



Initial Environment Examination

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Proposed Loan and Administration of Grant

Cook Islands: Renewable Energy Sector Project (Additional Financing)

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Ministry of Finance and Economic Management
Government of Cook Islands

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Asian Development Bank.

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ABBREVIATIONS

ADB	-	Asian Development Bank
AP	-	Affected Person
CEMP	-	construction environmental management plan
CIBD	-	Cook Islands Biodiversity Database
CIIC	-	Cook Islands Investment Corporation
CIREC	-	Cook Islands Renewable Energy Chart
Project	-	Cook Islands Renewable Energy Sector Project
EARF	-	Environment Assessment and Review Framework
EIA	-	Environmental Impact Assessment (under Environment Act 2003)
EMP	-	Environmental Management Plan
EPA	-	Environmental Protection Authority
ESD	-	Environmental Significance Declaration (under Environment Act 2003)
GDP	-	Gross Domestic Product
GEF	-	Global Environment Fund
GRM	-	Grievance Redress Mechanism
GWh	-	Gigawatt Hour
HV	-	High Voltage
IEA	-	Island Environmental Authority
IEE	-	Initial Environmental Examination
IEO	-	Island Environmental Officer
IES	-	International Environmental Specialist
IUCN	-	International Union for Conservation of Nature
LV	-	Low Voltage
MFEM	-	Ministry of Finance and Economic Management
MW	-	Megawatt
NES	-	National Environmental Service
OPM	-	Office of the Prime Minister
POE	-	Project Owners Engineer
PPE	-	Personal Protective Equipment
PPTA	-	Project Preparatory Technical Assistance
PSG	-	Project Steering Group
PV	-	Photovoltaic
REDD	-	Renewable Energy Development Division (Office of the Prime Minister)
SPS	-	Safeguard Policy Statement 2009 (of the ADB)
TAU	-	Te Aponga Uira (the utility)

CURRENCY EQUIVALENTS

(as of 3 October 2016)

Currency Unit = New Zealand Dollar (NZ\$)

NZ\$1.00 = US\$ 0.73

US\$1.00 = NZ\$ 1.37

NOTES

- (i) The fiscal year (FY) of the Government of Cook Islands ends on 30 June. FY before a calendar year denotes the year in which the fiscal year ends, e.g., FY2013 ends on 30 June 2013.

Executive Summary

1. **Introduction.** The Cook Islands is heavily reliant on imported fossil fuels for electricity generation. The Government of the Cook Islands is implementing The Cook Islands Renewable Electricity Chart (CIREC) which aims to supply 100% of the Cook Islands electricity generation from renewable sources by 2020. The Asian Development Bank (ADB) is supporting the Government of the Cook Islands (the government) to implement the CIREC through the Cook Islands Renewable Energy Sector Project (the Project) which aims to provide a secure, sustainable, and environmentally sound source of electricity for private and commercial consumers.

2. **The Project.** The Project has two outputs: (i) two-phased construction of solar photovoltaic (PV) power and/or energy storage systems on Mangaia, Mitiaro, Mauke and Atiu (Phase 1), Rarotonga and Aitutaki (Phase 2); and (ii) to provide institutional strengthening to the Cook Islands Renewable Energy Development Division (REDD). The Phase 1 subprojects will install a total of 1,246 kW of solar PV systems with battery storage. The systems at Mitiaro and Mauke will include new high speed diesel generators whilst the more modern existing diesel power stations on Mangaia and Atiu will be retained. The upgrade of the electricity distribution system is also included for all but the Atiu subproject. The Phase 2 subprojects include the installation of an additional 1,000 kW solar PV system on Aitutaki together with a new 300 kW high speed diesel and battery storage. On Rarotonga, it is the initial installation of a 1 MW, 4 MWh Battery Energy Storage System (BESS) to be complemented by a second stage of additional battery storage (R-ESS-2) with a capacity of 3 MW / 12 MWh. Table ES.1 provides a summary of the key features at each subproject site.

3. **Implementation arrangements.** The Ministry of Finance and Economic Management (MFEM) is the executing agency and utility Te Aponga Uira (TAU) and the REDD is the implementation agency. The implementing agency will be supported by the Project Owners Engineer (POE) for the design, construction and commissioning of the subprojects.

4. **Administrative, policy and legal framework.** The Project will comply with the requirements of the Cook Islands Environment Act 2003. With the exception of the Mangaia site, the subprojects will require a permit authorised by the Island Environmental Authority but administered through the National Environment Service (NES). The NES advised that the Mangaia subproject, despite not requiring a permit, would be subject to the same assessment process.

5. The Project must also comply with the requirements of ADB's Safeguard Policy Statement 2009 (SPS). The Project is classified as category B for environment. An initial environmental examination (IEE) has been prepared. This IEE will need to be updated as an environmental impact assessment (EIA) to meet the formal request of the NES and requirements of Environment Act 2003.

6. **Environmental impacts.** Each subproject site is located in a modified environment. Combined the subprojects will result in the clearing of up to 52,000 m² (5.2 ha) of vegetation (not all land acquired will be cleared).

7. Five of the six sites are vegetated (the exception being the Rarotonga site). Flora and fauna surveys were undertaken at the five vegetated subproject sites. The survey findings indicate that: (i) clearing of the sites will not result in the significant loss of any native vegetation; or (ii) there will not be any negative impacts on any species recorded as endangered on the Cook Islands Biodiversity Database (CIBD) or listed on the International Union for the Conservation of Nature (IUCN) Red List. Consultation with the mayors of each Island Council confirms there are no sites of cultural (marae) or historical significance associated with the subproject sites.

8. Potential impacts during the construction include dust and noise generation, waste (including hazardous materials), erosion, clearing, and health and safety issues. These effects can be avoided or controlled to acceptable levels with the implementation of the measures described in the environmental management plan (EMP). The construction of the solar sites will not result in significant, long term adverse environmental impacts or any effects beyond the immediate sites.

9. There are few potential operational environmental impacts. Batteries, inverters and solar PV modules that require replacement during the operational life of the project and/or decommissioning will be transported to Rarotonga for recycling or disposal.

10. **Environmental management plan.** The EMP identifies potential preconstruction, construction, operation and decommissioning environmental and social impacts associated with the subprojects. The EMP has been prepared for the subprojects and has been updated based on the design work undertaken during project implementation. The EMP will form part of the construction contract documents and the contractor will be required to prepare a site-specific construction environmental management plan (CEMP) responding to the bid requirements. The contractor will submit the CEMP to the POE for approval prior to commencement of works. The REDD and POE will be responsible for supervising implementation of the EMP at each subproject sites.

11. **Project benefits.** The Project will provide a secure, sustainable and environmentally sound source of electricity to each of the Phase 1 subproject islands. It will provide approximately 30% renewable energy on Aitutaki and increase the limit of renewable generation on the Rarotonga grid from 4.2 MW to 6.2 MW. The Project will provide a significant contribution toward the government meeting its goal of supplying 100% of the Cook Islands electricity generation from renewable sources by 2020.

12. The implementation of the subprojects will result in the displacement of approximately 4.05 GWh of diesel generated electricity per year which equates to a reduction in annual diesel usage of approximately 1.26 million litres. The displacement of 4.05 GWh of electricity avoids the emission of approximately 2,793 tons of CO₂ equivalent per year.

13. **Consultations and information disclosure.** Landowners and local communities were consulted during site selection. Landowners at the subproject sites agree, in principle, to transfer and use of the sites to the Government of the Cook Islands for the project purpose subject to agreement of a formal land use agreement. The site selected on Aitutaki is already leased by the Cook Islands Investment Corporation (CIIC) on behalf the Government of the Cook Islands and the site selected on Rarotonga is owned by the Government of the Cook Islands and already leased to TAU.

14. Local communities and community leaders from subproject islands were consulted during the PPTA and again during project inception and are aware of and fully support the Project. Information was provided to the local communities on the scale and scope of the Project, the expected impacts, proposed mitigation measures and institutional arrangements. Recommendations and suggestions received during consultations have been incorporated in the design of the project and in the project IEE and EMP.

15. **Grievance redress mechanism.** A grievance redress mechanism (GRM) is proposed for the Project to receive, evaluate and facilitate the resolution of affected people's concerns, complaints and grievances about the environmental and social performance of the Project. The GRM contains methods to promptly address affected people's concerns and complaints, using an understandable, transparent and culturally appropriate process. The mechanism does not impede access to the Cook Islands' judicial or administrative remedies.

Table ES1: Subproject Features

Feature	Atiu	Mitiaro	Mauke	Mangaia	Aitutaki	Rarotonga	Total
Geographical location	116 nautical miles NE of Rarotonga	142 nautical miles NE of Rarotonga	150 nautical miles NE of Rarotonga	110 nautical miles ESE of Rarotonga	140 nautical miles N of Rarotonga	-	
Land area (km ²)	26.9	22.3	18.4	51.8	18.1	67.2	204.7
Island population ¹	480	189	307	572	2038	13,095	16,681
Households ²	161	76	106	195	-	-	-
Project intervention	Installation of 399kW solar power plant with gel-acid battery storage plus power station upgrade with advanced control system	Installation of 157kW solar power plant with gel-acid battery storage plus new power station with new diesel generators and new control system plus upgrade of existing distribution system	Installation of 228kW solar power plant with gel-acid battery storage plus new power station with diesel generators and new control system plus upgrade of existing distribution system	Installation of 462kW solar power plant with gel-acid battery storage plus new control system for power station	Installation of 1000kW solar PV array, 300kW high speed diesel generator in existing power house, containerised battery storage system plus upgrade switchgear and controls	Installation of 1MW / 4MWh battery energy storage system and connection to the Rarotonga Grid. Installation of additional 3MW / 12 MWh battery storage system	
Location of site for solar installation	Vaitamina 556, former agricultural land approximately 140 m south of existing power station in Teenui village.	Teramake Section 8 and Tueru Section 9, <i>makatea</i> 230 m inland from existing power station behind Mangarei village.	Tengaru 6B, agricultural land in Areora village adjacent to Public Works shed and Agriculture Research buildings.	Aratane Section 35 Puna Keia, agricultural land and <i>makatea</i> 150 m SSE of existing power plant on E side of Aremauku Road.	10 parcels of land located approximately 1.2 km east of the village of Arutanga at the site of the existing power station	TAU owned airport solar PV array located at Rarotonga Airport, Avarua District southwest of terminal building and inland side of the airport. Existing TAU owned power station site.	
Ownership of land to be acquired	Privately owned native freehold land	Privately owned native custom land	Privately owned native freehold land	Privately owned native custom land	Privately owned native freehold land	Government of the Cook Islands	
Area to be acquired as site: m ² ha	15,000 est. 1.5	4,837 0.48	8,400 0.84	12,162 1.21	38,711 3.87		79,102 7.91
Land use	Unused – previous agricultural use	Unused	Unused – previous agricultural use	Unused	Unused	TAU airport solar PV array and existing power station site	

¹ 2011 Census.

² Active residential electricity accounts.

Feature	Atiu	Mitiaro	Mauke	Mangaia	Aitutaki	Rarotonga	Total
Vegetation	Vegetated with predominately introduced species	Vegetated with native and introduced species	Predominately cleared with sparse introduced species	Vegetated with native and introduced species	Vegetated almost entirely with introduced species	Cleared and sealed. No vegetation	
Terrain	Gently eastward sloping comprised of volcanic soils	Flat	Flat, volcanic soils	Flat	Flat, volcanic soils	Flat (existing hardstand)	

I. INTRODUCTION

I.1 Project Background and Rationale

1. The Cook Islands is a Pacific island country divided into two island groups—Northern and Southern—with a total resident population of 14,947 people (2011 census). The Northern Group consists of six low-lying, sparsely populated, coral atolls while the Southern Group consists of nine high islands mainly of volcanic origin and several smaller atolls. Approximately 74% of the country's population lives on the largest island, Rarotonga.

2. The Cook Islands Renewable Energy Sector Project (the Project) aims to assist the government's efforts to reduce the country's heavy reliance on imported fossil fuels for power generation by providing a secure, sustainable, and environmentally sound source of electricity for private and commercial consumers. The Project is financed by a loan from the Asian Development Bank (ADB) and grants from the European Union, the Global Environment Facility (GEF) and the Green Climate Fund (GCF) to be administered by ADB. The Project will be carried out in the islands of the Southern Group including Rarotonga, Aitutaki, Atiu, Mitiaro, Mauke, and Mangaia. Figure 1.1 shows the location of the six islands included in the Project.

Figure I.1: Project Location



3. The Cook Islands is heavily reliant on imported fossil fuels for electricity generation. In 2012 approximately 12.2 million litres of diesel was imported in to the Cook Islands of which approximately 7.2 million litres was used for electricity generation. The cost of imported fuels was \$58 million or approximately 28% of the Cook Islands gross domestic product (GDP) and electricity costs are currently amongst the highest in the Pacific. Like other Pacific island countries, the Cook Islands are highly vulnerable to fluctuating oil prices, affecting the affordability of food, goods, electricity, and transportation. Its dependency on imported fossil fuels consequently affects the economic growth of the country.

4. The government is also implementing the Cook Islands Renewable Electricity Chart (CIREC) which aims to supply one hundred per cent of the Cook Islands electricity generation from renewable sources by 2020. The Asian Development Bank (ADB) is supporting the government to implement the CIREC. The CIREC together with the CIREC Implementation Plan sets out the planned approach to replacing existing electricity generation with renewable sources on each island. Substantial progress towards meeting the plan has already been achieved, with six of the 12 inhabited islands (the Northern Group) having renewable electricity generation systems installed and operating since 2014.

5. The total installed power generation capacity in the Cook Islands is 11.75 megawatt (MW) with a distribution network comprising 80 kilometres (km) of 11 kilovolt (kV) underground cables and 200 km of 0.415 kV low voltage distribution lines. The power system generated 33.8 gigawatt-hour (GWh) of electricity in 2012. On the major islands of Rarotonga and Aitutaki, nearly 99% of all households are grid connected, 8% had additional domestic solar photovoltaic (PV) systems, and 3% also used small diesel generators. In the outer islands, about 60% of households are grid connected, and 43% have solar PV systems.

6. The Project will have two outputs:

- (i) **Solar Photovoltaic Power System Development.** In Phase 1, the project will construct solar PV power systems with a total installed capacity of approximately 1.2 MW on Mangaia, Mitiaro, Mauke and Atiu. The project will also install advanced secondary battery storage and control systems (all islands), new diesel backup generators (Mauke and Mitiaro), and new power stations (Mauke and Mitiaro), and will rehabilitate the distribution networks on Mitiaro, Mauke, and Mangaia. In Phase 2, the project will install a solar PV power system, advanced secondary battery storage and control systems and a new diesel backup generator on Aitutaki, and the installation of a Battery Energy Storage System (BESS) to be complemented by an additional second stage battery storage system (R-ESS-2) on Rarotonga.
- (ii) **Institutional Strengthening and Project Management Support.** The project will provide institutional strengthening to the Renewable Energy Development Division (REDD) for (i) developing the energy efficiency policy implementation plan including an energy audit and monitoring scheme to enhance demand side energy efficiency management practices for targeted major electricity consumer groups; (ii) developing capacity for renewable energy technology assessment and appropriate off-take tariff setting for power purchase agreements for private sector funded projects, and (iii) updating the CIREC Implementation Plan through refining electricity load demand up to 2020, renewable technology choice, and least cost investment plan. The project will also provide project management support to the implementing agency to implement the Project.

I.2 Report Purpose and Scope

7. **Report purpose.** The ADB provided project preparatory technical assistance to the government to develop the Project including: (i) solar resource assessment; (ii) screening and site selection for solar power plants; (iii) preparation of conceptual feasibility studies for selected subprojects including safeguards due diligence.

8. In accordance with the Project's environmental assessment and review framework (EARF), based on screening and categorization of the scope of works proposed, the Project is categorized as B for environment and due diligence has included environmental assessments of Phase 1 and Phase 2 subprojects. This initial environmental examination (IEE) presents the findings of the assessment.

9. The objectives of the IEE are to:

- Establish the baseline environmental and social conditions and values associated with the subproject sites;

- Identify whether any site contains critical habitat as defined in ADB Safeguard Policy Statement 2009 (SPS);
- Assess the potential environmental and social impacts (positive and negative) of the Project;
- Clearly identify measures to avoid, mitigate and/or manage the identified impacts;
- Identify the statutory requirements that will apply to the Project including need to apply for permits; and
- Undertake and document stakeholder consultations undertaken for the Project.

10. **Scope and methodology.** The IEE adheres to the requirements of the SPS. The Cook Islands National Environmental Service (NES) has formally requested the preparation of an environmental impact assessment (EIA) under the Cook Islands Environment Act 2003. This IEE will be updated and undertake additional studies as required in order to meet the requirements of the Environment Act 2003.

11. The IEE has been prepared based on:

- (i) Literature and database review: a review of existing reports and information available on the subproject sites, records of stakeholder consultations, the Cook Islands Biodiversity Database (CIBD) and the International Union for the Conservation of Nature (IUCN) Red List of Threatened Species (Version 2014.3);
- (ii) Stakeholder consultations: stakeholder consultations undertaken the preparation and development of the Project. Stakeholders consulted for the IEE included the NES, Cook Islands Natural Heritage Trust, Island Councils, Island Environmental Officers, TAU staff and landowners;
- (iii) Site visits: site visits were undertaken to all subproject sites. The sites of the proposed solar PV arrays and power stations were inspected. Other project elements were also inspected including existing power stations, substations that will require minor upgrade, the wharf and access roads to the proposed sites and potential sites for sourcing construction materials.
- (iv) Ecological assessment: flora and fauna surveys were completed at five of the six sites where vegetation and habitat is present (Rarotonga site contains no vegetation). The surveys were undertaken to identify the presence of listed or threatened flora and fauna species, the presence of natural and/or critical habitat and presence of species considered to have medicinal or economic value; and
- (v) Documentation of the forgoing assessment process: the IEE prepared for the Phase 1 sites has been updated to include the Phase 2 sites. The report is set out in accordance with the SPS and Cook Islands statutory requirements. The IEE contains an environmental management plan (EMP) outlining mitigation and management measures and a monitoring plan.

12. The scope of the IEE is limited to the subproject sites (including solar PV array, solar powerhouse and/or new power station/BESS (if applicable), additional battery storage system and associated infrastructure, such as substations, requiring upgrading.

13. The IEE will be made available through disclosure on the ADB's website and will also be disclosed locally at the offices of REDD, TAU and the subproject Island Councils.

14. In accordance with the SPS this IEE has the following contents:

- *Executive Summary.* This section briefly describes the critical facts, significant findings, and recommended actions.

- *Introduction.* Describes the overview of the project, environmental requirements, objectives and scope of the study, approach, and methodology.
- *Administrative, Policy and Legal Framework.* Discusses the national and local legal and institutional framework within which the environmental assessment is carried out.
- *Project Description.* Provides an overview of the proposed project, its objectives and major components including maps showing the project's location.
- *Description of the Existing Environment.* Describes the relevant physical, biological, and socioeconomic conditions within the target islands and specific to the project sites.
- *Anticipated Environmental Impacts and Mitigation Measures.* Provides an assessment of the associated environmental impacts and corresponding mitigation measures. The environmental impacts and mitigation measures including the environmental monitoring are summarized in the environmental management plan and environmental monitoring plan.
- *Analysis of Alternatives.* Examines the alternatives to proposed project sites to ensure avoidance of significant adverse environmental impacts.
- *Consultation and Information Disclosure.* Describes the process of engaging stakeholders and information disclosure. This section summarizes the comments and concerns of affected persons.
- *Grievance Redress Mechanism.* This section describes the grievance redress framework and setting out the timeframe and mechanisms for resolving potential complaints and/or issues from affected persons.
- *Environmental Management Plan.* Describes the set of mitigation and management measures to be taken for each identified environmental impact during project design, construction, and operation. This section also includes monitoring and reporting procedure as well as institutional implementation arrangements.
- *Conclusion and Recommendation.*

II. POLICY AND LEGAL FRAMEWORK

II.1 National Policy and Legal Framework

15. The implementation of the Project will be governed by the environmental laws and regulations of the Cook Islands and the safeguard policies of the ADB.

II.1.1 Environmental Laws and Regulations

16. **Environment Act 2003.** The Environment Act 2003 was established to provide for the protection, conservation, and management of the environment in a sustainable manner. It provides for the establishment of both the NES and the Island Environmental Authorities (IEA) and establishes their roles and functions. The Act does not apply on Mangaia, however, the NES has advised that the environmental assessment process as set out under the Act should still be followed.

17. Under the Part 5 of the Act any activity which is likely to cause significant environmental impacts shall require a permit issued by the permitting authority and that application for a permit shall be submitted to the NES and include an environmental impact assessment. Part 5 of the Act also outlines the information expected in the environmental impact assessment, public consultation and the process for the determining the permit application and the appeal of decisions.

