

Initial Environmental Examination

August 2014

Republic of Maldives: Preparing Outer Islands for Sustainable Energy Development

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CURRENCY EQUIVALENTS

(as of 31 March 2013)

Currency Unit = Maldivian Rufiyaa (MVR)
MVR1.00 = US\$ 0.065
US\$1.00 = MVR 15.410

LIST OF ABBREVIATIONS

ADB	-	Asian Development Bank
CFC	-	Chlorofluorocarbons
DG	-	Diesel Generator
EA	-	Executing Agency
EIA	-	Environmental Impact Assessment
EPA	-	Environmental Protection Agency
EMP	-	Environmental Management Plan
EPC	-	Engineering, Procurement and Construction
FENAKA	-	Fenaka Corporation Limited
GoM	-	Government of Maldives
GDP	-	Gross Domestic Product
GFP	-	Grievance Focal Points
GHG	-	Green House Gases
GRC	-	Grievance Redress Committee
GFP	-	Grievance Focal Point
IA	-	Implementing Agency
IEE	-	Initial Environmental Examination
IUCN	-	International Union for Conservation of Nature
MEE	-	Ministry of Environment and Energy
MOF	-	Ministry of Finance
PCBs	-	polychlorinated biphenyl
PMC	-	Project Management Consultant
PPTA	-	Project Preparatory Technical Assistance
PV	-	photovoltaic
REA	-	Rapid Environmental Assessment
SPS	-	Safeguard Policy Statement
TA	-	Technical Assistance
WHO	-	World Health Organization

NOTES

- (i) The fiscal year (FY) of the Government of Madives ends on 31 December. FY before a calendar year denotes the year in which the fiscal year ends, e.g., FY2012 ends on 31 December 2012.
- (ii) In this report, "\$" refers to US dollars

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EXECUTIVE SUMMARY

1. Environmental assessment of the proposed Preparing Outer Islands for Sustainable Energy Development Project (POISED or the Project) has been carried out in compliance with national and ADB's Safeguard Policy Statement (SPS) 2009 requirements. The Project is part of the Scaling Up Renewable Energy Program (SREP) and it is designed to reduce diesel dependence in the Maldives, improve the electricity sector, and address key macroeconomic issues through tapping into indigenous and cheaper sources of electricity.
2. The Project would enhance renewable based sustainable energy sector in the Maldives to be measured by increase of renewable energy (RE) in the supply mix of the Maldives, reduction in CO₂ emissions, and increase in cost coverage through tariffs. The outcome would be the reduction of diesel usage for electricity generation in outer islands of the Maldives to be measured by reduction of diesel consumption per unit of electricity in the outer islands by 2020. The outputs include (i) development of renewable energy ready mini grid systems for outer islands, (ii) capacity enhancement of EA and FENAKA to implement renewable energy mini grid projects.
3. The Project will scale up RE development in Maldives by delivering energy directly to many isolated, off-grid communities in outer islands through the installation of dispersed, small-scale RE system based sub-projects.
4. A phased intervention strategy has been proposed for the introduction of the RE in Maldives. In the first Phase demonstration hybrid RE projects are proposed be implemented on five Outer Islands and then subsequently ordered by geographical areas, savings in subsidies and economic feasibility until allocated budget limit for Phase 1. After Phase 1, in the subsequent phases these RE hybrid solutions shall be extended along about 160 medium to small outer islands of Maldives at commercial development under the sector approach under Road Map long-term strategy.
5. A detailed assessments of the RE resources (solar and wind) in Maldives has been undertaken and optimal individual RE solutions are proposed for each Islands. The scope of RE solutions envisaged under the Project in mostly include introduction of Solar-Diesel Hybrid System on about 160 medium to small outer islands of Maldives. Various components of the proposed RE solution on islands include:
 - **Component 1:** Installation of solar PV system (ground mounted and roof top)
 - **Component 2:** Diesel generation by replacement of inefficient DG sets and addition of new DG sets within existing powerhouses
 - **Component 3:** Refurbishment of distribution mini-grid systems
 - **Component 4:** Capacity building of PMU/FENAKA/STELCO staff on O&M of RE systems.
6. The Project will construct and operate hybrid energy systems that include solar power generation units (on ground and roof-top) with a total capacity of 20888 kWp and 40170 kW diesel generations on about 160 target islands. The combined capacity of proposed hybrid energy system is 61058 kW. Diesel generation would be added to the existing generation system by installing additional generators in existing power plants in each island whereas solar energy generation would be new addition. Solar generation would be mainly by installing solar PV panels (ground mounted and roof-top of public buildings). The hybrid system would range from 20 kWp to 1 MWp solar PV system and 35 kW to 1600kW diesel generators. Besides this, Li-Ion based battery storage system will also be installed in each island as part of hybrid energy system. The solar power generation units will consist in a set of solar photovoltaic (PV) modules, power inverters, switchgear, associated protection, control and

monitoring equipment's, and associated civil works. The electricity output will be directly fed into existing distribution network of FENAKA / STELCO / island councils for further distribution. Wherever required distribution grid will be upgraded by replacing grid assets such as underground cable, distribution boxes, switchgears etc. Table E.1 present the proposed capacity by components under the Project.

Table E.1: Summary of Proposed Interventions under the POISED Project

Proposed System	Proposed Capacity (kW)	
	On 5 Priority Islands	On 160 Islands
Diesel	8164	40170
Solar	2500	20888
Total	10664	61058

7. As part of environmental assessment of the Project, five sub-projects proposed for implementation under Phase 1 have been assessed in details as part of the project preparation and Initial Environmental Examination (IEE) has been carried out in accordance with Government of Maldives and ADB's SPS requirements. Whereas for sub-projects to be implemented in subsequent stages as part of long-term road map strategy, an Environmental Assessment and Review Framework (EARF) has been prepared. The EARF will be used for preparation of IEEs of future subprojects included in the sector program.

8. The Project is overall classified as ADB environment category B due to the potential impact of the most significant adverse impact: Solar-Diesel hybrid systems will cause adverse impacts related to construction activities as well as it will also lead to air pollution from new DG sets. Accordingly this IEE is prepared to meet the requirements of the government as well as ADB's SPS requirements for environment category B projects.

9. Assessment of potential environmental impacts and mitigation measures were derived based on the IEE of five sample sub-projects proposed under Phase 1 of the Project. Findings of IEE are summarized in subsequent sections.

10. The interventions proposed under Phase 1 of Project are located on five outer Islands of Maldives namely: B. Goidhoo, Lh. Kurendhoo, Th. Buruni, Ga. Villingili and Addu City. The scope of this IEE is limited to the locations of the all elements of the subprojects including locations of the solar power plants and roof-top solar PV systems. The purpose of this IEE is to assess potential environmental, health, safety and social impacts of the proposed interventions. This IEE is prepared during the project preparation work between the months of May and September 2013. The project is currently in bid preparation stage, and although there are no major changes in the project design and location of components, this IEE will be updated during detailed design in compliance with the ADB's SPS 2009.

11. The five sample sub-projects will require about 37500 sq.m (3.75 hectares)¹ land area mainly to install 2500 kWp capacity of solar power system on five target islands. The sites for solar PV panel installation are selected as open areas/plots for ground mounted installations and roofs of public buildings i.e. hospitals, schools, island council buildings etc. for rooftop solar PV panel installations. The proposed sites for ground installations are open areas with flat topography and free from any restrictions. Land use being mostly rural (non-residential) and little vegetative cover. There are no sensitive areas in and around these proposed sites. The land proposed for solar PV installations belonging to the government and it will be leased by the Project. Diesel generators will be installed in existing powerhouse therefore there is no

¹ Land requirement is estimated based on assumption that 1 kWp solar power requires about 15 sq.m. area for solar PV installation and space of access and distance between rows of panels.

additional land requirements for diesel generation. Table E.2 below summarizes the sub-projects (island) wise plant size and summary of existing features and proposed interventions.

Table E.2: Summary of Existing Features and Proposed Interventions on 5 Islands

Feature	Target Island / Sub-project				
	Goidhoo	Kurendhoo	Buruni	Villigili	Addu City
Atoll /Locality	South Maalhosmadulu (B)	Faadhippolhu (Lh)	Kolhumadulu (Th)	Ga Atoll (Ga)	Addu Atoll (S)
Geographical Location	Latitude 4°53' north and Longitude 73°00' east	Latitude 5°20,06' north and Longitude 73°27,87' east	Latitude 2°33' north and Longitude 73°6' east	Latitude 0°45' north Longitude 73°26' east	Latitude 0°40' north and Longitude 73°08' east
Total Land Area (Ha.)	163.7	21.3	35.0	98.0	971.5
Population (2006)	503	1218	1130	1976	17862
Number of Households	77	235	182	346	>2200
Distance from Male (km)	96.2	129.0	184.9	580.0	533.7
Proposed Interventions	Hybrid Energy System consist of: <ul style="list-style-type: none"> • Diesel Generator: 160kW (New DG set 1x160 kW) • Ground-mounted PV: 200kW • Li-Ion based battery storage system: 84kWh and 223 kW • Refurbishment of mini-grid 	Hybrid Energy System consist of: <ul style="list-style-type: none"> • Diesel Generators: 254kW (existing 104 kW+ new 150 kW), • On ground PV: 300 kW and • Li-Ion based battery storage system: 84 kWh and 223 kW • Refurbishment of mini-grid 	Hybrid Energy System consist of: <ul style="list-style-type: none"> • Diesel Generator: 100kW (New DG set 1x100 kW) • Roof-top PV: 100kW • Li-Ion based battery storage system: 41kWh and 111 kW • Refurbishment of mini-grid 	Hybrid Energy System consist of: <ul style="list-style-type: none"> • Diesel Generators: 800kW (new 1x500kW + new 1x300kW) • Rooftop PV: 300kW • Li-Ion based battery storage system: 84kWh and 223 kW • Refurbishment of mini-grid 	Hybrid Energy System consist of: <ul style="list-style-type: none"> • Diesel Generators: 6,850 kW-7 existing DG sets (3x1000 kW + 3x750 kW + 1x1600 kW) • Distributed ground and roof mounted PV (1600 kW) without battery storage system • Refurbishment of mini-grid
Location of proposed sites for interventions	Plot located west of the school (G1) on Goidhoo Island.	Plot besides existing harbour (B2) on Kurendhoo Island	Roof-top of school building (B3, B4, B5) and ground space adjacent to school (B1 and B2) on Buruni Island.	Rooftop of Hospital and School Buildings on Villigili Island	Rooftop and ground installations. – 600kW at Convention Center (on roof) – 1000kW at Stadium area (on ground)
Ownership of proposed land	Island Council / Government	Island Council / Government	Island Council / Government	Island Council / Government	Addu City Council / Government
Land requirement	3000 sq.m. (G1 –open area located west of the school)	4500 sq.m. (open ground next to harbor)	1500 sq.m. (roof-top of school buildings and open space)	4800 sq.m. (rooftop of school and hospital building)	24000 sq.m. (roof top of various buildings)

12. The proposed hybrid systems will not have any significant long-term adverse environmental impacts; in fact the project will create long-term environmental benefits by reducing CO₂ emissions (compared against the current baseline energy uses) as well as reduction in emission of SPM, SO_x and NO_x. Besides reduction in CO₂ emission, the project will also prevent associated pollutants from combustion of fossil fuels entering the regional airshed. Summary of annual CO₂ emission reduction and saving in diesel fuel cost over the life span of Project is presented in Table E-3.

