established under the OIREP will manage the activities under the new project and coordinate with other government ministries, departments, and the development partners. The PMU will include counterpart staff from TPL and MEIDECC supported by supervision consultants. The PMU will be responsible for the project's contract management, supervision, and day-to-day implementation, including safeguards compliance, financial management, monitoring, and evaluation. The PMU will be responsible for procuring the civil works contractor(s) with oversight by ADB. Under the project the PMU will be expanded to include the ESU. Figure 8.1 provides a proposed structure for the ESU.

Figure 8.1: Proposed ESU Structure



199. **Project supervision**. A supervision consultant will be recruited to support the PMU to deliver the project. The supervision consultant will include, inter alia, international and national environmental and social safeguards specialists who will provide support and mentoring as required to the national specialists for updating and implementing the required safeguards tools and instruments. During the pre-construction phase the supervision consultant will assist the PMU prepare the tender/bidding and contract documentation which will include the updated EMP and other provisions for safeguard requirements as relevant. The updated EMP and CCP will be disclosed to all stakeholders including the successful contractor(s).

200. Following award of the civil works contract, depending on the environmental management experience of the contractor, the supervision consultant may need to provide support and assistance to the contractor during preparation of the CEMP. The contractor will prepare and submit the CEMP and PMU-ESU will review and clear the CEMP prior to any physical activities being undertaken by the contractor. The PMU-ESU will advise the engineer/site supervisor the CEMP is cleared and no objection to commencement of works may be given. During construction, the PMU will regularly monitor compliance of the contractor with the approved CEMP; this will include inspections, spot-checks and audits which will be documented in the monitoring reports (refer Section H 3). The supervision consultant will assist in the preparation of suitable checklists for the compliance checks and inspections/audits.

201. **Project construction**. The contractor will be responsible for ensuring that the project's environmental management and mitigation requirements specified in the tender/bid and contract documents are implemented during construction. The contractor will designate a full-time staff as EHSO (and deputy EHSO) and recruit a CLO from the community to prepare, implement (and report on implementation of) the CEMP and CCP. For CEMP preparation and implementation, the contractor will need to undertake the following:

- Compliance with any conditions of GOT project clearance and approval(s);
- Compliance with environmental legislation, treaties and conventions, SPS, EHSG and COEP;
- Maintain a site diary and site-level grievance registry;
- Maintain a healthy safe work and practices for the workers and the public;
- Identify, control and where possible minimize the adverse environmental impacts arising from the works; and
- As per the CCP, provide timely information and communicate openly with the government and stakeholders regarding environmental performance.

202. The contract will specify the period, following contract award, within which the contractor must submit for review and clearance, their site-specific CEMP.[29] The contractor will be required to prepare their CEMP which will describe their site-specific construction methodology for the components of the project, risk assessment and the measures to avoid or mitigate the risks/impacts. These will be described in text and in drawings (site plans). The CEMP will include sections or sub-plans as identified in Section E and Table 8.1. The CEMP and all sub-plans will need to be consistent with ADB's SPS, the laws of Tonga and international treaties ratified by Tonga and the COEP. The CEMP will include sections or sub-plans covering:

- Earthworks and spoil management (including material re-use);
- Erosion and stormwater run-off/sediment control;
- Waste management;
- Hazardous substances management;
- Traffic management; and

[29] If one contract will be awarded covering all sites/components, in addition to the universal elements of the CEMP which will apply to all sites, the CEMP will include site-specific plans and drawings and construction methodologies for each site reflecting the specific conditions and requirements at that site.

- Health and safety (workers and community).

203. **Environmental management budget**. The costs for preparing and implementing the CEMP will be included in the civil works contract. The contract should identify costs in the bill of quantities for: (i) preparation of the CEMP; (ii) recruitment of the ESHO and deputy EHSO (full-time) for managing and reporting on the implementation of the CEMP; (iii) recruitment of a full-time CLO from the local community; and (iv) required mitigation measures. For item (ii) and (iii) the contractor will include a cost, and for item (iv), the contractor will be required to cost the mitigation measures identified in the outline EMP and included in their CEMP, these costs are also to be included in the civil works contract.

204. The costs of the national specialists in the PMU's ESU will be included as project costs (or government contributions if existing government staff are seconded to the roles) and the international specialists included in the supervision consultant will be included under the project services contract. The costs should be based on an international specialist providing intermittent 8.5 months' inputs over a 24-month period and include sufficient travel budget for travel to/from Tonga and to visit each outer island site at least twice during the construction period. For the replanting and site re-vegetation works, a separate shopping procurement process will take place. A budget of $15,000 to be included in the bill of quantities for purchase of suitable plants/trees and labor for the replanting the boundaries of each of the sites.

3. Monitoring and Reporting

205. **Monitoring.** The project monitoring program is commensurate with the project level of risk and will focus on the environment within the area of influence. The program considers the scope of monitoring and frequency. The monitoring program will largely focus on parameters, as identified in Table 8.1, which can be monitored visually or with the use of basic equipment if required (such as noise meter). No additional baseline or instrumented testing is required and the monitoring will focus on compliance with measures in the approved CEMP.