18. **Environment (Atiu and Takutea) Regulations 2008.** The Regulations are made under Section 70 of the Environment Act 2003 and provide for the establishment of specific regulations to manage and conserve the islands ecosystems. Relevant to the Project Part 2 of the Regulation provides for protection of Unga Kaveu, specific species of birds and native trees and shrubs, establishes protected areas and prescribes their management and prohibits removal or damage to artefacts and archaeological material. Part 3 provides for the establishment of Ra'ui over any land. Part 4 deals with environmental health including establishment of water reserves and control of construction within reserves and management of waste including hazardous waste.

19. **Environment (Mitiaro) Regulations 2008.** The Regulations are made under Section 70 of the Environment Act 2003 and provide for the establishment of specific regulations to manage the environment on Mitiaro. Relevant to the Project Part 1 of the regulations provides for the prohibition of the import of animals, management of the importation of plants, protection of the Iniao tree, protection of specific species of birds, management of invasive species, establishment and management of protected areas and the prohibition of the removal or damage of artefacts or archaeological material. Part 2 provides for the establishment of Ra'ui over any land and Part 4 deals with environmental health including water supply, waste management and hazardous materials.

II.1.2 Environmental Assessment Process in Cook Islands

20. The environmental assessment process in the Cook Islands includes the following steps:

21. **Environmental Significance Declaration.** Any building or development that may have a significant effect on the environment or that is in a specific area of concern is required to submit an Environmental Significance Declaration (ESD) to the NES. The ESD is assessed by the NES and Island Environmental Officer (IEO) to determine whether the project can be approved based on the ESD or will require an Engineering report and/or EIA. It is usual for the applicant to have a site meeting with the IEO to discuss the project.

22. **EIA Terms of Reference.** Where an EIA is required the NES will notify the applicant in writing and prepare Terms of Reference (TOR) for the EIA that outlines the information to be provided in the EIA and the key areas of concern.

23. **Preparation and submission of the EIA.** The applicant must engage a qualified environmental consultant (included on the register maintained by the NES) to prepare the EIA. The completed EIA is submitted to the NES who makes the EIA publically available for a period of 30 days. Anyone may make a written submission for or against the EIA during the consultation period. All submissions are provided to the applicant who, if necessary, responds by amending the EIA.

24. **NES review and approval of EIA.** The NES assesses the amended EIA and public submissions and prepares a Memorandum or Information Paper that includes the NES recommendation as to whether the EIA should be approved. The Memorandum or Information Paper is submitted to the IEA who determines whether the EIA is approved, deferred (the applicant must submit modifications) or refused.

25. Based on consultation with the NES, the implementing agency submitted ESDs for the four Phase 1 subprojects. The NES determined that each subproject would require the preparation of a technical report and issued the TOR. ESD will also be submitted for the remaining (Phase 2) subprojects covered in this IEE.

II.1.3 Cook Islands Environmental and Energy Policy

26. **The National Sustainable Development Plan 2011 – 2015.** The National Sustainable Development Plan was developed as a pathway for sustainable development in the Cook Islands. The plan contains two priority areas of particular relevance to the project: Priority Area 3: Energy Security and Priority Area 6 Ecological Sustainability.

- Priority Area 3: Energy Security sets out the goal of *renewable energy for energy security to enhance our economic and social development and environmental integrity*. It outlines key objectives to establish secure and reliable energy services and to foster investment in renewable energy development.
- Priority Area 6: Ecological Sustainability establishes a goal of a *Cook Islands where we sustain our ecosystems and use natural resources efficiently*. It documents key objectives and measures to achieve these objectives including improving the sustainable use of land and better protecting native ecosystems.

27. **Cook Islands Renewable Energy Chart.** The CIREC sets out the government's goal of transforming the energy sector from one based on imported fossil fuels to an independent, vibrant sector dominated by the efficient use of renewable energy. From an original baseline where all electricity was generated from fossil fuels (diesel), this chart sets a target of 100% of islands to be powered by renewable energy by 2020 (and 50% by 2015). The principles behind the chart are to; protect the environment by meeting climate change obligations and using environmentally friendly technologies, improve energy security by improving energy independence and reliability and increase economic growth by improving energy affordability and promoting a clean green image. The CIREC is backed by the CIREC Implementation Plan which sets out the means of achieving the CIREC goals. Substantial progress towards meeting the policy has been achieved already, with six of 12 inhabited islands (the Northern Group) having renewable electricity generation systems installed and operating since 2014. The next stage of implementation is planned for the Southern Group which is to be addressed through the Project.

II.2 ADB Safeguard Requirements

28. The environmental safeguard requirements of the ADB are set out in the SPS which requires that potential adverse environmental and social impacts of ADB financed investments are identified and avoided, and where impacts cannot be avoided, a suitable plan is prepared for them to be mitigated and managed.

29. 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.

30. ADB screens projects using a rapid environmental assessment checklist to identify their potential risks and impacts on a preliminary basis. The screening results in categorization of a project. The Project is classified as a category B for environment. Category B projects are judged to have some adverse impacts, but of lesser degree and/or significance than category A. The impacts of a category B project are generally site-specific and can be readily managed or mitigated to satisfactory levels. This IEE has been prepared to present the findings of the assessment for this Project.

II.3 Institutional Framework

31. **Executing and implementing agencies:** The Ministry of Finance and Economic Management (MFEM) is the executing agency and will be responsible for the overall environmental management of the project including obtaining necessary approvals. The TAU and the REDD are the implementing agencies. A Project Steering Group (PSG) has been established for the Project which is comprised of representatives of ADB, REDD, Office of Prime Minister (OPM), MFEM, TAU, Cook Islands Investment Corporation (CIIC) and New Zealand High Commission. A Project Management Unit (PMU) has also been established.

32. **Environmental agencies.** The NES or Tu'anga Taporoporo is the principle national environmental agency in the Cook Islands. The role of NES is to protect the environment (including people, communities, land, water, and native species), promote sustainable development, and prevent and control pollution. The Advisory and Compliance Division of the NES is responsible for administering the Environment Act 2003 including receiving and assessing environmental impact assessments and issuing permits for development. The IEAs are the determining authorities for permit applications on the subproject islands.

33. **Other agencies.** The CIIC provides support to the implementing agencies in project implementation and will be the owner of the assets generated by the project. Importantly for the project the CIIC will be responsible for acquiring land on the subproject sites in accordance with the Cook Islands Act 1915.

34. The Ministry of Transport –Energy Division is responsible for administering the Energy Regulations 2006 which govern the licensing, technical and safety requirements for power generation, distribution and consumer premise wiring. The project will result in changes to the generation and distribution (except Atiu) of electricity on the subproject islands and will require good coordination with the Energy Division.

35. The Ministry of Infrastructure and Planning is responsible for implementing the Cook Islands National Building Code. It also regulates construction of building and the issuance of building permits. The construction of the project will require consultation with this ministry.

36. **ADB.** As project financing agency ADB will be responsible for approval of project documents. In respect of safeguards, this includes approval of the IEE, and making sure that there are sufficient loan agreements and requirements in the Project Administration Manual covering updating of the IEE, integration of the EMP into bid and contract documents, monitoring undertaken and reported, and disclosure of environmental monitoring reports.

III. DESCRIPTION OF THE PROJECT

III.1 Project Location

37. The subprojects will be located in the Southern Group islands on Mangaia, Mitiaro, Mauke, Atiu, Aitutaki and Rarotonga (Figure 1.1). The location of the subproject sites on each island is shown in Figures 3.1 to 3.7 and a brief description is provided below.

38. **Mangaia.** The proposed solar site is located on a property called Aratane on the eastern side of Aremauku Road in Oneroa village approximately 150 m southeast of the existing power house. The area of land required for the subproject is 1.2162 ha. The land is privately owned native customary land.

39. **Mauke.** The subproject site is located near the centre of the island in Areora village immediately north northeast of the Public Works Machinery sheds. The area of land required for the subproject is 0.84 ha. The land is privately owned native freehold land.

40. **Mitiaro.** The subproject site is located on the Mitiaro Community Access Road just inland from Mangarei village. The area of land required for the subproject is 0.4837 ha. The land is privately owned native freehold land.

41. **Atiu.** The subproject site is located approximately 600 m west of the village of Teenui and the solar PV array site is approximately 140 m south southwest of the existing power station. The total area of land required for the subproject is 1.49 ha. However, this excludes land for the solar power house which will be constructed on the same parcel as the existing power station. The land is privately owned native freehold land.

42. **Aitutaki.** The subproject site is located approximately 1.2 km east of the village of Arutanga at the site of the existing power station. The solar PV array will be located approximately 100 m east of the power station. The total area of land required for the subproject is approximately 3.87 ha (current site of the Aitutaki power station) however, the solar PV array will require only approximately 1.1 ha. The land is privately owned native freehold land which the government currently leases.

43. **Rarotonga.** The subproject site is located at the Rarotonga Airport in Avarua District adjacent to the existing solar array just to the south west of the terminal building. The existing airport solar PV array site is approximately 1.4 ha; the area required for the BESS is less than 0.02 ha. The second stage additional battery storage system (R-ESS-2) is to be sited at two other locations; (i) inland side of the airport; and (ii) at the existing TAU power station site. All land is owned by the government and leased to TAU.

III.2 Project Scope

44. The subprojects will install solar PV systems on Mangaia, Mauke, Mitiaro, Aitu and Aitutaki (total solar PV capacity of 2,246 kW), a BESS with additional 3 MWh battery storage system on Rarotonga. The proposed layout of each system is shown in Figures 3.1 to 3.7 and a brief description provided below.

45. **Mangaia.** Installation of a 462 kW solar PV array, new solar power house adjacent to the solar PV array containing control system and battery storage, low voltage (LV) underground cable connecting the solar powerhouse to the existing power station (existing diesel generators, switch gear and distribution grid connection to be used) and upgrade of distribution system.

46. **Mauke.** Installation of a 228 kW solar PV array, new power station adjacent to solar PV array containing new diesel generators, control system and battery storage, high voltage (HV) underground cable connecting the new power station with a distribution grid connection point adjacent to old power station and upgrade of distribution system.

