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

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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 hour
kW = kilowatt
kWh = kilowatt hour

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 MW of renewable energy capacity in the outer islands, and almost 10.1 MW/22.2 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 existing renewable energy systems and provision of BESS for solar and wind facilities to be provided through independent power producer (IPP) agreements;
- 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 off-take 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, this IEE considers, as associated facilities, 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. The IEEs also meet the requirements of the country safeguards system including Environmental Impact Assessment (EIA) Act 2003 and EIA Regulations 2010.

9. **Project sites**. The project components are proposed in modified and/or highly disturbed sites (refer to Table ES.1). The project will install associated BESS at existing energy generation sites; Popua (existing 14 MW diesel and 1.3 MW solar), the new 2 MW solar plant under construction at Villa and the existing 1 MW solar plant at Vaini. The project will also provide stand-alone BESS for solar facilities at Fahefa and Matafonua and additional wind turbines (adjacent to the JICA wind farm) at Niutoua, each to be developed through IPP.

10. **Environmental impacts**. Pre-construction impacts relate mostly to siting of components, land acquisition and land use change. The sites developed through IPP will create minor land use change, with land converted from existing agricultural use to energy production.

11. Approximately 23 hectares will be required for the two solar facilities and the expansion of the wind farm to be developed through IPP. The sites have been identified and do not contain vegetation of high conservation or ecological value or habitat significance. The IPP will be encouraged to include revegetation, especially along the boundaries of sites to reduce visual impacts and assist with site security. The PMU may undertake re-vegetation works immediately after the construction phase though a separate shopping contract.

12. Installation of the BESS will create small-scale and limited impacts through earthworks for levelled building platform and construction of modular housing. Health and safety impacts and risks common to construction will be managed and mitigated through the environmental management plan (EMP).

13. There are environmental impacts that are anticipated during construction of the IPP solar plants and wind farm. These include noise emissions, dust generation, erosion, stormwater run-off, health and safety risks, and generation of waste. The key environmental risks during the operational phase of the associated wind farms are noise emissions, visual impact, and potential fatalities of birds and bats. The siting of the turbines provides enough buffer distance from residences, with noise modeling predicting that noise will be within the New Zealand standard for wind farms (NZS6808:2010). The siting also reduces visibility and landscape impacts with the turbines visible only at a distance from some coastal villages. Bird and bat species in the wind farm area have been studied extensively, and there is no high conservation species that have been identified as at risk. The area has no evidence of habitat for vulnerable birds or bats as it is largely degraded agricultural land. 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.

14. There are no unmanageable risks during the operational phase of the solar plants, wind farm expansion or the BESS facilities. 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. The project EMP requires proper handling and storage/disposal of spent batteries to ensure there is no residual environmental impact.

15. Overall the project will not cause significant adverse environmental impacts but will produce significant environmental benefits including the reduction of CO_2 emissions, reduction of diesel fuel imports, reduced risk of groundwater contamination through diesel spills, and increased resilience to economic and climate change shocks through decreased reliance on fossil fuel energy.

16. **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.

17. 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.

18. **Consultations and information disclosure**. During the assessment consultations were held with stakeholders to disclose project information and identify any concerns. No specific environmental issues were raised in discussions. Local communities and leaders support the project. The main issue consistently raised was need for a reliable power supply and that increased renewable energy sources should lead to reduced power prices to make a tangible impact on peoples' lives.

19. **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.

20. **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.

21. 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.

22. **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 Tongatapu

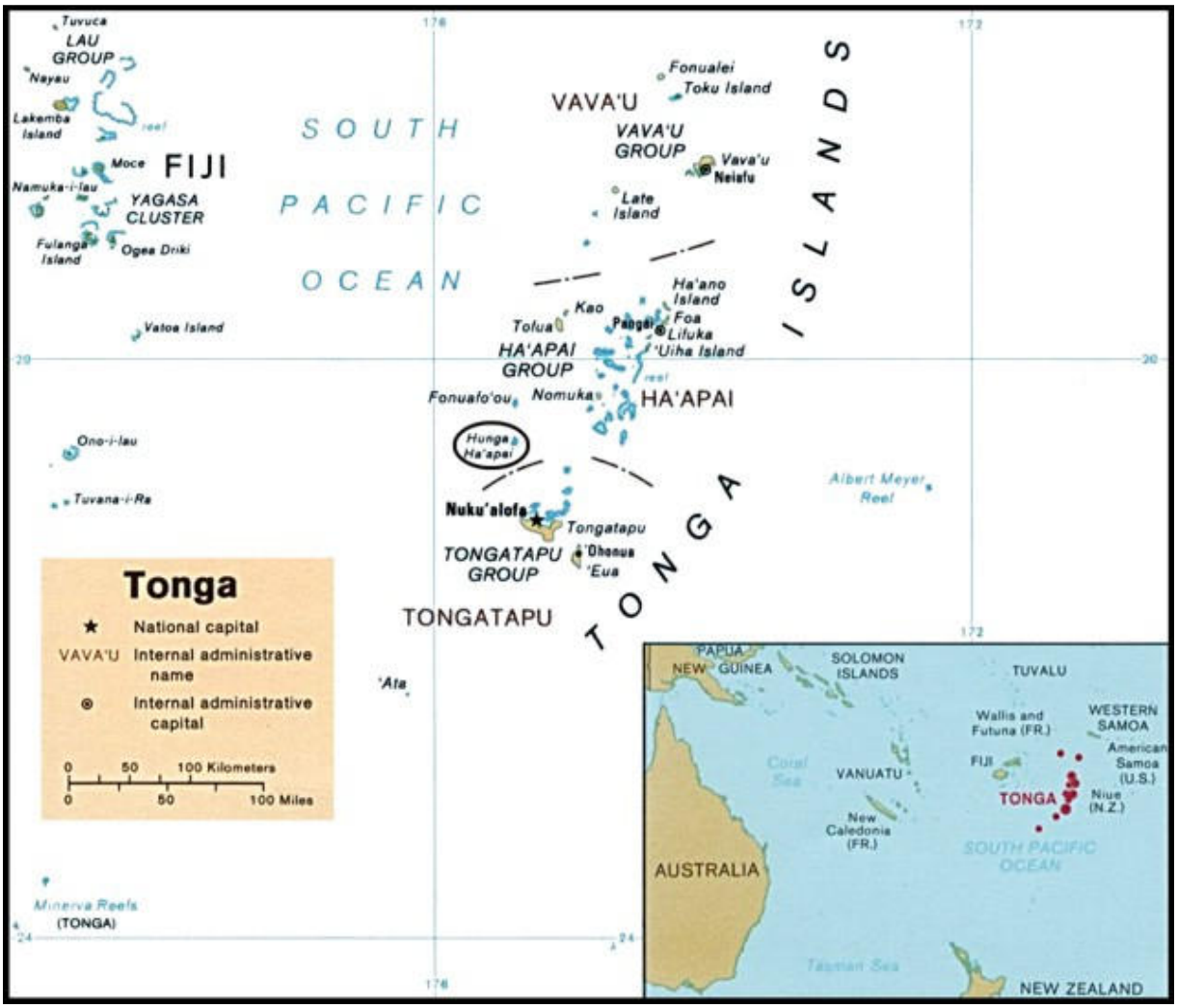
Site	Site/existing use	Existing generation (MW)	Project component	Additional storage capacity proposed				Land requirements* (ha)
				MW	MWh	kW	kWh	
Popua	Existing main power station (diesel + solar)	14 + 1.3	BESS	2.3	1.15			0
Villa	IPP solar plant under construction	2	BESS	2.3	16			0
Vaini	Existing solar plant	1	BESS	2.3	1.15			0
Fahefa	Proposed IPP solar (2 MW)		BESS			700	350	8.1
Matafonua	Proposed IPP solar (2 MW)		BESS			700	350	2.8
Niutoua	Proposed IPP (additional wind turbines)		BESS	1.8			900	12.1

* Land requirements are for the new IPP facilities/plant. BESS does not require additional land as will be located within existing or proposed sites.

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 CO2 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 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 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, for which 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 13,616 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 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) have been prepared. For completeness, this IEE considers, as associated facilities, 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.

7. This IEE covers the components proposed for Tongatapu, the main island of the Tongatapu Group. 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.

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. 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).

9. The GOT has 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, 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 and will become the Project Steering Committee. With support from the Project Management Unit (PMU) formed within MEIDECC, the Project Steering Committee will oversee project implementation, facilitate information flows and support coordination.

10. The 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. Supervision consultants will be mobilized through separate contractual arrangements to support the PMU delivering the project. 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.

11. **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.

[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.

12. 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

13. 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

14. 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

15. 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.

16. 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.

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

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

19. 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.

20. 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.

21. 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

22. 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.

23. 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.

24. 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.

25. 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 initiatives within the energy sector.

26. **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 they were commissioned under the auspices of the TERM.[6]

27. 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, site-specific or localized, small-scale, but nevertheless potential adverse environmental impacts. 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.

31. **Associated facilities**. The SPS requires identification and review of impacts of associated facilities. Associated facilities include those that are not funded as part of the project (funding may be provided separately by the borrower/client or by third parties), and whose viability and existence depend exclusively on the project and whose goods or services are essential for successful operation of the project.

32. Even though the impacts and mitigation measures from the development of associated facilities do not have to be analyzed in detail in the assessment of the project financed by ADB, basic information about the main design features, location, the significance of potential impacts, the required approval process and institutional arrangements should be described. ADB reviews these facilities as part of its due diligence to determine if the associated level of impacts on and risk to the environment and people is acceptable, recognizing that the borrower/client should address these impacts and risks in a manner that is commensurate to the borrower/client's control and influence over the associated facilities.

33. The two solar plant and wind farm expansion are associated facilities given that the project will provide BESS to enhance and expand storage capacity of those facilities and those facilities require the storage to improve their viability.

C. DESCRIPTION OF THE PROJECT

1. Project Rationale

34. 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)

35. 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.

36. 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).

37. 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.

38. 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);

39. 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.

40. **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.

41. **O&M contracts.** 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 islands with components 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 Tongatapu

42. The addition of the BESS facilities within the Tongatapu energy system will save approximately 1,200,000 liters/year of diesel and CO_2 emissions will be reduced by an estimated 3,250 ton/year. The BESS are integral to scaling up renewable energy systems in Tongatapu, providing TPL with a greater range of options for a sustainable and reliable energy system. Using battery storage, the diesel generators have a pro-longed life, as they do not need to frequently cut in and out to sustain energy feed into the distribution grid. Longer term storage will supplement short-term battery storage, providing storage of excess power that can then assist in peak demand periods. The battery storage, mini-grid controller and SCADA system will manage grid stability, which is essential considering rapid fluctuations from PV and wind output.