206. The monitoring and reporting requirements are specified in the EMP table. The monitoring time-frame will require either daily (by contractor and engineer/site supervisor) and monthly (by PMU) inspections during the construction phase especially during key activities associated with the site clearance and preparation and earthworks.

207. **Reporting**. The construction contractor will prepare monthly reports that will include a description of CEMP implementation, any non-compliances or corrective actions required, and will include summary of (i) the ESHO's site diary notes and completed checklists of the daily/weekly monitoring and main activities (including grievances registered) of the CLO.

208. The engineer/site supervisor will conduct regular checks of compliance with the approved CEMP as part of site and works quality/performance management and contract supervision, the PMU will regularly (at least monthly) undertake inspections and audits of the contractor's compliance with the approved CEMP. The PMU will prepare project quarterly progress reports (QPR) that will include a section on safeguards aspects, including a summary of contractor's monthly reports, CEMP compliance monitoring undertaken by the contractor, engineer and PMU, and any training and capacity building activities provided by the supervision consultant to the PMU, other government staff (i.e. TPL and MEIDECC) and/or contractor. Based on the QPR, the PMU will prepare and submit to MFNP and ADB, semi-annual safeguards monitoring reports. The outline contents of the semi-annual safeguards monitoring reports are included in the project administration manual.

Table 8.1: Environmental Management and Monitoring Plan

Project activity	Potential impact	Management and Mitigation		Monitoring		
		Proposed measures	Institutional responsibility	Frequency/ interval	Verification means	Institutional responsibility
Design and Pre-construction Phase						
Design and plant/equipment selection	Risk of climate change effects compromising project outcomes	1. Proposed siting has addressed climate change risk; 2. Project detailed design and bidding packages to ensure equipment selected is resilient to climate change; 3. Plant/equipment selected for low emissions; and 4. Transformers and other electrical system equipment to be free of polychlorinated-biphenyls	IA through PMU Contractor, SC/PMU	1.Once - site selection report 2. Once - contractor submission/tender 3.&4. Once – equipment and feeder line installation (underground)	Building Codes and COEP applied; Technical specifications; Performance of equipment purchased and installed	IA through PMU Contractor, SC/PMU
Bid and contract documents (BCD) preparation, tendering and contractor award	Poor project environmental management if systems not established properly and from outset of project implementation	1. PMU to establish ESU and allocate staff and resources for effective operation; 2. ESU updated project EMP and includes conditions of GOT approvals in BCD; 3. BCD requires contractor to: (i) comply with applicable COEP; (ii) designate full-time EHSO, Deputy EHSO and CLO; (iii) implement monitoring and reporting plan; (iv) provide induction and training for workers (and community) as specified); 4. Contractor to prepare site-specific CEMP; and 5. CEMP reviewed and cleared by ESU prior to works commencing.	EA/IA, SC, E/SS PMU-ESU, Contractor	1. Once – post loan/grant effectiveness; 2.– 5. Prior to contractor commencing works; Upon workforce mobilization	ESU established; Safeguards specialists recruited; BCD includes updated EMP and safeguards provisions; CEMP prepared and cleared; no objection for works commencement; Notes of induction and training	EA, IA, PMU
Implementation of project's communications and consultation plan (CCP) and grievance redress mechanism (GRM)	Establishes effective channels for project information and complaints/grievances	1. CCP updated and GRM established; 2. Procedure for accessing GRM disclosed; 3. Grievance focal points (GFP) appointed; 4. Contractor addresses relevant elements of CCP and GRM in CEMP; 5. GRM registers established at site and PMU; and 6. Niuafo'o site consultation with Tonga Airports Limited and application of COEP 17.	IA, SC/PMU, Contractor - CLO	1.- 3. Post loan/grant effectiveness 4. & 5. After contract award; 6. Prior to site works	CCP updated and disclosed; GRM established, GFPs appointed, register maintained; Consultations undertaken	IA, SC/PMU
Materials sourcing and materials, plant/equipment import	Imported materials or plant introduce alien or invasive species. Local material sourcing creates resource or other impacts	1. All materials, plant and equipment imported for the project to follow Quarantine Act and Quarantine regulations and requirements of Quarantine and Quality Management Division – MAFF; 2. Phytosanitary certificates obtained as required; 3. Locally sourced materials only obtained from sources agreed by resource/land owner. 4. Locally sourced materials to comply with GOT laws and obtain permits and consents as required; and 5. Materials extraction plan to be prepared by contractor and approved by PMU.	Contractor, PMU	1.& 2. On arrival of goods in Tonga; 3.& 4. Prior to any extraction activities	Phytosanitary certificates for imports; Permits/consents for materials sourcing; Land/resource owner agreements; Cleared materials extraction plan.	IA, SC/PMU