Table E.3: Summary of Emission Reductions with proposed Interventions

Target Island	Level of RE penetration (%)	Savings in Diesel Cost over the life span of Project (million US\$)	CO ₂ Emission Reduction (t/year)
On 5 priority islands	Unto 35 %	30.32	7160
On 160 islands	Unto 25.6 %	182.92	123184

Source: PPTA Consultant Assessment

13. The main environmental impacts are short-term and will be created during the construction stage. The main environmental impacts will be during site preparation, which will include the cutting and trimming of trees from surrounding area to prevent shading. There will also be impacts from noise and dust emissions due to increase in traffic for transportation of equipment and construction material as well as operation of construction machineries such as concrete mixer, bulldozer, dump trucks, cranes etc. However these will be short-term (approximately 3-5 days for the smaller sites and up to two month for the larger sites). Impacts associated with the installation of solar PV panels are mostly related to change in local topography and visual impacts. However, these impacts will not be significant as the size of the PV system is very small and will be installed on individual buildings or open ground mounted.

14. Noise impact could be an issue during construction due to movement of vehicles and machineries, and construction activities. Some of the sub-projects with solar PV installations will be located near sensitive receptors i.e. hospitals, schools, office buildings etc. Operation of machinery generating high levels of noise solar panel installations will be restricted to between 6:00 am and 10:00 pm in areas where there are nearby residences. Solar panel installations at schools and colleges will be scheduled to avoid class disturbance. Since there are no vacant periods at the hospital, installation of solar panels should be scheduled during the busy periods of the day, avoiding early mornings and evenings.

15. During operation phase batteries of solar system will have to be replaced after 7-8 years. These batteries may contain heavy metal and sulphuric acid. If the batteries are discarded in the surroundings then there will be soil and water contamination with lead and sulphuric acid in the area. To mitigate these impacts use of long life lithium-ion batteries with more charge-recharge cycle are proposed for the Project. Also the replaced batteries will be stored in leak proof battery collection system and will be sent to authorised handlers (in India and Sri Lanka) / manufacturers for recycling and further management. As discussed with the EPA, there are no authorised dealers in Maldives for handling of used batteries. The handling, storage and disposal of used batteries shall be done in compliance with Waste Management Policy and Waste Regulations (2013) of Maldives as well as in compliance with Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and their Disposal (1989).

16. Although DG sets will be installed in existing powerhouses, noise and air pollution from operation of these DG sets could also be an issue during operation. To minimise these impacts, the Project will install gensets which comply with international standards for noise as well as escape of polluting materials. The new diesel generators will be used which comply with World Bank Group's EHS guidelines for small combustion facilities and World

Bank's EHS guidelines for ambient noise both for day time and night time. The new diesel genset installation will include an on-line continuous exhaust gas analysing function, which will monitor the levels of NO_x, SO₂ and PM levels. This will enable operational monitoring in line with the World Bank's EHS recommended approach for engines.

17. Issues of safe handling, storage and disposal of fuel, oil residue and lubricating oil will be an issue during operation phase. It will be corrected as part of the installation of the new generation capacity. FENAKA will prepare and implement a plan for fuel and oil storage and handling. All these impacts are manageable by implementing mitigation measures proposed in the environmental management plan.

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

19. The interventions proposed under POISED Project will not cause any significant or lasting adverse environmental impacts during construction, operation and decommissioning. In terms of environmental impacts, the Project will bring about benefits by reducing gaseous emissions (CO₂, PM Level, SO_x, NO_x) through reducing dependence on existing diesel generator (DG) sets which use imported fossil fuels; reduction in noise from DG sets operations; and reduction in land and ground water contamination caused by spills from DG sets and diesel fuel storage areas. Only minor and transient environmental disturbances will be experienced at the project sites during construction and operation, and these can be minimized and managed through implementation of the EMP. Due to the limited and manageable nature of impacts this IEE is adequate to comply with the Act No. 94/3 of Maldives and ADB's SPS and therefore further environmental analysis of the five sub-projects to be implemented under Phase 1 of the Project is not required. However for sub-projects included in the long term roadmap will be developed in compliance with the Project's EARF. Requisite compliance measures (updating and implementation of EMP and monitoring plan) will be included in the sub-project specific bid/tender documents.

A. INTRODUCTION

1. Background

20. This Initial Environmental Examination (IEE) has been prepared for the proposed Preparing Outer Islands for Sustainable Energy Development Project (POISED or the Project). The Project is part of the Scaling Up Renewable Energy Program (SREP) and it is designed to reduce diesel dependence in the Maldives, improve the electricity sector, and address key macroeconomic issues through tapping into indigenous and cheaper sources of electricity.

21. The Project would enhance renewable based sustainable energy sector in Maldives to be measured by increase of renewable energy (RE) in the supply mix of the Maldives, reduction in CO₂ emissions, and increase in cost coverage through tariffs. The outcome would

be the reduction of diesel usage for electricity generation in outer islands of Maldives to be measured by reduction of diesel consumption per unit of electricity in the outer islands by 2020. The outputs include (i) development of renewable energy ready mini grid systems for outer islands, (ii) capacity enhancement of EA and FENAKA/STELCO to implement renewable energy mini grid projects.

22. The intervention strategy for the introduction of the RE into Maldives is divided into four phases namely:

- **Phase 1:** Implementing demonstration hybrid projects in five Outer Islands and then subsequently ordered by geographical areas, savings in subsidies and economic feasibility.
- **Phase 2:** Extending the Phase 1 solutions to an extended around sixty Outer Islands until reaching Phase 2 investment amount, and
- **Phase 3 and Phase 4:** Extending the RE hybrid solution to about 160 Maldives Outer Islands under the Road Map long-term strategy outlines.

23. The RE solutions sub-projects are being progressively identified, screened and assessed. Five sub-projects under Phase 1 have been selected and proposed at this stage, with the remainder to be assessed as the Project progresses.

2. Project Proponent

Project Name : Preparing Outer Islands for Sustainable Energy Development Project

Name of Proponent : The Ministry of Finance and Treasury, Government of the Republic of Maldives

Address of Proponent : Maafannu, Male' 20392, Republic of Maldives

3. IEE Preparation and Objectives of the IEE

24. This IEE has been prepared by the Project Preparatory Technical Assistance (PPTA) consultant on behalf of and in close collaboration with the MEE. This IEE is prepared during the project preparation work between the months of May and December 2013. The Project is currently in bid preparation stage, and although there are no major changes in the project design and location five sub-projects, this IEE will be updated during detailed design in compliance with the ADB's SPS 2009.

25. This IEE has been prepared in accordance with ADB's *Safeguard Policy Statement* (SPS, 2009) requirements and aims to ensure good environmental practice. The specific objectives of this IEE are to:

- provide an environmental and social baseline description of the Project;
- identify and describe the Project's potential environmental and social impacts;
- design mitigation measures to minimize adverse impacts;
- describe the Project's public consultation process and Grievance Redress Mechanism (GRM); and

- provide Environmental Management and Monitoring Plans for the overall Project (including defining institutional responsibilities, capacity building and training, and the required budget).

4. Scope and Methodology of the IEE

26. The scope of this IEE is based on ADB SPS assessment requirements as well as Government of Maldives (GoM) requirements. For Solar PV RE System, the GoM does not require to have an environmental assessment. Based on the likely types, sizes and locations of sub-projects, the Project has been classified as environment category B as determined by the Project's most environmentally sensitive component, the solar-diesel hybrid system sub-project.

27. The scope of this IEE is limited to the solar PV plant sites, existing powerhouses where DG sets will be installed, access to those sites, and associated distribution grids only. The purpose of this IEE is to assess potential environmental, health, safety and social impacts of the proposed interventions on five outer islands and propose suitable mitigation measures where required.

28. This IEE consists of project description and assessment sections covering the overall Project plus separate section assessing representative sub-projects on five selected islands under Phase 1 of the Project. Given that the Project would be extended to around 160 RE sub-projects, most of which will only be confirmed and assessed over the Project implementation period, five sample sub-projects (Table A.1) representing the range of sub-project types and different locations where they are likely to be installed have been assessed (all are solar-diesel hybrid systems). This assessment provides a good indication of the types and significance of the likely adverse impacts and benefits of the Project. The selected sub-projects are located each on five outer Islands of Maldives namely: B. Goidhoo, Lh. Kurendhoo, Th. Buruni, Ga. Villigili and Addu City.

Table A.1: Sub-Projects assessed under POISED Project

Feature	Goidhoo Hybrid System	Kurendhoo Hybrid System	Buruni Hybrid System	Villigili Hybrid System	Addu City Hybrid System
Atoll /Locality	South Maalhosmadulu (B)	Faadhippolhu (Lh)	Kolhumadulu (Th)	Ga Atoll (Ga)	Addu Atoll (S)
Proposed Interventions and Capacity	<p>Hybrid Energy System consist of:</p> <ul style="list-style-type: none"> • Diesel Generator: 160kW (New DG set 1x160 kW) • Ground-mounted PV: 200kW • Li-Ion based battery storage system: 84kWh and 223 kW. • Refurbishment of mini-grid 	<p>Hybrid Energy System consist of:</p> <ul style="list-style-type: none"> • Diesel Generators: 254kW (existing 104 kW+ new 150 kW), • On ground PV: 300 kW and • Li-Ion based battery storage system: 84 kWh and 223 kW. • Refurbishment of mini-grid 	<p>Hybrid Energy System consist of:</p> <ul style="list-style-type: none"> • Diesel Generator: 100kW (New DG set 1x100 kW) • Roof-top PV: 100kW • Li-Ion based battery storage system: 41kWh and 111 kW. • Refurbishment of mini-grid 	<p>Hybrid Energy System consist of:</p> <ul style="list-style-type: none"> • Diesel Generators: 800kW (new 1x500kW + new 1x300kW) • Rooftop PV: 300kW • Li-Ion based battery storage system: 84kWh and 223 kW. • Refurbishment of mini-grid 	<p>Hybrid Energy System consist of:</p> <ul style="list-style-type: none"> • Diesel Generators: 6,850 kW-7 existing DG sets (3x1000 kW + 3x750 kW + 1x1600 kW) • Distributed ground and roof mounted PV (1600 kW) without battery storage system: • Refurbishment of mini-grid

Feature	Goidhoo Hybrid System	Kurendhoo Hybrid System	Buruni Hybrid System	Villigili Hybrid System	Addu City Hybrid System
Number of beneficiaries (Households)	77	235	182	346	>2200

29. The Project will construct and operate hybrid energy systems that include solar power generation units (on ground and roof-top) and replacement/addition of diesel generators. The hybrid system would range from 20 kWp to 1 MWp solar PV system and 35kW to 1600kW diesel generation. Besides this, Li-Ion based battery storage system will also be installed in each island as part of hybrid energy system. The solar power generation units will consist in a set of solar photovoltaic (PV) modules, power inverters, switchgear, associated protection, control and monitoring equipment's, and associated civil works. The electricity output will be directly fed into existing distribution network of FENAKA / STELCO / island councils for further distribution. Wherever required distribution grid will be upgraded by replacing grid assets such as cable, distribution boxes, switchgears etc.