43. An additional 4 MW of solar power generation capacity in Tongatapu will result in an estimated saving of 1,500,000 liters of diesel per annum, and a reduction in CO_2 emissions of 4,100 ton/year. Installing the wind farm facilities is a vital component of diversifying the grid energy source inputs, and will assist significantly in times of low solar output such as heavy cloud or night. In addition, it will result in an estimated saving of 3,600,000 liters of fuel consumption per annum and a reduction in CO_2 emissions of 9,800 ton/year.

44. A critical component of Tonga's renewable energy focus is to seek a reduction in energy supply costs, part of which can be passed on to consumers. This will improve the environment for potential investment, increase the national GDP, and importantly, reduce the cost of living for households, particularly those on low incomes. Further project benefits in reducing the amount of energy generated by diesel include a reduction in noise emissions from the generators, and a reduction in the risk of land and ground water contamination caused by hydro-carbon spills.

45. Capacity building and strengthening of knowledge within TPL will be another key benefit of the Project. TPL staff have a sound existing knowledge of solar generation and energy supply, but through this Project will increase their capacity and experience with wind turbines and BESS. Their capacity to manage a complex mixed system of energy generation and distribution will be greatly enhanced through the improved infrastructure, training, and experience on the ground. In a field of rapidly changing technologies and evolving operational expectations, these skills are critical to the future of TPL. This Project is expected to be the catalyst for a paradigm shift, as it will take renewable energy use to a tipping point where it becomes a more default investment for both private and public sectors.

3. Location of Project Components on Tongatapu

46. Figure 3.1 provides an overview of each of the proposed project facilities. There are six proposed sites as outlined below; three sites include project financed BESS at existing plant and three sites are project financed BESS for solar/wind farm facilities to be developed through IPP arrangements. The sites have been selected based on land availability, and the technical requirements to place the power generation infrastructure to maximize the energy generation potential.[8] The wind farm expansion is a logical continuation of the arc of turbines provided through the JICA project and potential positioning of turbines will be determined by the IPP. Previous feasibility studies covering generation potential, land availability and potential environmental impacts have been consulted.

47. An estimated total of 23 ha is required for the plant to be developed through IPP, the BESS to be provided under the project will be co-located and will not require additional land.

[8] Aecom. 2016. Tonga Renewable Energy Master Plan. This document provides a roadmap for TPL to increase renewables, and recommendations for technical and siting options.

Figure 3.1: Locations of Project Sites and Components on Tongatapu

48. **Popua**. Is the existing main power generation site located adjacent to Fanga'uta Lagoon within Popua, an area within the capital Nuku'alofa. There are eight diesel generator sets installed with a capacity of 14 MW. The 1.3 MW Maama Mai Solar Farm is co-located at the site, along with a BESS of lithium ion batteries to assist with stabilization of the system. The batteries can run the system for up to 1 minute, which is of significant assistance in reducing the throttling of the generators to compensate for cloud cover. No additional land is required for the BESS as it will be sited within the existing TPL lease area.

49. **Villa**. This site is named for its location close to the Villa (residence of the previous King of Tonga) in Mataki'eua on the outskirts of Nuku'alofa. TPL has a lease on a site at the front of the Villa, where two developments are under construction phase: a new office for the three utility providers (TPL, Tonga Water Board and Waste Authority Ltd); and a new 2 MW solar facility which was approved by MEIDECC in 2016 and is being constructed through an IPP arrangement. TPL will procure power from the solar farm under a long-term power purchase agreement (PPA) with an agreed tariff and performance obligations. Based on technical analysis in the Tonga Renewable Energy Master Plan, it is strongly recommended that BESS be co-located with this facility to avoid network instability. The BESS will provide additional storage capacity of 2.3 MW /16 MWh. No additional land is required for this component as it will be sited within an existing TPL lease area.

50. **Vaini**. The existing 1 MW solar plant is located just outside the village of Vaini south of Nuku'alofa. No additional land is required for this component as the BESS will be sited within the site already leased to TPL.

51. **Fahefa**. In the south-west of Tongatapu, near the village of Fahefa is the site proposed for a new 2 MW PV solar facility and the project will provide stand-alone BESS (700 kW/350 kWh). A site of approximately 8 ha has been identified (Figure 3.2), the proposed facility requiring approximately 2 ha. The siting and layout will be determined by the IPP.

52. **Matafonua.** This site is north-east of Fahefa and located near Matafonua in the central west area of Tongatapu. The general area for the solar farm has been identified (Figure 3.3), the final 2 ha solar farm and BESS placement within that area is still to be determined. There is a cemetery near the site but this will be protected by a buffer zone to ensure the solar plant does not create impacts.

53. **Niutoua.** Is a coastal village in the north-east of the island, 1.5 km south-east of the village is the JICA-financed wind farm. The expansion proposed for financing through an IPP arrangement will extend the wind farm along the same service road and continue the arc of wind turbines along the coast, progressing towards the village of Haveluliku. The project will finance a BESS to provide storage capacity for energy produced by the wind farm. It is expected that when complete, the wind generation sites financed through various IPP will comprise an estimated 20 turbines requiring approximately 12 ha of land (Figure 3.4); the area currently identified will potentially affect 17 tax allotments.

Figure 3.2: Proposed Location of Solar Plant at Fahefa

Figure 3.3: Proposed Location of Solar Plant at Matafonua

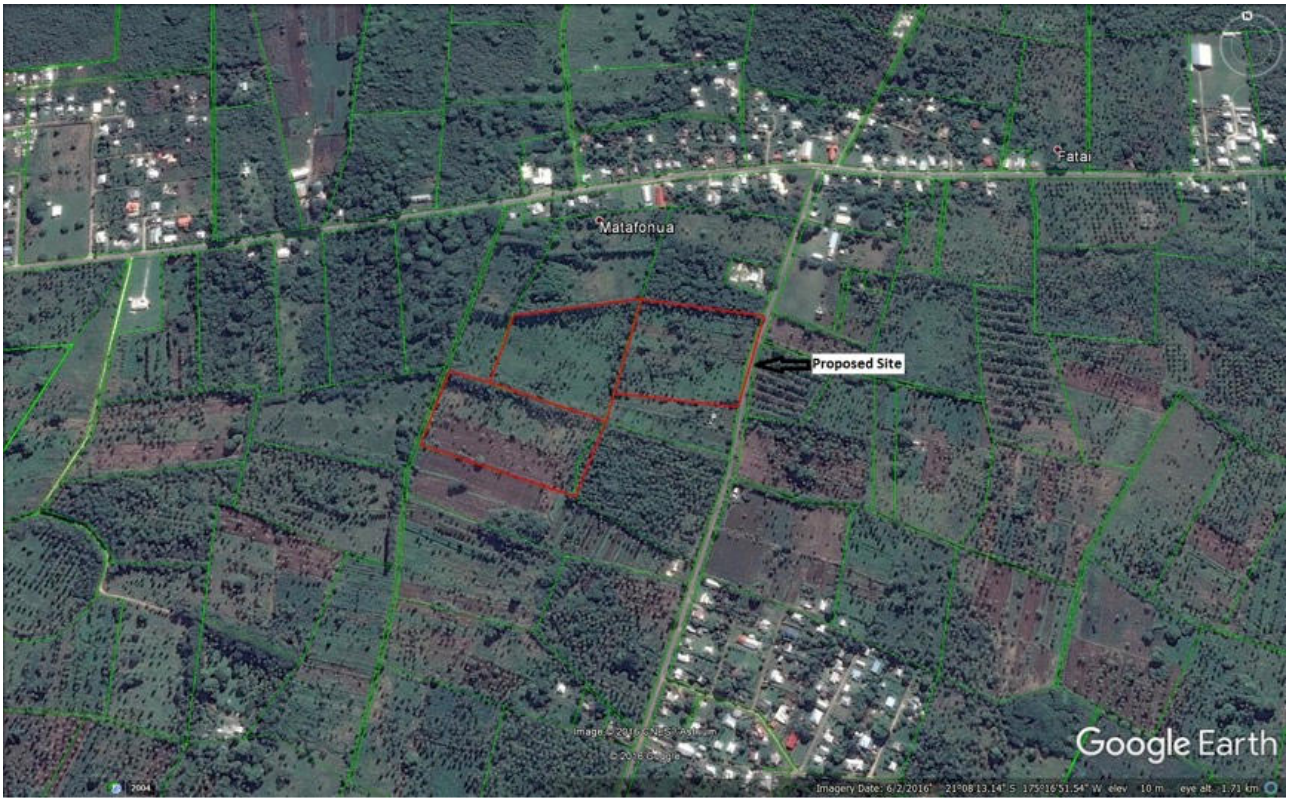
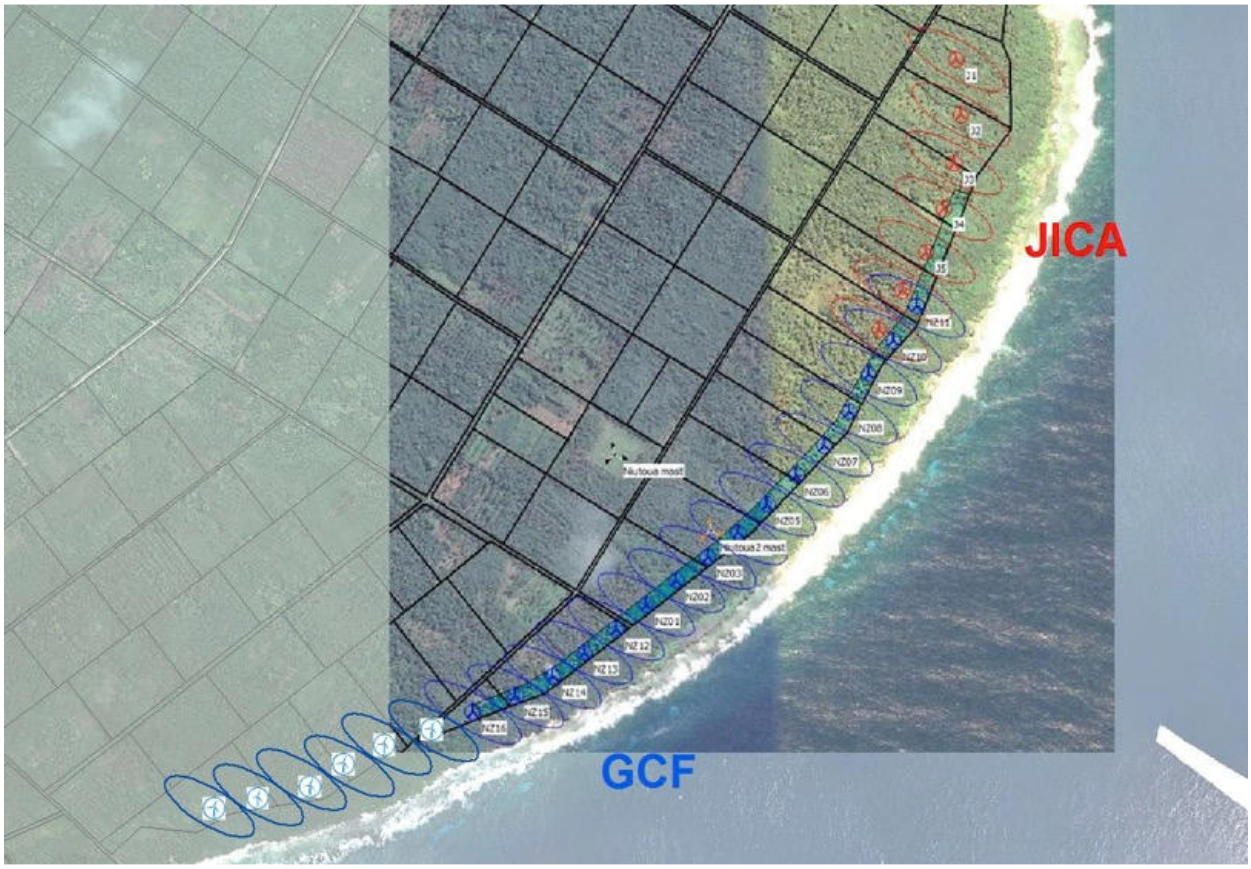