Figure III.1: Mangaia Project Location and Layout

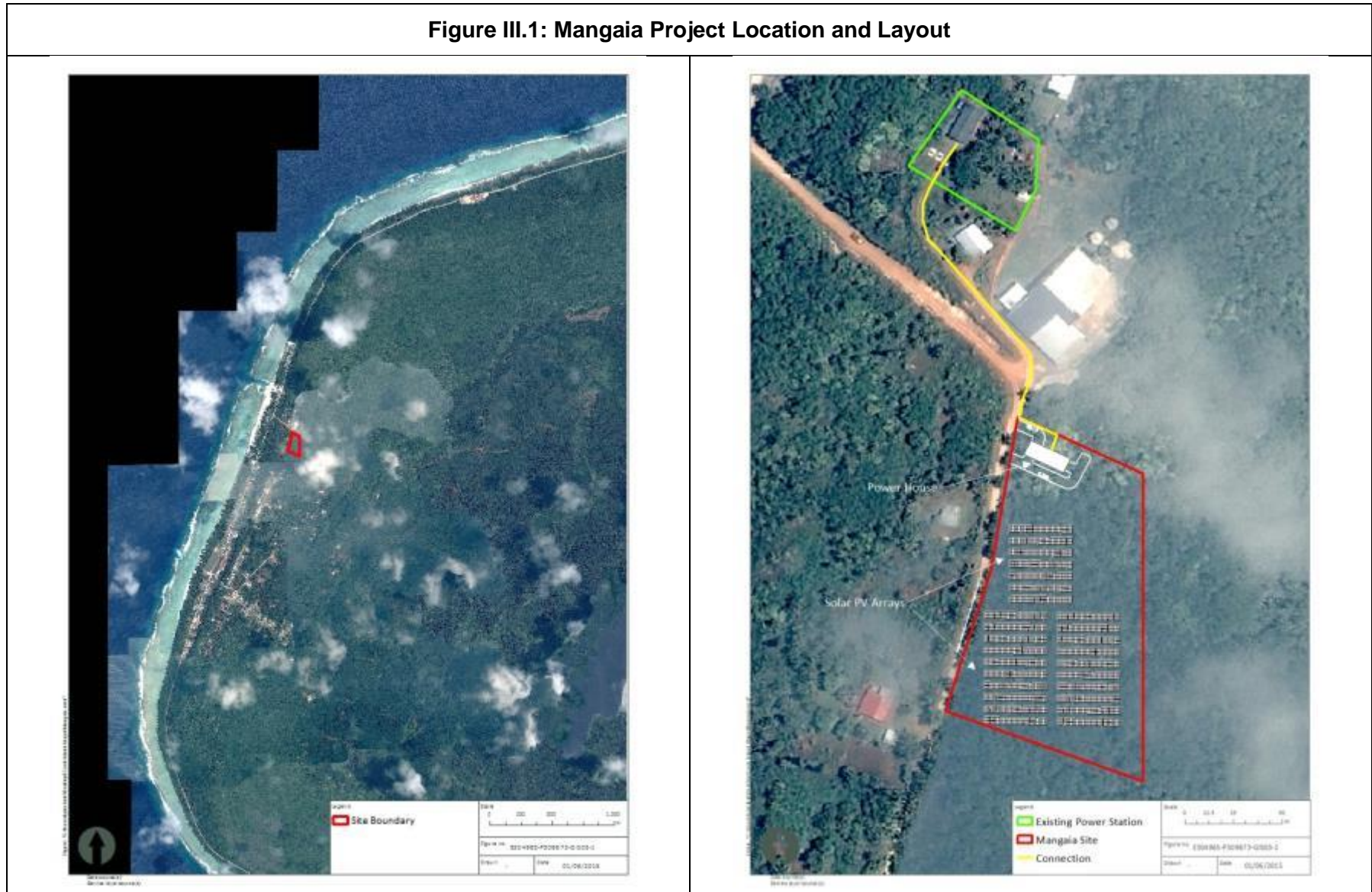


Figure III.2: Mitiaro Project Location and Layout



Figure III.3: Mauke Project Location and Layout

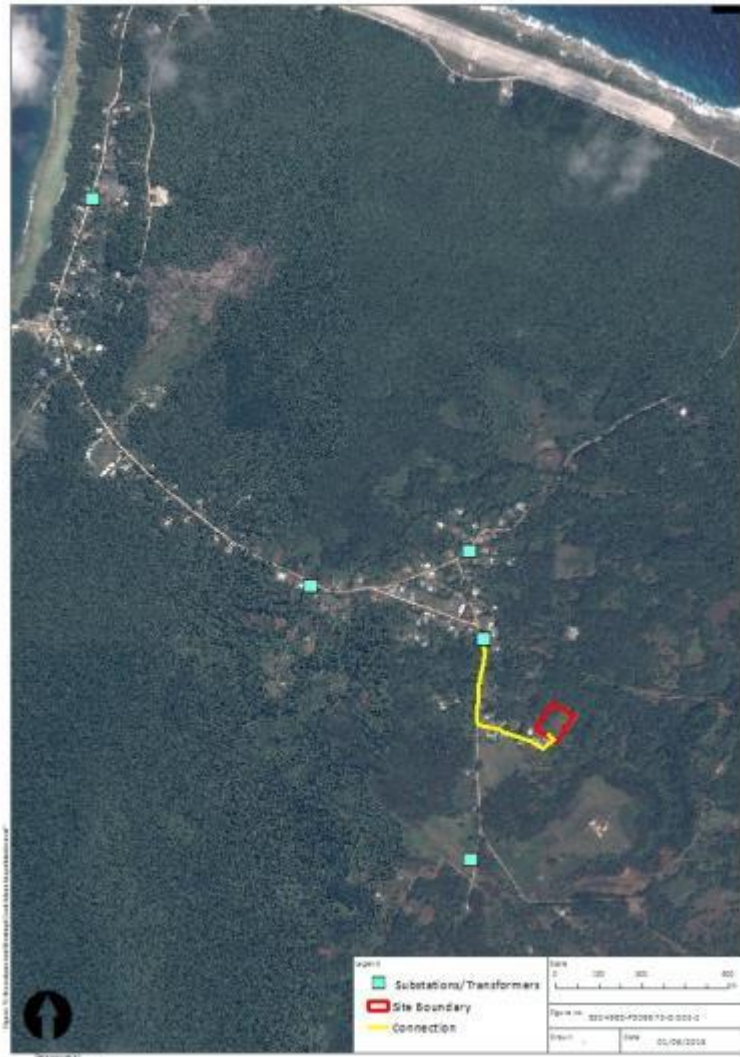


Figure III.4: Atiu Project Location and Layout

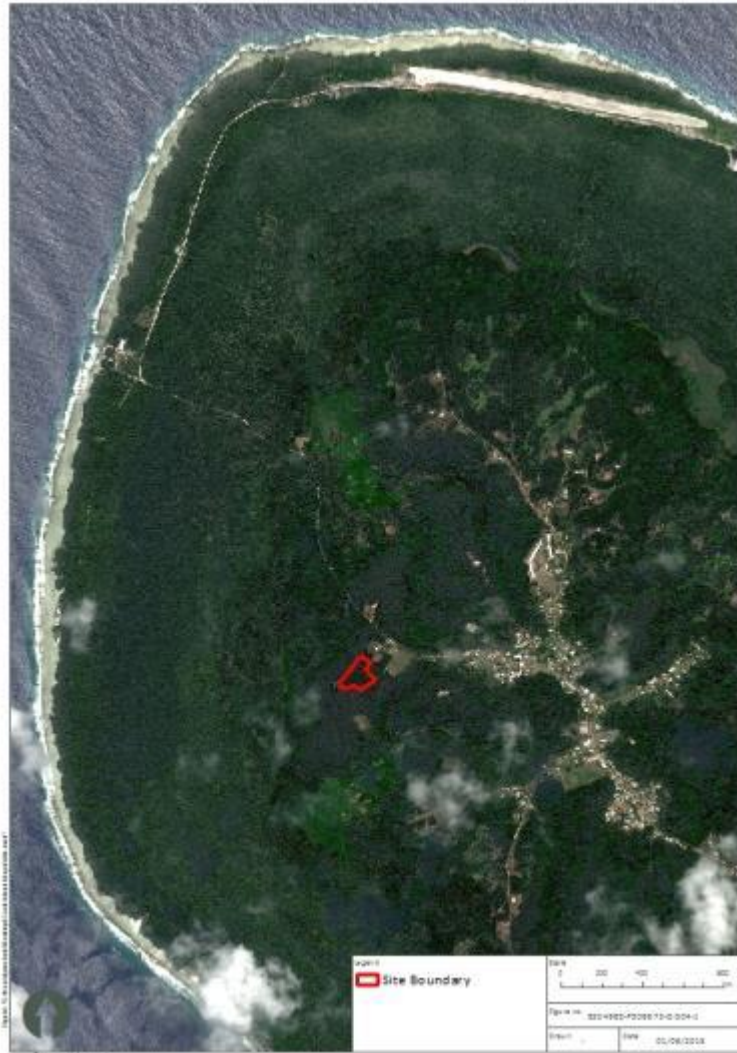


Figure III.5: Aitutaki Project Location and Layout

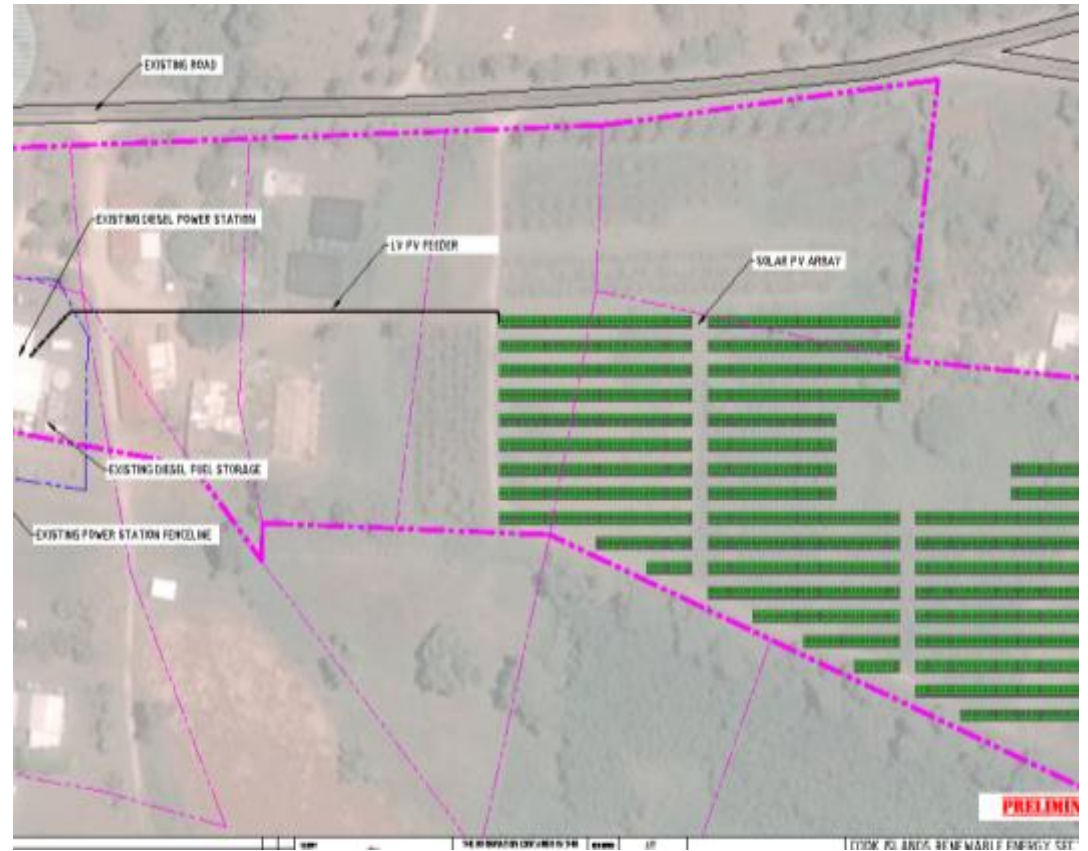
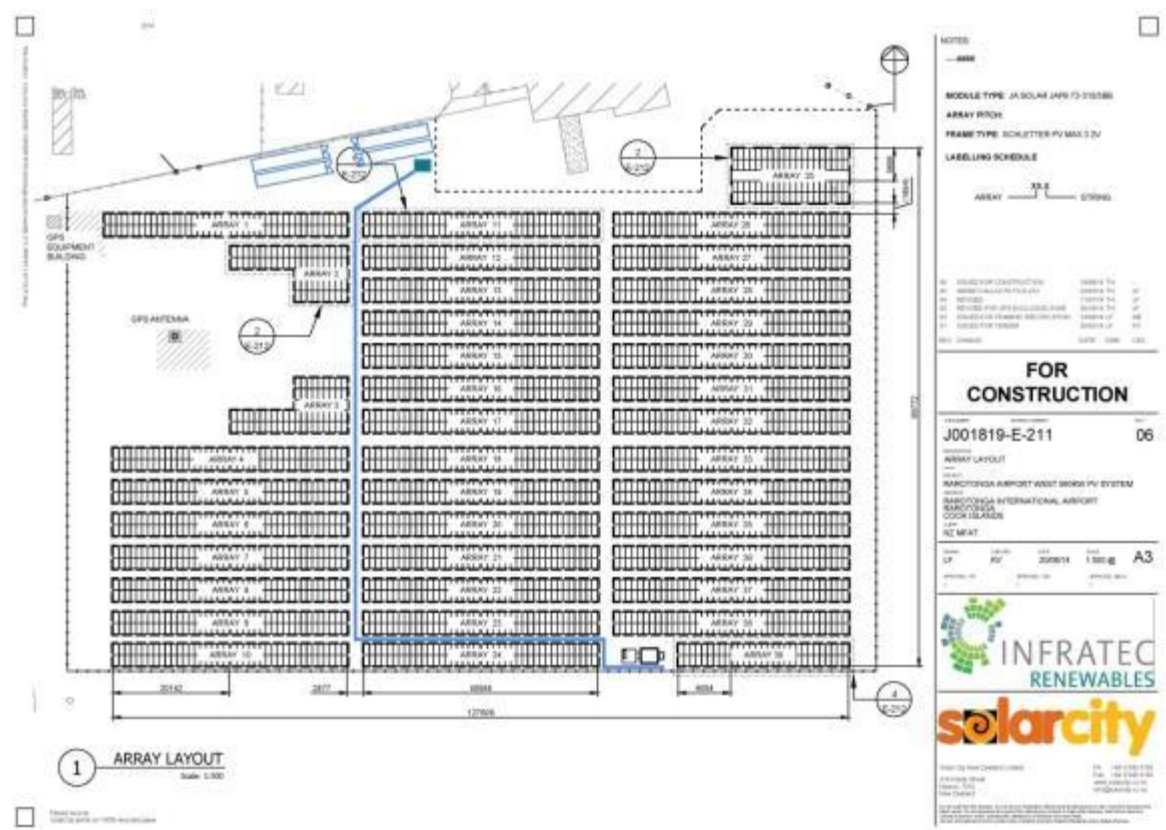


Figure III.6: Rarotonga Project Location and Layout



Note: The 1 MW BESS and connection is shown in blue, the solar array is the existing airport solar PV array). Additional 2 MW of storage will be installed at the airport; exact location to be specified; layout will be similar to the 1 MW BESS.

Figure III.7: 1 MW of storage to be sited at Existing TAU Power Station



47. **Mitiaro.** Installation of a 157 kW solar PV array, new power station adjacent to solar PV array containing new diesel generators, control system and battery storage, HV underground cable connecting the new power station with a distribution grid connection point adjacent to old power station and upgrade of distribution system.
48. **Atiu.** Installation of a 399 kW solar PV array, new solar power house adjacent to existing diesel power house containing control system and battery storage and LV underground cable connecting the new solar power house to the existing diesel power house (note the distribution system on Atiu is being upgraded under a separate project).
49. **Aitutaki.** Installation of a 1 MW (1000 kW) solar PV array, new 300 kW high speed diesel generator installed in a spare bay in the existing power station, and upgrades to the switchgear and control systems.
50. **Rarotonga.** Installation of a 1 MW/4 MWh BESS co-located at the site of the Rarotonga Airport solar PV array; the BESS subproject is at the tendering stage now. An additional 1 MW / 4 MWh energy storage at the existing TAU power station, and 2 MW / 8 MWh energy storage will be installed at the airport site; the exact locations and layouts for this subproject have not been determined.
51. A description of the key components of the solar diesel hybrid power systems are provided below.
52. **Solar PV modules and mounting.** Solar PV modules will be 250 Watt (W) 60-cell polycrystalline panels (or similar). They will be modern, high quality panels with a temperature / loss co-efficient suitable for the Cook Islands climate. The solar PV modules will be installed on a pre-manufactured solar PV array mounting system constructed of stainless steel, anodised aluminium and galvanised steel mounted on either concrete blocks (pre-cast or cast on site) or piles.
53. **Solar PV inverters and cabling.** Solar PV string will be installed within the solar PV array to convert direct current (DC) electricity produced by PV panels to alternating current (AC) for injection into the electrical grid. PV1-F Solar DC cabling either buried in HDuPVC conduit or attached to the rear of PV modules will be installed connecting the solar PV modules to solar PV inverters and inverters to the control system in the power station / solar power house.

54. **Power stations and diesel generators.** New power stations (Mauke and Mitiaro) and new solar power houses (Mangaia and Atiu) will be constructed of concrete block and will comply with the Cook Islands National Building Code and relevant Australian and New Zealand Standards. The new generators installed on Mauke and Mitiaro will be high speed diesel generators (nominally 2 x 88 kilovolt amps (kVA)) with control system, fuel tank and oil storage. The new diesel generator on Aitutaki will be nominally 300 kW with upgrades to the existing control system and fuel and oil storage (if required).

55. **Control system.** A control system will be installed in the power station / solar power house to manage the solar power system including regulating when electricity is injected into the grid from the solar PV panels, diesel generators and batteries and also control charging of batteries.

56. **Batteries and battery invertors.** High capacity batteries (likely to be valve regulated lead acid or lithium ion technology) will be installed in the power station / solar power house. Battery inverters will also be installed to convert AC to DC for charging batteries and DC back to AC for injection into the electrical grid.

57. **Existing and associated infrastructure.** Local infrastructure including roads, wharfs, and the pre-existing electricity distribution system will be used for the subprojects. The power station and existing diesel generators will also be retained on Atiu and Mangaia. Roads and wharfs were inspected during the site visits and found to be suitable for use during the construction of the subprojects. A perimeter security fence will be established around the solar PV array at all subproject sites.

58. A description of the key components of the 1 MW BESS (Rarotonga subprojects) is provided below:

- Batteries. The 1 MW BESS will be based on high capacity batteries (likely to be lithium ion or sodium sulphur technology).
- Power conversion. A four quadrant power conversion system (inverter) will be used to convert electricity from AC to DC for charging batteries and DC back to AC for connection to the substation.
- Control system. A control system will installed to manage the charge and discharge rates of the batteries, system parameters, monitoring, alarms, communications with other network systems and data logging.
- Cabling and connection. The 1 MW BESS will be connected to the existing electricity grid either at the existing solar PV array substation or directly into the West Coast Feeder. Connection cabling will be buried to either of these connection points.
- Housing. The 1 MW BESS will likely be housed in containerised modules (e.g. four forty foot shipping containers or similar) that contain all the necessary equipment for system other than cabling and transformers. The total footprint will be on the order of 2000 square feet (0.0128 hectares).

59. The second stage additional energy storage subproject (R-ESS-2) will have two components which are both inside-the-fence on developed sites: (i) 1 MW / 4 MWh for grid stability, to be installed at the diesel power station; and (ii) 2 MW / 8 MWh for load shifting capability, to be installed at the airport. This additional storage capacity will enable an additional 6 MW of solar PV capacity to be connected to the grid, after which electricity supply on Rarotonga will be approximately 50% renewable energy. Based on the analysis of alternatives conducted for this study, battery storage is expected to be the preferred solution for this subproject, but the specific type of battery system is not being proposed at this point due to rapid evolution in various technologies with declining costs. The proposed design and detailed specifications including technology selection will be finalized going forward.

III.3 Project Construction, Operation and Decommissioning

60. The follow provides a general description of the proposed construction, operation and decommissioning of all subprojects.

61. **Construction.** Construction of the subprojects (excluding Rarotonga) will generally include the following activities:

- Upgrade of the existing tracks to provide access to the solar PV array sites (where required);
- Clearing of existing vegetation and makatea (where required);
- Spreading of fill material, compaction and levelling (note: the solar PV site on Atiu will not be levelled although some minor localized levelling may be required to ensure solar PV modules can be installed optimally);
- Installation of site drainage, erosion and runoff controls;
- Installation of security fencing;
- Trenching and installation of underground cables and conduit;
- Installation of solar PV mounting system and installation of solar PV panels on mounting system;
- Construction of new power station / solar power house including excavation of footings, installation of earth grid, pouring of concrete slab and construction using concrete blocks and steel sheet roofing;
- Installation of generators (Mitiaro, Mauke and Aitutaki), control system and batteries in power station / solar power house;
- Landscaping of site. Landscaping will include planting low growing vegetation (e.g. grasses) beneath the solar PV modules to help stabilise the site and prevent erosion and
- Commissioning (load testing) of all equipment.

62. Construction of the BESS and R-ESS-2 on Rarotonga will include installation of containerised units (likely four 40ft ISO shipping containers), connection to the electricity grid and commissioning.

63. **Operation.** The Phase 1 subproject solar power systems are designed to deliver approximately 95% of electricity from the solar PV system. This is achieved using the solar PV modules to deliver electricity to the distribution grid and charge the batteries when the solar resource is adequate (e.g. sunny or light clouds) and batteries to deliver electricity when the solar resource is not (e.g. during the night or heavy clouds). When the solar system can't meet the load demand the diesel generators will be used to charge the batteries and deliver electricity directly the distribution grid. The control system will manage grid stability by controlling the source of electricity input into the grid as the output from the PV system fluctuates (e.g. a cloud passes of PV modules) and as the load changes. The control system also manages the charging of the battery storage. In the event of a system failure of the solar system, the existing diesel generators will be able to meet continuous load, and hence provide a level of redundancy. The systems will be able to be monitored remotely from Rarotonga but will also be monitored locally. During operation the solar power systems require minimal maintenance including cleaning PV modules and batteries and maintaining vegetation.

64. The Aitutaki subproject will supply solar PV generation capacity to meet approximately 30% of Aitutaki's annual electricity load. An upgraded control system will control grid stability by controlling the source of electrify into the grid as output from the PV system fluctuates and load changes. The new solar PV generation will coupled with either a forecasting system or

battery storage to manage output. The forecasting system will include a local met station, with a pyranometer (irradiance sensor), sky facing camera, data logger and software.

65. The system should provide estimated irradiance at the array at each 30 second interval out to 15 minutes from the current time. This device will be connected by communications cabling to the master controller at the power station. The master controller will transfer the estimated irradiance into an estimated power output of the array, and then make a decision as to whether it is satisfactory to operate with the single small diesel generator, or whether a larger generator needs to be brought online.

66. The Rarotonga subproject will install a BESS into the Rarotonga grid enabling more renewable energy generation to be installed and better utilising it once installed. Installing renewable energy generation in to the Rarotonga grid enables reduction in use of the diesel power station. However, when the difference between the load on the grid and the renewable energy being generated is less than the minimum loading requirement of the generators faults will occur that compromise system reliability. Studies have indicated that the limit of renewable energy generation in Rarotonga's grid is 3.3 MW. Currently, there is approximately 3.0 MW of installed renewable energy on Rarotonga's grid and, with current rates of installation, the 3.3 MW limit will be reached in the first half of 2016. TAU has set a limit of 4.2 WM (expected to be reached by mid-2017) and to reduce system faults will 'curtail' the output of the 1 MW airport solar PV array (owned by TAU) when required to satisfy the 3.3 MW limit. That is, in sunny conditions, where the power demand is low and solar PV output is high, they will provide a set-point to the Airport array to reduce its output (potentially down to zero). The BESS will store the otherwise curtailed output of the renewable generation (primarily solar PV generation) for reinjection into the grid when renewable energy generation is lower (e.g. overnight). The second stage additional battery storage system (R-ESS-2) will serve the same function and complement the BESS.

67. **Decommissioning.** The subprojects are expected to have a lifespan of approximately 25 years. It is likely that the system will be replaced with similar equipment and solar PV modules, batteries, inverters and other electronics and metal will be collected for recycling in the Cook Islands (where facilities exist) or in Australia and/or New Zealand.

68. **Implementation schedule.** The Phase 1 subprojects were implemented between June 2014 and December 2016. The Aitutaki subproject was implemented between June 2014 and March 2017. The Rarotonga 1 MW BESS subproject is to be implemented between February 2016 and June 2017 and the R-ESS-2 subproject is expected to commence tendering in the first or second quarter of 2017.

III.4 Project Benefits and Justification

69. The Phase 1 subproject solar power systems will deliver approximately 95% renewable energy, using a solar PV based generation system with battery storage to manage overnight load. Battery storage and the control system will manage grid stability in light of rapid fluctuations in PV output. The unmet load will be managed through the use of existing diesel generators for backup. Further, in the event of a system failure of the solar system, the existing diesel generators will be able to meet continuous load, and hence provide a level of redundancy. A reliable, 24/7 power supply, which is less vulnerable to diesel supply volatility, is thus expected to be achieved.

70. The Aitutaki subproject will deliver approximately 30% renewable energy using a solar PV based generation system with either a forecasting system or battery storage. The unmet load will be managed through the use of existing diesel generators with the addition of the new diesel generator installed as part of the sub project.

71. The Rarotonga subprojects (Phase 2 and 3) will enable the installation of a greater quantity of renewable energy on to the Rarotonga grid without compromising system stability and reliability.

72. The implementation of the Rarotonga energy storage subprojects will result in the displacement of diesel generation by enabling greater solar PV output and utilization in two stages. The 1 MW BESS will result in approximately 4.05 GWh of diesel generated electricity per year which equates to a reduction in annual diesel usage of approximately 1.26 million litres, with avoided emissions of approximately 2,793 tons of carbon dioxide equivalents per year (tCO₂e/y).³ The R-ESS-2 subproject will displace an estimated 7.8 GWh per year, reducing diesel consumption by about 1.5 million litres per year, with avoided emissions of about 6,370 tCO₂e/y.

73. In order to continue toward the government's 100% renewable electricity goal the TAU is working on the following initiatives:

- increasing the limit of renewable generation of the grid from 3.3 MW to a maximum of about 12 MW (including curtailment of existing generation where the capability exists);
- commissioning a detailed network study to determine the long term technical and commercial requirements for implementing storage and grid enabling technology which will ultimately lift the stability limit sufficiently to allow enough renewable generation to be installed to reach close to the 100% goal; and
- The Project, in cooperation with TAU, will lift the limit of renewable energy generation from 4.2 MW to about 12 MW, allowing more time to complete the detailed network study, while continuing installation of renewable generation, and maximising the output of generation (reducing curtailment) already installed or committed.

74. In addition, a key element of the Project will be capacity building including training of local power stations operators in the operation and maintenance of solar-diesel hybrid energy systems. The Project will also have a positive contribution by reducing emissions (including CO₂) from running of existing diesel generators; a reduction in noise from diesel generator operation and a reduction in land and ground water contaminations caused by spill of oil from diesel generator sets. Overall, at a local level, the project will improve socio-economic conditions of the local communities and at a national level will help improve the national GDP.

³ <http://www.epa.gov/cleanenergy/energy-resources/calculator.html>

IV. DESCRIPTION OF THE ENVIRONMENT: BASELINE CONDITIONS

IV.1 Physical Environment

75. **Physiography.** The Cook Islands is a Pacific island country comprising 15 islands scattered between Tonga to the west and New Zealand to the northeast. The islands are located between 8.0 and 23.0 south latitude and 156.0 and 167.0 west longitude and are geographically divided into two groups, commonly referred to as the Northern and Southern Group islands. The Northern Group consists of six low-lying, sparsely populated, coral atolls, while the Southern Group consists of nine raised atolls and volcanic islands.

76. The subproject islands are all volcanic islands that have central volcanic hills surrounded by makatea (coralline limestone). This structure has resulted from the subsidence of the volcanic hills followed by uplift forming the raised makatea. A brief description of each island is provided below.

- **Mangaia.** Located about 177 km south of Rarotonga, Mangaia is the southernmost island of the Cook Islands. With an estimated land area of 51.8 km², it is also the second largest island. It is the oldest island in the Pacific. Roughly circular in shape, it rises 4,750 m above the ocean floor. Mangaia consists of a low central plateau, which is separated from the completely encircling platform of makatea by a series of irregular swampy depressions. The subproject site on Mangaia is flat.
- **Mauke.** Mauke is one of the smallest islands lying at south-eastern corner of Cook Islands about 270 km northeast of Rarotonga. It is a raised atoll encircled by the characteristic fossilized cliffs of makatea. Mauke is virtually flat with its centre about 30 m above sea level. The island has a circumference of 18 km. The soil is fertile and supports agriculture. The total land area of Mauke is 18.4 km². The subproject site is flat.
- **Mitiaro.** Located at 230 km northeast of Rarotonga, Mitiaro stands in water 4,500 m deep, it is 6.4 km across at its widest point and has a total land area of 22.3 km². The centre is almost flat, quite swampy and contains two freshwater lakes. It is surrounded by 6 to 9 m high belt of makatea. The subproject site on Mitiaro is flat.
- **Atiu.** Atiu is located 214 km north east of Rarotonga and has an encircling ring of makatea around a raised volcanic interior. It has a total land area of 26.9 km². The subproject site slopes gently away from the power plant toward the south southwest. The terrain slopes steeply away from the solar site to the west and south, and slopes less steeply to the east.
- **Aitutaki.** Aitutaki is located 255 km north of Rarotonga and has a land area of 18.05 km². It is a raised volcanic island surrounded by a barrier reef and is the second most visited island in the Cook Islands. The subproject site is located in the interior of the island, well above sea level (the high point on Aitutaki is 123 m) and is flat.
- **Rarotonga.** Rarotonga is the largest of the Cook Islands with a land area of 67.05 km². It is a volcanic island and remnants of the original volcano can be seen in the steep interior landscape. The tallest peak, Te Manga, rises to 658 m above sea level. The sub project site is located on an existing hardstand.

77. **Climate.** The climate of the Cook Islands is sub-tropical and tropical oceanic, moderated by trade winds. It has two distinct seasons. The average rainfall is between 2,000 and 3,000 mm per year. The mean annual temperature is 24°C with little seasonal variation.

78. Temperatures range between 18°C and 28°C in the southern winter, which is May to October, and between 21°C and 29°C in the summer, which spans from November to April. The wet season is normally January to early May.

79. Seasonal temperatures differ between the northern and southern Cook Islands. The Northern Cook Islands' position so close to the equator results in fairly constant temperatures throughout the year, while in the Southern Cook Islands, temperatures cool during the southern winter. Changes in temperatures are strongly tied to changes in the surrounding ocean temperature. The annual average temperature at Penrhyn in the Northern Group is 28°C and at Rarotonga in the Southern Group is 24.5°C.

80. Rainfall in the Cook Islands is strongly influenced by the South Pacific Convergence Zone. This band of heavy rainfall is caused by air rising over warm waters where winds converge, resulting in thunderstorm activity. It extends across the South Pacific Ocean from the Solomon Islands to east of the Cook Islands. It is centred close to or over the Southern Group from November to May. From November to March, the South Pacific Convergence Zone is wide and strong enough for the Northern Group to also receive significant rainfall. The driest months of the year in the Cook Islands are from June to October.