30. The IEE followed a number of steps:

- Conduct field visits to collect primary or secondary data relevant to the project area to establish the baseline environmental condition;
- Assess the potential impacts on environmental attributes due to the location, design, construction and operation of the project through field investigations and data analysis;
- Explore opportunities for environmental enhancement and identify measures;
- Prepare an environment management plan (EMP) outlining the measures for mitigating the impacts identified including the institutional arrangements;
- Identify critical environmental parameters required to be monitored subsequent to the implementation of the project and prepare an environmental monitoring plan;
- Compare the environmental safeguard requirements of Government of Maldives and ADB, and identify measures to bridge the gap, if any;
- Carry out consultation with affected stakeholders, Island administrative authorities to identify perception of the project, introduce project components and anticipated impacts; and,
- Disclose the draft IEE at ADB website and prepare project brief and/or FAQs in local language to be made publicly available at the offices of MEE, FENAKA, STELCO, Island Council Offices of five islands.

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

5. Structure of the IEE

32. In line with SPS 2009 requirements for sector program, this IEE is organized into (i) general sections that discuss the entire project, plus (ii) separate section that assess the five example sub-projects, as indicated below. The assessment of each of the five sample sub-projects covers: (i) Sub-Project Description; (ii) Description of the Baseline Environment; and (iii) Impact Assessment and Mitigation Measures. The IEE report has following contents:

- Executive Summary
- Introduction
- Policy, Legal, and Administrative Framework
- Description of the Project
- Summary of Project Impacts and Benefits
- Sample Sub-projects assessed for IEE
- Analysis of Alternatives
- Consultation, Participation and Information Disclosure
- Grievance Redress Mechanism
- Environmental Management Plan, and
- Conclusion and Recommendation.

B. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

33. Environmental assessment of the Project has been carried out in compliance with ADB's SPS and the government's legislation and requirements. The laws, regulations, policies and guidelines that may be applicable to the Project based on the location, design and operation of sub-projects which are mostly yet to be confirmed, are summarized in the subsequent sections.

1. The Government Environmental Laws and Regulations

34. Some of the important acts and regulations of Maldives relevant to the Project focusing on environmental management are summarized in Table B.1.

Table B.1: Summary of Relevant Environmental Laws and Regulations of Maldives

Environmental Legislation	Year Passed	Objective
Environment Protection and Preservation Act (Act No. 4/93)	2003	<p>The Environment Protection and Preservation Act of Maldives (Law No. 4/93) provides the basic framework for environmental management in Maldives including Environmental Impact Assessment Process which is being currently implemented by EPA on behalf of MEE. Articles 2, 4, 5, 6, 7, and 8 of the law are relevant to the POISED Project.</p> <ul style="list-style-type: none"> • Article 2 states that the concerned government authorities shall provide the necessary guidelines and advise on environmental protection in accordance with the prevailing conditions and needs of the country. All concerned parties shall take due considerations of the guidelines provided by the government authorities. The project proponent shall abide by any guidelines or advice given by the concerned Government authorities for the Project. The concerned Government authorities are identified in this Chapter. • Article 4 states that the Ministry of Environment and Energy

Environmental Legislation	Year Passed	Objective
		<p>shall be responsible for identifying protected areas and natural reserves and for drawing up the necessary rules and regulations for their protections and preservation. The proponent shall ensure that there is no negative impact from the proposed Project on any protected areas.</p> <ul style="list-style-type: none"> • According to Article 5 (a) of the Act, an Environmental Impact Assessment study shall be submitted to the Ministry of Environment and Energy before implementing any activity that may have an impact on the environment. The project proponent has prepared and submitted necessary documents to the EPA to fulfil the legal requirement stipulated in Act (4/93) Article 5. Proposed POISED Project do not need EIA as per Government regulations. • According to Article 6, the Ministry of Environment and Energy has the authority to terminate any project that has any undesirable impact on the environment. A project so terminated shall not receive any compensation. The Project proponent is aware of this provision and will take all practical measures to ensure there is no irreversible and significant negative impact of the project. • Article 7 of the Act (Act No. 4/93) prohibits the disposal of wastes, oil and gases in a manner that will damage the environment. Wastes, oil and gases has to be disposed off in areas designated by the Government. Hence, the project proponent shall use the Environmental Management Plan for this project which specifies how the wastes, oil and gases generated by the project will be disposed. • Article 8 of the Act No. 4/93) prohibits the disposal of hazardous wastes. Any hazardous wastes that may be generated from the project shall be transferred to the designated waste sites for disposal according to Government regulations and standards.
Environmental Impact Assessment Regulation 2012	2007 (revised in 2012)	<ul style="list-style-type: none"> • The EIA Regulation, which came into force in 2007, has been recently revised and the revised EIA Regulation 2012 is currently in force since May 2012. • The EIA Regulation 2012 is currently available only in Dhivehi and an official translation is awaited. The Regulation sets out the criteria to determine whether a development proposal is likely to significantly affect the environment and is therefore subject to an EIA. Schedule D of the EIA Regulations defines the type of projects that would be subject to an Environmental Impact Assessment. • The main purpose of this Regulation is to provide step-by-step guidance for proponents, consultants, government agencies and general public on how to obtain approval in the form of an Environmental Decision Statement.
Regulation on Uprooting, Cutting and Transportation of Palms and Trees	2006	The primary purpose of the Regulation is to control and regulate large- scale uprooting, removal, cutting and transportation of palms and trees from one island to another. According to the regulation, certain types of trees and plants

Environmental Legislation	Year Passed	Objective
		that have unique attributes are prohibited to be removed from its natural environment. Also, uprooting and removal of 10 or more trees and palms are subject to environmental impact assessment (EIA), which is required to be submitted to the Environmental Protection Agency and written approval is required prior to implementation of the project.
Environmental Damage Liabilities Regulation, 2011	2011	The main purpose of this regulation is to stop unlawful activities on environment and adequately implement a fining procedure for violations as well as implement a compensation mechanism on environmental damages. Its Schedules form the basis for levying fines on various environmental components and activities.
National Environmental Action Plan III (NEAP III)	-	The NEAP III of the Government of Maldives sets out the agenda for environmental protection and management for the period 2009 till 2013. NEAP III provides the basis for environmental planning, budgeting, performance measurement and accountability. The key target of NEAP III is to achieve measurable environmental results that matter to the people of the Maldives.
National Biodiversity Strategy and Action Plan 2002	2002	<p>The goals of the National Biodiversity Strategy and Action Plan (MHAHE, 2002) are:</p> <ul style="list-style-type: none"> • Conserve biological diversity and sustainable utilization of biological resources. • Build capacity for biodiversity conservation through a strong governance framework, and improved knowledge and understanding. • Foster community participation, ownership and support for biodiversity conservation.
The Strategic Action Plan 2009 – 2013	-	The Strategic Action Plan 2009 - 2013 (SAP) of the Government of Maldives sets out the agenda for environmental protection and management as one of the key area. SAP provides the basis for environmental planning, budgeting, performance measurement and accountability. The new policy focus is to ensure sustainable adaptation measures and is developed on the view that ability to adapt to environmental degradation is fundamentally linked to good governance and careful planning.
Waste Management Policy		<p>The aim of the waste management policy is to formulate and implement guidelines and means for solid waste management in order to maintain a healthy environment. Accordingly, the key elements of the policy include:</p> <ul style="list-style-type: none"> • Ensure safe disposal of solid waste and encourage recycling and reduction of waste generated; • Develop guidelines on waste management and disposal and advocate to enforce such guidelines through inter-sectoral collaboration; • Ensure safe disposal of chemical, hazardous and industrial

Environmental Legislation	Year Passed	Objective
		waste.
Waste Regulations 2013	2013	<p>The aim of the regulation is to protect environment through implementation of national waste management policy and to achieve the following:</p> <ul style="list-style-type: none"> • To minimise direct and indirect negative impacts that occurs or may occur resulting from waste to environment and human health • To formulate waste management standards • To develop interlinked framework and a mechanism to manage waste in environment friendly, safe and sustainable manner • To encourage waste reduction, reuse, recycling and recover • To implement polluter pay principle • To introduce extended producer responsibility
Regulations of Conservation of Old Trees	-	<p>Due to the rapid increase in cutting down of trees impacting natural features and losing the greenness of the islands. The regulation aims to conserve and protect old trees which are rare and are in extinct at island, atoll and national level. This regulation also aims to fulfil obligations under “Convention on Biological Diversity” which Maldives has signed and aims to support environmental initiatives under taken by the Maldives at national, regional and global level. Four categories of trees protected under this regulation:</p> <ul style="list-style-type: none"> • Based on the age of trees (50-100 and over 100 years old) • Based on the number of trees in Maldives or on particular island • Based on environmental importance • Based on community requests (individually or community as a whole) <p>This regulation was formulated under Environment Protection and Preservation Act (Act No. 4/93), clause 4.</p>

Source: Environmental Protection Agency (EPA) of the Republic of Maldives under the Ministry of Environment and Energy (www.epa.gov.mv)

2. International and Regional Agreements and Conventions

35. The Republic of Maldives is a party and signatory to several international and regional environmental agreements to which the MEE is the National Focal Point or the EPA is the Implementing Agency. Some of the international conventions / declarations to which Republic of Maldives is a party are:

- UN Convention on the Law of the Sea – UNCLOS (1982)
- International Convention for the Prevention of Pollution of the Sea by Oil (1982)
- Vienna Convention for the Protection of the Ozone Layer (1985)
- Montreal Protocol on Substances that Deplete the Ozone Layer (1987)
- Basel Convention on the Control of Transboundary Movement of Hazardous Wastes

and their Disposal (1989)

- The London Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer (1990)
- Agenda 21 and the Rio Declaration of the United Nations Conference on Environment and Development (1992)
- Convention on Biological Diversity (1992)
- United Nations Framework Convention on Climate Change (1992)
- The Copenhagen Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer (1992)
- The Montreal Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer (1997)
- The Beijing Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer (1999)
- Washington Declaration on Protection of the Marine Environment from Land- Based Activities
- Kyoto Protocol to the United Nations Framework Convention on Climate Change (1998)
- Cartagena Protocol on Biosafety (Maldives acceded on 2 September 2002)
- United Nation Convention to Combat Desertification (2002).