Project activity	Potential impact	Management and Mitigation		Monitoring		
		Proposed measures	Institutional responsibility	Frequency/ interval	Verification means	Institutional responsibility
Site selection, confirmation and final design decisions on placement of structures within site	Visual and landscape impacts	1. Site selection, application of COEP 1 and COEP 14; 2. Careful selection of site away from inhabited areas. For sites close to residences (mini-grids) ensure available land for buffer; and 3. Retain boundary vegetation if possible or replant upon works completion.	IA, PMU, SC Contractor	1. & 2. Once - site selection report and final design; 3. Following works completion	Building Codes and COEP applied; BOQ item allocated for revegetation of sites, tree retention/replanting around site	PMU
	Land use changes and impacts	1. Site selection and application of COEP 1; 2. Timely and effective consultation; and 3. Negotiation with land owners/lease holders.	IA, PMU, SC	1.Once - site selection report and final design; 2. & 3.Prior to and during final design	Site selection report; Lease agreements; Consultation minutes	PMU
Tree and vegetation removal, land clearance, site preparation	Landscape and visual impacts	1. Careful site selection; 2. Application of COEP 1 and COEP 14; 3. Retain vegetation as far as possible and/or replant site boundary	IA/PMU PMU, E/SS	1. & 2. Once - site selection report, final design; 3. Following works completion	Site boundaries replanted	PMU
	Ecological impacts – clearing beyond marked area	1. Care taken to only clear and remove trees as marked on approved plan; 2. Trees to be protected clearly marked on site	Contractor, E/SS	1. During site clearance and preparation	Site plan, trees retained/replanted	PMU
Land clearance	Land acquisition/lease, asset removal/acquisition	1. Affected people will be compensated as per entitlement matrix in resettlement plan (RP); 2. Application of COEP 3; 3. Consultation will be ongoing and transparent.	EA/IA, PMU	As per RP	As per RP	EA, IA, PMU
Construction Phase						
Equipment operation and vehicle movements	Air quality, fugitive emissions, dust	1. Application of COEP5 (section 6.7) and CEMP to include the following; 2. Reduce the speed of all vehicles entering and working within the site to reduce potential dust; 3. Trucks carrying material should be covered with a tarpaulin so that any material will not be spilled during transportation between the project site and boat anchorage area or local material source; 4. A water truck will spray the site and local roads as required as per water spraying schedule on days there is no rain; 5. Regular cleaning (washing) of construction vehicles in a dedicated location to reduce dust on site; 6. Anti-dust breathing facemasks are to be used by all staff working in high dust areas; 7. All machinery, equipment and all vehicles used should be well maintained and emission level should be kept low; 8. Cover storage and handling areas, where practicable; and	Contractor, E/SS	1-9 daily and weekly; Overall CEMP implementation monitoring - monthly	CEMP; PPE allocated and worn; Water spraying schedule; Washing of vehicles; Dust complaints	Contractor; PMU

Project activity	Potential impact	Management and Mitigation		Monitoring		
		Proposed measures	Institutional responsibility	Frequency/ interval	Verification means	Institutional responsibility
		9. Minimize stockpile heights and contain stockpiles with perimeter wind break fencing (or at least covers).				
Earthworks and stockpile management	Stability of excavations and stockpiles, erosion	1. Application of COEP5 (section 6.3) and CEMP to include the following; 2. Topsoil will be preserved and reinstated at the end of the construction period.; 3. Earth excavated for footings and facility platforms will be stockpiled at designated areas within the site and re-used if possible; 4. Stockpile material that cannot be re-used will be distributed around the site and levelled, excess material will be removed to a designated off-site area approved by the engineer/site supervisor (with permission of local government and/or land owner); 5. Bare ground at the site will be seeded/sowed with appropriate species of grasses, particularly under the solar panel arrays, to minimize erosion; and 6. Vehicles transporting loose materials will be covered and secured with tarpaulin to prevent dust or spillage.	Contractor, E/SS	1-7 daily and weekly; Overall CEMP implementation monitoring - monthly	CEMP; Stockpiles according to site layout plan; Minimization of bare ground; Re-seeding/grassing; Trucks hauling material are securely covered.	Contractor; PMU
Drainage, stormwater management	Site drainage issues, erosion and uncontrolled stormwater run-off	1. Application of COEP5 (section 6.5) and CEMP to include the following; 2. CEMP to include a drainage and erosion control plan which will identify existing stormwater flow paths across the site and potential erosion and stormwater run-off routes and measures to mitigate and control the flow. The plan will identify where drainage, diversion channels and collection tanks will be installed and how frequently they will be cleared and where any material cleared from the drains/channels will be removed to and disposed of; 3. To prevent run-off or water from adjacent land shedding onto the site and creating erosion or siltation, bunds or swales/diversion channels will be installed where required along the site boundary; 4. Any wastewater generated during construction will be managed through the construction of temporary collection tanks; 5. Cover/stabilize all exposed surfaces and excavated materials during construction; 6. Implementing effective construction site drainage such that runoff is directed to sediment traps before discharge to the environment; 7. All waste-water should not be directed to nor spilled onto any natural water course or body;	Contractor, E/SS	1-9 daily and weekly; Overall CEMP implementation monitoring - monthly	CEMP; Approved drainage plan; Bunds, swales and drainage on-site; Cleaning of ponds and collection tanks.	Contractor; PMU