81. The Cook Islands' climate varies considerably from year to year due to the El Niño-Southern Oscillation. This is a natural climate pattern that occurs across the tropical Pacific Ocean and affects weather around the world. There are two extreme phases of the El Niño-Southern Oscillation: El Niño and La Niña. There is also a neutral phase. The El Niño-Southern Oscillation has opposite effects on the Northern and Southern Groups. In Rarotonga, in the south El Niño events tend to bring drier and cooler conditions than normal, while in the north, El Niño usually brings wetter conditions. Ocean temperatures are warmer in the north during an El Niño event and consequently air temperatures also warm.

82. Tropical cyclones affect the Cook Islands between November and April. In the 41-year period between 1969 and 2010, 47 tropical cyclones passed within 400 km of Rarotonga, an average of just over one cyclone per season. The number of cyclones varies widely from year to year, with none in some seasons but up to six in others. Over the period 1969 to 2010, cyclones occurred more frequently in El Niño years.

83. **Geology and soils.** The islands of the Southern Group differ widely in form, structure and relief, such that it is difficult to construct a geological history that is consistent for the whole group. They include a high mountainous island, Rarotonga; four raised coral islands with volcanic cores, Mangaia, Mauke, Mitiaro and Atiu; one atoll, Manuae; one "near-atoll" with a volcanic core, Aitutaki; and a sand-cay on a coral foundation, Takutea. The geology of Southern Group is comprised of three soil forming deposits. These are the volcanic rocks, the raised coral limestone, and the swamp deposits. The volcanic rocks are mainly olivine basalts including tuffs, breccias, and dikes. The coral limestone forming the makatea comprises mainly calcite and aragonite but is magnesium enriched in some inland areas. The swamp deposits in the depression comprise fine textured basaltic alluvium derived from erosion of interior upland rocks.

84. The soils in the Southern Group generally consist of six types; Tamarua Clay Loam, Makatea Sand, Keia Clay Loam, Oneroa Clay Loam, Ivirua Clay Loam, and Tupapa Clay Loam (Grange and Fox, 1952).

85. **Water resources.** The water resources of the islands consist of rainwater (collected from roofs and stored in tanks), groundwater (fresh and brackish), surface water lakes (brackish) and swamps (fresh and brackish). Many of the community buildings have rainwater collection systems and there are also some at private houses.

IV.2 Biological Environment

IV.2.1 Overview of Island Ecology

86. The Cook Islands' flora and fauna is limited in diversity. The estimated plant and animal biodiversity is about 7,000 species, divided almost equally between marine and terrestrial species. There are few terrestrial endemic species.

87. The vegetation of subproject islands is sharply divided, dependent on substrate of either volcanic hills or makatea. The volcanic hills have been intensively cultivated and little native vegetation remains. The 'Au (*Hibiscus tiliaceus*) and Toa (*Casuarina equisetifolia*) are the only native tree species which remain common. On makatea the vegetation is less disturbed and becomes more diverse away from the coast. The makatea vegetation is similar across all islands and contains many native species. At the junction of the makatae and volcanic hill substrates wet, marshy areas often occur. These have been almost entirely used for wetland taro cultivation.

88. The fauna of the Cook Islands is generally common in the region and few species are considered threatened. There are eight species of range restricted birds of which two the Atiu swiftlet (*Aerodramus sawtelli*) and Mangaia kingfisher (*Todiramphus ruficollaris*) are endemic to those islands; both these species are listed as vulnerable on the IUCN Red List.

IV.2.2 Subproject Island and Site Ecology

89. Flora and fauna assessments have been completed for five subproject sites and the findings are presented in Appendix 1. The site on Rarotonga is clear of vegetation. The assessments included review of existing databases (CIBD and IUCN Red List), consultation with stakeholders including Cook Islands National Heritage Trust, NES and IEA/IEOs and a field survey of the sites. The results of the assessments are summarized below.

Mangaia. The subproject site is covered by secondary forest that is comprised of canopy species including *Cocos nucifera*, *Syzygium cumini*, *Elaeocarpus tonganus*, *Hernandia moerenhoutiana*, *Aleurites moluccana*, *Adenantha pavonina* and *Falcataria moluccana*. Plate IV.1: *Syzygium cumini* (Java plum) dominated secondary forest



90. A secondary (lower) tree layer was present which was predominantly comprised of *Eugenia uniflora* and *Morinda citrifolia*. The ground layer is generally bare with few plant species present. Overall 36 flora species were recorded across the site during the field survey

of which 16 were native and 20 were introduced. The native species are widespread throughout the Cook Islands and none are listed as endangered or critically endangered on the CIBD or listed on the IUCN Red List. Nineteen of the flora species have medicinal uses and one has economic value (*Cocos nucifera* - coconut palm). Ninety coconut palms were counted in the survey area during the survey. Eight moderate to serious weed species were recorded, all from the road verge on the edge of the site including two creepers; the hard and soft shell passion fruits (*Passiflora edulis* and *Passiflora maliformis*) and two small trees, the menemene (*Eugenia uniflora*) and the guava (*Psidium guajava*).

91. The Mangaia Kingfisher (*Todiramphus rufficollaris*) a native bird species endemic to Mangaia has been reported by locals as regularly being observed in the vicinity of the survey site, although it was not recorded during the survey. The Mangaia Kingfisher is listed as Vulnerable on the IUCN Red List. The survey site is likely to provide foraging habitat but is unlikely to provide breeding habitat for the Mangaia Kingfisher.

92. **Mitiaro.** The subproject site is vegetated with flora species that are commonly found growing on makatea (

93. The field survey recorded 29 flora species of which 19 were native. Two species *Pouteria grayana* and *Pisonia grandis* (Plate 4.3) are recorded as Locally Endangered on the CIBD, but neither are listed on the IUCN Red List. Both species are widespread on Mitiaro and the Locally Endangered listing applies to other islands. Nineteen of the species recorded have medicinal uses but none had economic value. Several invasive weed species were recorded in previously disturbed areas associated with the road and it is likely that they could spread into the project area when vegetation clearing and ground disturbance occurs.

94. Plate IV.). The over story was dominated by the trees *Timonius polygamus*, *Guettarda speciosa*, *Pisonia grandis*, *Elaeocarpus tonganus*, *Myrsine cheesemanii* and *Pipturus argenteus*. There were also patches of the native small trees Pandani (*Pandanus tectorius* complex) and *Pouteria grayana* present across the site. Shade tolerant species grew below the canopy and in shady areas formed by makatea including several fern species and herbs (e.g. *Peperomia pallida* Bold-Vein Peperomia).

Plate IV.2: Sharp makatea (uplifted coral) terrain



95. The field survey recorded 29 flora species of which 19 were native. Two species *Pouteria grayana* and *Pisonia grandis* (Plate 4.3) are recorded as Locally Endangered on the CIBD, but neither are listed on the IUCN Red List. Both species are widespread on Mitiaro and the Locally Endangered listing applies to other islands. Nineteen of the species recorded have medicinal uses but none had economic value. Several invasive weed species were recorded in previously disturbed areas associated with the road and it is likely that they could spread into the project area when vegetation clearing and ground disturbance occurs.

Plate IV.3: *Pisonia grandis* covered by *Cassytha filiformis* and *Guettarda speciosa*



96. The Pacific Pigeon (*Ducula pacifica*) and Cook Islands Warbler (*Acrocephalus kerearako*) are both reported to use the site though neither were seen or heard during the survey. Both are listed as locally endangered on the CIBD but not listed on the IUCN Red List. Both bird species are widespread on Mitiaro and the Locally Endangered listing applies to other islands. The Chattering Kingfisher (*Todiramphus tuta*) is reported by locals to use the site but was not seen or heard during the survey. No habitat or fauna species are listed as endangered or critically endangered on the CIBD or IUCN Red List.

97. **Mauke.** The subproject site is located on agricultural land that has been used by the National Ministry of Agriculture for agriculture research development purposes for the last 50 years (Plate 4.4). Agricultural plant species present include Macadamia trees (*Macadamia integrifolia*), Teak (*Tectona grandis*), coconut palms, mango (*Mangifera indica*), lime (*Citrus aurantifolia*), dry land taro (*Xanthosoma sgittifolium*), kumara (*Ipomoea botatas*), nono (*Morinda citrifolia*), banana (*Musa ABB group*) and pineapple (*Ananas cosmosus*) growing over introduced grasses.

Plate IV.3: Grassed area with *Macadamia integrifolia*, *Tectona grandis*, coconut palms



98. Only four species native to the Cook Islands were recorded at the site out of a total of thirty-one flora species. The four native species are widespread throughout the Cook Islands and none are listed as endangered on the CIBD or the IUCN Red List.

99. Eleven of the flora species recorded at the site also have medicinal uses. They are all designated as 'very common' on the CIBD and are widely distributed on Mauke. Two of the most common serious weed species recorded at the site are Mimosa (*Mimosa pudica*) and the Sickie pod (*Senna obtusifolia*).

100. **Atiu.** The subproject site has been planted with two introduced tree species Caribbean Pine (*Pinus caribaea*) and Java Plum (*Syzygium cumini*) as shown on Plates 4.5 and Plate IV.5. These two species dominated the canopy layer and the fine needle leaves of the Caribbean pine forms a dense fine litter layer resulting in only a sparse cover of shade tolerant species. A total of 15 flora species were recorded across the site of which only four were native. No species recorded were listed as endangered on the CIBD or listed on the IUCN Red List. Five flora species have medicinal uses.

Plate IV.4: Caribbean pine (*Pinus caribaea*) forest



Plate IV.5: Java plum (*Syzygium cumini*) forest



101. Four species of flora on the project site were introduced for economic purposes and all four have become invasive species. Albizia (*Folcataria moluccana*) was introduced in the 1930s as a source of timber for making crates used to pack and export tomatoes and bananas. Caribbean pine was introduced to protect the soil from erosion following the collapse of the pineapple industry in the 1980s. Acacia (*Acacia mangium*) on the other hand was introduced to Atiu as a source of fuel wood for the purpose of wood burning power generation in the mid-1980s. Java plum was introduced as a wind break plant to protect orange plantations. All four economic species are serious and invasive weed species.

102. The Chattering Kingfisher (*Todiramphus tuta*) and Cook Islands Fruit Dove (*Ptilinopus rarotongensis*) are regularly reported by locals at the project site where they feed on the fruit of the Java plum during its fruiting season. Neither species was recorded during the survey. The Cook Islands Fruit Dove is listed as moderately endangered on the CIBD and vulnerable on the IUCN Red List.

103. **Aitutaki.** The subproject site is dominated by weed species and appears to be abandoned maniotia (*Manihot esculenta*) plantations (Plate Plate IV.6). Remnant Java plum (*Syzygium cumuni*) trees border the western and southern boundaries of the site. Twenty one species were recorded of which only four were native. Two of the common weed species recorded on site para grass (*Brachiaria mutica*) and the Calopo (*Calopogonium mucunoides*) are highly invasive and will require control during the operation of the Project. Neither of the native species that were identified during the survey that are recorded as endangered on the

CIBD or listed on the IUCN Red List. Nine of the species recorded are medicinal species however, all are listed as very common on the CIBD and are widespread on Aitutaki.

Plate IV.6: Weed dominated subproject site



104. The Blue Lorikeet (*Vini peruviana*) is regularly reported by locals at the project site however, it was neither seen nor heard during the survey. The Blue Lorikeet is listed as endangered in the CIBD and vulnerable on the IUCN Red List.

IV.2.3 Protected Areas

105. The Cook Islands' protected area network consists of one national park, one wildlife sanctuary, and six island specific conservation areas/reserves. The reserves in Cook Islands range from whole island reserves to specific locations on various islands. None of the subproject sites are located within or near any of the protected or conservation areas.

106. **Suvarrow National Park.** Suvarrow Atoll was the first island to be formally established as a National Park in the Cook Islands in 1978 for the protection of the wildlife and the marine resources that it possesses. Suvarrow is an important sea-bird breeding site not only for the Cook Islands but also for the region and the world. Eleven species of seabirds breed are found on the island. It supports regionally significant colonies of Lesser Frigatebirds (9% of world population), Red-tailed tropicbirds (3% of world population), and the Cook Islands only large colony of Sooty Terns. The atoll also supports locally significant colonies of Red-footed Boobies, Great Frigate birds, Masked boobies and Brown Boobies. In addition, it is an important wintering site for Alaskan migrant, the vulnerable Bristle-thigh Curlew.

107. Takutea Wildlife Sanctuary. The Island of Takutea, a breeding ground for birds has been a Wildlife Sanctuary since 1903. The traditional leaders of Atiu who are the trustee of Takutea still manage the island as a conservation area for wildlife.

108. In addition to the two nationally protected areas, there are six island specific reserves, which are declared by island councils based on conservation significance. These are Rarotonga Island Reserves, Aitutaki Island Reserves, Pukapuka Island Reserves, Mitiaro Island Reserves, Rakahanga Island Reserves, and Manihaki Island Reserves.

IV.3 Socio-Economic Environment

109. **Demography.** The population of the Cook Islands is approximately 17,794 people (Census 2011) consisting of 8,815 men and 8,979 women. The 2011 census reflects a decrease of 1,315 people compared to the 2006 Census population of 19,342. There has been a declining population trend since the early 70's, with the population declining quite dramatically, between 1971 and 1976, as a result of the opening of the Rarotonga International Airport in 1974, when many people took the opportunity to migrate to New Zealand.

110. The distribution of the total population varied considerably by region. About 74% (13,095) lived in Rarotonga, 20% (3,586) lived in the Southern Group islands, and 6% (1,113) in the Northern Group islands. The population density varied widely by island. While there were about 347 people per square kilometre in Pukapuka, in Mitiaro Island, there are only eight people per square kilometre. The population density of Rarotonga was 195 people per square kilometre. The average household size is four persons per household. Table 4.1 presents the demographic features of each subproject island.

Table IV.1: Subproject Demographic Features

Feature	Cook Islands	Subproject Island					
		Mangaia	Mauke	Mitiaro	Atiu	Aitutaki	Rarotonga
Area (km ²)	236.7	51.8	18.4	22.3	26.9	18.1	67.2
Population	17,794	562	307	189	468	2038	13,095
Male	8,815	283	162	101	228	994	6,460
Female	8,979	279	145	88	240	1,044	6,635
Pop. density pers./km ²)	75.18	11.04	16.68	8.48	17.39	112.59	194.86
Sex ratio	1.02	0.99	0.90	0.87	1.05	1.05	1.03
Number of households ⁴	-	195	106	76	161	-	-

Source: Government of Cook Islands – Census 2011

111. Cook Island Maori made up the bulk of the resident population with 12,930 persons (84%), 1,045 persons (7%) were part Cook Island Maori, and 1,349 persons (9%) were of foreign descent. The largest single group of foreigners were New Zealand European (458 people) and Australian (311).

112. The Cook Islands Christian Church (CICC) continues to be the dominant religious denomination of the resident population; however, affiliation with this church has declined from 55% in 2001 to 53%. The next largest group is the Roman Catholic Church with 2,599 members (17%), followed by the Seventh Day Adventist Church (SDA) with 1,154 members (8%). All other religious denominations account for 6% of the resident population and people with no religion comprised of 4% of the resident population.

113. **Economy and infrastructure.** The per capita GDP of Cook Islands at current price is NZD 17,799 (Cook Islands Statistics Office, 2011/2012). GDP per capita is high compared to other economies in the region.

114. Tourism is vital to the Cook Islands economy and is estimated to account for around 60% of GDP, with tourist arrivals ranging from 100,000-120,000 each year. The Cook Island's economic prospects are largely reliant on its capacity to grow and continually improve its tourism product. Tourism is currently focused on Rarotonga and Aitutaki. Subproject islands such as Atiu and Mauke also have smaller tourist operations.

115. Other economic activities on the subproject islands include agriculture (taro, pineapples, noni), and fisheries which play a role in supplying local markets within the Cook Islands. On each subproject island government employment is the main source of cash income together with fishing, agriculture, pension, and private sector (small retail shops and tourism-related

⁴ Active residential electricity accounts (not available for Aitutaki and Rarotonga)

activities). On the smaller subproject islands many households also have significant subsistence income. Private enterprise is the largest source of employment on Aitutaki and Rarotonga however, both also have high levels (approximately 40%) of government employment. Subproject island economic activity data are presented in Table 4.2.

Table IV.2: Subproject Economic Activities

Feature	Cook Islands	Subproject Island					
		Mangaia	Mauke	Mitiaro	Atiu	Aitutaki	Rarotonga
Average annual household income (NZ\$)	15,028	8,070	8,070	8,070	8,070	8,070	17,695
Employed population	6,938	132	102	63	130	654	5,411
Economically active pop.	7,554	179	122	74	148	771	5,774

Source: Government of Cook Islands – Census 2011

116. Almost all households are connected to the grid/mini grid for power. Account records show average residential monthly power bills from NZD 67 (Atiu and Mitiaro), NZD 70 (Mangaia), and NZD 83 (Mauke). No account records were available for Aitutaki and Rarotonga. Electricity in the outer islands is heavily subsidized by the government.

IV.3.1 Land Use and Ownership

117. Land use and ownership at the sites of the subproject islands is summarised below.

118. **Mangaia.** The subproject site is currently unused. There are approximately 90 coconut trees on the site that have economic value which will be cleared as part of the subproject.

119. All land on Mangaia is classed as privately owned native customary land and is not subject to the Land Court but rather to local custom. The landowners and their *ariki* (high chief), *kavana* (senior chiefs), and *rangatira* (sub-chiefs) all agree, in principle, to transfer use of the subproject site to the government for the project purpose subject to agreement of a formal land use agreement.

120. **Mitiaro.** The subproject site is currently unused and has no residential or other structures and no other economic assets.

121. The subproject site straddles two different properties—Teramake Section 8 and Tueru Section 9—that are owned by two different family groups. The two sets of landowners agree, in principle, to transfer use of the site to the government for the project purpose subject to agreement of a formal land use agreement.

122. **Mauke.** The government has used the site for many years as an agriculture research and extension station. The site is now abandoned by government and has no residential or other buildings and no structures other than a pig fence in the NW portion of the site. The fence protects the crops of one landowner from foraging pigs and encloses a small piggery belonging to one landowner.

123. The subproject site falls within Tengarū 6B which has been investigated by the Land Court, and the many individual owners are thus known and registered (subject to updating any succession orders). The landowners agree, in principle, to transfer use of the site to the government for the project purpose subject to agreement of a formal land use agreement.

124. **Atiu.** With the exception of the existing Atiu Power Station the subproject site is currently unused and has no residential or other buildings and no other economic assets. It has not been used productively since the site was intensively farmed for pineapples more than 30 years ago. The government subsequently planted Caribbean Pine on the site to help control erosion. Those introduced trees are now mature, but they have no economic value on Atiu. A rugby field is located to the north east of the site.

125. The subproject site is part of a large section known as Vaitamina 556. Vaitamina 556 has been investigated by the Land Court, and the many individual owners are thus known and registered (subject to updating any succession orders). The landowners agree, in principle, to transfer use of the site to the government for the project purpose subject to agreement of a formal land use agreement.

126. **Aitutaki.** There is a government agricultural research station and the existing Aitutaki power station located on the subproject site. The area of land intended for the solar PV array is currently unused. There are no private non-land assets on the site.

127. The subproject site consists of 10 parcels of private freehold land. Each of the 10 parcels is secured by the CIIC under a long-term lease on behalf of the Government of the Cook Islands.

128. **Rarotonga.** The BESS subproject site contains the airport solar PV array owned and operated by TAU. This subproject site is surrounded by the Rarotonga Airport. The R-ESS-2 sites are inland directly from the airport and on the existing TAU power station, both sites leased by TAU from the government. All land required for the subprojects is privately owned native freehold or customary land.

129. The subproject site for the BESS is owned by the government and is managed by the Airport Authority. TAU has leased the subproject site from the Airport Authority. For the R-ESS-2, two sites have been identified by TAU leased from the government. However, as both the Airport Authority and TAU are administered and managed by CIIC all parties to the leases are bodies of the national government.

130. **Cultural and heritage resources and sites.** The Mayors of each of the subproject islands were consulted to determine whether any sites of cultural significance (marae) or historical significance existed on the project sites. The subproject sites on Rarotonga are previously disturbed and there is no potential to disturb sites of cultural or heritage significance. Letters were received from each subproject island confirming that there are no marae or historical sites associated with the project sites. The letters have been included as Appendix 2.

V. ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

V.1 Design and/or Pre-construction Impacts

131. **Climate change adaptation:** A climate risk profile for Cook Islands indicates that the main impacts of climate change are expected to be high sea levels, extreme winds, and extreme high air and water temperatures. Best estimates of long-term, systematic changes in the average climate for Cook Islands indicate that sea level is likely to have increased by 4 to 15 cm and the frequency of severe short sea level rise resulting from storm surge (2.2 m above mean sea level) will increase from a one in 580-year event to a one in 5-year event by 2050.