36. The Republic of Maldives is also a key player in formulating and adopting various regional plans and programmes to protect the environment by continuously participating in various activities organized by regional bodies such as SACEP, ESCAP and SAARC. As a result the Republic of Maldives is committed to the following:

- SAARC Environment Action Plan adopted in 1997 in Male'
- SAARC Study on Greenhouse Effect and its Impact on the Region
- South Asian Regional Seas Action Plan and Resolutions concerning its implementation (1994)
- SAARC Study on Causes and Consequences of Natural Disasters
- South Asian Seas Programme initiated by SACEP, and
- Male' Declaration on Control and Prevention of Air Pollution and its likely Transboundary Effects for South Asia (1998).

37. The interventions proposed under the Project shall be implemented in compliance with applicable international/regional conventions and declarations listed above.

3. Environmental Assessment Process in the Maldives

38. Under the Maldivian regulatory framework (Act No 4/93 and EIA Regulations 2012) all development activities must be referred to the Minister of Environment and Energy. According to Article 5 (a) of the Act, an Environmental Impact Assessment study shall be submitted to the Ministry of Environment and Energy before implementing any activity that may have an impact on the environment. The project proponent need to prepare requisite documents for each sub-project to fulfill the legal requirement stipulated in Act (4/93) Article 5.

39. EIA Regulations were issued by the Ministry of Environment and Energy on 8th May 2012. The first step in environmental assessment process involves screening of the project to be classified as one that requires an EIA or not. Based on this decision, the Ministry then

decides the scope of the EIA, which is discussed with the proponent and the EIA consultants in a “scoping meeting”. The consultants then undertake the EIA starting with baseline studies, impact prediction and finally reporting the findings with impact mitigation and monitoring program. The report shall follow the principles and procedures for EIA outlined in the EIA regulations.

40. The EIA report is then submitted to the EPA. Following the review of the EIA by the EPA an EIA Decision Note will be given to the proponent who will have to implement the Decision Note accordingly. As a condition of approval, appropriate environmental monitoring may be required and the proponent shall have to report monitoring data at required intervals to the Ministry. The project proponent shall be committed to implement all impact mitigation measures that are specified in the EIA report. Furthermore, the proponent shall be committed to environmental monitoring and shall fulfill environmental monitoring requirements that may be specified in the EIA decision note as a condition for project approval.

3.3.1 Environmental Impact Assessment (EIA) Decision Note

41. The most important environmental permit to initiate sub-project work would be a decision regarding the EIA. The EIA Decision Note, as it is referred to, shall govern the manner in which the sub-project activities must be undertaken. The EIA report assists decision makers in understanding the existing environment and potential impacts of the sub-project. Therefore, the Decision Note may only be given to the Proponent after a review of EIA document following which the EPA may request for further information or provide a decision if further information is not required. In some cases, where there are no major environmental impacts associated with the project, the EPA may provide the Decision Note while at the same time requesting for further information.

3.3.2 Government Requirements for five sub-projects assessed

42. The sub-projects assessed in five outer islands under the Project mainly involve implementation of solar-diesel hybrid energy systems (solar PV system on roof-top and ground mounted). This activity is not listed in the list of activities (Appendix D of the EIA Regulations 2012) require an EIA. Therefore an Environmental Screening Form is submitted to the EPA by the project proponent (MEE) to check whether sub-projects require an EIA or not. After reviewing the scope of sub-projects, the EPA issued a decision stating the sub-project activities in five islands are mainly solar PV system installation; therefore EIA is not required for these activities. However, it stated that project proponent have to have an EMP in place to mitigate any unforeseen impacts. Also if any sub-project requires removal of more than 10 trees, it has to submit an EIA to the EPA. The Decision Note issued by EPA (in Dhivehi language) is attached as Appendix 4. For any change in scope including change in location, MEE shall submit screening form to EPA to check whether any further study is required to fulfill government requirements.

4. ADB’s Environmental Safeguard Requirements

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

44. As per the SPS the objective of environmental safeguard is to ensure the environmental soundness and sustainability of the Project and to support the integration of environmental considerations into the project decision-making process. To help achieve the desired outcomes, ADB adopts eleven policy principles for guiding the assessment of projects that trigger environmental risks and impacts.

45. ADB uses a classification system to reflect the significance of a project's potential environmental impacts. A project's category is determined by the category of its most environmentally sensitive component, including direct, indirect, cumulative, and induced impacts in the project's area of influence. Each proposed project is scrutinized as to its type, location, scale, and sensitivity and the magnitude of its potential environmental impacts. Projects are assigned to one of the following four categories accordingly to the significance of likely impacts:

- (i) **Category A** - A proposed project is classified as category A if it is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works. An environmental impact assessment is required. Category A may apply to projects located in environmentally sensitive areas.
- (ii) **Category B** - A proposed project is classified as category B if its potential adverse environmental impacts are less adverse than those of category A projects. These impacts are site-specific, few if any of them are irreversible, and in most cases mitigation measures can be designed more readily than for category A projects. An initial environmental examination is required.
- (iii) **Category C** - A proposed project is classified as category C if it is likely to have minimal or no adverse environmental impacts. No environmental assessment is required although environmental implications need to be reviewed.
- (iv) **Category FI** - A proposed project is classified as category FI if it involves investment of ADB funds to or through a FI.

46. In accordance with ADB's Safeguard Policy Statement (SPS, 2009) the Project requires an IEE. This report fulfills this environmental assessment requirement. In addition, each sub-project requires an environmental assessment, either in the form of an IEE or desktop assessment, based on whether the sub-project is classified as either an environmental category B or C, providing a level of detail commensurate with the likely impacts of that development. Most of the solar-diesel hybrid systems are likely to be classified as environment category B as they will involve construction activities, which will cause environmental impacts (mostly temporary). An IEE will be prepared for each such sub-project.

47. The ADB principles for sensitive habitats will be applied at the sub-project screening stage and in the sub-project environmental assessment. Proposed sub-projects within 1 km of a sensitive habitat will be subject to prior review by ADB, and will be initially considered as environment Category B for purposes of assessment. Sub-projects located within sensitive habitats will be considered as the net benefits are expected to far outweigh any potential negative impacts. ADB principles for sensitive habitats are described in SPS Environmental Safeguards, Policy Principle number 8, as follows:

Critical Habitats: Do not implement project activities unless:

- (i) There are no measurable adverse impacts on the critical habitat that could impair its ability to function
- (ii) There is no reduction in the population of any recognized endangered or critically endangered species
- (iii) Any lesser impacts are mitigated

Legally Protected Areas: Implement additional programs to promote and enhance the conservation aims of the protected area.

Natural Habitats: There must be no significant conversion or degradation, unless:

- (i) Alternatives are not available
- (ii) The overall benefits of the project substantially outweigh the environmental costs.
- (iii) Any conversion or degradation is appropriately mitigated.

5. Institutions

48. The main government institutions that have roles and responsibilities relevant to the Project are:

5.4.1 Ministry of Finance and Treasury

49. The Ministry of Finance and Treasury is the executing agency of the Project and will have overall responsibility to manage the project including safeguards management.

5.4.2 Ministry of Environment and Energy

50. The primary environmental institution in Maldives is the Ministry of Environment and Energy (MEE). It is mandated with formulating policies, strategies, laws and regulations concerning environmental management, protection, conservation and sustainable development. The head of EPA within MEE gives the environmental approval or clearance to EIA by an Environmental Decision Statement. Additionally, MEE is responsible for formulating relevant laws and regulations, policies and strategies concerning energy, water and sanitation, waste and infrastructure.

5.4.2 Environmental Protection Agency (EPA) of Maldives

51. EPA is the key regulatory body on environment, which is an autonomous body formed under the umbrella of MEE. It is mandated with implementing the EIA process in Maldives, implementing the Environment Act and subsequent regulations on behalf of MEE, regulating water and sanitation, biodiversity conservation, waste management and coastal zone management. Also, it is responsible for developing environmental standards and guidelines in the country.

5.4.3 Ministry of Housing and Infrastructure

52. The Ministry of Housing and Infrastructure (MHI) is responsible for the construction of infrastructure in Maldives.

5.4.4 Atoll /City Councils and Island Councils

53. Under the Maldives Decentralization Law, elected Atoll Councils, City Councils and Island Councils have been formed as regulatory bodies dealing directly with atoll, cities and island issues respectively. In this regard, some of the development projects are subject to approval of these councils through a public consultation process. For the proposed Project, public consultation process has been performed at each of sub-project in five islands as part of IEE preparation.

5.4.5 ADB

54. As project financing agency, ADB will be responsible for approval of EARF, new and updated IEEs, disclosure of EARF and IEEs and review and approval of environmental monitoring reports.

C. DESCRIPTION OF THE PROJECT

1. Project Rational and Objectives

55. The Republic of Maldives is a collection of small islands to the southwest of Sri Lanka in the Indian Ocean. It comprises 1,190 islands grouped into 26 natural atolls that together occupy a land area of 298 sq. km and form a chain over 820 km in length and 80-130 km in width, spread over an area of more than 90,000 sq km.

56. Nearly half the country's population living on the outer islands.² Each outer island is electrified with its own diesel powered mini grid system and while there is 100% access to electricity, supply is not reliable and it is expensive. The cost of diesel power is unaffordable at 30-70 cents/kWh and requires government subsidies of about \$25 million annually. In 2011, Maldives spent \$261 million to import 316 thousand tons of oil equivalent (toe) of diesel or nearly 7% of GDP on fuel imports for electricity generation. Electricity sector subsidies are one of four identified areas for government expenditure management. The 100% diesel dependence of Maldives also makes its carbon emissions per unit of electricity among the highest in the region.

57. The solution to the above problem is to develop renewable energy based generation, the cost of which is expected to be significantly lower than existing diesel based power generation. The transition to renewable energy based systems has sound economic rationale. The Government's effort to increase electricity production from indigenous sources, including solar and wind power, to enhance energy security will reduce the pressure on the balance of payments and improve the fiscal position. The development of renewable energy projects is in line with the Government's goal of going carbon neutral by 2020. To support the Government's goal, the SREP Investment Plan over 2013-2017 was endorsed by the SREP sub-committee on 31 October 2012 to initiate the transformation of the energy sector. Based on the priority requirements identified during the SREP investment planning process, the government developed an investment plan to initiate the transformation from 100% diesel based power systems to renewable energy systems by focusing on about 40 outer islands between 2013- 2017 through a public-private partnership approach. SREP funds would be channeled through multi-lateral development banks and would be leveraged with financing from other sources including the private sector.