Project activity	Potential impact	Management and Mitigation		Monitoring		
		Proposed measures	Institutional responsibility	Frequency/ interval	Verification means	Institutional responsibility
		8. Close construction supervision to ensure the above measures are implemented; and 9. Provisions of stop work during periods of heavy rainfall.				
Import of materials and equipment and all construction activities	Generation and management of waste	1. Application of COEP11 and CEMP to include the following; 2. The site will be kept in a tidy and hygienic condition. Covered rubbish and waste receptacles will be provided on site; as far as is practicable waste will be segregated (organic, plastic/tin and paper/cardboard for potential reuse or recycling); 3. The contractor will discuss disposal and reuse/recycling options with the Waste Authority Ltd and GIO Recycling and include any agreed arrangements in the site-specific CEMP; 4. No on-site burning of waste, especially plastics, will be permitted; 5. Waste wood will be cut to appropriate lengths and given away as fencing materials or firewood; 6. Remaining organic materials are to be neatly stockpiled and/or buried (if acceptable and approved by the engineer/site supervisor) and allowed to decompose over time; 7. Waste that cannot be reused will be stored on site in appropriate bins, and removed off-site by the contractor to a designated/approved disposal site; and 8. Final disposal in Vava'u will be at the Kalaka landfill and in 'Eua at the Angaha landfill. In Ha'apai and Niuafo'ou, where there are no landfills (only informal dump sites), unless otherwise agreed, waste will be transported to Tongatapu for safe disposal at the Tapuhia landfill.	Contractor, E/SS	1-8 daily and weekly; Overall CEMP implementation monitoring - monthly	CEMP; Condition of site; Number of receptacles; Waste segregation practices being implemented.	Contractor; PMU
Storage, use and disposal of hazardous substances	Pollution, contamination and health and safety risks	1. Application of COEP 12 and CEMP to include the following; 2. Hydrocarbon and toxic material will be stored in adequately protected site/s consistent with national and local regulations and codes of practice to prevent soil and water contamination or harm to people; 3. Fuel, oil and hazardous substances must be secured safely at designated areas on site. The area for fuel and oil storage will be concreted and bunded for 110% capacity of the largest volume container stored on site;	Contractor, E/SS	1-12 daily and weekly; Overall CEMP implementation monitoring - monthly	CEMP; Bunds and concrete platforms at storage and refueling area; Labelling of stored chemicals; Spill kit use and training; Condition of ground/soil at oil/fuel storage area.	Contractor; PMU

Project activity	Potential impact	Management and Mitigation		Monitoring		
		Proposed measures	Institutional responsibility	Frequency/ interval	Verification means	Institutional responsibility
		4. Store hazardous substances above possible flood level; 5. All hazardous substances will be stored in a lockable unit within which all substances will be clearly labelled as to what they are, what their use is, and that they are harmful/poisonous; 6. An appropriate spill kit/spill containment materials will be kept on site and designated workers will be trained in its use; 7. Refueling of vehicles and plant to be undertaken on concrete pads adjacent to the bunded fuel and oil storage area; 8. Ensure that safe storage of fuel, other hazardous substances and bulk materials are agreed by DOE and follow internationally recognized good practice; 9. Segregate hazardous wastes (oily wastes, used batteries, fuel drums etc) and ensure that storage, transport and disposal shall not cause pollution and shall be undertaken consistent with national regulations and COEP 12; 10. Regularly check containers for leakage and undertake necessary repair or replacement; 11. Discharge of oil contaminated water shall be prohibited; and 12. Used oil and other toxic and hazardous materials shall be disposed of off-site at a facility authorized by the DOE.				
Construction activities	Run-off to or impacts on water resources (likely minimal if at all)	1. Review of applicability of COEP 9 and recommended measures to be included in CEMP if required.	Contractor, PMU	As required	Items included in CEMP if required	Contractor; PMU
Workers mobilized to site(s)	Impacts of workers on flora and fauna	1. Workers inducted to site and made aware of provisions of CEMP which will include: 2. Workers are not permitted to cut any trees (including mangroves) other than for site clearance purposes and other than those marked on the approved plan; 3. Workers will be informed about the tree protection/retention and replanting requirements; 4. Workers will be instructed that hunting, capture or killing of any birds or other fauna is prohibited, and sanctions (including possible removal from site) will be imposed on any worker who does not comply; and 5. Workers will be instructed that diving for sea cucumbers and hunting, capture or killing of turtles, dolphins and other marine fauna is prohibited and	Contractor, PMU	Weekly; Overall CEMP implementation monitoring - monthly	CEMP; Records of training; Records of worker sanctions etc	Contractor; PMU