Figure 3.4: Proposed Area for Additional Wind Turbines at Niutoua



4. Detail of Project Components

54. **Improving energy storage and grid control**. Three of the project components involve existing TPL lease areas, which will be utilized to install BESS facilities at Popua, Vaini and Villa. At Popua, the project will also install and commission a Scada control system and mini-grid controller. The project will also finance provision of BESS at three renewable energy facilities (two solar plants and wind farm expansion) to be constructed under IPP arrangements.

55. The BESS facilities are essential for managing fluctuations in renewable energy power supply and maintaining energy stability, including 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, simplifying 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. Cabling and connection to the existing electricity grids through feeder lines or directly to solar PV arrays will be required. It is likely that connection cabling will be underground.

56. With the increase in renewable energy, TPL face several challenges in coordinating the sources of generation, along with managing storage and distribution. Installing a mini-grid controller at the Popua plant will maintain stability and power quality, optimizing plant operations to achieve the most economic generation of electricity.

57. The SCADA control system proposed for Popua is necessary to replace the current ageing system, which is inadequate for an automated mini-grid control system for renewable energy. A SCADA system's primary function is to enable operators to monitor and control all dispersed plant from a single location. The proposed system will also allow staff to gather historic data for analysis.

58. **Improving storage capacity for solar farms**. The project will improve storage capacity by providing BESS for solar plants to be developed through IPP at two sites (Fahefa and Matafonua); the additional generation capacity is expected to be 4 MW (2 x 2 MW). Both sites will house BESS facilities to provide energy storage of 700 kW and 350 kWh batteries.

59. **Improving storage capacity for wind farms**. From the feasibility work conducted by in 2016, generating more than a quarter of Tongatapu's energy from solar PV is possible only with wind generation to complement outputs.[9] The site at Niutoua has been under investigation for development as a wind farm since early 2014.[10] The JICA-financed wind farm is at an advanced stage of development.[11] Expansions to the JICA-financed wind farm are expected to provide renewable energy output of up to 5.3 MW. Depending on the final configuration of how the turbines are placed on the land, it is estimated that each turbine requires approximately 0.8 ha of land, which allows for adequate buffer.[12] The turbines will likely be sited as per the feasibility work undertaken, as close as possible to the coast whilst maintaining an appropriate setback from property boundaries and including a buffer zone to protect the vegetation within the coastal margin. The design proposes the turbines to be located at 90-150m from the coast. This turbine positioning was found to best harness the wind resource without encroaching on undisturbed vegetation within the publicly-owned coastal margin. The design proposes the wind turbines be placed in a single row in an arc following the coastline.

5. Construction, Operation and Decommissioning

60. **Construction and installation activities**. Construction of the project components on Tongatapu will include the following:

- Site preparations works, as required for BESS containerized housing, 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 and siltation of neighboring properties.
- Security fencing will be constructed around new facilities.
- Installation of BESS facilities, to be housed in modular containers at each site, as well as at the three existing sites at Popua, Vaini and the Villa.

[9] Aecom. 2016. Ibid.

[10] Investigations undertaken between 2014 and 2017 by TPL, MFAT and JICA.

[11] The development inputs already completed for the JICA project include wind modelling and climate risk assessments; community consultations; formal lease agreement has been secured for an area of land to accommodate five turbines to be financed by JICA; Environmental surveys have been performed and used to prepare an amendment for the wind farm to be funded by JICA; electrical modelling has been undertaken to assess the capability of the grid to absorb the power produced by the wind farm; and geotechnical investigations have been undertaken at sample locations across the project area to inform the design and costing of civil works

[12] Based on the siting and completed lease negotiations for the five turbines financed by JICA.

- Associated connection works into the grid, requiring a mixture of overhead lines and trenches for underground cabling.
- Site landscaping where required.
- Commissioning of all equipment.

61. **Operation**. During the operational phase, the additional wind and solar generation facilities and the BESS will work in an integrated system to supply the maximum amount of energy from renewable sources. By providing power to consumers from renewable sources, it is expected that costs will decrease, with associated economic benefits for the people of Tonga. As outlined in the TERM, TPL will require expertise to manage the more complex mixed power generation system for Tongatapu. Having a high renewable energy penetration requires a multi-level control strategy to maintain power stability and quality, whilst achieving economic and environmental objectives. Optimizing the operation of each of the power sources and energy storage components will ultimately reduce costs and emissions. Hence the operations will require a focus on renewable energy and storage efficiencies to maximize benefits to end users.

62. **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. However, with panels containing at least one rare or precious metal such as silver, tellurium or indium, recycling will become more critical over time as production rates continue to grow exponentially. It is assumed that recycling options will be viable within 25 years, and that batteries, PV modules, inverters and other electronics, will all be recyclable in Australia, New Zealand or the Asia Pacific Region.

63. **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 Q1 2019
- Contract award: Q2 2019
- Construction: Q3 2019
- Testing/commissioning: Q2 2020

D. DESCRIPTION OF EXISTING ENVIRONMENT

1. Physical Environment

64. **Island location and topography**. 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 (Figure 4.1 a and b); 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.

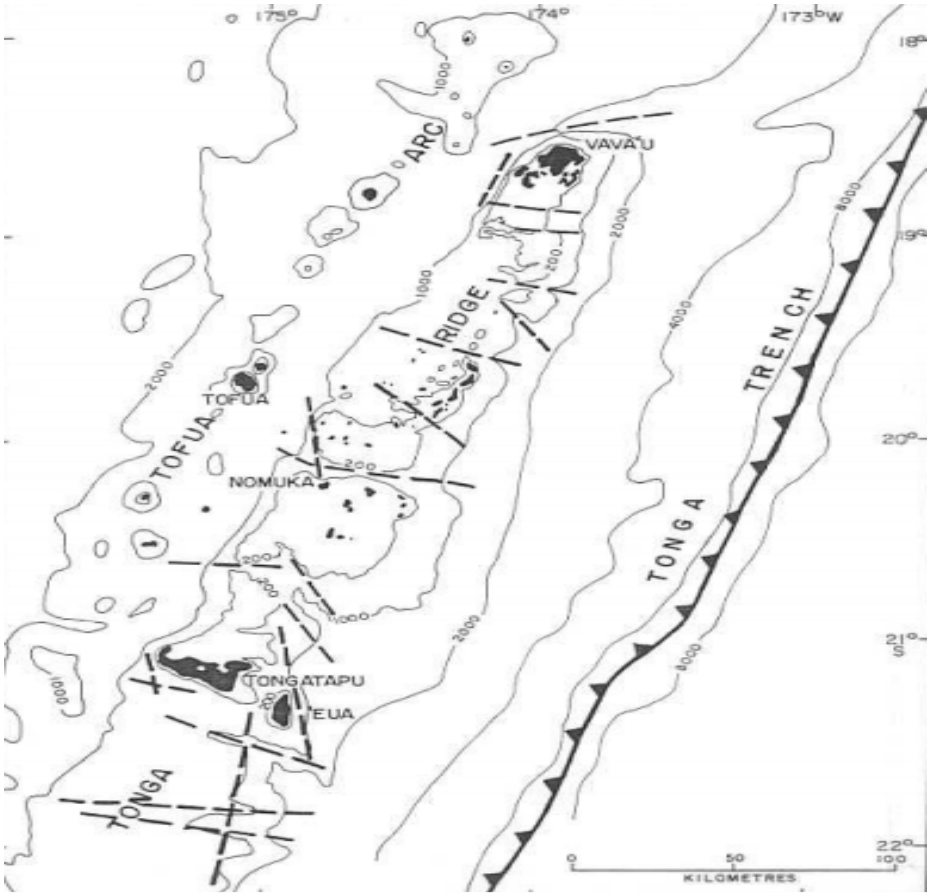
Figure 4.1a: Location of Tongatapu within Island Group

Figure 4.1b: Tongatapu Island

65. Tongatapu itself is a raised coral island. Uneven uplift has resulted in a pronounced tilt from south-east to north-west. The maximum elevation on the south-east side is 65 m above mean sea level. The island is generally flat, apart from some small localized slopes. The most rugged topography on the island is associated with near-vertical sea cliffs up to 30 m high on the windward coasts. In most areas, these are fringed by a narrow reef flat with a well-developed algal rim. Elsewhere, the morphology of the island is very subdued. Typically, the land surface is flat to gently undulating with occasional steep-sided hills 10-25 m high and linear, scarp-like features. The dimensions of the hills range from a few hundred meters to 1 km in diameter.

66. **Geology and soils**. The Tongan Ridge (Figure 4.2) 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.