132. With the exception of Rarotonga all subprojects are located away from the coast and are not expected to be impacted by sea level rise. Although Rarotonga is located relatively close to the coast it is not located in a mapped coastal hazard zone. All components procured for the subprojects will be suitable for tropical marine and coastal environments, preferably be preassembled and will be as resistant to corrosion as practicable (e.g. stainless or galvanized steel mounting systems). Components will meet international standards (e.g. IEC 61730 Photovoltaic (PV) module safety qualification). The subprojects have been designed to withstand extreme winds (e.g. cyclones) and temperatures.

133. **Ecological impacts from site clearance.** Clearing for the subprojects will result in the direct loss of up to 5.2 ha (52,000 m²) of vegetation (it is not expected that all of the project site at Atiu or Aitutaki will be cleared). There is no requirement for the temporary clearing of vegetation for access or for material or equipment storage. Flora and fauna surveys were undertaken at all subproject sites. The results of the surveys demonstrate that clearing of the sites selected for the subprojects will not result in the substantial loss of any native vegetation or have significant negative impacts on any species recorded as endangered on the CIBD or listed on the IUCN Red List.

134. All the sites are part of larger contiguous areas of similar vegetation type and the clearing will not result in the fragmentation of habitat. The subproject sites are currently all easily accessible and their development will not result in increased access to previously remote areas that can result in an increase in vegetation clearance.

135. A description of the potential impacts specific to each subproject is provided below.

136. **Mangaia.** Clearing for the sub project will result in the loss of native species however, all affected species are widespread on Mangaia and the clearing will not result in a significant adverse impact. No significant flora species are present on the site. The subproject site is likely to be used by the Mangaia Kingfisher. However, it does not provide breeding habitat for the species which breeds inland in dense Barringtonia forest. Although the subproject will result in the loss of a small area of potential habitat (1.22 ha) it is unlikely to have a negative impact on the Mangaia Kingfisher as this habitat type is widespread on Mangaia. It is likely that the Mangaia Kingfisher will continue to use the project site as it moves between the surrounding habitats. Glare from the solar panels are unlikely to have any impact on the kingfisher. Several serious weed species were recorded and care will be required to prevent their spread on the site and into the surrounding environment. There are economic trees present on the site and the owners will be compensated as outlined in the Resettlement Plan.

137. **Mitiaro.** The subproject site is largely undisturbed due to its inaccessibility. Clearing will result in the loss of native species. However, the native species at the site are all widespread on Mitiaro and the small area to be cleared for the subproject (0.48 ha) does not represent a significant adverse impact. Two flora species present on the site and two bird species reported to use the site are listed as Locally Endangered on the CIBD. However, all are widespread on Mitiaro and the Locally Endangered listing applies to other islands. Several serious weed species were recorded and care will be required to prevent their spread on the site and into the surrounding environment.

138. **Mauke.** The subproject site has historically been used for agricultural purposes and few native species are present. There is no fauna habitat for any significant species. No species were recorded that are listed as threatened on the CIBD or listed on the IUCN Red List. Several serious weed species were recorded and care will be required to prevent their spread on the site and into the surrounding environment. There are economic trees present on the site and the owners will be compensated as outlined in the Resettlement Plan.

139. **Atiu.** The site is dominated by introduced species (Caribbean Pine and Java Plum) that are widespread on Atiu. Clearing for the sub project will not result in a significant impact to native species nor will it adversely impact any significant flora species. The Caribbean Pine performs the role of a soil stabiliser at the site and prevents erosion. The civil works design will include appropriate drainage structures that adequately control surface water flow and prevent erosion of surrounding land. The loss of a small area (1.5 ha) of potential habitat containing the Java plum and Polynesian Elaeocarpus is unlikely to have a negative impact on the Cook Islands Fruit Dove and other bird species that feed on the fruit of these species as both species are widespread on Atiu. It is likely that the Cook Islands Fruit Dove will continue to use the project site as it moves between surrounding habitats, Glare from the solar panels are unlikely to have any impact on the fruit dove.

140. **Aitutaki.** The subproject site is in poor condition with only two native species being recorded. No species were recorded that are listed as threatened on the CIBD or listed on the

IUCN Red List. Several serious weed species were recorded and care will be required to prevent their spread on the site and into the surrounding environment. Although the Blue Lorikeet is regularly reported by locals the subproject site contains only marginal habitat for the species which is usually found in open forest, cultivated trees, plantations and gardens where it feeds on fruit, nectar and soft flowers. Clearing of a small area (1.1 ha) of poor quality habitat is unlikely to have a negative impact on the Blue Lorikeet.

141. All sites are readily accessible via existing roads and tracks and will not require the clearing of additional vegetation.

- The PMU and contractor will conduct a survey on each site and prepare a plan/drawing clearly indicating the vegetation to be cleared. Only trees and vegetation marked on the plan will be removed from each site;
- Vegetation cleared from the subproject sites will be disposed of in consultation with the POE and IEO (e.g. chipped and made available to local residents as mulch). A significant amount of vegetation will be required to be disposed of on Atiu and options are being investigated to determine an environmentally appropriate solution; and
- During site clearance the contractor will implement controls to ensure that invasive species do not infest the sites or adjacent land.

142. **Site selection.** The construction of the solar power/ energy storage systems on all subproject islands requires the use of relatively large areas of land. It is critical that the project site selected is acceptable to land owners and the wider island community. The subproject sites were selected based on consultation with stakeholders and landowners and taking into consideration technical and environmental considerations. There are no marae or historical values associated with any of the sites. The sites are all located such that the solar PV arrays will not be visually obtrusive to nearby residents.

143. Land for all sites is either owned by the government or privately owned native freehold or customary land. The availability of all sites has been agreed in principle with landowners and the Island Council's. Affected people will be compensated as per the entitlement proposed in the project Resettlement Plan. Since the proposed sites are free from any agricultural/commercial activities, the livelihoods of affected people will not be impacted. In addition there will be no relocation of people as proposed sites are free from buildings/structures.

144. The design of the subprojects has minimized visual impacts to local residents by: (i) specifying that cables connecting the solar PV array to the power house will be buried; and, (ii) the power house (and other above ground infrastructure other than the PV panels) will be painted in neutral colours to reduce visual impact.

145. **Institutional readiness of executing and implementing agencies.** The executing and implementing agencies have implemented the earlier phase of the Project and therefore can be considered ready to implement Phase 2.

146. To measures/activities that will be required prior to construction activities commencing include:

- Ensure that the project execution agency and TAU and REDD have made the necessary arrangements for, and mobilized, the agreed environmental specialists to be engaged in the PMU.
- The PMU will provide support and assistance as required to the contractor(s) in respect of EMP, monitoring and reporting.
- Monitoring and reporting forms prepared for Phase 1 subprojects will be adapted and/or modified as required for the phase 2 subprojects prior to the commencement of construction mobilization.

147. Project's compliance with country's legal environmental safeguard and associated requirements. The TAU and REDD (with assistance as required from the PMU) will submit the ESDs, update the IEE (undertaking additional studies as required) as EIA to comply with the NES' requests under the Environment Act 2003 and submit the EIA and applications for approval under the Environment Act 2003.

148. Ensuring environmentally responsible procurement. The measures to be implemented by the TAU, REDD and PMU include the following:

- Update of the EMP, as required based on detailed design, and include the ADB-cleared and NES approved EMP in the bidding and contract documents.
- Include in the contract the requirement for the contractor(s) to prepare the site-specific construction EMP (CEMP) that will respond to the EMP included in the bid and contract documents (including sub-plans as identified in section 5 of the IEE including waste management plan, health and safety plan, emergency response plan, and chance finds plan).
- Preparation of, and obtaining PMU clearance for, the CEMP for each site prior to commencement of works at any site.
- Ensure the contract requires the submission by the contractor of a monthly environmental monitoring report, outline to be appended to the contract. Ensure Contract stipulates some tie-up of progress payment and collection of performance bond with the performance in CEMP implementation.

149. Community preparation for construction. This will include ensuring that the Project's communication and consultation plan is implemented and that the community and Island Councils are advised prior to the mobilization of the contractor to each site. Pre-mobilization consultations and notice will inform the affected communities of the: (i) implementation period, contact and other details, such as probably restricted area to use along access road or potential blocking of site from pedestrians, (ii) potential risk of communicable and transmittable diseases brought with the entry of outside workers, (iii) overall health and safety hazards during construction, and (iv) grievance redress mechanism (GRM). Post details on project implementation at strategic locations in the main area of influence at the latest one month prior to construction mobilization. Details to include, among others – implementation period, name and contact details of the contractor and focal persons of the PMU, TAU and REDD.

V.2 Construction Stage Impacts

V.2.1 Physical Environment

150. Air quality and dust. The construction of the subprojects has the potential to generate excessive dust through construction activities such as earth moving, by the movement of vehicles and machinery and by exposed soil on the cleared sites or in soil stockpiles. Implementation of good practice construction measures will reduce the impacts to air quality.

151. Mitigation measures include:

- Vehicles carrying soil, sand, crushed aggregate or other fine materials to or from the project site will be covered.
- The project site, material stockpiles and access roads, including those from the wharf, and material stockpile areas, will be wetted or stabilised if dust is generated.
- Earth moving equipment will be cleaned prior to leaving site to prevent the tracking of soil on nearby roads.

- The contractor will employ a water truck during the dry season to spray the sites to reduce dust or emissions of fugitive particulates.

152. **Waste management.** The installation of the solar plant at each site will involve generation of waste and construction activity debris. Management of waste during construction of the subprojects is important to prevent pollution of surrounding water and land. Waste management during all phases of the subprojects will seek to reduce, reuse and recycle waste as far as possible and dispose of waste in an appropriate way. There are expected to be few hazardous wastes generated during construction; with the exception of on Rarotonga, there are no facilities to process any hazardous wastes. Hazardous wastes (see item below) will be transported to, and disposed of, on Rarotonga.

153. Mitigation measures include:

- The contractor will prepare a waste management plan as part of the CEMP.
- The contractor will consult with the POE and IEO to identify opportunities to avoid and reduce the generation of waste and to recycle or re-use waste generated.
- Bins for recycling and general rubbish will be provided at the project site and materials laydown area for the disposal of construction wastes.
- Construction wastes that cannot be re-used or recycled on the subproject island will be transported off site for reuse, recycling or disposal.
- If excess spoil is generated during site preparation it will be stored at an existing stockpile site, agreed to by the IEO and POE, for re-use.
- Hazardous waste (if generated) will be transported off the subproject island and disposed of on Rarotonga at the dedicated facility in accordance with manufacturer requirements.

154. **Hazards materials.** Hazardous materials will be required for the construction of the subproject. Hazardous materials (e.g. fuels and oils) will be appropriately managed during construction to prevent pollution of surrounding land and water.

155. Mitigation measures will include:

- As part of their CEMP, the contractor will prepare a hazardous materials management plan that shall, at a minimum, include:
 - The type and quantity of hazardous materials that will be present on site.
 - Safety Data Sheets for all hazardous materials.
 - A spill response plan including training for staff in the use of spill kits.
 - Details of planned transport, storage and disposal of hazardous materials (including compliance with commitments contained within this IEE).
- The transport of hazardous materials will be done by an appropriately experienced and equipped contractor.
- Hazardous materials will be stored in appropriate containers that are in good condition with adequate labelling.
- Hazardous materials (including fuel and oils) storage will be appropriately banded.

- Spill kits and containment devices appropriate for the type and volume of hazardous materials on site will be located at the storage area(s), on the site and on vehicles carrying hazardous materials.
- Hazardous materials will be transported offsite and disposed of at the dedicated facility on Rarotonga.

156. **Noise and vibration.** The construction activities (site clearance, levelling of the site, transport of plant and equipment) will generate noise through the operation of machinery on the site and movement of vehicle and machinery transporting equipment and materials to site. Construction noise impacts will be sporadic and are expected to be minor. Implementation of good practice construction measures will reduce noise impacts.

157. Mitigation measures will include:

- If required, a condition survey of buildings and structures that could be affected by vibration will be undertaken prior to commencement of any works.
- The requirements of the World Bank Environmental Health and Safety Guidelines (EHSG) in respect of noise will be implemented.
- Wherever possible working hours will be between 8am and 5pm Monday to Friday. Where safety or technical reasons require work to be completed outside of these hours, noise levels will be kept to a minimum and the Island Council together with nearby residents will be informed.
- Noise generating activities e.g. site clearance will be carried out in the least sensitive time periods to be determined in consultation with the Island Council.
- Equipment and plant will be maintained in good order. Noise reduction components (e.g. mufflers) will be inspected prior to the commencement of works to ensure they are fully functional. Noise emissions from construction equipment will not exceed 75 dBA.

158. **Water resources and quality:** The construction of the subprojects has the potential to interfere with local water resources (ground or surface water) through inappropriate abstraction for construction, alteration of surface water flow across the site leading to sedimentation of adjacent environments (refer erosion control below) and pollution of water resources through accidental spillage of hazardous materials (refer hazardous materials).

159. Mitigation measures will include:

- Where feasible construction techniques will be specified that minimise the need to alter the topography (e.g. piling) and hence surface water drainage on the site.
- Silt laden run-off will not be discharged directly to watercourse or the coast. The site will include silt settling basins or ponds as required.
- Water required for construction (e.g. concrete mixing) will be sourced with the agreement of the Island Council, IEO and POE.
- Cement and other materials required for concrete will be stored in containers and not within 50m of watercourse or the coast.

160. **Erosion control.** Erosion has the potential to occur when the sites have been cleared of vegetation but have not yet been stabilized or from stockpiles of materials. In particular, Atiu is susceptible to erosion due to its soil type and sloping topography. Erosion can lead to instability of the project site and surrounds causing damage to vegetation and sedimentation of surrounding streams and lakes.

161. Mitigation measures will include:

- All land disturbances will be confined to the minimum practicable working area to ensure that the minimum land area is exposed to erosion for the shortest possible time.
- Existing drainage lines will be protected and diversion of drainage lines avoided.
- Surface water will be diverted around the construction footprint using structures such as catch drains, silt fences or bunds. Surface water will not be diverted across erosion prone slopes.
- Erosion control works and measures will be installed to control surface water runoff and prevent the export of sediments from the site by ensuring;
 - discharge of storm water is to stable preferably vegetated land
 - erosion control measures closely follow land contours to reduce runoff velocity from exposed soils.
- Sediment traps (e.g. silt fences) will be constructed across all drainage lines and erosion controls from site that are likely to receive runoff from exposed or disturbed soils. Sediment traps will be installed where required.
- The site will be covered with geotextile fabric immediately after clearing to prevent the loss of top soil (Atiu and if deemed necessary by the POE and IEO).
- A shade tolerant low groundcover (e.g. grass) will be established across the site as soon as practicable after site clearance. The species of groundcover used will be selected in consultation with the IEO and will not shade the PV modules.
- Sediment and erosion control measures will be monitored regularly to ensure their continued correct functioning.
- Cable trenches will remain open for the shortest duration possible to reduce erosion and where possible will not be open during periods of heavy rain.
- Spoil from excavated trenches will be stored on the uphill side of the trench such that any sediment from the spoil is deposited in the trench.

V.2.2 Biological Environment

162. **Ecological.** As outlined above the clearance of the sites will not result in the significant loss of any native vegetation or the loss of any species recorded as endangered on the CIBD or listed on the IUCN Red List. Neither will the clearing of vegetation result in the loss or fragmentation of any significant fauna habitat. The loss of vegetation from the site has the potential to impact the surrounding environment through unauthorised clearing outside the site boundary, clearing additional areas (e.g. to store materials) or by causing damage to surrounding vegetation through erosion or the introduction of invasive species.

163. Mitigation measures will include:

- To ensure vegetation clearing is restricted to within the site boundary and is the minimum practically required a representative of the POE and the IEO will be on site during clearing.
- On Atiu, trees on steeply sloping land within the project site boundary (close to the northwest boundary) will not be removed.

- Cleared vegetation will be removed and will not be stockpiled on site or pushed into existing vegetation adjacent to the site.
- Machinery storage and materials lay down areas will be established in previously disturbed areas to avoid increasing the footprint of the project site.
- As far as is practicable existing stockpiles of fill material will be used. If new fill material is required it will be sourced from locations approved by the IEO that do not result in the disturbance of native vegetation.
- Immediately following clearing the site will be planted with low growing grass species to help stabilise the site and minimise the spread of weeds (there is a risk of weeds spreading into newly cleared sites at all subproject locations).
- Bermuda grass (*Cynodon dactylon*) exists on Mauke and Mitiaro and the subproject sites shall be mowed after clearing to encourage this species to establish.
- Weed hygiene measures (e.g. cleaning machinery before it enters the site) will be implemented to prevent introduction or spread of invasive species.

V.2.3 Socio-economic Environment

164. **Social disruption and impacts.** Social impacts during construction of the project may include increased work opportunities for local contractors, increase in traffic, including heavy haulage at wharfs and on roads and health and safety risks to contractors, power station operators and the general public. The subprojects are likely to require a small number of foreign contractors and technical specialists for the duration of construction (six to eight weeks) which can lead to conflict between foreign workers and local communities.

165. Mitigation measures will include:

- A list of relevant local contractors available on each subproject island will be provided in tender documentation to facilitate the engagement of local industry by the selected construction contractor.
- Opportunities will be made available by the contractor for local contractors and businesses to be engaged during construction and commissioning of the power station.
- With the exception of Rarotonga, the Island Council, visitors centre, landowners, local residents and stakeholders will be kept informed of the project via monthly meetings during construction including details of:
 - the progress of the works and expected completion date
 - scheduled delivery of materials and equipment
 - any disruptions to the use of the wharf or site access roads
 - upcoming works that are likely to be noisy.
- As far as is practicable works will be timed to avoid disruption to local events.
- The contractor will identify in their CEMP how they intend to implement the relevant parts of the Project's GRM.
- Contractor's staff, especially any foreign workers will be discouraged from fraternizing with locals and will observe the protocols to be agreed with the Island Councils.

166. **Health and safety.** The construction activities will be for a relatively short period at each site. However, there will be a need to implement measures to ensure occupational health and

safety of workers and that the health and safety of the people from the adjacent community are not impacted.

- The contractor(s) will be required to develop an occupational health and safety plan as part of the CEMP prior to the commencement of any works on site.
- The site shall be fenced off. Within the site and work areas, fencing shall be installed on all areas of excavation greater than 1m deep whether temporary or permanent.
- Workers shall be provided (before they start work), at no cost to them, appropriate personnel protective equipment (PPE).
- Adequate sanitation and potable water will be supplied by the contractor.
- Non-authorized people will not be allowed to access the site during construction activities.

167. **Cultural and heritage resources:** No marae or historical sites or artefacts are known to be associated with any of the subproject sites. Nonetheless, in the unlikely event of an artefact being uncovered during construction activities, the contractor will: (i) implement the measures in the “chance finds” plan; and (ii) work will cease immediately and the Island Council and POE will be notified. Work will not recommence until authorised by the POE.

V.3 Impacts and Mitigation Measures from Operation

168. The operation of the solar power systems will have minimal environmental impacts at the subproject sites and in surrounding areas.

169. **Noise emissions.** The operation of new diesel power stations on Mauke and Mitiaro has the potential to increase noise levels at surrounding residences and release polluting exhaust emissions. The closest occupied residence at Mauke is approximately 70 m from the power station and the closest occupied residence at Mitiaro is approximately 180 m from the power station. Noise modelling has been undertaken for the proposed Mauke and Mitiaro power stations.⁵ Using measured standard noise emissions from a generator typical of one which may be used on site (Cummins high speed 60 kW) it was found that the noise level at the closest occupied residence on Mauke was naturally attenuated to 40 dBA whilst the noise level at the nearest residence at Mitiaro was attenuated to 30 dBA (Figure 5.1 and Figure 5.2).