Project activity	Potential impact	Management and Mitigation		Monitoring		
		Proposed measures	Institutional responsibility	Frequency/ interval	Verification means	Institutional responsibility
		sanctions (including possible removal from site) will be imposed on any worker who does not comply.				
Equipment and vehicle operation, construction activities	Noise	1. Application of COEP 5 (section 6.4) and CEMP to include the following; 2. Machinery and vehicles will be maintained regularly, with attention to silencers and mufflers, to keep construction noise levels to minimum. Machinery to be equipped with silencers as far as practicable; 3. Protective devices (ear plugs or ear muffs) will be provided to the workers operating equipment/machinery or in-high noise generating activities; 4. For project sites close to sensitive receivers, such as the villages in Ha'apai group, noise barrier/baffle to be installed around the site (can be used a security fence/wall post-construction); 5. Advance notification to neighboring residences and uses (including signage) announcing work activities, especially when work is being undertaken outside normal working hours; and 6. Scheduling construction, including noisiest, activities to normal working hours (8am – 5pm) Monday to Saturday. Earlier and/or later hours to be agreed locally. No work will be undertaken on Sundays.	Contractor, PMU	1-6 daily and weekly; Overall CEMP implementation monitoring - monthly	CEMP; Advance notices to community; PPE allocated and worn; Installation of noise barrier around site; Grievances citing noise; Records of work days and hours	Contractor; PMU
Haulage of plant and materials to and from site	Pedestrian safety, traffic issues	1. Application of COEP 7; 2. CEMP to include a traffic management plan	Contractor, PMU	1-2 daily and weekly; Overall CEMP implementation monitoring - monthly	CEMP and traffic management plan; Traffic controls and measures	Contractor; PMU
Construction activities, equipment operation	Health and safety risks for workers	1. Application of COEP 6 and EHSG and CEMP to include the following; 2. The contractor will prepare a health and safety plan (HSP) as part of the CEMP. The HSP will establish: (i) activity/job safety procedures and protocols; (ii) plan for HSP training and "toolbox" sessions for workers; (iii) first aid facilities (on-site and in vehicles), personal protective equipment (PPE) and medical evacuations; (iv) routine safety and accident prevention measures; (v) emergency response and preparedness; (vi) accidental environmental instance (e.g. spill) procedures highlighting the sizes and types of impacts that may occur, and the resources (onsite and/or offsite) that will be required to handle and treat the spill; and (vii) accident, near-miss and emergency registry, monitoring and reporting;	Contractor, PMU	1-16 daily and weekly; Overall CEMP implementation monitoring - monthly	CEMP; HSP and training plan; Designation of EHSO and Deputy EHSO; First aid kits appropriately stocked; PPE allocated and worn; Records of training sessions; Records of age (and provenance) of workers; Accident register; Number of medivacs etc	Contractor; PMU

Project activity	Potential impact	Management and Mitigation		Monitoring		
		Proposed measures	**Institutional responsibility**	**Frequency/ interval**	**Verification means**	**Institutional responsibility**
		3. The HSP will cover both occupational health and safety (OH&S) and community health and safety. The HSP will meet the requirements of good engineering practice, national laws and regulations and the EHSG; 4. Before construction commences the contractor/s will conduct training for all workers on environmental safety and environmental hygiene. The contractor will instruct workers in health and safety matters as required by the HSP, good engineering practice and national regulations; 5. The contractor will designate one full-time staff as EHSO to implement the HSP; 6. The contractor will engage an approved service provider to deliver a program of communicable diseases (including HIV/AIDS/STI) awareness and prevention training to workers and the community; 7. Conduct regular meetings to maintain awareness levels of health and safety issues and requirements; 8. Ensure that first aid kits and facilities, including access to trained medical personnel, is available on site and arrangements in place to ensure medical attention (including evacuation as necessary) of workers who have suffered an accident or sudden illness; 9. Ensure adequate spill response kits are provided, accessible and that designated key staff are trained in their use; 10. Workers will be trained in use of any special equipment or machinery. Workers will be instructed in use of safety equipment (harness etc) for working at heights or on scaffolding; 11. Observe working hours and official holidays as set out in national law and regulations; 12. Excavated trenches must be effectively marked with approved safety signage and/or barrier tape to prevent any accidents; 13. Workers, at no cost to themselves, shall be provided (before they start work) with appropriate PPE suitable for the tasks and activities they will undertake. PPE will include safety boots, helmets, gloves, protective clothes, goggles, and ear protection. Instructions on their use around the construction site will be delivered as part of the safety procedures;				