Figure 4.2: Location of Central Tonga Ridge and Main Islands



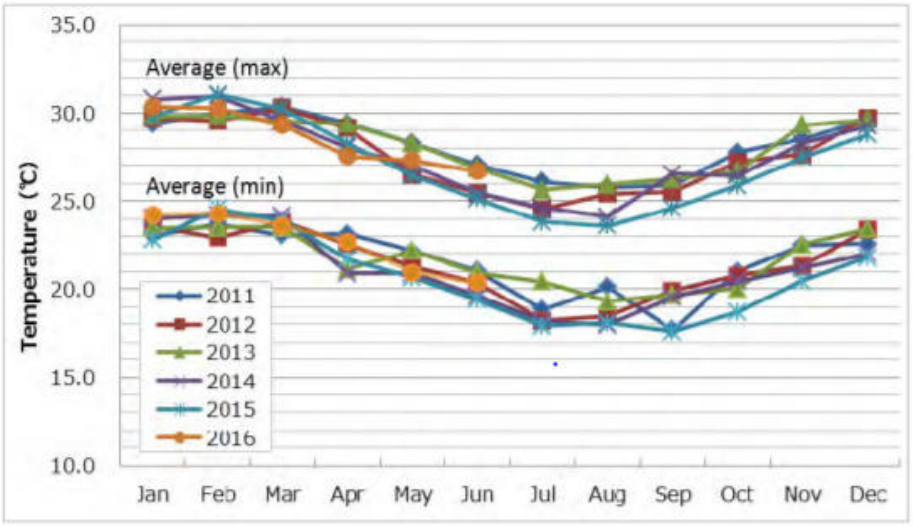
67. The islands of Tongatapu are composed of emerged and tilted limestones of Pliocene and Quaternary age with a volcanic soil mantle. Their morphologies and surface geology are mainly the result of subaerial and marine erosion. Tongatapu is made up of Pliocene and Pleistocene limestone 130-250 m thick overlying lower Pliocene and older volcaniclastics. The limestone is elevated above present sea level and reaches a maximum height of 65-70 m at the southern end of the island. This forms the high point of a narrow and irregular ridge (0.5-1.25 km wide and mostly rising more than 20 m above sea level) that extends to the northeast and northwest along the windward coasts. The ridge encompasses a broad, low area in the central and northern part of the island that rises gently to the south. The sea bed on the island's windward coast slopes steeply to depths of 200 m but the northern part of the Tongatapu block comprises a shallow lagoon (mostly < 50m in water depth) about 600 km in area.

68. In Tongatapu, many primary depositional features - reef rim, patch reefs and lagoon bed - are still evident and some may be associated with relict deposits of construction material. Soils were formed from a thick deposit of volcanic ash covering most of Tongatapu and ranging in thickness from about 5 meters in the west of the island to just 1 meter in the east.[13]

[13] Furness, L. & Helu, S. 1993: The Hydrology and Water Supply of the Kingdom of Tonga. Ministry of Lands, Survey and Natural Resources. Tonga.

69. **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). Mean annual temperatures in Tonga vary from 27^{0}C in the northern islands to 24^{0}C on Tongatapu; diurnal and seasonal variations can reach as high as 6^{0}C throughout the island group. The average temperature during the wet season in Tongatapu is 28^{0}C and during the dry season is 26^{0}C with the warmest months being January - March and coolest months being July-September (Figure 4.3).

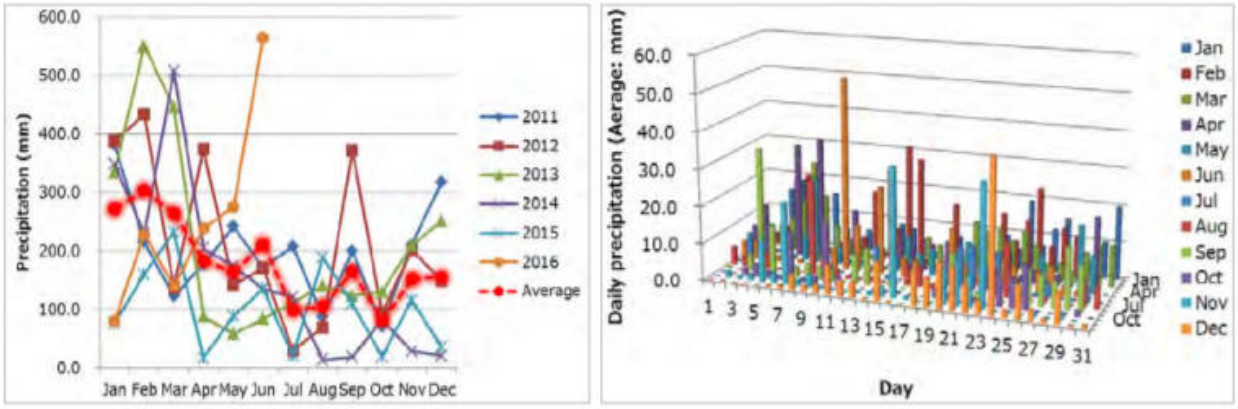
Figure 4.3: Maximum and Minimum Average Annual Temperature 2011 – 2016



Source: Tonga Meteorological Service (2017)

70. Tongatapu has an overall average rainfall of 2,032 mm per annum with the highest rainfall months occurring December – July (Figure 4.4). Monthly average rainfall is 236 mm and varies from 215 mm in January to 104 mm in June and 115 mm in July. In 2016, April - June received uncharacteristically high rainfall (238 mm, 276 mm and 564 mm respectively).

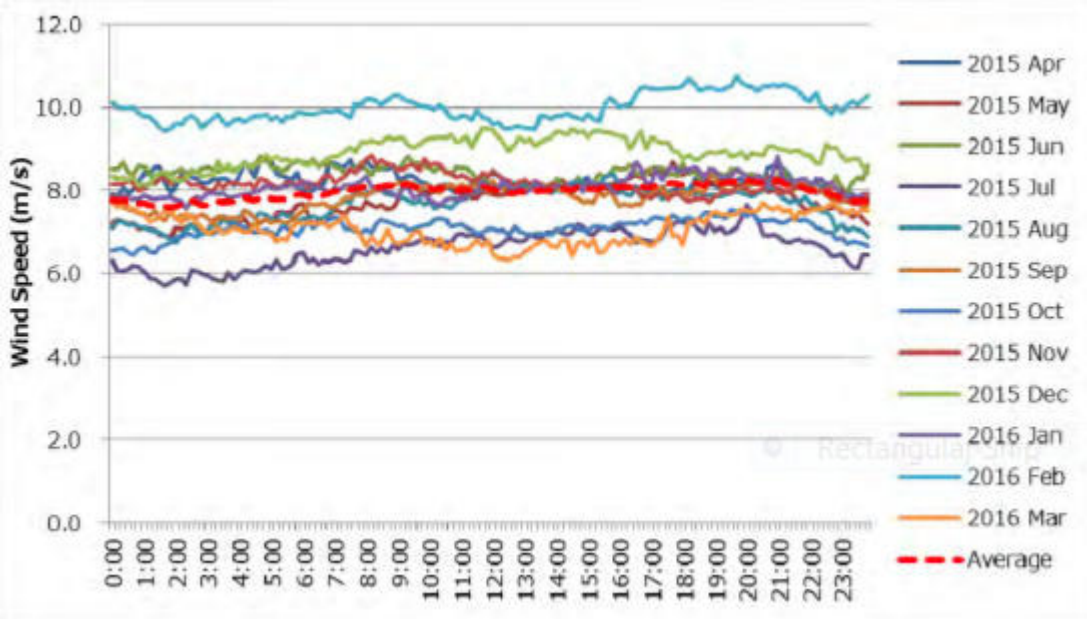
Figure 4.4: Average Annual and Daily Rainfall 2011 – 2016



Source: Tonga Meteorological Service (2017)

71. Tonga's prevailing winds blow from the east and the southeast and average 12 knots throughout the year. Its location in the Southwest Pacific makes Tonga vulnerable to cyclones and severe weather systems, with an average of 1.3 tropical cyclones per year. 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. Over the period 1969–2010 cyclones occurred more frequently in El Niño years. At Niutoua, wind speed is stable at 6 to 10 m/s (Figure 4.5) throughout the year and is approximately 4 m/s stronger than speeds recorded at the airport. This is due to Niutoua receiving wind from the sea (east and south-east).

Figure 4.5: Average Monthly Wind Speed at Niutoua



Source: Survey Report for Installation of Wind Generation Power System (JICA, 2017)

72. Longest daylight hours are December-January with 13.5 hours and decreasing to 11 hours across months May – July.

73. **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.

74. Climate projections for Tonga include:[14]

- 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;

[14] PCCSP. 2011. International Climate Change Initiative. Volume 2 - Climate Change in the Pacific: Scientific Assessment and New Research and Climate Projections Tool – Pacific Climate Futures.

- 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.

75. **Water resources**. Fanga'utu and Fanga Kakau Lagoons are shallow water bodies in the interior of the island and occupy an irregular depression bounded by the 5 m scarp. The island of Tongatapu has no surface water resources, with the water supplied from groundwater stored in a freshwater lens. This lens varies in depth from 1.0 - 2.5 m below sea level in the west, and approximately 5-8 m below sea level in the central and eastern part of the island. There is a well-field at Mataki'eua that extracts water to supply the capital city, Nuku'alofa.

2. Biological Environment

76. **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)*. No endemic flora is found on Tongatapu.

77. In Tongatapu, extensive land clearance has occurred for settlement and agriculture. The three-existing plant at which the project will provide BESS are already cleared and developed (see Plates 4.1 and 4.2).

79. The sites identified for new renewable energy sources to be developed through IPP (Matafonua, Fahefa and Niutoua) are predominantly agricultural land, with patches of scrub and woodland. None of the proposed sites contain any areas of habitat value or vegetation of conservation of significance (refer to Plates 4.3- 4.4).

80. **Fahefa**. The site identified as target land near Fahefa is agricultural and currently without any intensive agricultural activities (some grazing activities undertaken). There are mature mango trees evident, along with coconut trees and a variety of introduced low trees and grasses.

81. **Matafonua**. The Matafonua site is agricultural and without intensive food. There are coconut trees, panicum grassland, mango trees, papaya trees, and introduced grasses and weeds present.