170. The World Bank EHS stipulate that residential noise levels should not exceed 55 dBA during the day (07:00 to 22:00) and 45 dBA during the night (22:00-07:00).⁶

⁵ ISO 9613-2: First edition, 1996-1 2-15: Acoustics - Attenuation of sound during propagation outdoors - Part 2: General method of calculation

⁶ World Bank. 2007. Environmental Health and Safety Guidelines

Figure V.1: Modelled sound contours Mauke

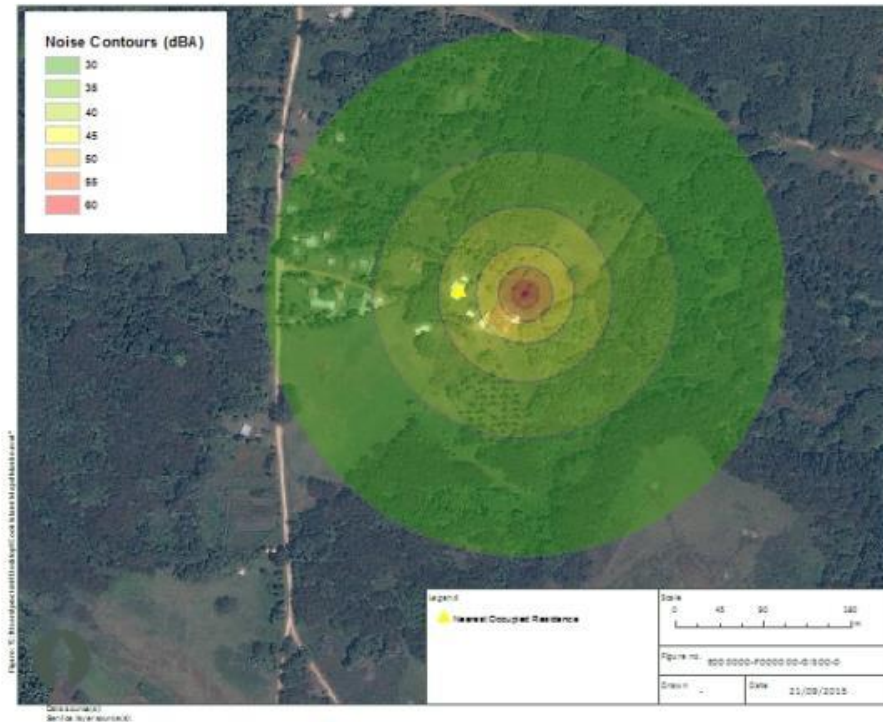
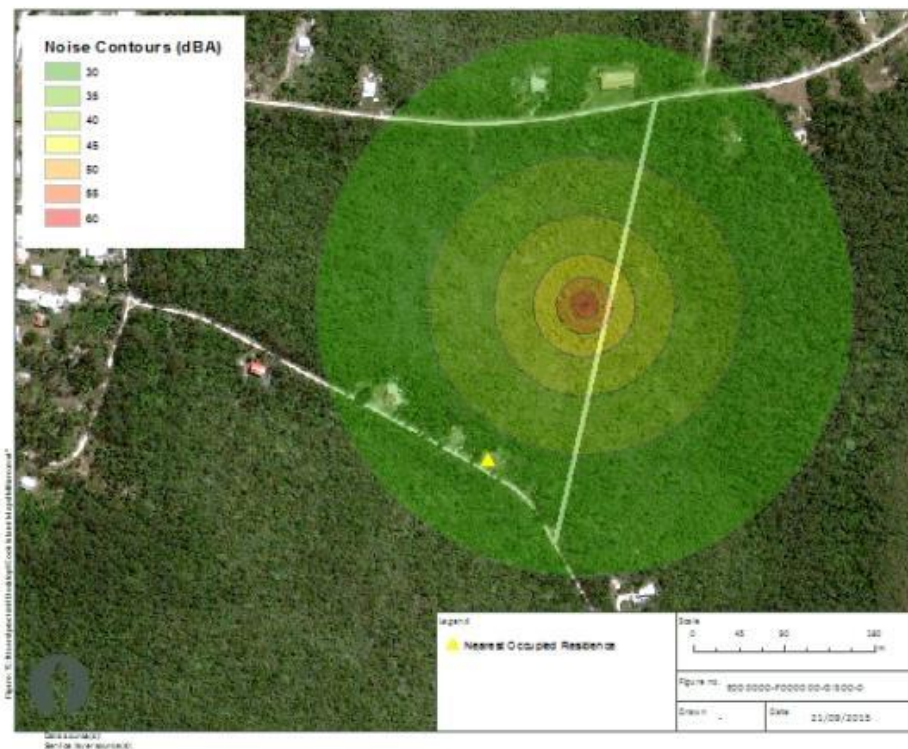


Figure V.2: Modelled sound contours Mitiaro



171. The modelled noise levels at both Mauke and Mitiaro fall within these levels. The modelled levels are conservative and do not take into consideration attenuation provided by the concrete block power station building or vegetation between the power station and the residence. The measured noise levels would be expected to be significantly lower. Further, the generators will only run infrequently (<5% of the time). However, given the proximity of residences to the power station additional noise mitigation measures will be considered in the detailed design of the power station (e.g. installation of bay doors instead of roller doors to help attenuate noise), the procurement of diesel generators and the operation of the power station (e.g. program battery charging to only occur during the day). Noise modelling will be rerun using the selected generator to ensure modelled noise levels comply with EHSG at nearby residences.

172. The diesel generators will comply with relevant American Environmental Protection Authority emission standards.

173. The subprojects on Rarotonga, Atiu and Mangaia do not include the installation of new diesel generators or any other sources of significant noise or air emissions. The subproject on Aitutaki includes the installation of a new diesel generator within the existing power station and is not expected to significantly increase noise emissions when the generators are in use. The implementation of these subprojects will reduce the use of the existing diesel generators thereby reducing noise and air emissions.

174. **Waste and hazardous materials.** The operation of the subprojects will generate waste, including hazardous waste (e.g. inverters and batteries will require replacement after approximately 10 years), which must be appropriately managed to prevent contamination of surrounding land and water.

175. Mitigation measures will include:

- Inverters and batteries that have been replaced during the operating lifetime of the power station will be removed, transported and disposed of by an appropriately experienced and equipped contractor.
- Where possible batteries and inverters will be recycled. If recycling is not possible they will be disposal will be at a facility approved by the NES.
- Waste oil and other hydrocarbons from generators will be stored in a bunded hydrocarbon storage area.
- No hazardous waste (e.g. used oils, batteries or inverters) will be disposed of on the subproject Island (except Rarotonga). Waste will be sent for disposal at regular intervals and not allowed to accumulate at the power station.
- Washing of solar PV panels would only be undertaken on an 'as needs' basis to minimise the generation of waste water. Disposal of waste water will be agreed with the Island Environmental Officer.
- All infrastructure containing hazardous materials (e.g. batteries, transformers, generators) will be inspected regularly to ensure it is functioning correctly and no hazardous materials are being discharged.
- Screening vegetation will be established between the PV array and the road to minimise dust from the road settling on the panels.

176. **Water resources.** Water will be required for washing solar PV modules during operation of the subproject. A source of water will be agreed with the Island Council and IEO.

177. **Erosion control.** If localised erosion is detected during operation of the subproject effective mitigation measures such as application of mulch, covering with open weave jute

matting and reseeded with ground cover, protection with geotextile fabric or localised flow dispersal and diversion structures will be installed.

178. **Biological impacts.** No significant impacts to the biological environment are anticipated due to operation of solar power systems. Some subproject sites are located within habitat for bird species and it is possible that birds will avoid overflying the sites due to glare from the panels. The sites do not cause any habitat fragmentation, are relatively small and are not expected to significantly impact any species known to occur in the vicinity of the sites. Weed monitoring will be carried out at the subproject site regularly and ongoing weed control will take place to prevent the establishment and spread of invasive species.

179. **Social impacts.** It is expected that existing employees will be retained to operate the new solar power systems. Training will be provided for power station employees in the operation and maintenance of the new solar power system.

180. The solar power station will be monitored remotely and any faults rectified by onsite maintenance staff reducing the risk of a health and safety incident (e.g. fire) occurring.

181. The POE will prepare an operational emergency response plan. The plan will be included in the training provided to employees and be implemented during the operation of the solar power system.

V.4 Impacts and Mitigation due to Decommissioning

182. The subproject's solar PV modules are expected to have an economic life of 25 years. At this time it is expected that they will be replaced by modern solar PV modules. The removal of the solar PV modules will be contracted to a specialist supplier. The BESS installed on Rarotonga an additional battery storage system proposed for phase 3 are expected to have an economic life of between 10 and 20 years dependent on the battery type selected. All equipment will be removed from the subproject sites (e.g. PV modules, batteries, invertors) and will be reused or recycled where possible. Equipment that cannot be reused or recycled will be disposed of at a facility approved by the NES.

183. The decommissioning contractor will be required to develop a hazardous materials management plan prior to the commencement of any works on site.

184. If the site is not reused it will be replanted with species appropriate to the future land use of the site.

V.5 Cumulative Impacts

185. The installation of the solar power / energy storage systems will either incorporate the existing diesel power stations (Mangaia, Atiu, Aitutaki and Rarotonga) or replace the existing diesel power station (Mitiaro and Mauke). Presently, there is no future development or expansion plans of the existing diesel power plants. Therefore, there will be no cumulative environmental effects of constructing solar power systems of each of the subproject islands.

186. There are likely to be significant benefits in aligning the Phase 1 subproject design with each other and the Northern Group systems which have already been installed. Benefits include; common operating procedures allowing for easier training of staff and staff movement between stations, cost effective procurement of spare parts and redundancy of parts between stations in the event of emergencies.

VI. ANALYSIS OF ALTERNATIVES

187. An assessment of alternatives was completed with and without the proposed project. The results of the assessment found that the outer islands would continue to pay a high price for diesel imports for electricity generation which affects the economic development of the subproject islands and the Cook Islands as a whole. Further, reliance on diesel imports risks security of supply, and price spikes or transport delays can significantly affect the local economy. Implementation of the project will bring positive economic, social, and environmental benefits. Economic benefits will be from the reduction in import of diesel for power generation, and increased security of supply. Social benefits include a sustainable electricity supply to the consumers and environmental benefits will be from reduction in emissions and reduced transport and storage of hazardous fuels.

188. For Phase 2 subprojects, to manage grid stability, considering the distributed nature of the generation system as well as required storage, in particular on Rarotonga, a fast and capable communication system integrated with the power station SCADA a critical requirement, will also be necessary for future smart grid enhancements (e.g., automated demand response). It is not possible at this time to specify the exact mix of enabling technologies; however, given the relative environmental sensitivities, gestation periods, and ease of installation, the BESS and R-ESS-2 battery storage systems are the preferred option.

189. As part of capacity building local staff will be trained in the maintenance and operation of solar-diesel hybrid systems.

190. Alternative sites were considered however, the selected subproject sites were considered the most suitable sites because they met the following constraints:

- Technical: sites must be within close proximity to the existing power station, provide easy access to the existing distribution grid, receive sufficient solar radiation, reduce the need for extensive civil works and preferably be accessible by existing roads.
- Environmental: construction on the sites must not result in a significant adverse impact of species listed as endangered on the CIBD or listed on the IUCN Red List.
- Social: sites must be acceptable to local community, landowners must be willing to enter into a land use agreements, not contain marae or historical values and preferably not negatively impact the livelihoods of affected people.

VII. CONSULTATION AND INFORMATION DISCLOSURE

VII.1 Stakeholders and Community Consultations

191. As part of the PPTA consultations were carried out during field visits in December 2013. Stakeholder consultations were carried out by holding meetings at offices of the respective agencies in Rarotonga, as well as at island council offices. Whereas personal discussion, focus group discussions and questionnaire surveys were used for community/public consultations.

192. In total eight stakeholder meetings involving 31 officials from various agencies, i.e., the REDD, TAU, NES, Island Environment Authorities, Statistics and Economics, Utilities from targeted islands, women groups, etc., were consulted during the fact-finding visits. The list of officials/stakeholders consulted and summary of the issues raised are presented in Appendix 3.

193. The consultations included both discussions with stakeholders and discussions with community/island level authorities including project affected people, landowners and women groups from the islands. Affected people and landowners (64 in total involving 26 women participants) and women groups (one group from each Island) were consulted during the field visits. Consultation will continue at next stages, i.e., after finalization of detailed design and before start of the civil works construction, as well as at implementation stage. The details of such consultation carried out during reconnaissance field visits are presented in Appendix 3.

194. Information was provided on the scale and scope of the Project, the expected impacts and the proposed mitigation measures.

195. Local communities and community leaders from subproject islands are well aware of and strongly support the proposed project, as the installation of solar power plants will bring benefits to the islands in terms of improved and sustainable electricity supply, improve the overall economy situation by saving in cost of imported diesel and some employment opportunities.

196. Consultations have continued and will continue at the next stages--i.e., during the detailed design and before the start of civil works. The implementing agency with CIIC representative will continue consultations with leaders in the Island Councils, village leaders including traditional chiefs, affected landowners/APs, and other interested members of the community.

197. Recommendations and suggestions from stakeholders and the public were incorporated in the design of the Project and in the IEE.

VII.2 Information Disclosure

198. 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.

199. The EMP requires the contractor to respond to the requirements of the Project's GRM so that any concerns raised during construction or operation of the subprojects can be addressed.

VIII. ENVIRONMENTAL MANAGEMENT PLAN

VIII.1 Introduction

200. This EMP is intended to cover all phases of the subproject implementation including design, construction, commissioning, operation and decommissioning. The EMP complies with the SPS and includes the following information:

- Implementation arrangements including institutional roles and responsibilities for the EMP implementation throughout all phases of the project.
- Environmental mitigation requirements and EMP table including:
 - Potential environmental impacts at each stage of the project
 - Proposed mitigation measures to address each potential impact
 - Costs associated with implementation of the mitigation measure
 - Institutional responsibility for implementing proposed mitigation measures
 - Schedule of implementation of mitigation measures.
- Environmental monitoring including:
 - Aspects to be monitored to ensure mitigation measures have been implemented effectively
 - Schedule and frequency of monitoring
 - Costs associated with monitoring
 - Responsibility for implementing and supervising monitoring.

VIII.2 Arrangements and Responsibilities for Environmental Management

201. MFEM as the executing agency has overall responsibility for all aspects of the Project. TAU and REDD as the implementing agencies, supported by the PMU, are responsible for the implementation of, and compliance with, the environmental management requirements of the Project. The PMU and PSC have been set up to support the implementation of the project. REDD will be responsible for ensuring the EMP is implemented for each of the four subprojects and at for stages of development. This includes ensuring compliance with all Government of the Cook Islands and ADB safeguard requirements. The NES and IEOs in the IEA will also be involved in environmental management activities.

202. Whilst the ultimate responsibility for the subproject implementation resides with REDD, the PMU (with support from the POE) will be responsible for the day to day implementation of the EMP during the design, construction and commissioning phases of the subprojects.

203. The POE's international environmental specialist (IES) will be responsible for submitting environmental documentation to the NES as required under the Environment Act 2003 and ensuring that the environmental management and monitoring budgets are available and utilized as necessary for timely implementation of EMP.

204. The PMU, predominately via the POE IES and national specialist (NS), will support REDD in the following:

- Prepare the ESD and EIAs in accordance with the Environment Act 2003 and the subproject specific terms for reference prepared by the NS to obtain project consent.

- Ensure REDD and contractors are aware of any consent conditions and the implications for the implementation of the subprojects.
- Ensure pre-construction environmental mitigation measures are incorporated into the project design.
- Updating the EMP, as required, based on detailed design.
- Preparation of tender and contract documents including integration of the updated EMP and as required provide inputs to REDD in respect of environmental management aspects of tender evaluation.
- Review and approve selected contractor(s) subproject specific CEMP for each site which will include construction methodologies, sub-plans, and GRM requirements.
- Supervise the implementation of the approved CEMP at all subproject sites including monitoring of compliance with the approved CEMP.
- Work with the PMU's International Social Specialist to ensure the GRM is implemented.
- Provide training to implementing agency and contractor staff on managing the environmental issues associated with project.
- Review of contractors monthly reports on CEMP implementation.
- Include results of contractor's monthly reporting and POE audits and checks in quarterly progress reports.
- Prepare semi-annual safeguards monitoring reports to be submitted to MFEM, ADB and NES, and ADB. All safeguards monitoring reports will be disclosed as per ADB policies.

205. The contractor. The contractor will be required to designate at least one staff with experience responsible for implementation of the environmental management provisions. This staff will be responsible for preparing the CEMP for each site; emergency preparedness plan; occupational health and safety plan, and day-to-day implementation of the approved CEMP.

VIII.3 Grievance Redress Mechanism

206. A GRM is proposed for the Project to receive and facilitate the resolution of affected peoples' concerns, complaints, and grievances about the project's environmental and social safeguards performance. When and where the need arises, this mechanism will be used for addressing any complaints that may arise during the construction and operation of the project. The grievance mechanism is scaled to the risks and adverse impacts of the project. It addresses affected people's concerns and complaints promptly, using an understandable and transparent process that is gender responsive, culturally appropriate, and readily accessible to all segments of the affected people at no costs and without retribution. The mechanism does not impede access to the Cook Islands' judicial or administrative remedies. The TAU and REDD will appropriately inform the affected people about the mechanism before commencement of any works.

207. **Proposed GRM.** The key functions of the GRM are to: (i) record, categorize and prioritize the grievances; (ii) resolve the grievances in consultation with complainant(s) and other stakeholders; (iii) inform the aggrieved parties about the solutions; and (iv) forward unresolved cases to higher authorities for resolution. The ISS and NS in the PMU will be the grievance focal points to receive, record, review, and address project related concerns in coordination with government authorities. Affected persons (APs) have been and will be made fully aware of their rights during consultations about land requirements.

208. Any complaint will be recorded and investigated by the PMU working with relevant staff of the individual subproject. The PMU will inform or update the relevant implementing agency immediately of any complaints. A complaints register will be maintained that will record the date, details, and nature of each complaint, who makes the complaint, and the date and actions taken as a result of the resulting investigation. The register will also cross reference any non-compliance report and/or corrective action report or other relevant documentation.

209. When subproject implementation starts, a sign will be erected at all sites providing the public with updated project information and summarizing the grievance redress mechanism process including contact details of relevant persons at the PMU. All corrective actions and complaint responses carried out on site will be reported back to the PMU. The PMU will include the complaints register and corrective actions/responses in its progress reports to the ADB.

210. In the GRM process, relevant Cook Islands national agencies will always be available to review public complaints and advice on the PMU’s performance for grievance redress.

211. Any APs, village chiefs, or elected officials can take a grievance to the PMU or to the site office. On receipt of a complaint in any form (in person, telephone, written), the PMU focal officer for the respective site or subproject will log the details in a complaints register. PMU will review and find a solution to the problem within two weeks in consultation with village or traditional chief and relevant local agencies. Then PMU will report back the outcome of the review to the village/traditional chief and affected persons within a week’s time. If the complainant is dissatisfied with the outcome at the PMU level or has received no advice in the allotted time period, he or she can take the grievance through the Island Council to relevant national agencies (CICC, REDD, etc.). The relevant national agency then reviews and reports back to the Island Council/AP/village or traditional chief about the outcome. If unresolved, or at any time complainants is not satisfied, the complainant can take the matter to the appropriate court. Both successfully addressed complaints and non-responsive issues will be reported to the ADB by the PMU.

212. Table 8.1 presents the steps and corresponding time frame for proposed grievance redress mechanism.

Table VIII.1: Grievance Redress Process

Stage	Process	Duration
1	Affected Person (AP), island elected or traditional chief, or other concerned party takes grievance to PMU.	Any time
2	PMU reviews and finds solution to the problem in consultation with island elected or traditional chief and relevant agencies.	2 weeks
3	PMU reports back an outcome to people who submitted the grievance.	1 week
If unresolved or not satisfied with the outcome at PMU level		
4	Concerned party takes grievance through Island Council to relevant national agency (CIIC, REED, etc.).	Within 2 weeks of receipt of decision in step 3
5	National agency reviews and finds a solution which may include recommendation of dispute resolution, including an appropriate body to oversee’.	4 weeks
6	National agency reports back to the people who made the complaint.	1 week
If unresolved or at any stage if AP is not satisfied		
Concerned party can take the matter to appropriate court.		As per judicial system

VIII.4 Mitigation Measures

213. Environmental mitigation measures have been designed to avoid potential impacts where possible and to mitigate impacts that cannot be avoided. Implementation of this EMP and mitigation measures will ensure compliance with obligations under the Cook Islands Environment Act 2003 and ADB safeguard standards.

214. To ensure mitigation measures contained in the EMP are successfully implemented:

- The updated EMP will be included in tender and contract documentation.
- The contractor(s) shall prepare a CEMP for each site describing the subproject and site specific measures that will be implemented to comply with the EMP.
- The contractor(s) will submit its CEMP to the POE and implementing agency for approval prior to the commencement of construction.
- The POE will ensure there are sufficient resources to oversee the implementation of the EMP at all subproject sites.
- The EMP and GRM will be disclosed to the public in accordance with the Section 7 of this IEE.

215. An environmental management plan describing the potential impacts and proposed mitigation measures and responsible agency has been prepared in a matrix form and presented in Table 8.2.

VIII.5 Monitoring and Reporting

216. **Monitoring.** Environmental monitoring and supervision will be carried out through all phases of the subproject development to ensure that the environmental mitigation measures are effective and that actual environmental impacts accord with predicted impacts and are in compliance with the Environment Act 2003 and ADB safeguard requirements.

217. The POE will ensure appropriate monitoring is undertaken during construction in accordance with subproject progress.

218. Complaints received from the public will be monitored and resolved in accordance with GRM. If required, additional monitoring inspections will be undertaken.