Project activity	Potential impact	Management and Mitigation		Monitoring		
		Proposed measures	**Institutional responsibility**	**Frequency/ interval**	**Verification means**	**Institutional responsibility**
		14. Provision of potable water supply and sanitary toilet and ablution facilities at the site; 15. Child and/or trafficked labor will be strictly prohibited for any activities associated with the project; and 16. All measures related to workers' safety and health protection will be free of charge to workers. The HSP, also covering include community health and safety, is to be submitted by the contractor before construction commences and approved by PMU-ESU.				
Construction activities, equipment operation	Health and safety risks for workers	1. Application of COEP 6, EHSG and CEMP's HSP; 2. The contractor's HSP will address community impacts and management measures in addition to worker health and safety. The HSP will meet the requirements of good engineering practice, national law and regulations and comply with the EHSG; 3. The HSP will include agreement on consultation requirements, establishment and monitoring of acceptable practices to protect community safety, links to the complaints management system for duration of the works (in accordance with the GRM) and system for reporting of accidents and incidents; 4. Contractor will coordinate directly with the grievance focal point(s) (GFP) appointed for the project; 5. Before construction commences the contractor/s will conduct training for all workers on environmental safety, health and hygiene including delivery of the HIV/AIDS/STIs awareness and prevention training and the code of conduct (see below); 6. The contractor, following the requirements of the project's CCP, will inform the community of the works (likely impacts and control and mitigation measures), including the timeframe through information brochures and/or community meetings; 7. Tongan minimum wage requirements to be observed, if local staff are employed. There will be proper enforcement of the labor laws at the work place; 8. Child and/or trafficked labor will be strictly prohibited for any activities associated with the project; 9. Children will be prohibited from entering the sites (including worker's accommodation, works area/construction zone) and prohibited from playing on any equipment or machinery; 10. All advisory and warning signage will be clear, secured on fences, gates and signboards and be	Contractor, PMU	1-16 daily and weekly; Overall CEMP implementation monitoring - monthly	CEMP; HSP and training plan; Designation of EHSO and Deputy EHSO; Designation of CLO; Designation of GFPs and implementation of GRM; Delivery of communicable diseases awareness and prevention program and records of training sessions	Contractor; PMU

Project activity	Potential impact	Management and Mitigation		Monitoring		
		Proposed measures	Institutional responsibility	Frequency/ interval	Verification means	Institutional responsibility
		posted in Tongan, the language of the main nationality of workers and repeated in English; 11. The contractor will implement the traffic management plan which will include traffic control and pedestrian safety measures; and 12. Contractor will fence off and post warning signs at site to prevent public access during construction.				
Influx of labor and workers at site(s)	Conflict with local people, stress of local resources	1. Implementation of the project's CCP; 2. Contractor to recruit CLO from local community; 3. Ensure that community and stakeholders are aware of the GRM and how to access the GRM; 4. PMU-ESU and CLO to facilitate agreement of protocols--code of social conduct--between the contractor and community leaders. The protocols will govern workers' conduct while in communities, behavior around women and children, restrictions on alcohol consumption, prohibitions (with sanctions for non-compliance) on hunting or fishing, implementation of awareness programs, implementation of the GRM and handling of complaints, hiring of local labor, and implementation of the HSP; 5. The contractor will engage/recruit an approved service provider to deliver the HIV/AIDS/STI awareness and prevention program to workers and community; 6. Workers' access to portable toilets and associated sanitation facilities will be provided at the site(s); 7. Contractor will erect notice boards and distribute information pamphlets regarding schedule of construction and activities causing disruptions or access restrictions; 8. All notice boards/signage to be in English and Tongan; 9. For unskilled activities, every effort to hire local people (including women) as priority: 10. Accidental damage to utilities will be minimized by (i) obtaining plans from public utilities identifying locations of pipelines, conduits and power cables and (ii) consultation with staff on the location of utilities prior to commencing excavation operations.	Contractor, PMU	1-10 daily and weekly; Overall CEMP implementation monitoring - monthly	CEMP; CCP and code of conduct; Designation of CLO; Designation of GFPs and implementation of GRM; Contract with approved service provider; Records of training and awareness sessions	Contractor; PMU
Earthworks, site excavations (incl. at potential materials source sites)	Unexpected discovery of cultural artifacts	1. CEMP to include "chance finds" protocols; 2. Application of COEP 4; 3. Coordination through CLO and E/SS;	Contractor, E/SS, PMU	As required upon any find	Chance find protocol in approved CEMP; Implementation of protocols	Contractor, PMU

Project activity	Potential impact	Management and Mitigation		Monitoring		
		Proposed measures	Institutional responsibility	Frequency/ interval	Verification means	Institutional responsibility
		4. Stop works as required and recommence only on advice from PMU.				
Operation Phase						
Operation of mini-grids	Waste, dust, potential for oil or fuel spill	1. TPL and MEIDECC to implement similar management and mitigation measures to those of construction stage; 2. Application of COEPs 11-15 and 19, 20; 3. Provision and maintenance of adequate drainage system.	TPL, MEIDECC	As required	Operations plan; O&M works plan; Grievance register	EA
Operation of BESS	Poor waste storage and disposal practices leading to pollution	1. TPL and MEIDECC to implement similar management and mitigation measures to those of construction stage; 2. Application of COEPs 5, 11-15 and 19, 20; 3. Provision and maintenance of adequate drainage system	TPL, MEIDECC	As required	Operations plan; O&M works plan; Grievance register	EA
Operation of solar farms	Visual impacts and glare	1. Design and orientation of solar arrays to absorb incident solar radiation.	TPL, MEIDECC	As required	O&M works plan; Grievance register	EA
Operation of mini-grids	Noise emissions from back-up generators	1. Hours of operation to be determined by community to minimize impact of noise on nearby residents.	TPL, MEIDECC	As required	O&M works plan; Grievance register	EA
Decommissioning						
Dismantling of PV panels	Pollution from improper disposal.	1. Contract agreements with replacement PV panel suppliers to include dismantling and recycling/disposal; 2. Application of COEPs 19 and 20.	MEIDECC	As required – end of life	As per COEP	MEIDECC
Disposal of used batteries, including lithium ion.	Pollution from improper storage and disposal.	1. Contract agreements with replacement battery suppliers to include recycling/disposal. Interim storage to take place at designated area which has floor and roof to prevent degradation and contamination; 2. Application of COEP 15.	MEIDECC	As required – end of life	As per COEP	MEIDECC