58. The Project is aligned to ADB's Strategy 2020 of supporting sustainable energy growth, Energy Policy 2009 and is included in the Maldives COBP for 2013-2015. Based on the government's investment plan for the outer islands and the characteristics of the electricity systems, a sector lending approach is proposed to be adopted.

59. The proposed ADB project on the outer islands would focus on readying public sector mini grids and facilitating private sector renewable energy investments in generation. The ADB Project will initiate the transformation process for reducing diesel dependence and emissions on the outer islands and reducing the government subsidy burden. Successful demonstration of this structure will support the transition process on remaining islands

² Mini-grid systems range in size from 25-50 kW on small islands with population of about 1000 to MW scale systems on larger islands with populations of about 5000.

possibly through commercial investments based on diesel and renewable energy cost trends. Separately, the government will pursue a de-carbonization approach for the Greater Male region to be supported by the World Bank under SREP. This would be coordinated with committed projects including the renewable energy base load project for Male and the JICA Male rooftop program. De-carbonization of the private tourist islands would be separately pursued by the Government through policy instruments.

2. Project Location

60. The Project is located in over 160 outer islands of Maldives, generally where there is no grid electricity connection. The specific locations of sub-projects will only be determined as the Project is implemented. Sub-projects will potentially be in any outer island of Maldives where communities require an off-grid power supply.

61. The Project will scale up RE development in Maldives by delivering energy directly to many isolated, off-grid communities in outer islands through the installation of dispersed, small-scale RE system based sub-projects.

62. The intervention strategy for the introduction of the RE into Maldives is divided into three phases namely:

- **Phase 1:** Implementing demonstration hybrid projects in five outer islands and then subsequently ordered by geographical areas, savings in subsidies and economic feasibility.
- **Phase 2:** Extending the Phase 1 solutions to an extended around sixty outer islands until reaching Phase 2 investment amount, and
- **Phase 3:** Extending the RE hybrid solution along about 160 Maldives islands at commercial development and under the Road Map long-term strategy outlines.

3. Impact, Outcome and Outputs

63. The impact of the proposed Project would be enhanced renewable based sustainable energy sector in the Maldives to be measured by increase of renewable energy in the supply mix of the Maldives, reduction in CO₂ emissions, and increase in cost coverage through tariffs. The outcome would be the reduction of diesel usage for electricity generation in outer islands of the Maldives to be measured by reduction of diesel consumption per unit of electricity in the outer islands by 2020. The outputs include (i) development of renewable energy ready mini grid systems for outer islands, (ii) capacity enhancement of MEE PMU (EA) and FENAKA/STELCO to implement renewable energy mini grid projects.

4. Project Cost and Financing Plan

64. The Project is part of the SREP overall investment plan on the outer islands and would focus on developing public sector infrastructure and facilitating preparatory activities for private sector renewable energy investments in generation. The life of the Project would be 25 years.

65. The overall investment plan for the energy sector transformation on about 160 outer islands of Maldives would be about US\$ 114 million over the period 2014- 2019. The financing of the investments and the working capital will come from different sources as identified in Table C.1. These will be further confirmed during the project processing.

66. The component wise breakup of the total investment of US\$ 114 million is presented in Table C.2

Table C.1: Investment Plan and Financing Plan for the Outer Islands

Source	Amount (\$ million)	Share of Total (%)
Asian Development Bank Special funds resources (grant)	38	33%
SREP	12	11%
IsDB	10	9%
EIB	40	35%
Maldives Government	14	12%
Total	114	100%

Source: Asian Development Bank estimates.

67. The project will be developed into four phases comprising in Phase 1 the 5 islands of the pilot study, and then subsequently ordered by geographical areas, savings in subsidies and economic feasibility.

68. For the economic and financial feasibility we have developed a model that returns as a result several key performance indicators like FIRR, EIRR, FNPV and ENPV. Most of the islands show positive differential results in both financial and economic analysis. This implies that the shift to RE is generally positive for the local community of Maldives and for the governmental agencies in charge of electricity supply, in this case FENAKA.

69. The introduction of RE in the whole life of the project as well as the improvements in the diesel engines will save to the local community a total amount of US\$ 209 million (at net present value) in CO₂ carbon emission trades.

70. Another important impact that will benefit the community, through the savings in subsidy in usage, coming from the reduction of the actual status quo. No increase in the tariff to consumers is contemplated in the study.

5. Implementation Arrangement and Schedule

71. Existing and newly established institutions will support the project implementation. The government through its Ministry of Finance and Treasury (MoFT) will be the executing agency (EA) of the Project and will oversee the project with the support of a Project Management Unit (PMU). The PMU will consist of staff drawn from MoFT, MEE, STELCO, FENAKA and other organizations. The Ministry of Environment and Energy (MEE) along with STELCO (State Electric Company) and FENAKA (state owned water, sewerage and electricity utility company), through its island/atoll offices will be the implementing agencies (IAs) for the projects at island level. Project Implementation Units (PIU) will be established in FENAKA and STELCO to assist in preparing an overall implementation plan, contract packing and annual budgets. PIUs will also be responsible for overall intra-agency and intra-department coordination; bid management, project management, plan implementation, monitoring and evaluation of project outputs and results. It will provide project implementation support to Contractors and will liaise with the Islands where project is to be implemented. It will also be responsible for organizing training programs for building institutional capacity of FENAKA and STELCO. A team comprising solar energy specialist, field engineer, safeguards specialist, and financial expert will be established as the Project Management Consultant (PMC) to

support the EA and IAs. The PMC will take over project implementation, and after start up will design and conduct operations and maintenance (O&M), and capacity building of FENAKA/STELCO staff and members of the island councils to guarantee for at least five years the project sustainability. During project implementation a project steering committee chaired by the MoFT will supervise the project implementation of the Project. The Project will be implemented over a period of approximately five years from the date of grant effectiveness.

72. MEE, through the PMU, will be responsible for the design and environmental assessment of sub-projects, and monitoring their environmental management during construction and operation. MEE PMU staff expertise will be complemented by a network of qualified consultancies that will be utilized to assist in preparing the Project pipeline of sub-projects as required, including sub-project feasibility studies, safeguard assessments, environmental management plans (EMPs) and monitoring reports.

6. Project Components and Activities

73. As part of the Project hybrid energy systems will be installed on about 160 outer Islands of Maldives. A typical hybrid energy system will comprise generation mix of solar-diesel-wind or solar-diesel or wind-diesel or solar only. The architecture of a typical hybrid energy system is described in Figure C.1.

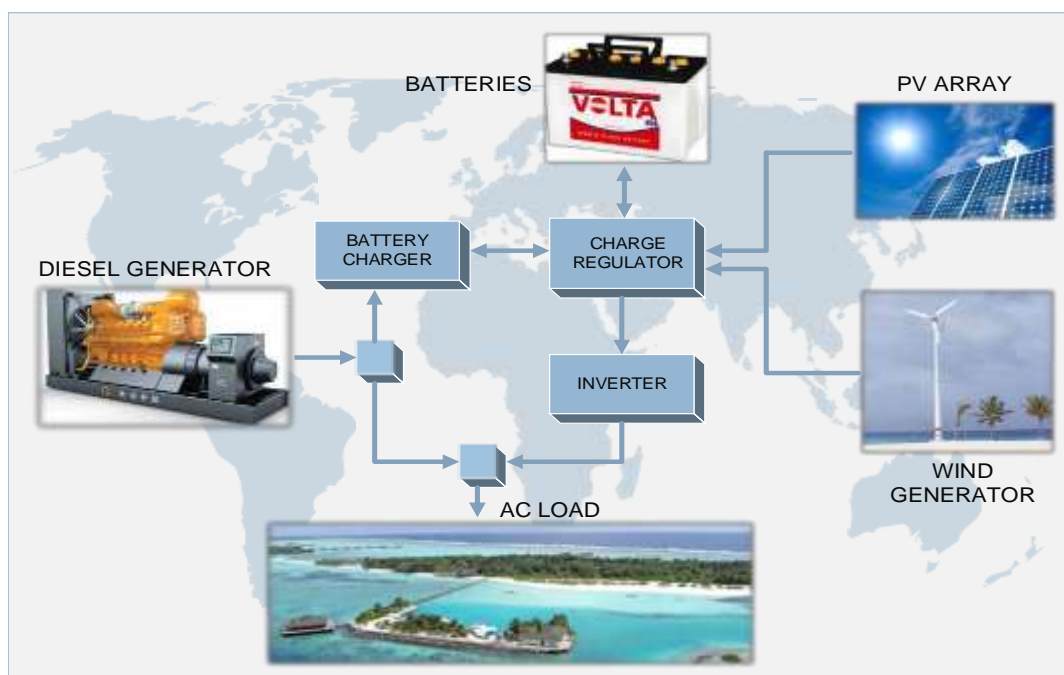


Figure C.1: Typical Architecture of a Hybrid System

74. Various components of the hybrid renewable energy system proposed and to be implemented under the Project are:

- **Component 1:** Solar generation by installation of solar PV system (ground mounted and roof top)
- **Component 2:** Diesel generation by replacement of inefficient DG sets and addition of new DG sets
- **Component 3:** Refurbishment of distribution mini-grid systems

- **Component 4:** Capacity building of PMU/FENAKA/STELCO staff on O&M of RE systems.

75. Under the proposed Project solar-diesel hybrid system is proposed in all 160 islands. Summary of RE systems proposed under the Project is presented in Table C.3.

Table C.3: Summary of Proposed Interventions under the POISED Project

Proposed System	Proposed Capacity (kW)	
	On 5 Priority Islands	On 160 Islands
Diesel	8164	40170
Solar	2500	20888
Total	10664	61058

76. As part of POISED Project a combined capacity of 61058 kW will be introduced in about 160 outer islands of Maldives of which 40170 kW is diesel generation and 20888 kWp is solar generation. Diesel generation would be added to the existing generation system by installing additional generators in existing power plants in each island whereas solar generation would be new addition. Solar generation would be mainly by installing solar PV panels (on-ground and roof-top of public buildings). Besides this, Li-Ion based battery storage system will also be installed in each Island as part of hybrid energy system. Existing grids will also be upgraded as part of the Project.

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

78. The Project will construct and operate hybrid energy system comprise diesel generators, solar PV generation, inverters and a battery-based storage system with associated control devices with a total capacity of 61058 kW. The solar power generation units will consist in a set of solar photovoltaic (PV) modules, power inverters, switchgear, associated protection, control and monitoring equipment, and associated civil works. The electricity output will be directly fed into existing distribution network of FENAKA / STELCO and island councils for further distribution. Table C.4 summarizes salient features of a solar power generation unit.