82. **Niutoua**. The wind turbines will be installed in an arc along the coastline near Niutoua towards Haveluliku. The site has been extensively surveyed as a part of the earlier feasibility studies. The area is productive agricultural land and/or land formerly used for agriculture. There is a predominance of young or regrowth vegetation, with more established trees such as mature mango trees in the area. There is low-intensity cattle grazing. There is no mature forest. The average height of the vegetation ranges from 2-4 m, except for individual or groups of trees and palms over 10 m. There is significant vegetation beyond the site within the coastal zone, with 100 m wide coastal flora along the line of the coast.

83. **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)*[15] 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. There are no endemic fauna species on Tongatapu.

84. The most comprehensive study of birds in Tonga was undertaken in 2001, which reported a total of 74 species.[16] 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.

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

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

Plate 4.1: Unused land at TPL lease site at existing Vaini solar plant

Plate 4.2: Site clearance for IPP solar farm development at Villa

Plates 4.3 a & b: Mango and coconut trees at Fahefa site

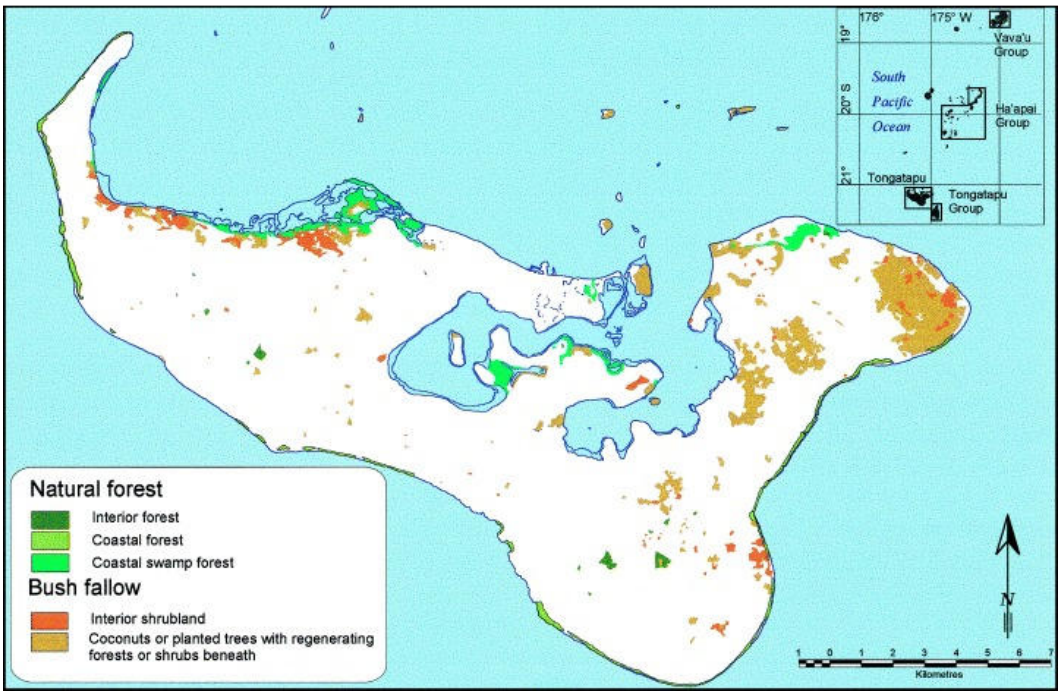
Plates 4.4 a & b: Vegetation at Matafonua site

85. No bird conservation areas or migratory corridors have been identified at any of the project sites or the wider project area. An ornithological study undertaken in 2015 found that there is potential for bird landings and feeding areas within the Niutoua coastal zone, but that the area had no special characteristics to signal significance as habitat for birds. Additional bird counts were undertaken at 13 locations within the site in October 2015. All birds sighted and heard during this study were recorded, with a total of nine species identified. All species have been identified as IUCN as 'least concern' for their conservation status given global population numbers for each of the identified birds and that the species are widespread and common.[17] Appendix 2 contains bird count results from the 2015 study.

86. There is no evidence of significant vertebrate or invertebrate species at the Matafonua site. Due to its long history as tax allotments (farming parcels) the ecology is highly disturbed. As per the Matafonua site, the level of site disturbance at Fahefa has resulted in a site with limited conservation values. There was no evidence of any species of significance in the preliminary site survey. There have been comprehensive fauna and bird surveys undertaken at the Niutoua site as a part of the feasibility and detailed design work undertaken to date with the assistance of MFAT and JICA. In an ecology survey undertaken in early 2015, mature trees were assessed for habitat of flying foxes (*Pteropus tonganus*), but there were no signs of bat roosting observed. One lizard was identified within the area of interest, the dark-bellied copper-striped skink (*Emoia impar*). This is one of 17 lizard species found in Tonga, and is common throughout the Pacific.

87. **Forests.** The original vegetation on Tongatapu was lowland rainforest. However, this was extensively cleared for settlements and cultivation activities, and there is little of conservation value remaining as shown in Figure 4.6.

Figure 4.6: Remaining Forest by Type on Tongatapu



[17] Aurecon. 2015. Tongatapu Wind Generation Study. Phase 2b Detailed Design – Draft A Report (2B of 2 – Appendices). Ministry of Foreign Affairs and Trade.

88. **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.[18] 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)

89. The closest national park is 'Eua National Park on the neighboring island. The protected area network focuses on marine reserves includes Tongatapu's Fanga'uta Lagoon Reserve, which is also a key ecologicl feature of the island.

90. The Fanga'uta Lagoon is increasingly threatened by the pressures of poorly planned urban development. Pollution from inadequately built and unmaintained septic tanks, poor solid waste management practices, and clearance of mangrove areas are having serious cumulative impacts on the lagoon and its ecology. Levels of phosphate, nitrate and faecal coliforms now exceed the Australian standards for seafood, recreation, and risk of algal blooms. Despite a management plan prepared for the lagoon area in 2001, lack of resources to implement the plan has resulted in continued deterioration.[19] Under the Global Environment Facility Ridge to Reef program's Fanga'uta Lagoon Environmental Management Project this situation is improving with a focus on pollution control and community managed projects.

91. A new national park was proposed in 2016. The 4.05 ha area to be designated as Va'epopua National Park is the site of the former Nuku'alofa rubbish dump. The proposal is controversial as it excludes the 500-600-year old Va'epopua Sia Heulupe archaeological site approved for protection by the GOT in September 2015.

3. Socio-economic Conditions

92. **Population and demography**. The preliminary published data from the 2016 census records a total population of 100,745 for Tonga, distributed over 36 of its 172 islands. Compared with 103,036 recorded in the 2011 census, the population has decreased by 2,291.[20] This decrease is due to the high rates of emigration from Tonga, as the diaspora community continues to grow, particularly in New Zealand, Australia, and the USA.

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

[19] ADB 2007: *Initial Environmental Examination. Appendix G, Technical Assessment Report.* Tonga Integrated Urban Sector Project.

[20] Statistics Department. 2017. *Tonga National Population and Housing Census 2016. Preliminary Results.*

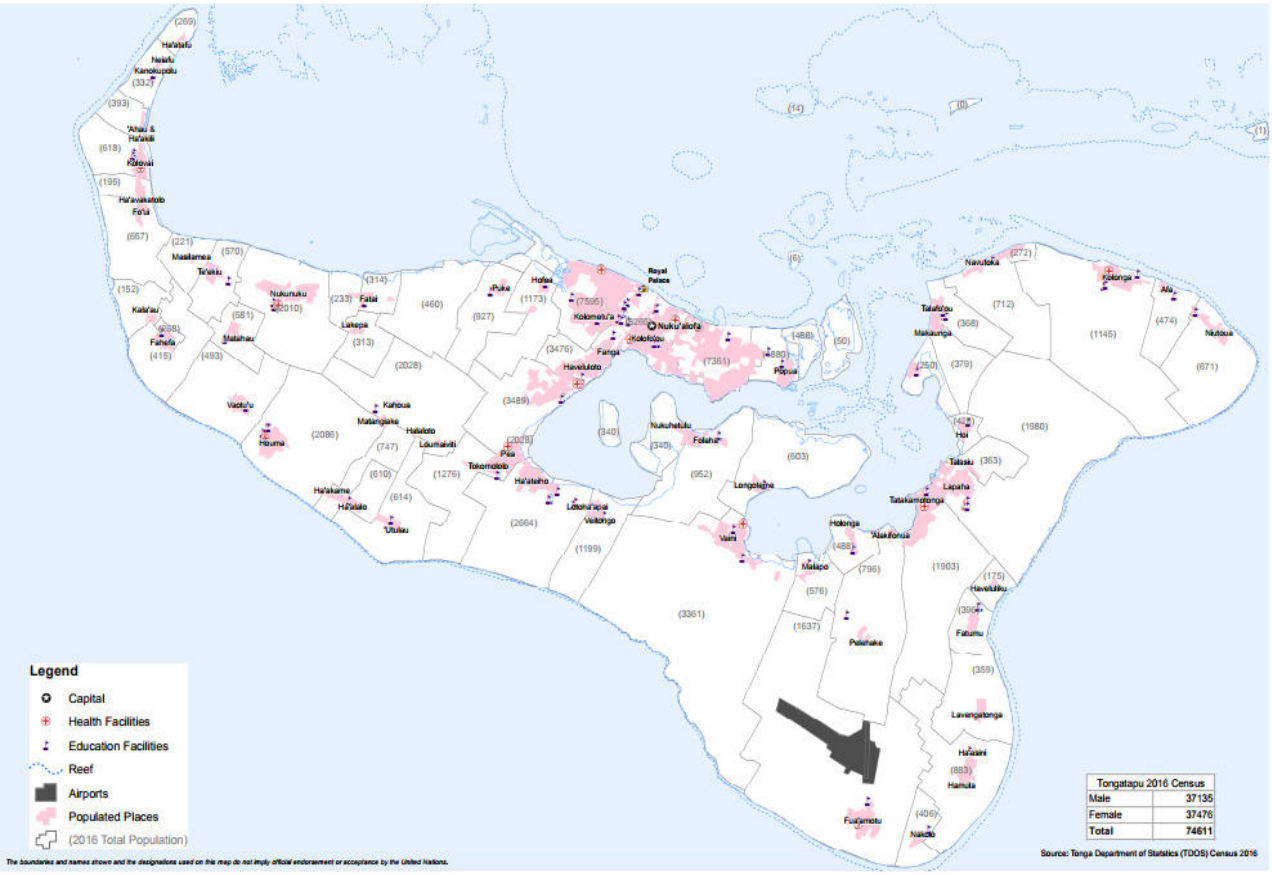
93. Some 74% of the national population resides on the largest island of Tongatapu. The total 2016 population on Tongatapu is 74,611 with 37,135 males and 37, 476 females. Over the last three decades, population density in Nuku'alofa has increased from 184 persons/km^2 to 245.1 persons/km^2, significantly higher than the national figure of 150.5 persons/km^2. Table 4.2 provides the population data for villages closest to project sites. Figure 4.7 shows Tongatapu island divided into administrative wards with 2016 population.