KEY: BCD = bid and contract documents; BOQ = bill of quantities; CCP = communications and consultation plan; CEMP = construction EMP; CLO = community liaison officer; DOE = Department of Environment; EA = executing agency; EHSO = environmental, health and safety officer; E/SS = engineer/site supervisor; GFP = grievance focal point; GRM = grievance redress mechanism; HSP = health and safety plan; IA = implementing agencies; PMU = project management unit; SC = supervision consultant

I. CONCLUSION AND RECOMMENDATION

209. The implementation of the proposed project will result in major positive environmental benefits, providing the necessary infrastructure for Tonga to achieve its goal of generating 50% of its energy needs from renewable sources. The saving of CO_2 emissions, and the building of Tonga's resilience against economic and climate change shocks are essential components of adaption in a changing world. The mini grids will provide an expansion of the electrification of remote communities, providing the associated social and economic benefits, and possibly stemming the flow of migration off the islands. The mini-grid component also provides the opportunity to test new models of tariffs and maintenance to improve the sustainability aspects of this important work.

210. The environmental impacts associated with the proposed project components have been identified and assessed. The findings establish that the project sites are not located in ecologically important areas, and will not have any social or cultural impacts. The project will not cause any significant or lasting environmental impacts. Minor impacts will be monitored and mitigated through the implementation of site-specific EMPs, with monitoring and oversight undertaken by the ESU.

211. The anticipated environmental benefits of the project include:

- Reduction in local air pollution and noise impacts on local communities through reduced reliance on diesel generated electricity;
- Reduction in the use of diesel will lower risk of fuel spills and land/water contamination (both at sea when transporting the fuel (including waste oil) and on land when stored or being used);
- Less damage from the misuse of batteries. In the past, many of the small islands have faced environment degradation due to mishandling of old and damaged lead acid batteries used in conjunction with SHS; in some places, this is becoming a serious issue. The project will remove the batteries from these islands and replace existing fragmented solar home systems with clean solar PV mini-grid. Batteries will be centralized and properly managed; and
- Systematic and consistent implementation of environmental safeguards through the COEP will have a positive influence on development on the islands (including encouraging local businesses and community groups to adopt environmental standards).

It is concluded that the project will not have residual environmental impacts. The measures identified in the EMP (and in the CEMP to be developed) will be implemented and monitored, ensuring compliance with ADB's SPS 2009 and CSS requirements.

APPENDIX 1: LIST OF THE CODES OF ENVIRONMENTAL PRACTICE[30]

COEP 1 – Site Selection and Project design

COEP 2 – Stakeholder Engagement

COEP 3 – Land Acquisition, Resettlement and Compensation for Lost Assets

COEP 4 – Cultural Heritage

COEP 5 – Construction and Decommissioning

COEP 6 – Community Health and Safety

COEP 7 – Traffic Management

COEP 8 – Biodiversity

COEP 9 – Water Quality

COEP 10 – Working in Coastal Marine Areas

COEP 11 – Solid Waste

COEP 12 – Hazardous Substances

COEP 13 – Noise

COEP 14 – Landscape and Visual Impacts

COEP 15 – Battery Disposal

COEP 16 – Shadow Flicker

COEP 17 – Interaction with Aviation Operations

COEP 18 – Electric and Magnetic Fields

COEP 19 – Network Upgrades/Maintenance

COEP 20 – Monitoring and Management

[30] World Bank. 2016. New Renewable Electricity Generation and Electricity Infrastructure in Tonga: Code of Environmental Practice - Managing Environmental and Social Impacts; and Guidelines for Land Acquisition Approvals, Environmental Permits and Building Permits.