Table C.4: Salient Technical Features of the a Solar PV System

S. No.	Component	Features / Specifications
1.	Solar PV Panels	
	Type of Panels	poly-crystalline, photovoltaic (PV)
	Dimensions of each panel	Approx. Rectangular, 2 m by 1 m
	Inclination	8 degrees
	Life Cycle	25 years
2.	Loading Controllers	5 stations
3.	DC-AC Inverters	100 kW, 5 units
4.	Transformers	To be defined
5.	Batteries	Li-Ion

6.	Wires and other accessories	As per locally available
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7. Local Infrastructure Required

79. The local infrastructures required for the Project are the roads, wharf and the pre-existing energy grid. The roads and wharf will be needed to transport necessary materials and equipments during construction. It is estimated that maximum 10 trucks will be moving daily for a maximum 3-4 days during peak construction time in each Island.

80. All outer islands have wharfs and sub-project sites will be accessible by existing roads from the wharf. Therefore project will not required construction of any new access roads or wharfs. The solar power plant will be connected to the existing grid and will feed its energy. Batteries are to be installed as part of the project to ensure smooth transition from solar plant to grid.

8. Sub-Project Development

81. All the sub-projects included in the POISED Project shall be screened and developed in compliance with the Environmental Assessment and Review Framework (EARF) provided in Appendix 2 (Linked Document 13).

D. SUMMARY OF PROJECT IMPACTS AND BENEFITS

82. This section provides an overview of the Project's impacts and benefits, describing (i) the typical adverse impacts and benefits of each type of sub-project, and (ii) the total net adverse impacts and benefits of the overall Project. This description is based on the assessment of five sample sub-projects as presented in Section E describing the typical types and significance of environmental and social impacts that are likely to occur.

1. ADB Environmental Categorization

83. Individual energy system sub-projects will be classified as ADB environment category B as they involve physical works but are generally expected to have limited, insignificant, and manageable direct and induced adverse environmental and social impacts. All solar-diesel hybrid systems are expected to be environmental category B considering its construction related potential adverse impacts. Solar PV system sub-projects are expected to be environmental category B depending on the type of installations (roof-top or ground mounted) and the capacity of the plant.

84. Overall, the Project is classified as ADB environment category B due to the potential impact of the most significant adverse impact: Solar-Diesel hybrid systems will cause adverse impacts related to construction activities as well as it will also lead to air pollution from new DG sets.

2. Typical Sub-Project Adverse Impacts

85. Individual renewable energy hybrid energy systems (sub-projects) will be classified as ADB environment category B as they involve physical works but are generally expected to have limited, insignificant, and manageable direct and induced adverse environmental and

social impacts. Sub-projects located directly in or within 1 km boundary of protected areas /areas with critical habitats will not be supported by the Project.

86. Overall, the Project is classified as ADB environment category B due to the potential impact of the most significant adverse impact: Solar-Diesel hybrid systems will cause adverse impacts related to construction activities as well as it will also lead to air pollution from new DG sets.

87. All the sub-projects included the Project will be configured as solar-diesel hybrid energy system, which will have limited adverse environmental and social impacts due to the small scale of the plant, location on open ground and on roof-top of public buildings (schools, hospitals, government offices etc.), and limited activities during operation. Solar PV panels will be installed at new locations either on ground mounted or on rooftop of public buildings, which will be confirmed during the project preparation. The area (plots) required for the solar PV installations will be in the range 300 sq.m to 15000 sq.m for a PV plant ranging between 20 kWp to 1 MWp assuming that solar PV panels would require about 15 sq.m. area to generate 1 kWp electricity. The typical solar panels (approximately 1 sq.m each) would be mounted on 1 m high stands. It will also have a battery storage system called battery bank (commonly 200-300 batteries). The new DG sets would be installed on the existing powerhouses on each Island. The electricity generated would be directly fed into existing grid managed by STELCO and FENAKA. As part of the Project, inefficient grid assets such as cables, distribution panels, switchgears, etc. would also be replaced to ensure efficient delivery of electricity to the end users.

88. The land for solar PV installations would be mostly government owned land. Sites for ground installations would be selected to avoid loss of trees / vegetation and also to the extent possible this will be selected adjacent to the existing powerhouses to avoid construction of new distribution grid and new access roads. No forest will be cleared to install the panels. However trees from surrounding areas may require trimming to avoid shading on the PV panels.

89. Solar PV plant facility construction will take 1-2 months and involve: minor site clearance; excavation of the panel stand footings; transport of equipment to site; concreting footings; installation of the stands, and panels; and refurbishment of the associated electricity mini-grid distribution system. The refurbishment of mini-grid systems will be limited to the replacement of grid assets. The transport of equipment to remote islands will usually be undertaken by vessels and by trucks from the wharfs to the site. Existing wharfs and roads will be used for transport of equipment and material to the Islands. Therefore construction of new wharfs or access roads is not envisaged as part of this Project. Construction camps will not be required due to the small scale of installations, short construction period and use of local labor. Operation phase activities will be limited to minor maintenance (e.g. cleaning solar panels, grid cables and electrical equipment) and the replacement of used batteries every eight years or so.

90. Typical potential adverse impacts of solar-diesel hybrid system sub-projects, and the main management measures that will be implemented to avoid or mitigate these impacts, are:

2.1 Impacts associated with pre-construction activities

91. The location of sub-project sites for ground mounted solar PV installations will be mostly on open plots free from any encroachments but may have been covered by thin vegetation. Roof-top installations will be mostly done on selected public buildings. The project facilities will not encroach any of the environmentally sensitive areas. Also there will be no sites of any archaeological importance in and around the project facilities. DG sets will be installed in existing powerhouses and grid assets will be replaced mostly on existing grid system. Therefore impacts associated with project siting on physical environment will be negligible.

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

93. The equipments to be procured and installed by the Project will comply with international standards for noise as well as escape of polluting materials. The new diesel generators will be designed to comply with World Bank Group's EHS guidelines for small combustion facilities and World Bank's EHS guidelines for ambient noise both for day time and night time.

94. Storage and handling of fuel, oil residue storage and lubricating oil storage will be an issue as the current practices at power plants are inadequate. As part of installations of new diesel generating capacity, these practices need to be improved. FENAKA will prepare and implement a plan for fuel and oil storage and handling at powerhouses. This will include (i) improvements to the existing bunded structure at the fuel storage tanks so that it will be protected from rain and will store spilt or leaked fuel for pump-out and proper disposal; (ii) redesign and construction of the existing oil-separator; and (iii) construction of a bunded concrete area for the storage of empty lubricant oil drums. Additionally, work practices and site environmental management needs to match and this requirement to ensure that no fuel, oil or other lubricant is allowed to enter the external environment.

95. The Project will use transformers of forced-oil and forced-air-cool designs, which do not use polychlorinated biphenyl (PCB). Therefore, there will be no PCB disposal problem from new transformers. As far as possible the Project will not replace old transformers containing PCB. However in case replaced transformers need replacement, they will be sent to authorized dealers for safe handling, treatment and ultimate disposal.

96. The project will provide solar PV plants with resilience to climate change through compact and preassembled systems resistant to marine environment.

97. The project may need cutting/trimming of few trees (<10 trees in each of sub-project) from the proposed sites. The loss of trees will be compensated by planting additional trees as per government requirements. The proposed subprojects will not be located in any protected areas, therefore there will not be any impacts of the fauna due to subprojects.

98. The proposed solar PV installations will require a land area in the range of 300 - 15000 sq.m. depending on the size of the sub-project. The land for ground mounted solar PV installation will be done mostly on government/island council owned land and it will be transferred to the Project as per national regulations. To ensure the livelihood of affected people due to loss of crops, roof area etc. there is possibility that the affected people will be employed by the project. Since project will be implemented on government land, there will be no relocation issue.

2.2 Impacts associated with construction/installation activities

99. Impacts on topography due to installation of solar plant on ground and roof-top of public buildings will be insignificant. The PV panel will be visible on ground for solar plant and individual buildings. This small change in topography will be visible in the habitation. This change will be permanent. Visual impacts are anticipated due to storage and haulage construction material and movement of equipments and machineries. This will be minimized by the selection of suitable storage areas for materials or plant with minimum visibility from residences and roads with screening where necessary.

100. Impacts on water resources are not anticipated as the sub-project sites will be located away from the water bodies. Domestic wastewater generated from temporary laborers' sites (10 cubic meters per day) during construction will be managed by constructing temporary soak pits. These soak pits will be closed once construction activities are completed.

101. The sub-projects will involve only minor civil works such as clearing of site, earth work and foundation for solar panels. Mechanical and electrical works will take place at various locations within a large sub-project sites. The site preparation will involve only minor leveling, and thus will not significantly change the drainage pattern. The transportation of construction materials and project equipment will require about 10 truck trips per day during the working period of 8 hours. It will mean there is more traffic, particularly heavy traffic, on the road than usual. The distance from the wharf to the proposed sites is generally short so few roads will be affected by this. Traffic level will return to normal after the construction of the solar plant is completed.

102. Noise impact could be an issue during construction due to movement of vehicles and machineries, and construction activities. Some of the sub-projects with solar PV installations will be located near sensitive receptors i.e. hospitals, schools, office buildings etc. Typical solar PV installation would take about 8-10 days time. Operation of machinery generating high levels of noise solar panel installations will be restricted to between 6:00 am and 10:00 pm in areas where there are nearby residences. Solar panel installations at schools and colleges should be scheduled to avoid class disturbance. Since there are no vacant periods at the hospital, installation of solar panels should be scheduled during the busy periods of the day, avoiding early mornings and evenings.

103. The construction will require not more than 30 workers, who will reside outside the sub-project sites. No groundwater will be tapped at the sub-project sites as these sites have low groundwater potential. The water required for construction (concrete mixing) and consumption will be brought in from outside sources. About 2-3 new mobile toilets will be used for construction workers. Domestic wastewater generated by the construction workers would not be more than 10 cubic meters per day per site and will be treated either in a small centralized package treatment plant or by individual septic tanks, one for each toilet.

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

2.3 *Impacts associated with operation and decommissioning*

105. Operation of the solar power plant will have insignificant environmental impacts. There will be no waste products, no requirements for cooling, no moving parts, no noise, and no impact on flora and fauna.

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

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

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

During operation phase batteries of solar system will have to be replaced after 7-8 years. These batteries may contain heavy metal and sulphuric acid. If the batteries are discarded in the surroundings then there will be soil contamination as well as marine pollution with lead and sulphuric acid in the land area or in the sea. To mitigate these impacts use of long life lithium-ion batteries with more charge-recharge cycle are proposed for the Project. Also the replaced batteries will be stored in leak proof battery collection system and will be sent to authorised handlers (in India and Sri Lanka) / manufacturers for recycling and further management. As discussed with the EPA, there are no authorized dealers in Maldives for handling of used batteries. The handling, storage and disposal of used batteries shall be done in compliance with Waste Management Policy and Waste Regulations (2013) of Maldives as well as in compliance with Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and their Disposal (1989).