Table 4.2: Population of Villages in Proximity to Project Sites

Village	Population (2016 Census)	2011-2016 Intercensal change
Popua - existing power generation site	1,854	- 0.8%
Vaini - village near existing solar farm	3,294	+ 0.4%
Tofoa – near Villa site	3,510	- 0.1%
Fahefa - village near proposed new solar facility	431	+ 0.8%
Matafonua - village near proposed new solar facility	235	+ 7.5%
Niutoua - village closest to wind farm	671	- 1.9%
Haveluliku - village in proximity to proposed expansion	182	+ 0.9%
Lapaha - village in proximity to proposed expansion	1,995	- 0.8%
Hoi - village in proximity to proposed expansion	427	- 1.0%

Source: Tonga National Population and Housing Census 2016. Preliminary Results

Figure 4.7: Tongatapu Administrative Wards and 2016 Population



94. **Poverty**. The official poverty line in Tonga was established at $2,586 per person per year in 2009 and Bureau of Statistics data indicated 22% of population were living below the poverty line. The 2016 poverty data based on ADB data indicated about the same proportion of population (23% or 23,231 people) live below the national poverty line.

95. Statistics for infant mortality rate also show that for every 1,000 babies born in Tonga, 14 die before their first birthday. While most, if not all Tongans have access to an improved drinking water source, the high cost of living affects people who are having difficulty in meeting basic needs. In addition are the lack of access to basic infrastructure, services and utilities and the lack of employment or income generating opportunities. Tonga is also vulnerable to natural disasters, which is costly.

96. **Economy**. Tonga's 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.[21] 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.

97. 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. The seasonal work visa program offered by Australia over the past five years has had a positive benefit for many families accessing work, particularly in fruit picking.

98. Agriculture, industry and services are the main contributors to Tonga's GDP. When the GDP data is aggregated to the sector level, the services sector is the largest contributor to the GDP. This indicates a change in the economy, with gradual diversification from agriculture to services. It is expected that this sector will continue to strengthen, particularly with opportunities in the tourism market. GDP data for 2014 – 2017 period is provided in Table 4.3.

Table 4.3: Tonga GDP Data 2014 – 2017

Year	GDP growth (%)	GDP per capita growth (%)	Inflation (%)
2014	2.1	2.0	2.5
2015	3.7	3.7	-1.0
2016	3.1	3.2	2.0
2017	2.8	2.7	2.5

Source: ADB Development Outlook 2017

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

E. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

99. The assessment of impacts covers both the installation of the BESS and the associated facilities. The GOT will be encouraged to adopt a standardized approach to identification and mitigation of impacts of activities in the energy sector and especially for the project and associated facilities, as a minimum the COEP will apply to the associated facilities.

1. Design and Pre-construction Impacts

100. **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 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 and the COEP to ensure they will withstand strong wind.

101. The turbines are proposed for sites that will take advantage of the wind. Increasing high wind events due to climate change, and ongoing risk of cyclone provide an element of risk for any infrastructure development in Tonga. All construction for the solar panel arrays and the housing for the BESS facilities will be undertaken in accordance with the Tongan Building Code and Standards Act 2002 and the Building Code Regulations 2007, to ensure they are built to withstand strong winds.

102. For the wind turbines, cyclone occurrence is a significant risk. Even turbines that have been designed to withstand strong wind conditions can be damaged in extreme events, as was the case with the Vesta turbines in New Caledonia.[22] In the Feasibility work undertaken by Aurecon, whilst this risk is flagged, it is concluded that sound construction technologies will mitigate the risk to some degree. There are two major design responses typically utilized. The first is strengthened mast and construction tie down systems, and the second is the use of turbines that can be laid down in the event of severe weather warnings, as is illustrated in Figure 5.1. Vergnet are one supplier that makes a turbine designed to be lowered in severe weather conditions. The company states that it will take 2 people less than one hour to lower and secure one turbine. Given that there will be a total of approximately 25 turbines, including the turbines to be funded by JICA, this will require approximately 50 person-hours. Whilst there are usually a few days warning for an approaching cyclone, given other TPL and personal priorities, this may be a logistically challenging operation. If this type of turbine is to be installed, a detailed and practical emergency response procedure will need to be developed by TPL to protect the assets.

103. As an important mitigation measure to the risk of damage from severe weather events, design is critical. Suppliers will be required to provide the best available technology suitable to withstand severe weather, and technologies proven in cyclone prone regions are recommended for selection.

[22] Aurecon (2015): *Phase 2 Feasibility Report.*

Figure 5.1: Example of Fold-down Turbine Design (1 turbine upright and 1 prone)

Source: Halatuituia, N: TPL Proposed Wind Farm EIA (2014)

104. **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.

105. 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.

106. 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.

107. 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. 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).

108. 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.

109. 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.

110. **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.

111. **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.

112. The project components proposed for the existing sites (Popua, Vaini and the Villa) will not have any impacts on the landscape or visual amenity. The works are minor in their scope, and can easily be placed on the sites to blend in with the existing facilities, as the BESS facilities are supplied in modular units complete with housing.

113. The new solar facility proposed near the village of Fahefa will be located on three titles of agricultural land. The land is relatively flat, and has existing vegetation that will require clearing. The change of land use will impact on the landscape of the area, although there will be no significant loss of unique landscape. Some existing residential houses across from the facility will see the solar panels, but at a reasonable buffer distance. The second new solar facility proposed near Matafonua is also sited on three titles of agricultural land. It will be visible from the public road but is unlikely to be visible from any residences.

114. Managing the visual impact of wind turbines is always an important consideration in the decision making around facility siting. The selected area has a reasonably uniform topography, which assists in reducing the visibility of the turbines. The visual impact is quickly diminished over distance due to the vegetation in the broader area. The nearest residential dwellings on the south-eastern perimeter of Niutoua are unlikely to see the turbines.

115. It is more likely that they will be visible from the long distance view from the coastal areas at the villages of Fatumu and Lavengatonga. The vegetation in the surrounding areas, whilst not blocking all views of the turbines, will provide a low-level buffer. The wind turbines will become a landscape feature, adding a unique element to this area of Tongatapu. Given the significant buffer distances from settlements that will see the turbines, it is not projected to have any significant impact on visual amenity.

116. It will be necessary to undertake significant vegetation clearance for the wind turbines to operate effectively. However, the vegetation to the west, and the topography of the landscape itself will effectively reduce this visual impact. To retain the landscape amenity, it is recommended that land clearance to the east does not encroach on the coastal landscape, as this vegetation provides an important visual buffer from the broader area. With the vegetation providing partial or full screening from public and private vantage points along Liku Road and the closest residential areas, on balance it is viewed that there will not be significant visual impact from the wind farm developments.

23. **Ecological impacts**. Land clearance and tree removal at the solar 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. These trees do not have significant conservation or habitat value, and as such any impact will be minor. The planting will mitigate the loss of vegetation. At the wind farm, tall trees upwind of each turbine will require clearance to maximize power generation potential. The proposed wind farm sites are sited on predominantly under-utilized agricultural land, partially cleared with scattered palm trees, coconut trees, and small remnants of bush. 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.

117. **Socio-economic impacts**. During the design and pre-construction phase, socio-economic impacts include land clearance and land use change. The BESS will not require additional land. The total area required for the associated facilities is 23 ha. The access to the land at the sites will be agreed and compensated as per the resettlement plan to prepared for the associated facilities and application of COEP 3.

118. The acquisition or lease of land for the associated facilities and conversion from 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.

119. For the project components on existing TPL lease areas at Popua, Vaini and the Villa site, there will be no social impacts, as the works will occur in already developed sites.

120. At Fahefa and Matafonua, there will be the need to secure the use of each parcel of land through a lease agreement. Current lease holders will receive the lease payments as per the Government of Tonga process, as well as compensation for any livelihood loss through the removal of any food trees and crops. The sites have been carefully selected to minimize disruption

to economic activity whilst ensuring that the sites meet the technical requirements. Whilst the development will create a change in land use and loss of agricultural land, it is not viewed as significant in scale. Any potential impacts on the cemetery near the Matafonua site are avoided through siting the development with an adequate buffer zone.

121. At the wind farm sites, there will be a need to negotiate lease agreements between TPL and current lease holders. Government processes and the ADB SPS policy will be adhered to, ensuring that no land owner or user will be worse off through the development. The siting of the wind farms is in a relatively isolated area, with no nearby residences. Impacts associated with project siting on the social environment are viewed as negligible.

2. Construction Impacts on Physical Environment

122. **Construction activities**. The activities for the installation of the BESS will include minor earthworks and land-leveling for housing platform and construction of the modular housing. The construction activities at the associated facilities 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.

123. **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.

124. 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).

125. **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.

126. **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.

127. **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 will be at the landfill, unless otherwise agreed, waste will be transported for safe disposal at the Tapuhia landfill.

128. **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.

129. **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

130. 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.

131. **Vegetation removal**. Minor land clearance will be required at the solar and wind farm sites for the associated facilities. 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.

132. **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

133. **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 and the wind turbines and BESS.

134. 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.

135. 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 closest villages to the solar and wind farm sites, 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.

136. **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.

137. 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.

138. **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.

139. **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.

140. **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.

141. 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.

142. 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.

143. **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

144. Unlike diesel generation plants, BESS, solar power plants and wind farms 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.

145. 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.

6. Operation Impacts on Ecological Environment

146. 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.[23] 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. 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.

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

147. No significant impacts are anticipated on the local ecology due to operation of solar power plants. A significant concern regarding operational wind farms is the potential for bird and bat fatalities. In the literature on birds of Tonga, and the bird counts undertaken on site in 2015, the development site is not a known migration path or significant habitat for birds. There was also no evidence of bats inhabiting the development envelope. It is known that inclement weather patterns leading to poor visibility, eg fog and snow, will increase bird mortalities. As these weather patterns do not occur in Tonga, this decreases the risk of bird strike. However, bird and bat strike remains a risk for any wind farm development and needs to be monitored during the operational phase. It is recommended that TPL maintain records of bird and bat mortalities, and collaborate with MEIDECC to monitor this issue.