219. An environmental monitoring plan is presented in Table 8.3 and outlines the parameters, frequency and responsibility for monitoring.

220. **Reporting.** In consultation with MFEM and ADB, the TAU and REDD will establish a system for reporting. This will include quarterly progress reports (QPR) prepared by the POE/PMU which will include sections on safeguards performance monitoring, issues resolution, and corrective action plans. The QPR will include a summary of the contractor's monthly reports.

221. The POE/PMU will prepare and submit semi-annual environmental monitoring reports to MFEM, ADB and NES.

222. Contractors will report on construction progress on a monthly basis. The monthly reports will include a section on implementation of the approved CEMP including GRM provisions as required. The contractor's monthly reports will describe the implementation of the CEMP including any non-compliances and corrective actions. The report will be submitted to, reviewed and approved by the POE.

Table 8.2: Environmental Management Plan Matrix

Project activity/ stage	Potential impact	Actions/proposed mitigation measure	Mitigation Cost	Institutional responsibility	Timing
Pre-construction					
Site selection	Selected sites contain significant ecological values, will result in impacts to threatened species and/or are located in protected areas.	Flora and fauna surveys were undertaken at all subproject sites. The results of the surveys demonstrate that the sites selected for the subprojects will not result in the significant loss of any native vegetation or have any significant negative impacts on any species recorded as Endangered on the CIBD or listed on the IUCN Red List	Project Cost	PMU/PEO (on behalf of executing agency)	Detailed design
	Visual impacts	Careful selection of site away from inhabited areas.			
	Selected sites contain heritage values and/or are located in protected areas	The Island Councils from each subproject island were consulted and confirmed that there are no marae or historical significance associated with any of the subproject sites.			
	Selected sites are unacceptable to landowners or stakeholders.	Consultation has been undertaken with the local community. Landowners at all subproject sites agree, in principle, to transfer use of the site to the government for the project purpose subject to agreement of a formal land use agreement.			
Statutory clearances/ permits	Obtain environmental permit and other statutory permits from the NES	Prepare EIA(s) in accordance with NES request and the Environment Act 2003. Ensure EIA is approved and Environmental Permit received prior to the commencement of onsite works.	Project Cost	PMU/PEO (on behalf of executing agency)	Following project approval and start of detailed design stage
Climate Change	Increased severe weather events and/or rise in sea level as a result of climate change.	Locate project sites inland and above predicted sea level rises. Ensure components procured are suitable for tropical marine and coastal environments and meet relevant international standards. Design subproject to withstand extreme weather events (e.g. cyclones).	Project Cost	TAU, REDD through PMU	Detailed design
Drainage and erosion	Development of the subprojects results in erosion at project sites.	The civil works design will include appropriate drainage structures that adequately control surface water flow and prevent erosion of surrounding land (particularly Atiu).	Project Cost	PMU/PEO (on behalf of executing agency)	Detailed design
Resettlement (land acquisition)	Social inequities	Affected people will be compensated as per entitlement matrix proposed in the project Resettlement Plan	Project Cost	PMU/PEO (on behalf of executing agency)	Following update of RP based on detailed design
Access	Impacts due to construction of new access roads and wharfs	Proposed sites are accessible by existing wharf and road network. Therefore there is no requirement to construct new access roads or wharfs.	Project cost	PMU/PEO (on behalf of executing agency)	Detailed design
Project administration	Updated EMP incorporated into bid and contract documents	Mitigation measures defined in this EMP have been updated and incorporated into the detailed design to minimize adverse impacts; Prepare environmental contract clauses for contractors, namely the special conditions (e.g. incl. updated EMP and monitoring table), include conditions from environmental permit	Project cost	PMU/PEO (on behalf of executing agency)	Detailed design and tendering process

Project activity/ stage	Potential impact	Actions/proposed mitigation measure	Mitigation Cost	Institutional responsibility	Timing
Equipment design and selection Equipment design and selection	Release of toxic chemicals and gases in receptors (air, water, land)	PCBs should not be used in transformers and other project facilities or equipment.	Project Cost	PMU/PEO (on behalf of executing agency)	Tendering process
	Noise and air emissions	Undertake desktop noise modeling to ensure selected generators meet or exceed IFC EHS Guidelines – Noise. New diesel generators will comply with relevant American emission standards.	Project Cost		Tendering Process
	Hazardous materials	PCBs will not be used in transformers and other project facilities or equipment.	Project Cost		Tendering process
Tender and contract award	Contractor unaware of environmental mitigation measures. Need for environmentally responsible procurement	Bid evaluation to include specific consideration and evaluation of responses to environmental management requirements; Successful contractor provided support, as required, during preparation of CEMP; Contractor to prepare CEMP responding to requirements; PMU to review and clear CEMP prior to commencement of works	Project Cost	TAU, REDD through PMU Contractor	Engagement of contractor
Resettlement (land acquisition)	Social inequities	Affected people will be compensated as per entitlement matrix proposed in the project Resettlement Plan	Project Cost	PMU/PEO (on behalf of executing agency)	Prior to start of onsite work
Construction					
Air quality and dust	Generation of excessive dust through project construction activities.	Vehicles carrying soil, sand, crushed aggregate or other fine materials to or from the project site will be covered The project site, material stockpiles and access roads, including those from the wharf and material stockpile areas, will be wetted or stabilised if dust is generated. Earth moving equipment will be cleaned prior to leaving site to prevent the tracking of soil on nearby roads.	To be included in Contractor cost.	Contractor (preparation and implementation) PMU (approval)	During civil work and construction
Waste management	Inappropriate storage and disposal of waste	Waste management during the subprojects will seek to reduce, reuse and recycle waste as far as possible and dispose of waste in an appropriate way. No hazardous wastes will be disposed of on any of the subproject islands. Vegetation cleared from the site will be disposed of in consultation with the POE and Island Environmental Officer (e.g. chipped and made available to local residents as mulch). A significant amount of vegetation will be required to be disposed of on Atiu and options are being investigated to determine an environmentally appropriate solution. The construction contractor will consult with the POE and Island Environmental Officer to identify opportunities to avoid and reduce the generation of waste and to recycle or re-use waste generated. Construction wastes that cannot be re-used or recycled on the island will be transported off site for reuse, recycling or disposal.	To be included in Contractor cost.	Contractor (preparation and implementation) PMU (approval)	During all onsite works

Project activity/ stage	Potential impact	Actions/proposed mitigation measure	Mitigation Cost	Institutional responsibility	Timing
		<p>If excess spoil is generated during site preparation it will be stored at an established stockpile site (e.g. airport) for re-use.</p> <p>Hazardous waste (if generated) will be transported off the subproject island and disposed of in accordance with manufactures requirements at a facility approved by the NES.</p> <p>Concrete waste (including water) will be captured and taken off the subproject island for disposal.</p> <p>Bins for recycling and general rubbish will be provided at the project site and materials laydown area for the disposal of construction wastes.</p>			
Noise and vibration	Disturbance to local community and project staff through noise and vibration	<p>Wherever possible working hours will be between 8am and 5pm Monday to Friday. Where safety or technical reasons require work to be completed outside of these hours noise levels will be minimised as much as possible and the Island Council together with nearby residents will be informed. Work will not be undertaken on Sundays and holy days.</p> <p>Noisy activities e.g. site clearance will be carried out in the least sensitive time periods to be determined in consultation with the Island Council.</p> <p>Equipment and plant will be maintained in good order. Noise reduction components (e.g. mufflers) will be inspected prior to the commencement of works to ensure they are fully functional.</p> <p>Noise level not to exceed 85 dB(A) (over 8 hr period).</p>	To be included in Contractor cost.	Contractor PMU (approval)	During civil work and construction
Water resources and quality	Depletion or contamination of local water resources	<p>Where feasible construction techniques will be specified (e.g. piling) that minimise the need to alter the topography (e.g. levelling) and hence surface water drainage on the site.</p> <p>Water required for construction (e.g. concrete mixing) will be sourced with the agreement of the Island Council, Island Environmental Officer and POE.</p>	To be included in Contractor cost.		During civil work and construction
Hazardous materials	Release of hazardous materials to the surrounding environment	<p>The Contractor(s) will prepare a hazardous materials management plan that shall at a minimum include:</p> <p>The type and quantity of hazardous materials that will be present on site.</p> <p>Safety Data Sheets for all hazardous materials.</p> <p>A spill response plan including training for staff in the use of spill kits.</p> <p>Details of planned transport, storage and disposal of hazardous materials (including compliance with commitments contained within this IEE).</p> <p>Transport of hazardous materials will be by an appropriately experienced and equipped contractor.</p> <p>Hazardous materials will be stored in appropriate containers that are in good condition with adequate labelling.</p>	To be included in Contractor cost.	Contractor (preparation and implementation) PMU (approval)	During all onsite works

Project activity/ stage	Potential impact	Actions/proposed mitigation measure	Mitigation Cost	Institutional responsibility	Timing
		<p>Hazardous materials (including fuel and oils) storage will be appropriately banded.</p> <p>Spill kits and containment devices appropriate for the type and volume of hazardous materials on site will be located at storage area(s), on the site and on vehicles carrying hazardous materials.</p> <p>Hazardous materials will not be disposed of on the subproject island but will be transported offsite and disposed of at a facility approved by the NES.</p>			
Erosion control	Erosion of project site and surrounds.	<p>All land disturbances will be confined to the minimum practicable working area to ensure that the minimum land area is exposed to erosion for the shortest possible time.</p> <p>Existing drainage lines will be protected and diversion of drainage lines avoided.</p> <p>Surface water will be diverted around the construction footprint using structures such as catch drains, silt fences or bunds.</p> <p>Surface water will not be diverted across erosion prone slopes.</p> <p>Erosion control works and measures will be installed to control surface water runoff and prevent the export of sediments from the site by ensuring:</p> <p>Discharge of storm water is to stable preferably vegetated land.</p> <p>Erosion control measures closely follow land contours to reduce runoff velocity from exposed soils.</p> <p>Sediment traps (e.g. silt fences) will be constructed across all drainage lines and erosion controls from site that are likely to receive runoff from exposed or disturbed soils. Sediment basins will be installed where required.</p> <p>The site will be covered with geotextile fabric immediately after clearing to prevent the loss of top soil (Atiu and if deemed necessary by the POE and Island Environmental Officer for remaining subprojects).</p> <p>A shade tolerant groundcover will be established across the site as soon as practicable after site clearance. The species of groundcover used will be selected in consultation with the Island Environmental Officer.</p> <p>Sediment and erosion control measures will be monitored regularly to ensure their continued correct functioning.</p> <p>Cabling trenches will remain open for the shortest duration possible to reduce erosion and where possible will not be open during periods of heavy rain.</p> <p>Spoil from excavated trenches will be stored on uphill side of the trench such that any sediment from the spoil is deposited in the trench.</p>	To be included in Contractor cost.	Contractor (preparation and implementation) PMU (approval)	During all onsite works
Ecology/ site clearance	Unauthorised clearing of vegetation	To ensure vegetation clearing is restricted to within the site boundary and is the minimum practically required a representative	To be included in Contractor cost.	EA, IAs through PMU	During all onsite works

Project activity/ stage	Potential impact	Actions/proposed mitigation measure	Mitigation Cost	Institutional responsibility	Timing
	Introduction of invasive species	<p>of the POE and the Island Environmental Officer will be on site during clearing.</p> <p>On Aitu trees on sloping land within the project site boundary (close to the north west boundary) will not be cleared.</p> <p>Cleared vegetation will be removed and will not be stockpiled on site or pushed into existing vegetation adjacent to the site.</p> <p>Machinery storage and materials lay down areas will be established in previously disturbed areas to avoid increasing the footprint of the project site.</p> <p>As far as is practicable existing stockpiles of fill material will be used. If new fill material is required it will be sourced from locations approved by the Island Environmental Officer and OEPMS that do not result in the disturbance of native vegetation.</p> <p>Immediately after clearing the site will be planted with low growing grass species to help stabilise the site and minimise the spread of weeds (there is a risk of weeds spreading into newly cleared sites at all subproject locations).</p> <p>Bermuda grass (<i>Cynodon dactylon</i>) exists on Mauke and Mitiaro and the site shall be mowed after clearing to encourage this species to establish.</p> <p>Biosecurity measures will be implemented to prevent introduction of invasive species cause damage to flora and fauna.</p>			
Social	Disturbance to local community Increased opportunity for local businesses and contractors	<p>A list of relevant local contractors available on Atiu will be provided in tender documentation to facilitate the engagement of local industry by the selected construction contractor.</p> <p>Opportunities will be made available by the contractor for local contractors and businesses to be engaged during construction and commissioning of the power station.</p> <p>The Atiu Island Council, Visitors Centre, landowners, local residents and stakeholders will be kept informed of the project via monthly meetings during construction including details of: the progress of the works and expected completion date scheduled delivery of materials and equipment any disruptions to the use of the wharf or site access roads upcoming works that are likely to be noisy.</p> <p>As far as is practicable works will be timed to avoid disruption to local events.</p> <p>Fencing shall be installed on all areas of excavation greater than 1m deep.</p> <p>The contractor(s) will be required to develop an occupational health and safety plan prior to the commencement of any works on site.</p>	To be included in Contractor cost.	Contractor (preparation and implementation) PMU (approval)	During all onsite works

Project activity/ stage	Potential impact	Actions/proposed mitigation measure	Mitigation Cost	Institutional responsibility	Timing
		Workers shall be provided (before they start work) with appropriate personnel protective equipment (PPE). Adequate sanitation, potable water and first aid facilities will be supplied by the contractor.			
Heritage	Unexpected discovery of an artefact	In the event of an artefact being uncovered during construction work will cease immediately and the Island Council and POE notified. Work will not recommence until authorised by the POE	To be included in Contractor cost.	EA, IAs through PMU	During civil work construction
Construction activities	Unexpected environmental impacts	If unexpected environmental impacts occur during construction phase, the POE will update the EMP, and the environmental protection measures will be designed to address the impacts.	Project cost	EA, PMU	During construction
Operation and Maintenance					
Waste and hazardous materials	Inappropriate disposal of waste	Inverters and batteries that have been replaced during the operating lifetime of the power station will be removed, transported and disposed of by an appropriately experienced and equipped contractor. Where possible batteries and inverters will be recycled. If recycling is not possible they will be disposal will be at a facility approved by the NES. Waste oil and other hydrocarbons from the generator will be stored in a bunded hydrocarbon storage area. No hazardous waste (e.g. used oils, batteries or inverters) will be disposed of on the subproject Island. Waste will be sent for disposal at regular intervals and not allowed to accumulate at the power station. Washing of panels would only be undertaken on an "as needs" basis to minimise the generation of waste water. Disposal of waste water will be agreed with the Island Environmental Officer. All infrastructure containing hazardous materials (e.g. batteries, transformers, generators) will be inspected regularly to ensure it is functioning correctly and no hazardous materials are being discharged. Screening vegetation will be established between the PV array and the road to minimise dust from the road settling on the panels.	O&M cost.	IAs	During operation
Water resources	Depletion of local water resources	A source of water for washing panels will be agreed with the Island Council and Island Environmental Officer.	O&M cost.	IAs	During operation
Erosion control	Erosion of project sites	If localised erosion is detected during operation of the subproject effective mitigation measures such as application of mulch, covering with open weave jute matting and reseeding with ground cover, protection with geotextile fabric or localised flow dispersal and diversion structures will be installed.	O&M cost.	IAs	During operation
Weeds	Spread of weeds and invasive species	Weed monitoring will be carried out at the subproject site regularly and on-going weed control will take place to prevent the establishment and spread of invasive species.	O&M cost.	IAs	During operation

Project activity/ stage	Potential impact	Actions/proposed mitigation measure	Mitigation Cost	Institutional responsibility	Timing
Social	Solar power station operators	It is expected that existing employees will be retained to operate the new solar power systems. Training will be provided for power station employees in the operation and maintenance of the new solar power system.	O&M cost.	IAs	During operation
Emergency Plan	Emergency response	The solar power station will be monitored remotely and any faults rectified by onsite maintenance staff reducing the risk of a health and safety incident (e.g. fire) occurring. The POE will prepare an operational emergency response plan. The plan will be include in the training provided to employees and be implemented during the operation of the solar power system.	O&M cost.	IAs	During operation
Operation of project facilities	Unexpected environmental impacts	If unexpected environmental impacts occur during project operation phase, the implementing agency will update the EMP, and the environmental protection measures will be designed and resources will be utilized to cope with these impacts.	O&M Cost	IAs	During operation
Decommissioning					
Decommissioning of solar PV array	Disposal of solar PV modules	The removal of the solar PV modules will be contracted to a specialist supplier. All equipment will be removed from the project site (e.g. PV modules, batteries, invertors) will be reused or recycled where possible. Equipment that cannot be reused or recycled will disposed of at a facility approved by the NES. The decommissioning contractor will be required to develop a hazardous materials management plan prior to the commencement of any works on site.	Maintenance cost	EA	Post operation
	Rehabilitation of subproject site	If the site is not reused it will be replanted with species appropriate to the future land use of the site.	Maintenance cost	EA	Post operation

Table 8.3: Environmental Monitoring Plan

Environmental Features	Aspect to be Monitored	Time and Frequency of Monitoring	Location	Monitoring Cost	Responsible party (Implementation/ Supervision)
Construction stage					
Dust and air quality	Dust emissions	POE - At least twice during civil works (visual check). Contractor – daily visual checks during civil works	Project site and access roads from wharf and laydown areas and stockpile sites	Project cost	Contractor / POE
Waste management	Waste collection, storage and disposal.	POE – once every two weeks. Contractor – daily visual checks of storage locations and records of all waste disposed (i.e. volume, location, contractor etc)	Project site, storage areas and disposal facility (if required)	Project cost	Contractor / POE
Noise	Noise levels in dB(A)	At least twice during construction period at times of predicted high noise (e.g. site clearance).	Project site boundary closest to nearest occupied residence	3000*2 =6000	Contractor / POE
Hazardous materials	Storage and disposal of hazards materials	POE – once every two weeks. Contractor – daily visual checks of storage locations and records of all waste disposed (i.e. volume, location, contractor etc)	Project site, storage areas and disposal facility (if required)	Project cost	Contractor / POE
Erosion control	Correct functioning of erosion control measures.	POE – once every two weeks. Contractor - daily visual checks of erosion control measures when rain has fallen in the previous 24hrs.	Project site	Project cost	Contractor / POE
Site clearance	Scope of clearing	POE representative to be present during site clearing	Project site	Project cost	POE
Stakeholder consultation	Records of consultation	POE – once every two weeks	Island Council	Project cost	POE
Occupational Health and Safety	As specified in project health and safety plan prepared by Contractor	Once every two weeks	Project Site	Project cost	Contractor & POE
Operation Stage					
Hazardous waste	Disposal of hazardous waste	Quarterly	Power station and hazardous materials storage areas	O&M cost	IAs
Weed control	Control of weeds and invasive species	Quarterly	Project site	O&M cost	IAs
Occupational Health and Safety	As specified in project OHS plan prepared by Contractor	Weekly	Project Site	O&M cost	IAs

Note: This monitoring plan is prepared for one subproject site. The same plan will be implemented at all subproject sites.

IX. Conclusion and Recommendation

223. All the subproject sites are located in modified environments and, although the subprojects include the clearing of up to 5.2 ha of vegetation, their construction will not result in a significant adverse environmental impact.

224. Flora and fauna surveys were undertaken at all subproject sites (with the exception of Rarotonga which does not require any vegetation clearing) the results of which demonstrate that clearing of the sites selected for the subprojects will not result in the significant loss of any native vegetation or have a significant negative impact on any species recorded as Endangered on the CIBD or listed on the IUCN Red List. Consultation with the Mayors of each subproject island has also shown that there are no sites of cultural significance (marae) or historical significance associated with the subproject sites.

225. Landowners at all subproject sites agree, in principle, to transfer use of the site to the Government of the Cook Islands for the project purpose subject to agreement of a formal land use agreement.

226. Potential construction, operation and decommissioning environmental impacts are not significant and can be avoided or controlled to acceptable levels with the correct implementation the mitigation measures contained in the EMP.

227. It is recommended that the project be considered environmentally feasible, and that this environmental assessment is adequate to justify the environmental feasibility of the project

228. The EMP identifies potential environmental impacts arising from the project along with a corresponding schedule of mitigation measures to ensure potential impacts are maintained at insignificant levels. It also includes the institutional arrangements for implementing the EMP to ensure its effectiveness.

229. This IEE and EMP will be updated during detailed design. During this stage of the project implementation, the applications will be made under the Environment Act 2003, this will require the IEE updated as EIA to comply with NES request.