109. Although diesel generators will be placed inside existing powerhouses and also sensitive receptors are at least 100m away from existing powerhouses; noise and air pollution from operation of DG sets could be an issue during operation. To minimise these impacts, the Project will install gensets which comply with international standards for noise as well as escape of polluting materials. The new diesel generators will be designed to comply with World Bank's EHS guidelines for small combustion facilities and World Bank's EHS guidelines for ambient noise both for day time and night time. The new diesel genset installation will include an on-line continuous exhaust gas analysing function, which will monitor the levels of NO_x, SO₂ and PM levels. This will enable operational monitoring in line with the EHS recommended approach for engines.

110. Issues of safe handling, storage and disposal of fuel, oil residue and lubricating oil will be an issue during operation phase. It will be corrected as part of the installation of the new generation capacity. As identified above FENAKA will prepare and implement a plan for fuel and oil storage and handling.

111. Impacts on fauna species due to project activities are not envisaged. Wastewater generated from cleaning of solar panels will be collected for sediment removal before discharging to the water bodies, therefore impact on aquatic life is not expected.

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

113. The Project's solar PV panels are expected to have an economic life of 25 years. The suppliers will accept the decommissioned solar PV panels for recycling based on the thin-film technologies and their update. Dismantling of the PV panels will be handled by suppliers that offer the best price for used PV panels in the future. As part of procurement procedures, EA will ensure that supplier has environmental friendly system in place for safe disposal/management of used batteries.

114. The impacts associated with refurbishment of mini-grids would be insignificant as the scope of upgrade would include only replacement of the grid assets such as distribution panels, cables/wires, switchgears etc.

3. Typical Sub-project Benefits

115. Project environmental and socio-economic benefits are expected to far outweigh the Project's adverse impacts given the number of households, community facilities, service institutions and businesses that will be powered, against the relatively minor construction and operation impacts of the proposed solar PV plants and associated facilities.

116. The successful implementation of the 61058 kW of clean energy by direct fuel efficiency or adding energy to the grid from renewable (solar) in about 160 outer islands of Maldives, as part of POISED Project will result in reduction of annual diesel import for power generation equivalent to US\$ 182.92 millions over the project life span of 25 years. This will allow over 30000 households in 160 islands will be supplied with electricity generated from fuel efficient and renewable sources, out of them at least 30 percent households are headed by women. Besides this, schools, hospitals, offices and mosques will also be benefited from the Project.

117. This project directly implements ADB's climate change strategic priority for expanding the use of clean and renewable energy. Maldivian Island's dependency on fossil fuel for energy is total, and therefore very high when compared with global figures. The high dependence on fossil fuels also provides opportunities for significant reductions in greenhouse gas emissions wherever fuel efficiencies and renewable sources of electricity can be brought on-line.

118. Since the project is an off-grid project, if the climate change conditions or frequency of extreme weather increases then the project will be provided with to the resilient to use the energy from solar PV system.

119. The subprojects in over 160 islands all reduce fossil fuel demand either by direct fuel efficiency (by replacement of non-performing DG sets) or adding energy to the grid from renewable (non fossil fuel) sources. The saved fuel has been calculated as net savings in emissions, and these amounts are listed in Table D.1.

Table D.1: Summary of Emission Reductions with proposed Interventions

Target Island	Level of RE penetration (%)	Savings in Diesel Cost over the life span of Project (million US\$)	CO ₂ Emission Reduction (t/year)
On 5 priority islands	Upto 35.0	30.32	7160
On 160 islands	Upto 25.6%	182.920	123184

Source: PPTA Consultant Assessment. (Details estimate are available in Feasibility Study of the individual Island, presented in Road Map)

120. In can be seen from the table that the total savings in fuel cost (US\$ 182.92 millions over the project life span of 25 years based on current energy uses) is substantial and will result in not only GHG emission reduction (123184 ton of CO₂-e per year), but it will also prevent associated pollutants from combustion of fossil fuels entering the regional airshed.

121. In addition, a key element of the project will be capacity building including strengthening of staff from FENAKA/STELCO in the areas of O&M of solar-diesel hybrid energy systems. The Project will also bring positive impacts by reducing gaseous emissions (CO₂, PM Level, NOx, SOx) from running of existing DG sets; reduction in noise from DG sets operations, reduction in land and ground water contaminations caused by spill of oil from DG sets. Overall, at a local level the Project will improve socio-economic conditions of the local communities in the targeted areas and at a national level will help improve the national Gross Domestic Product (GDP).

4. Cumulative Impacts

122. The Project's contribution to significant cumulative biophysical and socioeconomic impacts that are occurring from the range of activities and developments in a defined geographic area/island/atoll will be insignificant due to the small scale and remote locations of sub-projects under the POISED Project.

E. SAMPLE SUB-PROJECTS ASSESSED FOR IEE

1. Type of Sub-Projects

123. The sub-projects assessed for IEE comprised of solar-diesel hybrid energy system on selected five priority islands of Maldives. The sub-projects included in Phase 1 are categorized as environment category B as per ADB SPS requirements. Rapid Environment Assessment (REA) checklists for various components under Phase 1 sub-projects are provided in Appendix 4.

124. The sub-projects will construct and operate hybrid energy systems that include solar power generation units (on ground and roof-top) with a total capacity of 2500 kWp, and addition of new diesel generators on five target islands. The combined capacity of proposed hybrid energy system is 10664 kW. The solar power generation units will consist in a set of solar photovoltaic (PV) modules, power inverters, switchgear, associated protection, control and monitoring equipment's, and associated civil works. The electricity output will be directly fed into existing distribution network of FENAKA / STELCO / island councils for further distribution. Refurbishment of grid mostly by replacement of inefficient grid assets i.e. cables, distribution panels, switchgears etc. is also included as part of interventions in each island.

2. Location of Sub-Projects

125. All the physical components covered under this IEE report as part of proposed POISED project are located in five outer islands of Maldives namely: B. Goidhoo, Lh. Kurendhoo, Th. Buruni, G. Villingili and Addu City. Maldives is a country of South Asia, situated in the Indian Ocean, south-southwest of India. Figure 1 shows the locations of proposed sub-projects on Country map of Maldives.

126. **Goidhoo Island** lies in a small separate atoll along with Fulhadu and Fehendhu. This atoll is oval in shape and small, its greatest length being 17 kilometres. Its geographic coordinates are Latitude 4° 53' North and Longitude 73° 00' east. It has a population of about 800 people in one single urban area. The total surface area is 163.7 Ha and is located 96.2 km from Male and 26.7 km from the Atoll capital. The island has a triangular shape 2.13 km long and 1.58 km wide.

127. **Kurendhoo** is on the southwestern side of Lhaviyani atoll. The island is on the ocean side of the atoll. Its geographic values are Latitude 5° 20,06' North and Longitude 73° 27,87' East. It has a population of about 1900 people in one single urban nucleus that covers most of the land area. The total surface area is 21.3 Ha and is located 129 km from Male and 16.4 km from the Atoll capital. The island has an oval shape 660 m long and 360 m wide.

128. The island of **Buruni** is located to the north of the Kolhumadulu Atoll, and happens to be a typical example of a small island with some reduced yet stable population that is sustained by fishing and farming activity that provides most of basic food demands. The island has a rectangular shape with major distances being 1,450 m by 340 m, a total surface area of 35 Ha and a population of 580 inhabitants. The urbanized area is in the middle and consumes about one third of the total island size while the two third of islands extremes area is undeveloped. Male is about 185 km away from the Island, while the atoll capital is 42.3 km towards the south.

129. **Villingili** is one of the inhabited islands of Gaafu Alif Atoll and it is located on the Northeastern rim of the Huvadu Atoll. Its geographic coordinates are Latitude 0°45' North and Longitude 73° 26' east. It has a population of about 2,460 people in one single urban nucleus. The total surface area is 112.4 Ha from which some 41 Ha have been recently reclaimed. It is situated about 379 km away from Male and the present shape is fairly rectangular with 1,565

m in length by 720 m in width. The old non-reclaimed island surface is mostly urbanized while the new reclaimed area is planned for a dense new urban infrastructure.

130. **Addu City** is located on the south of Maldives, in the most southern atoll. Its geographic values are 0° 40' North Latitude and 73° 08' East Longitude. It has a population of over 23,000 inhabitants, being the second largest habited region. The city is formed by the four districts Hithadhoo, Maradhoo, Maradhoo-Feydhoo, and Feydhoo, all at the southern atoll part, and a fifth community up in the north-east atoll islands not connected to the first four settlements.

131. Figure E.1 shows the location of five sub-projects on the country map. Detailed maps showing locations of individual sub-project/plant sites are provided in Appendix 1.