148. To date there are no experimental studies in the peer reviewed scientific literature that attempt to quantify the impact of PV solar farms on birds purely from an ecological perspective. DeVault et al (2014) conducted a study that 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 attraction of birds to solar PV installations was recognized as a concern by a focus group held to determine the potential hazards of large scale PV development at airports (Wybo, 2013). 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.[24] There are four broad types of impacts wind farms can have on birds: mortality due to collision, disturbance displacement, barrier effects and habitat loss (Drewitt & Langston, 2006). However, wind turbines have the critical characteristics of large fast moving parts and structures extending attitudinally.

149. There should be no degradation or destruction of critical natural habitats. Other impacts which cannot be avoided should be addressed by way of mitigation. The project proponent should mitigate any residual adverse biodiversity impacts which might arise after consideration of careful site selection, plant layout and operation.

150. Mitigation measures for the associated facilities could include the following as appropriate (many of these relate to wind generation projects and may not be relevant to other types of generation):

- Modify project design (number and size of turbines, plant layout) in accordance with site-, species-, and seasonal-specific risks and impacts. Fewer taller towers may reduce collision risk for most birds and reduce vegetation clearing for construction. The location of associated infrastructure, such as electricity distribution lines and access roads, should also be accordingly informed by such risk and impact identification;
- Pre-construction/pre-disturbance surveys by qualified ecologists to remove nests or other biodiversity features of importance are recommended. This may include translocation of animal or plant species to suitable areas outside of the project's impact area;
- If located near high biodiversity value areas, implement shut-down procedures (curtailment) at times when large aggregations of birds are moving towards the project area;

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

- Avoid artificially creating features in the environment that could attract bird and bats to the facility, such as water bodies or perching or nesting areas. Capping or fixing any holes is also beneficial;
- Avoid artificial light sources. Lights attract prey (e.g., insects). If lights are used, blinking or pulsing lights are best. Steady or slow blinking lights are to be avoided. Timers, motion sensors or downward-hooded lights help to reduce light pollution. Lights on taller structures pose a greater risk;
- Remove carcasses, to avoid attracting carrion-eating birds that may be at higher risk of collision;
- Siting project and aligning electricity distribution lines to avoid important habitats (e.g. nesting grounds, foraging corridors, and migration corridors); and
- In areas of natural habitat, mitigation measures will be designed to achieve no net loss of biodiversity or ecosystem services, where feasible.

151. Given the global concern with this ecological impact, wind power generation companies are working closely with wildlife experts to improve performance through devices such as sonic sound emitters and early warning radar detection systems. There is significant research and development on automated slowdowns or shut downs of turbines when conditions are high risk or a collision has been detected. It is expected that as technologies are field tested and become commercially widespread, that there will be increased options for TPL to reduce mortalities if required. However, given the siting of the turbines, there is not expected to be a significant issue of bird and bat mortalities during the operational phase.

7. Operation Impacts on Socio-Economic Environment

152. **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.

153. For wind farms, there are some risks of environmental impacts for operations. One potential concern is noise emissions. During the feasibility work, modeling showed that there is minimal risk of disturbance from noise emissions. The closest dwellings are located over 1 km to the south of the development site. Using conservative assumptions on turbine placement and type (based on the worse-case scenario from a noise perspective), the modeling projected a sound pressure level of 38 dBA at the closest residence. The standard for wind farm noise in New Zealand (NZS6808:2010) sets a limit of 40 dBA, or 5 dBA above background noise level. This is based on avoiding sleep interruption in a house with open windows. Given the conservative assumptions used, the proposed wind farm is unlikely to create disturbance through noise emissions. Noise from turbines increases with wind intensity, but higher winds will ameliorate this noise as background noise levels are raised through the wind itself. As a mitigation measure, it will be important in the final design to exercise care in siting the turbines closest to nearby residences.

154. **Access to improved and reliable energy sources**. A clear message from the consultations was that people are looking for renewable energy to generate a reduction in the cost of power. 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. 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.

155. **Ability to pay**. A potential impact is unsustainable financial obligations for people. There is a concern that this inability to pay will continue for the larger obligation under a higher power consumption model. 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. 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.

156. **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.

157. About 23% of Tonga's population are considered to live in poverty.[25] 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.[26] 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.[27]

158. **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

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

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

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

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

159. **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.

160. 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.

161. 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.

162. 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.

163. 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.

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

9. Cumulative Impacts

165. The proposed project and associated facilities is part of an integrated model of 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. Adding the solar and wind energy generation components of this project, along with increasing the battery storage facilities, all make a significant contribution to achieving this vision. With the proposed project combined with existing renewable energy infrastructure in place or in the pipeline, Tonga will meet its commitment to produce 50% of power through renewable energy sources. Cumulatively this is of substantial environmental, economic and social benefit to Tonga.

166. The BESS components proposed for Popua, Vaini and the Villa site have minimal cumulative impacts, given that they will be constructed on existing TPL sites (containerized), and have relatively minor footprints.

167. The two proposed solar farms on Tongatapu will be in addition to the existing solar farms at Popua and Vaini, and the IPP solar farms. The existing and pipeline solar farms have a generation capacity of approximately 6 MW. Adding a further 4 MW takes the total generation capacity from solar energy to 10 MW. While the two new plants will result in new solar array structures, the design height of 3 m, and the siting of the facilities limit the impact on neighboring properties. The cumulative impact of converting productive agricultural land to solar facilities is a consideration. However, given the economic benefits compared to agriculture, and that the potential for further additional solar farms are limited, this is not viewed as a significant cumulative impact.

168. The proposed wind farms will result in an estimated 20 turbines in addition to the turbines being constructed in the Niutoua area by JICA. This significantly increases the scale of the development, extending it in a line following the coast line in a south westerly direction. However, to meet the recommendations of the TERM, wind generation is a key component of the optimum technical mix to maximize renewable energy in Tonga. The feasibility and environmental investigation undertaken to date concur that the cumulative impacts will not outweigh the benefits of the development.

169. The cumulative impact of land clearance on the land for the new solar and wind farm sites will be mitigated through a re-vegetation program. Wherever practical, cleared land will have boundary plantings undertaken by the proponent provided this could be achieved within the lease area, and without compromising energy generation potential.

F. ANALYSIS OF ALTERNATIVES

170. TPL, in consultation with external experts, considered alternative sites in designing this project. For the BESS facilities, it was recommended to split the facilities between sites for technical advantages. Given the low impact of the developments due to their modular and fully contained systems, the splitting of the systems over more than one site was preferable alternative, as it will increase the resilience of the overall system.

171. Potential sites were explored for the siting of additional solar farms. One constraint is that each facility needs to be a minimum of 4 km from any existing solar farm. Alternatives were considered near the villages of Foui, Houma, Puke, Veitongo, and the Fuamotu Airport. The two sites near Fahefa and Matafonua were selected based on technical appraisal, land availability, existing land use, and predicted environmental impacts. The Fahefa and Matafonua sites are on previously cleared agricultural land, and with adequate buffers to nearby residences.

172. In selecting the sites for the wind farms, there was a detailed analysis based on wind monitoring data, and exploration of sites including land closer to Lapaha, and in the far western tip of the island at Ha'atafu. Concentrating the turbines in the one area was viewed as less impact, and the Niutoua area was selected over the other sites due to its reliable wind patterns, and the minimal environmental and social impacts.

173. With and without project alternatives were analyzed and it was found that without the developments, Tonga would continue to pay a heavy price for diesel imports, affecting the overall economic development of the country. The implementation of the Project will bring positive economic, social and environmental benefits. Economic benefits will be reducing the import of diesel for power generation, thereby boosting GDP and reducing power pricing, which in turn will encourage investment. Social benefits will include sustainable and more affordable electricity supply to the consumers, and a highly skilled local workforce in new and emerging technologies. Environmental benefits are a reduction in CO_2 emissions from diesel generators, reducing diesel transport, and reducing the risk of spills in the transport, storage, and use of diesel; and a reduction in noise levels from generators.

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. Environmentally, maintaining the current status of power generation would result in approximately 17,150 tons per year of CO_2 emissions that were preventable if this development had occurred. 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. CONSULTATIONS, INFORMATION DISCLOSURE AND GREIVANCE REDRESS

1. Stakeholder Consultations

175. As part of the environmental assessment process for BESS installation, community consultations were undertaken during field visits. The list of people met, and a summary of concerns raised is included in Appendix 3. In total 20 stakeholders were met during the field work in Tongatapu.

176. From a community perspective, the main issue raised was the requirement for the investment in renewables to return a dividend to the people of reduced power pricing. All Town and District officers expressed this concern. The consultation with MEIDECC staff raised concerns on changing land use, land clearance, project coordination, and requirements of the EIA process in Tonga.

177. **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.

2. Information Disclosure

178. All environmental documents are subject to public disclosure, and therefore will be made available to the public. The IEE will be disclosed on ADB's website upon receipt as per ADB's Public Communications Policy 2011. The PMU will ensure that project information, including this IEE, is disclosed locally.

3. Grievance Redress Mechanism

179. 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.

180. 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.

181. **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.

182. 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.

183. 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.

184. 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.

185. 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.

186. **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.

187. 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.

188. 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

189. 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.

190. 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.

191. 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.

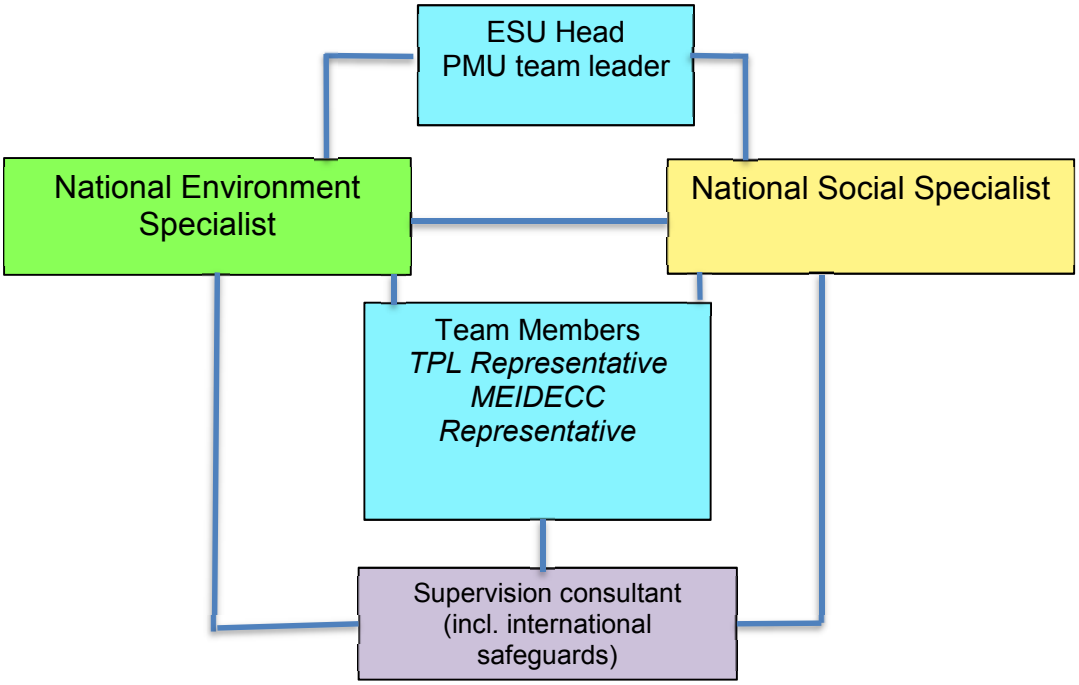
192. The requirements identified for pre-construction mostly relate to PMU requirements in respect of EMP updating and incorporation into bid documents, obtaining government approvals and clearances, and contractor requirements in respect of preparation of the CEMP, induction to the site and implementation 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

193. **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.