APPENDIX 2: SUMMARY OF PERSONS CONSULTED

Location: Vava'u				
Date: 30 March 2017				
Name	Designation	Location	Comment/Interview type	
Lord Fulivai	Governor		Recommended His Majesty's land in front of the current solar farm for storage site instead of the other site with several small landholders.	
Lucy Fa'nunu	Officer-in-Charge	MEIDECC	Introduced the project team to the workshop organized by MEIDECC	
Mele Finau	Environment Officer	MEIDECC	Interviewed	finaumele@gmail.com
Pipena Liu	Teacher	Tafisi Primary	Interviewed	
Siunipa Tiepa'aua	Teacher	Talihau Primary	Interviewed	

Vava'u Public Meeting			
Date: 30 March 2017			
No.	**Villages/Schools/Organization**	**Names**	**Phone No.**
1	GPS Tu'anuku	Tevita.S.Kiteau	7574346
2	GPS Tu'anekivale	Sione Vea	7746886
3	GPS Tu'anekivale	Mele Fa'anunu	8513815
4	GPS Tu'anekivale		6478996
5	GPS Feletoa	Kalesita Fangupo	8899385
6	GPS Makave	Sione 'Alatini	7517507
7	GPS Toula	'Atu 'Ulungamanu	8886977
8	GPS Neiafu	Taiana Tu'ipulotu	7709393
9	GPS 'Utungake	Tevita Toli	8777547
10	MET Office	Taniela Vaha'i	8837834
11	GPS 'Utungake	Alex Burgos	8782300
12	GPS Tu'anuku	Vanesa Kind	8708716
13	GPS Holonga	Filimone 'Anitoni	8417146
14	GPS Tu'anuku	Tevita Latu	8474115
15	Falaleu	Simoneti Toko (Town Officer)	8867976
16	Makave	Sosefo Niukapu (Town Officer)	7710005
17	GPS Nga'unoho	Taniela Ikamanu	8474769
18	GPS Makave	Peni Sinipata	874-2758
19	GPS Tefisi	Fine Sinipata	882-4966
20	GPS Tefisi	Jacqueline Wexel	879-2878
21	GPS Tefisi	Pipiena Liu	8421063
22	GPS Leimatu'a	Mafi.'O.Latu	77334
23	GPS Leimatu'a	Mele.L.Sekeni	870-8695
24	Mizbah High School (Makave)	Alebina Mikaele	770096
25	'Uiha & Sons	Mo'ungamaka	70-910
26	GPS Neiafu	Fipe Latu	70-078
27	GPS Liviela (Neiafu)	Nanise Finau	70-079
28	GPS Toula	Soane Lavakei'aho	8625128
29	Chanel College	'Atomalo Kaufusi	777-2408
30	Fungamisi	Nikola Sesau (Town Officer)	842-8649
31	GPS Ha'alaufuli	'Ilisapeti Likiliki	8420223
32	GPS Holonga	Fine Ikatonga	7774374
33	GPS Longomapu	Sione Lavemai	8323203
34	Neiafu	Vava Fifita (Town Officer)	7701640/8876124
35	GPS Feletoa	'Aisea Paongo	8789099
36	Tailulu College	Talanoa Tu'ipulotu	70432/8416193
37	St.P.Chanel College	Sione Sosefo Fitu Ma'ilangi	7558075
38	GPS Nga'unoho	Sunipa Tepa'ava	8469416
39	V.E.P.A	Lisa Fanua	7517184

'O'ua (Ha'apai) Public Meeting				
Date: 04 April 2017				
Name	**Male or Female**	**ORGANISATION**	**DESIGNATION**	**CONTACT NUMBER**
'Osai Heitonga	M		Care Taker of Site	7268695
'Ofa Latu	F		Women Committe	7707946
Vai Tau	F			7769274
Moala Vainga	F			7268972
'Elenoa Latu	F			7792202
Lavinia Kolopeaua	F			7708383
Meleane Vea Mafua	F			731792
Talafungani Heitonga	F			7268687
Pouanga Taualupe	M			
Sione Fe'ao	M		Pastor Church of Tonga	7713949
Manase Tualau	M		Town Officer	7268654
Taniela Tualau	M			
Filimone Mahe	M		Pastor Church of Tonga	

Tungua (Ha'apia) Public Meeting			
Date: 05 April 2017			
Name	**Male or Female**	**ORGANISATION**	**Phone Number**
Siaosi Tuai	M		
Sunia Tu'ipulotu	M	Reverend	7315991
Vaiki Vaiomo'unga	M		
F. Maka	M		
Levuka Lafitani	M		
Sione Pule	M		
Uatesoni Lasitani	M		
'Unaloto Vaiomo'unga	M		
Lei Lasitani	M		

Kotu (Ha'apai) Public Meeting				
Date: 06 April 2017				
No.	**Name**	**Position**	**Organisation**	**Phone No.**
1	Siueti Kaifoto		Siulolo Vao	731-9078
2	Kaneisini 'Ilangana			776-2295
3	'Ana Malau Taufa			77-4944
4	Salote Taufa			73-13623
5	Toekava Pule'anga			774-4266
6	Tupou Mafi			731-8492
7	'Ana Fisi			774-8166
8	Mele 'Ilangana			
9	Langi Koloa			773-7592
10	Fapiola Mafi			770-6040
11	'Atalia Matangi			
12	Saane Koloa			751-9856
13	Heamasi Koloa	Town Officer		773-7592