Appendix 1: Flora and Fauna Assessments

Appendix 2: Marae Letters

Appendix 3: List of Stakeholders / Communities Consulted PPTA and Project Implementation

List of people consulted during PPTA 2013

No.	Name	Designation and Organization
RAROTONGA		
1.	Roger de Bray	Energy Commissioner, Office of the Prime Minister, Rarotonga, Cook Islands
2.	Tangi Tereapii	Director, Renewable Energy Development Division, Office of the Prime Minister, Rarotonga, Cook Islands
3.	Apii Timoti	Chief Executive Officer, Te Aponga Uira (TAU), Rarotonga, Cook Islands
4.	Ngateina Rani	PEC Fund Coordinator, Renewable Energy Development Division, Office of the Prime Minister, Rarotonga, Cook Islands
5.	Vanessa Jenner	ADB Liaison Officer, Development Coordination Division, MFEM, Rarotonga, Cook Islands
6.	Vavia Tangataia	Manager, Advisory and Compliance Division, National Environment Service, Rarotonga, Cook Islands
7.	Celine Dyer	Climate Change Coordinator, Climate Change Division, NEW, Rarotonga, Cook Islands
8.	Tamari'i Tutangata	Chief Executing Officer, CIIC, Rarotonga, Cook Islands
9.	Morgan Hanks	Statistics Officer, Statistics and Economic Department, Rarotonga, Cook Islands
10.	Kevin Hosking	Sr. Statistician, Statistics and Economic Department, Rarotonga, Cook Islands
11.	Otherniel Tangianau	Director, Pa Enea Division (Outer Islands), Office of the Prime Minister, Rarotonga, Cook Islands
MANGAIA		
12.	Anthony Whyte	Energy Manager, Mangaia Power House, Mangaia Island, Cook Islands
13.	Teremoana Atariki	Mayor, Mangaia Island Council, Mangaia Island, Cook Islands
14.	Nena Ngametua	Executive Officer, Mangaia Island Council, Mangaia Island, Cook Islands
15.	Allan Tuara	President, Mangaia Environment Society, Mangaia Island, Cook Islands
16.	Thaine Tuara	Member, Mangaia Environment Society, Mangaia Island, Cook Islands
		Island council member and community leaders, Mangaia Island, Cook Islands
		Women groups and affected landowners, Mangaia Island, Cook Islands
MAUKE		
17.	George Samuela	Mayor, Mauke Island Council, Mauke Island, Cook Islands
18.	Taukea Raui	Executive Officer, Mauke Island Council, Mauke Island, Cook Islands
19.	Basilio Kaokao	Environment Officer, Island Environment Authority, Mauke Island, Cook Islands
20.	Maara Kimiora	Manager, Mauke Power Plant, Mauke Island, Cook Islands

		Island council member and community leaders, Mauke Island, Cook Islands
		Women groups and affected landowners, Mauke Island, Cook Islands
MITIARO		
21.	Vaine Putiare	Dy. Mayor, Mitiaro Island Council, Mitiaro Island, Cook Islands
22.	Nga Tama	Executive Officer, Mitiaro Island Council, Mitiaro Island, Cook Islands
23.	Maara Kimiora	Manager, Mitiaro Power House, Mitiaro Island, Cook Islands
24.	Nooroa Pouao	Environment Officer, Island Environment Authority, Mitiaro Island, Cook Islands
		Island council member and community leaders, Mitiaro Island, Cook Islands
		Women groups and affected landowners, Mitiaro Island, Cook Islands

Summary of views and stakeholder consultations

Date / Venue / No. of participants	Issues discussed / remarks⁷
05.12.13 (6 pax) TAU Boardroom	<p>Discussions were held with Officials from the Office of the Energy Commissioner, REDD and TAU on following aspects.</p> <p>Objectives and scope of project in each island, technical details of interventions being proposed, clarifications of status and land ownership of land being proposed for solar power plants, environmental issues associated with implementation of solar power plants such as management of used batteries, current institutional and capacity building need, implementation arrangements, applicability and requirements of EIA for proposed interventions under Environment Act 2003.</p> <p>Current capacity and capacity building needs are incorporated in the IEE. Also mechanisms to handle discarded batteries and used oil from existing diesel generator sets are discussed in the IEE and appropriate mitigation measures were recommended in the project EMP.</p>
05.12.13 (5 pax) MFAI Boardroom Officials from National Environment Service (NES)	<p>Scope of proposed project, roles and responsibilities of NES, national environmental policies and regulatory framework, as well as requirements for preparing EIA and permits, applicability of the Cook Islands' Environment Act 2003 to this project, EIA approval process and time frame. Officials from NES informed that NES is responsible to issue environmental permit for developmental projects in the Cook Islands. For this project, project proponent (REDD here) should submit application to NES with project details to determine whether project needs an EIA or not.</p> <p>National policy and regulatory framework and requirements of NES for project implementation are incorporated in the IEE.</p>
05.12.13 (4 pax) MFEM Boardroom	<p>Discussions were held with Officials from Statistics and Economics Division on following aspects.</p>

⁷ Queries raised by people were answered to their satisfaction and it was assured that their concerns would be addressed in the process of project design.

Date / Venue / No. of participants	Issues discussed / remarks ⁷
	Socioeconomic and demographic data for target islands, major economic activities and development projects in the target islands, social/poverty issues, etc.
05.12.13 (3 pax) CIIC Boardroom /03	Together with social expert, discussions were held with CEO of CIIC on following aspects. Scope of proposed project, roles and responsibilities of CIIC, ownership status of the land proposed for power plants, policies and regulatory framework for land acquisition, timeframe and process for land acquisition as per government laws. It is informed by CEO that CIIC will be responsible for acquiring the land on behalf of the government as per Cook Islands laws.
06 .12.13 (21 pax) Mangaia Island Council Chamber, Island council members, community leaders, landowners, women groups	Information about existing power generation system, status of land proposed for power plant, presence of environmental sensitive areas on and around the proposed site, existing capacity of Island Electricity Committee in managing environmental issues were assessed. It is informed by Island Council representative that the land proposed for solar power plant belongs to 3 landowners (private). He informed that landowners agreed to give their land for solar PV plant and necessary discussion was held with landowners by Island Council. Local community leaders informed that there are no environmental sensitive areas in and around the proposed site and land use is makatea (volcanic deposit with invasive trees and bushes). Mayor of Mangaia informed that there is a need of capacity building in managing the solar plant plants. Necessary capacity building and training requirements are proposed in the IEE. Mayor informed that local communities support the project. Landowner's greed to let their land for the solar PV plant.
10.12.13 (14 pax) Island Council Court Room, Mauke/ Island Council Members, Comm. Leader, women groups, land owners	Discussions were held together with social team to inform communities about the proposed project and understand their concerns, if any. Communities were informed about the benefits both socio-economic as well as environmental benefits of the project. All the participants consulted fully support the project. Women groups recommended need for the support for women groups and other community facilities. Present of environmental sensitive areas were discussed with the Island Mayor and Environment Officer and they informed that there are no such area on the island.
12.12.13 (18 pax) Mtiaro Representatives from Island Council Utility, Island Environment Authority, landowners and community leaders	Discussions were held together with representative from REDD. Island council members were informed about project and its objectives. Land use and ownership status were discussed with Dy. Mayor and he informed that proposed land is private land belonging to six families. Local communities and landowners were consulted to inform them about the proposed project and to understand their concerns, if any. Communities were informed about the benefits both socio-economic as well as environmental benefits of the project. All the participants consulted fully support the project. Women groups recommended need for the support for women groups and other community facilities. When asked about participation of women in the project, President of CICC informed that women are willing to participate at admin level. She also suggestion training and awareness program for local women groups on energy conservation and efficient use of appliances. Training and awareness programs for women groups are recommended in the

Date / Venue / No. of participants	Issues discussed / remarks ⁷
	<p>social report. Present of environmental sensitive areas were discussed with the Island Mayor and Environment Officer and they informed that there are no such area on the island.</p> <p>Landowners also support the project and they are willing to give land for the project.</p>
<p>17.12.13 (11 pax) Island Council Secretariat Rep. from Island Council, Utility, Island Environment Authority</p>	<p>Discussions were held together with representative from REDD. Island council members were informed about project and its objectives. Land use and ownership status were discussed with Mayor and he informed that proposed is Crown Land but need to check status with CIIC as they do not have documents with them about ownership of the land.</p> <p>Proposed land is open land adjacent to the existing power plant. Local communities were consulted to inform them about the proposed project and to understand their concerns, if any. Communities were informed about the benefits both socio-economic as well as environmental benefits of the project. All the participants consulted fully support the project.</p> <p>Present of environmental sensitive areas were discussed with the Mayor and Environment Officer and they informed that there are no such area on the Island. When asked about the issue of battery disposal, environment officer informed that used batteries should be sent back to the manufacturers for treatment and disposal. Measures to handle and disposal of used batteries are included in the project EMP.</p> <p>APS Officer informed that their existing capacity to manage solar technology and environmental issues is inadequate and they need training and capacity building on these issues. Training on technical aspects to implementing agency staff is included in the scope of the POE as part of the project management support.</p>

List of people consulted at Phase 1 subproject sites 2015

Atiu (4 May and 20 May, 2015)

No	Name	Designation and Organization
1.	Ina Mokoroa	Mayor, landowner
2.	Vaine Paretoa	Deputy Mayor
3.	Tuainekore Samuel	Areora Council Member
4.	Teura Kea	Ngatiarua Council Member/Energy Manager
5.	Teremoana Windy	Mapumai Council Member
6.	Teariki Teiotu	Tegatangi Council Member, landowner
7.	Teariki Maurangi	Executive officer
8.	Henry Ngamaru	Ngamaru Ariki
9.	Maara Tairi	Parua Ariki Representative, Agriculture Manager
10.	Tapuni William	Council Clerk
11.	Tereapii Porio	Infrastructure Manager, landowner
12.	Tangata Vainepoto	Landowner/ Justice Department
13.	Kau Henry	Environment Officer
14.	Teina Toru	Landowner
15.	Upokoina Rau	Power Crew
16.	Maire George	Power Crew
17.	Adrian Teiotu	Power Crew
18.	Rouru Georg	Power Crew

No	Name	Designation and Organization
1.	Ina Mokoroa	Mayor, landowner
2.	Vaine Paretoa	Deputy Mayor
3.	Tuainekore Samuel	Areora Council Member
4.	Teura Kea	Ngatiarua Council Member/Energy Manager
5.	Teremoana Windy	Mapumai Council Member
6.	Teariki Teiotu	Tegatangai Council Member, landowner
7.	Teariki Maurangi	Executive officer
8.	Henry Ngamaru	Ngamaru Ariki
9.	Maara Tairi	Parua Ariki Representative, Agriculture Manager
10.	Tapuni William	Council Clerk
11.	Tereapii Porio	Infrastructure Manager, landowner
12.	Tangata Vainepoto	Landowner/ Justice Department
13.	Kau Henry	Environment Officer
19.	Vaine Potoro	Landowner
20.	Teupoko Ioana	Landowner
21.	Janet Paretoa	Landowner
22.	Ina Toti K. Ioeina	Landowner
23.	Clara Matapakia	Landowner
24.	Tupuna Rau	Landowner
25.	Takai Uringarangi o Tangaroa Murare	Landowner
26.	Upokoina Matapakia	Landowner
27.	Moana Mingi	Landowner
28.	Koronui Tura	Landowner
29.	Teina Toru	Landowner
30.	Tupuna Rouru Upoko Tuariki	Landowner
31.	Tini Tivini Rau Isaaka	Landowner
32.	Ngatokorua Rau Isaaka	Landowner
33.	Tauu Porio	Landowner
34.	Dr. Roger Malcolm	Private sector, Owner of Atiu Villas

Mitiaro (5 May and 20 May, 2015)

No	Name	Designation and Organization
1.	Fred Tereva	Mayor
2.	Aunty Mii, Atu Enea	Councillor, Ariki
3.	Makera Murare	Councillor, landowner
4.	Nane Hodson	House of Ariki
5.	Teata Teava	Councillor and Rep for Tetava Ariki
6.	Ngarouru Tou	Councillor and Rep for Tou Ariki
7.	Kau Kaiui	Government Representative
8.	Ngametua Tama	
9.	Nooroa Pouao	Environment Officer, landowner
10.	Toru Ngatoko	Landowner
11.	Nga Patia	Landowner
12.	Moetu Aurupe	Landowner
13.	Ake Pouao	Landowner
14.	Mama Temou Raeputa	Landowner
15.	Turagatura Turangatura	Councillor
16.	Tunoa Raeputa	Councillor
17.	Shirley Patia	Landowner
18.	Tere Patia	Landowner
19.	Maara Kimiora	Councillor and Energy Person
20.	Cecilia Kimiora	
21.	Teremoana Patia	Landowner

No	Name	Designation and Organization
22.	Ake Pouaao	Landowner
23.	Tunoa Raipota	Landowner
24.	Matara Murare	Island Council
25.	Akeunga Taua Pouao	Landowner
26.	Mata Tunoa Rae Puta	Landowner

Mauke (6 May and 28 May, 2015)

No	Name	Designation and Organization
1.	Tangata Ateriano	
1.	George Samuela	Mayor
2.	Terepai Tuakana	Deputy Mayor
3.	Tetai Teatai	Council Member
4.	Vaine Aberahama	Council Member-
5.	Dennis Tararo	Council Member
6.	Johnstone Dyer	Government Representative
7.	Josephine Ivirangi	Executive Officer, landowner
8.	Clema Vainetutai	Energy Operator
9.	Lucky Vainetutai	Energy Operator, landowner
10.	Arapo Tutai	Overseer-Energy
11.	Ngatuaine Tutere	Manager-Energy
12.	Martina Vaeruarangi	
13.	Prisca Oariki	
14.	Timeni Oariki	Landowner
15.	Ngavaine John Makitae	Landowner
16.	Edwin Ngariki	
17.	Tiraa Putai Kairae	Landowner
18.	Temakave Tua	Landowner
19.	Ngate Oti	Landowner
20.	Ngavarue Tuakangaro	
21.	Melita Tapoki	
22.	Tuangane Oti	
23.	Samuela Ariki	
24.	Taunga Tararo	
25.	Bele Tararo	
26.	Apii Teao	
27.	Mata Lucky	
28.	Kura Uraarii	
29.	Moumou Moetaua	
30.	Arekaoati Uraii	
31.	Pickering Taripo	
32.	Hon. Tai Tura	Member of Parliament, landowner
33.	Roura Tura	
34.	Mareta Teaukiaua	
35.	Terepai Tuakana	Deputy Mayor
36.	Tekura S. Kura	Financial Administrator
37.	Marce Akamoeau	Landowner
38.	Eti Ngaiki	Landowner
39.	Archie Taripo	Landowner
40.	Metua Rongoape	Landowner
41.	Teariki Aoa Teao	Landowner
42.	Matina Oti	Landowner
43.	Timeni Oariki	Landowner
44.	Matanoanoa Vainetutai	Landowner
45.	Tuakana Noetana	Landowner
46.	Tangata Tufai	Landowner

No	Name	Designation and Organization
47.	Arekava Uraarii	Landowner
48.	Ngatokorua Vaeruarangi	Landowner
49.	Mareta Tutaikaokao	Landowner
50.	Vainetutai Samuela	Ariki (high chief)
51.	Noo Puaapii	Landowner

Mangaia (7 May and 3 and 4 June, 2015)

No	Name	Designation and Organization
1.	Teremoana Atariki	Mayor
2.	Maara Peraua	Acting Councillor for Ivirua
3.	Daddy Mauriiti	Mangaia Aronga Mana
4.	Paster Periki Poila	Chair, Religious Advisory Council, landowner
5.	Ngametua Toko	Island Councillor, Karanga
6.	Nga Ivaiti	Island Councillor,, Veitatei
7.	Andy Matapo	Island Councillor, Tamarua, landowner
8.	Tiare Mangara	Island Councilor, Keia
9.	Hon Wesley Kareroa	Member of Parliament for Oneroa
10.	Hon Tangi Matapo	Member of Parliament for Tamarua
11.	Aerenga Matapo	Policeman, landowner
12.	Thomas Kareroa	Energy and Water Staff
13.	Ngametua College	Executive Officer, Mangaia Island Government
14.	Tangi Moeauri	Energy and Water Staff
15.	Anthony Whyte	Public Utilities Manager, Mangaia
16.	Ngametua Papatua	Landowner
17.	Pareina Ngatupuna	Government employee
18.	Mata Herman	Public Utilities Supervisor, landowner
19.	Teremoana Poila	Landowner
20.	Porua Poila	Landowner
21.	Tereapii Taokia	Landowner
22.	Ngatamaroa Pekepo	Landowner
23.	Teokotai Pekepo	Landowner
24.	Tangimama Pekepo	Landowner
25.	Teremoana Atariki	Landowner
26.	Taoi Nooroa	Secretary, <i>Aronga Mana</i>
27.	Teina Ngametuatooe	Rangatira (subchief)
28.	Tuatane Pakatooe	Rangatira (subchief)
29.	Ngametua C. Pokino	Executive Office, Mangaia Island Council
30.	Povitai Poila	Landowner
31.	Tako Ruatooe	Kavana (district chief)
32.	Ngaariki e Toru o Enuamanu Adams	Landowner
33.	Mrs. Takaruatooe	Representing Kavana (district chief)
34.	Aerenga Matapo	Landowner

List of government representatives consulted 2015

No	Name	Designation and Organization
1.	Tangi Tereapii	Director, Renewable Energy Development Division (REDD)
2.	Ngateina Rani	PEC Fund Coordinator, REDD
3.	Alex Henry	Project Officer, REDD
4.	Elizabeth Wright-Koteka	Chief Secretary, Office of the Prime Minister (OPM)
5.	Repeta Puna	OPM
6.	Roger de Bray	Energy Commissioner, OPM
7.	Tamarii Tutangata	CEO, Cook Islands Investment Corporation (CIIC)
8.	Lloyd Miles	CIIC Counsel
9.	Mike Henry,	CIIC Board of Directors
10.	Malcolm Sword	CIIC Board of Directors
11.	Enua Pakitua	Senior Statistician/Acting Statistician
12.	Tanga Morris	Senior Statistician
13.	Mata	Chairman of the Board, Te Apunga Uira (TAU)
14.	Aprii Timoti	Chief Executive Officer (CEO), TAU
15.	Steve Anderson	Board of Directors, TAU
16.	Liz Tome	Finance Director, TAU
17.	Otheniel Tangaiuanu	Director, Pa Enua Division (Outer Islands)
18.	Vavia Tangatataia Jr.	Manager, Advisory and Compliance Division, National Environmental Services (NES)
19.	Celene Dyeoer	Climate Change Coordinator
20.	Elizabeth Ponga	Policy Officer, Ministry of Culture
21.	Ruth Pokura	Director for Gender and Development, Ministry of Internal Affairs
22.	Noora Numanaga	Director, Disability Issues
23.	Richard Neves	Secretary of Finance, Ministry of Finance and Economic Management (MFEM)
24.	Peter Tierney,	Manager, Development Coordination Division, MFEM
25.	Charmaine Dolan	MFEM
26.	James	MFEM
27.	Catherine Evans	Senior Counsel, Crown Law
28.	Woo Yul Lee	ADB Project Officer, Manila
29.	Vanessa Jenner	ADB Liaison Officer, Cook Islands
30.	Martin	New Zealand Ministry of Foreign Affairs and Trade (MFAT)
31.	Joseph Mahew	NZ MFAT
32.	Steve Henderson	New Zealand High Commission, Cook Islands

List of people consulted Phase 2 subprojects 2015 / 2016

Aitutaki (4 May 2015)

Person Met	Position
Hon. Teina Bishop	Member of Parliament
John Baxter	Mayor
Tekura Bishop	Deputy Mayor
Tuanguaru Bishop	Island Council, Vaipeka District Representative
Temanu Unuka	Island Council, Vaipae District Representative
Ookotai Tangi	Island Council, Tautu District Representative
Ngatokorua Rota	Island Council, Reureu District Representative
Junior Rikiau	Island Council, Arutanga District Representative
Strickland Henry	Island Council, Ureia District Representative
Terepoto Williams	Island Council, Amuri District Representative
Pumati Isaraela	Mataiapo District Representative (Traditional Leader)
Ina Solomon	Council Clerk
Tiraa Arere	Council Executive Officer

Manarangi Ariki	<i>Ariki</i> (Traditional Chief)
Allan Mills	Chairman, Power Station Board of Directors
Long Tuiravakai	General Manager, Power Station

Rarotonga (23 February 2016)

Person Met	Position
Joe Ngamata	Chief Executive Officer, Airport Authority
Tamarii Tutangata	Chief Executive Officer, CIIC
Lloyd Miles	Legal Advisor, CIIC
Apii Timoti	Chief Executive Officer, Te Aponga Uira
Dallas Young	Commercial Manager, Te Aponga Uira
Tama Heather	Electrical Engineer, Te Aponga Uira
Steve Anderson	Board Member, Te Aponga Uira
Elizabeth Wright-Koteka	Chief of Staff, Office of the Prime Minister