194. **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



195. **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).

196. 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.

197. **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.

198. The contract will specify the period, following contract award, within which the contractor must submit for review and clearance, their site-specific CEMP.[28] 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

[28] 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).

199. **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.

200. 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

201. **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.

202. 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.

203. **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.

204. 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.	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
		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.				
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;	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
		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 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	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
		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; 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	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

Project activity	Potential impact	Management and Mitigation		Monitoring		
		Proposed measures	**Institutional responsibility**	**Frequency/ interval**	**Verification means**	**Institutional responsibility**
		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.				
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; 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	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
		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 sanctions (including possible removal from site) will be imposed on any worker who does not comply.	Contractor, PMU	Weekly; Overall CEMP implementation monitoring - monthly	CEMP; Records of training; Records of worker sanctions etc	Contractor; PMU
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	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

Project activity	Potential impact	Management and Mitigation		Monitoring		
		Proposed measures	Institutional responsibility	Frequency/ interval	Verification means	Institutional responsibility
		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.				
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; 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	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
		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; 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				

Project activity	Potential impact	Management and Mitigation		Monitoring		
		Proposed measures	Institutional responsibility	Frequency/ interval	Verification means	Institutional responsibility
		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	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
		signboards and be 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)	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

Project activity	Potential impact	Management and Mitigation		Monitoring		
		Proposed measures	Institutional responsibility	Frequency/ interval	Verification means	Institutional responsibility
		consultation with staff on the location of utilities prior to commencing excavation operations.				
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; 4. Stop works as required and recommence only on advice from PMU.	Contractor, E/SS, PMU	As required upon any find	Chance find protocol in approved CEMP; Implementation of protocols	Contractor, 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

205. 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.

206. 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.

207. 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; 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).

208. 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[29]

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

[29] 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 BIRD COUNT FROM 2015 ORNITHOLOGICAL STUDY

Table 2a: Summary of all birds seen (S) and heard (H) during thirteen bird counts at Niutoua site (14-16 October 2015)

BC#	Date	Zone Type	Bird species																	
			Foulehaio carunculatus		*Pycnonotus cafer*		*Lalage maculosa*		*Apionis tabuensis*		*Ptilinopus porphyraceus*		*Todiramphus chloris*		*Gallus gallus*		*Egretta sacra*		*Fregata sp.* (female)	
			S	H	S	H	S	H	S	H	S	H	S	H	S	H	S	H	S	H
1	14/10/15	Plantation	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	14/10/15	Coastal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	14/10/15	Boundary	0	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
4	14/10/15	Boundary	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	14/10/15	Coastal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	14/10/15	Plantation	0	3	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
7	15/10/15	Coastal	0	4	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
8	15/10/15	Boundary	0	3	0	0	0	1	0	0	0	1	0	0	0	4	2	0	1	0
9	15/10/15	Plantation	0	1	0	0	0	1	2	4	0	0	0	1	0	2	0	0	0	0
10	15/10/15	Coastal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	15/10/15	Boundary	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	15/10/15	Plantation	0	5	2	0	0	0	0	2	0	2	0	1	0	0	0	0	0	0
13	16/10/16	Plantation	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
TOTAL			**1**	**24**	**2**	**0**	**0**	**2**	**2**	**9**	**0**	**4**	**1**	**3**	**0**	**6**	**2**	**0**	**1**	**0**

Source: Aurecon. 2015. Tongatapu Wind Generation Study. Phase 2b Detailed Design – Draft A Report (2B of 2 – Appendices).

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Table 2b: List of birds seen flying across Niutoua proposed wind farm footprint and their directions of travel (during 5-minute sky scans)

Scan #	Date	Lat/Long	Species seen	No	Flight direction	Notes
1	14/10/15	175 02 046 21 09 116	*Sterna sumatrana**	1	North-east	Flying just over tops of coconut palms
1	14/10/15	175 02 046 21 09 116	*Todiramphus chloris*	1	North	Just skimming tops of coastal forest trees; stopped to perch on top of trees.
2	14/10/15	175 02 594 21 09 637	*Todiramphus chloris*	2	Towards coast	Along edge of open field of palms
2	14/10/15	175 02 594 21 09 637	*Todiramphus chloris*	2	North	
2	14/10/15	175 02 594 21 09 637	*Sterna sumatrana**	1	East	Towards coast
3	15/10/15	175 02 330 21 09 416	*Aplonis tabuensis*	1	Towards coast	
3	15/10/15	175 02 330 21 09 416	*Aplonis tabuensis*	1	East	
3	15/10/15	175 02 330 21 09 416	*Sterna sumatrana*	1	Beach to inland	
4	16/10/15	175 02 475 21 09 494	*Fregata sp.* (female)	1	All directions	Bird was soaring and hovering, first travelled towards coast then moved back inland soaring sideways.
* A white tern seen, could not be confirmed whether it was *Sterna sumatrana or Gygis alba*						

Source: Aurecon. 2015. Tongatapu Wind Generation Study. Phase 2b Detailed Design – Draft A Report (2B of 2 – Appendices).

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Table 2c: IUCN conservation status and global population size and trend of bird species observed during field surveys

Species	IUCN Status	Global Population - size	Global Population - trend
Black-napped tern (*Sterna sumatrana)*	Least concern	Very large	Unknown
Frigate bird (*Fregatta* sp) probably lesser frigate bird (*Fregatta ariel*)	Least concern	Very large	Decreasing
Jungle fowl (*Gallus gallus*)	Least concern	Widespread and common	Decreasing
Many coloured fruit dove (*Ptilinopus perousii*)	Least concern	Uncommon and local	Decreasing
Pacific harrier (*Circus approximans*)	Least concern	10's of 1000's	Stable
Polynesian starling (*Aplonis tabuensis*)	Least concern	Widespread and common	Unknown
Polynesian triller (*Lalage maculosa*)	Least concern	Widespread and common	Stable
Red-vented bulbul (*Pycnonotus cafer*)	Least concern	Abundant (millions)	Increasing
Reef heron (*Egretta sacra*)	Least concern	100,000 – 1,000,000	Stable
Wattled honeyeater (*Foulehaio carunculatus*)	Least concern	1,000,000 – 2,000,000 550,000 American Samoa	Decreasing
White-collared kingfisher (*Todiramphus chloris*)	Least concern	Widespread	Decreasing
White tern (*Gygis alba*)	Least concern	Very large	Stable

Source: Aurecon. 2015. Tongatapu Wind Generation Study. Phase 2b Detailed Design – Draft A Report (2B of 2 – Appendices).

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APPENDIX 3: SUMMARY OF PERSONS CONSULTED IN TONGATAPU

Name	Designation	Organization/ Village	Key Discussion Points	Contact Details
Kakau Foliaki	Principal Energy Planner	MEIDECC Energy Division	Project design, implementation and potential challenges	kfoliaki@pcreee.org 7721204
Johnny Lillis	Project Manager OIREP	MEIDECC Energy Division	Project design, implementation and potential challenges. Experience to date with OIREP and community responses	johnny@energyforgood.eu 888 0005
Andrea Tali'uli	Strategic Development Manager	Tonga Power Ltd	Project design, implementation and potential challenges. Site visits and particular issues with each site.	ataliauli@tongapower.to
Finau Katoanga	Project Engineer	Tonga Power Ltd	Site visits and particular issues with each site.	fkatoanga@tongapower.to
Jane Guttenbeil	Communications Manager	Tonga Power Ltd	Community consultations, perceptions from community on power pricing and renewable energy	jguttenbeil@tongapower.to
Setitaia Pasivaka Chen	General Manager, Operations	Tonga Power Ltd	Scope of works for each TPL site; guided site visits for solar sites	schen@tongapower.to
Simon Wilson	Major Projects Manager	Tonga Power Ltd	Scope of works for each TPL site	swilson@tongapower.to
Murray Sheerin	Power Generation Manager	Tonga Power Ltd	Operations of Popua PV	msheerin@tongapower.to
Telefoni Laume	Town Officer	Fua'amotu	Group meeting. Introduced the renewable energy project Discussed their concerns, and recommendations relevant to the project. Main question asked of the team was when will their power bill will be reduced? TPL replied that renewable energy will help stabilise the power supply and reduce power cost, but this will take time and infrastructure investment. 50% renewable target does not mean 50% less cost.	77-16276
Paluio Laume	Town Officer	Niutoua		877 3361
Moala Aniseko	Town Officer	Nukunuku		77-19320
Samuela Kotu	Town Officer	Fo'ui		8745747
Timote Eteak'i	Town Officer	Houma		
Usaia Fifita	Town Officer	Tofoa		77-16752
Malolo Tupou	Town Officer	Puke		77-66344
?	Town Officer			
?	Town Officer			
Lesieli Tuivai	Environment officer EIA Division	MEIDECC	Meeting with EIA Division. Discussion of proposed project and potential impacts. MEIDECC pointed out the need to demonstrate tangible benefit, and to ensure the facilities have the maximum life to improve sustainability. Also discussed changing land use and the EIA process requirements.	tuivailh@gmail.com 7784054
Siosina Katoa	Environment officer EIA Division	MEIDECC		zenakatoa@gmail.com
Tukia Lepa	Environment officer EIA Division	MEIDECC		makitala23@gmail.com