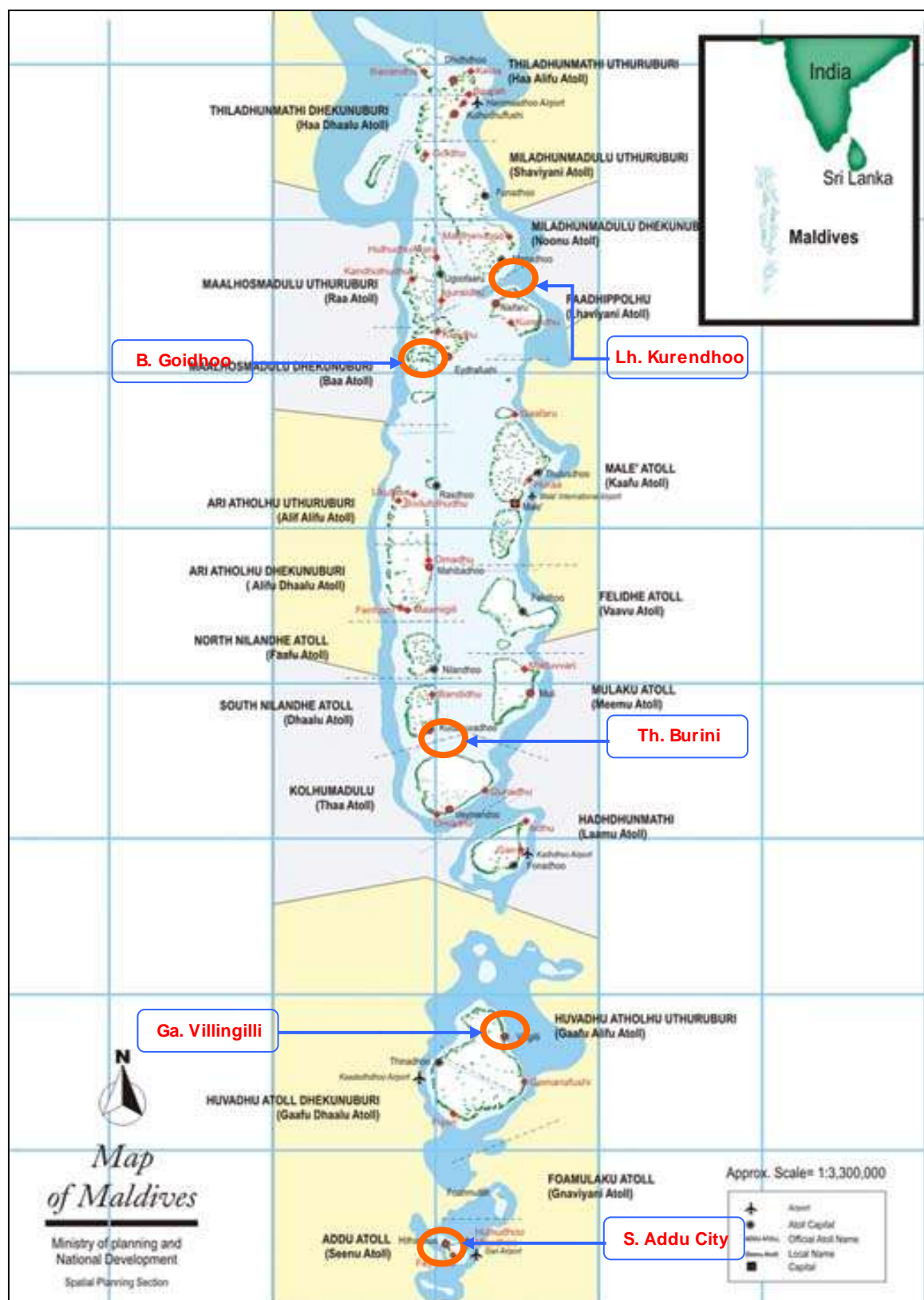


Figure E.1: Locations of Sub-Project on Country (Maldives) Map³

³ Source: <http://www.fao.org/docrep/010/ai387e/ai387e03.htm>

3. Description of the Sub-Projects

132. Under the POISED Project solar-diesel hybrid energy system is proposed in all five islands. Summary of proposed interventions is presented in Table E.1.

Table E.1: Summary of Proposed Interventions on each Island

Proposed System	Target Island / Proposed capacity (kW)					
	Goidhoo	Kurendhoo	Buruni	Villingilli	Addu City	Total
Diesel	160	254	100	800	6850	8164
Solar	200	300	100	300	1600	2500
Total	360	554	200	1100	8450	10664

133. A combined capacity of 10664kW will be installed in selected five island of which 8164kW is diesel generation, and 2500 is Solar PV system. Diesel generation would be added to the existing generation system by installing additional generators in existing power plants in each island whereas solar energy generation would be new addition. Solar generation would be mainly by installing solar PV panels (on-ground and roof-top of public buildings). Besides this, Li-Ion based battery storage system will also be installed in each Island as part of hybrid energy system. The electricity generated would be directly fed into existing mini-grids managed by FENAKA. Refurbishment of grid will also take place mostly by replacing inefficient grid assets such as distribution panels, cables, switchgears etc.

134. The sub-projects will require about 37500 sq.m (3.75 hectares)⁴ area mainly to install 2500 kWp capacity of solar power system in five islands. The sites for solar PV panel installation are selected as open areas/plots for on-ground/ground mounted installations and roofs of public buildings i.e. hospitals, schools, island council buildings etc. for rooftop solar PV panel installations. The proposed sites for ground installations are open areas with flat topography and free from any restrictions. Land use being mostly rural (non-residential) and little vegetative cover. There are no sensitive areas in and around these proposed sites. The land proposed for solar PV installations belonging to the government and it will be leased by the Project. Diesel generators will be installed in existing powerhouse therefore there is no additional land requirements for this. Table E.2 below summarizes the island wise plant size and summary of existing features and proposed interventions.

Table E.2: Summary of Existing Features and Proposed Interventions

Feature	Goidhoo	Kurendhoo	Buruni	Villigili	Addu City
Atoll /Locality	South Maalhosmadulu (B)	Faadhippolhu (Lh)	Kolhumadulu (Th)	Ga Atoll (Ga)	Addu Atoll (S)
Geographical Location	Latitude 4°53' north and Longitude 73°00' east	Latitude 5°20,06' north and Longitude 73°27,87' east	Latitude 2°33' north and Longitude 73°6' east	Latitude 0°45' north Longitude 73°26' east	Latitude 0°40' north and Longitude 73°08' east
Distance from Male (km)	96.2	129.0	184.9	580.0	533.7

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

Feature	Goidhoo	Kurendhoo	Buruni	Villigili	Addu City
Proposed Interventions	Hybrid Energy System consist of: <ul style="list-style-type: none"> • Diesel Generator: 160kW (New DG set 1x160 kW) • Ground-mounted PV: 200kW • Li-Ion based battery storage system: 84kWh and 223 kW. • Refurbishment of mini-grid 	Hybrid Energy System consist of: <ul style="list-style-type: none"> • Diesel Generators: 254kW (existing 104 kW+ new 150 kW), • On ground PV: 300 kW and • Li-Ion based battery storage system: 84 kWh and 223 kW. • Refurbishment of mini-grid 	Hybrid Energy System consist of: <ul style="list-style-type: none"> • Diesel Generator: 100kW (New DG set 1x100 kW) • Roof-top PV: 100kW • Li-Ion based battery storage system: 41kWh and 111 kW. • Refurbishment of mini-grid 	Hybrid Energy System consist of: <ul style="list-style-type: none"> • Diesel Generators: 800kW (new 1x500kW + new 1x300kW) • Rooftop PV: 300kW • Li-Ion based battery storage system: 84kWh and 223 kW. • Refurbishment of mini-grid 	Hybrid Energy System consist of: <ul style="list-style-type: none"> • Diesel Generators: 6,850 kW-7 existing DG sets (3x1000 kW + 3x750 kW + 1x1600 kW) • Distributed ground and roof mounted PV (1600 kW) without battery storage system • Refurbishment of mini-grid
Location of proposed sites for interventions	Plot located west of the school (G1) on Goidhoo Island.	Plot besides existing harbour (B2) on Kurendhoo Island	Rooftop of school building (B3, B4, B5) and ground space adjacent to school (B1 and B2) on Buruni Island.	Rooftop of Hospital and School Buildings on Villigili Island	Rooftop and ground installations. <ul style="list-style-type: none"> – 600kW at Convention Center (on roof) – 1000kW at Stadium area (on ground)
Ownership of proposed land	Island Council / Government	Island Council / Government	Island Council / Government	Island Council / Government	Addu City Council / Government
Land requirement	3000 sq.m. (G1 –open area located west of the school)	4500 sq.m. (open ground next to harbor)	1500 sq.m. (rooftop of school buildings and open space)	4800 sq.m. (rooftop of school and hospital building)	24000 sq.m. (rooftop of various buildings)

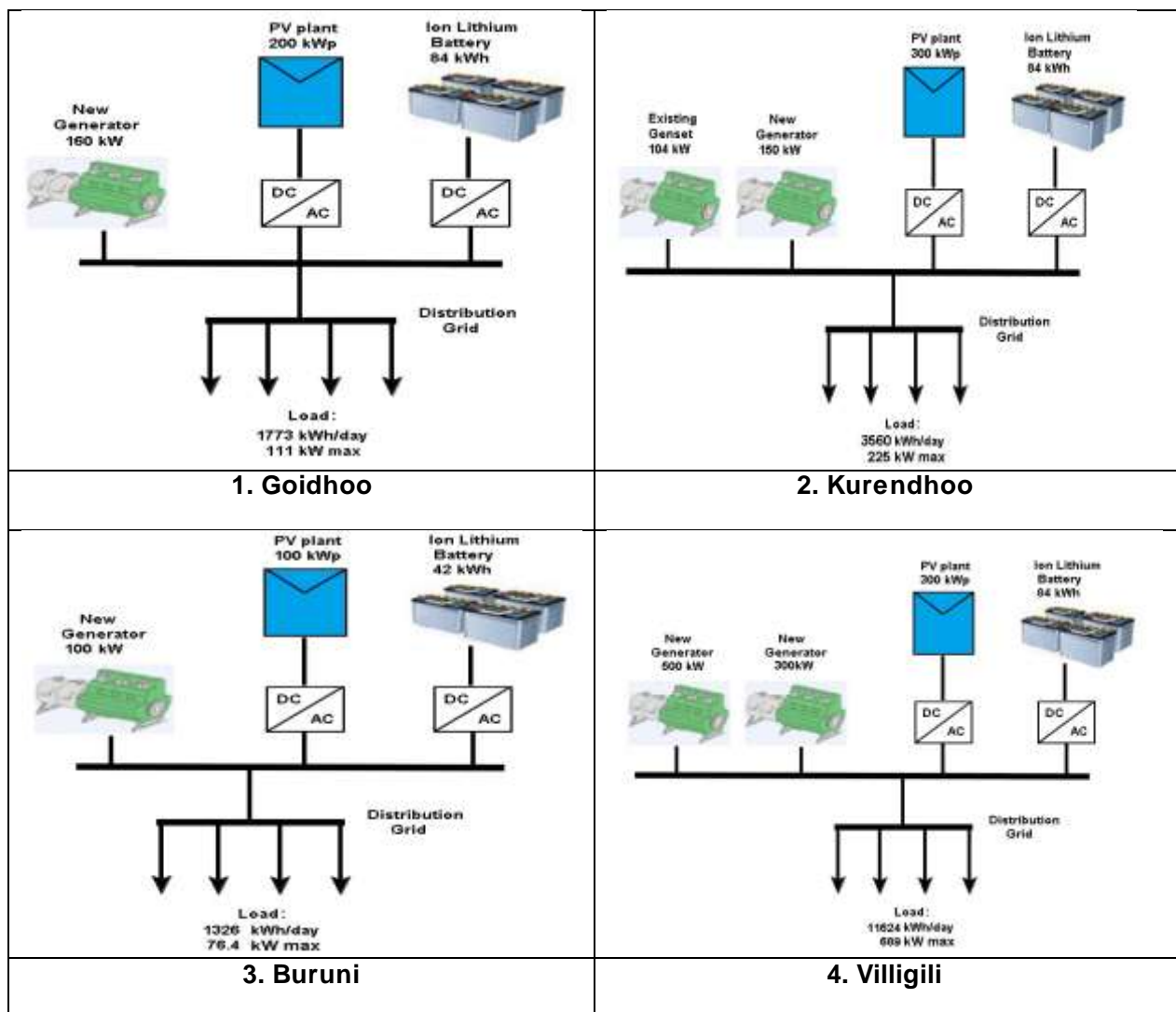
135. The main activities under the sub-projects are summarized below:

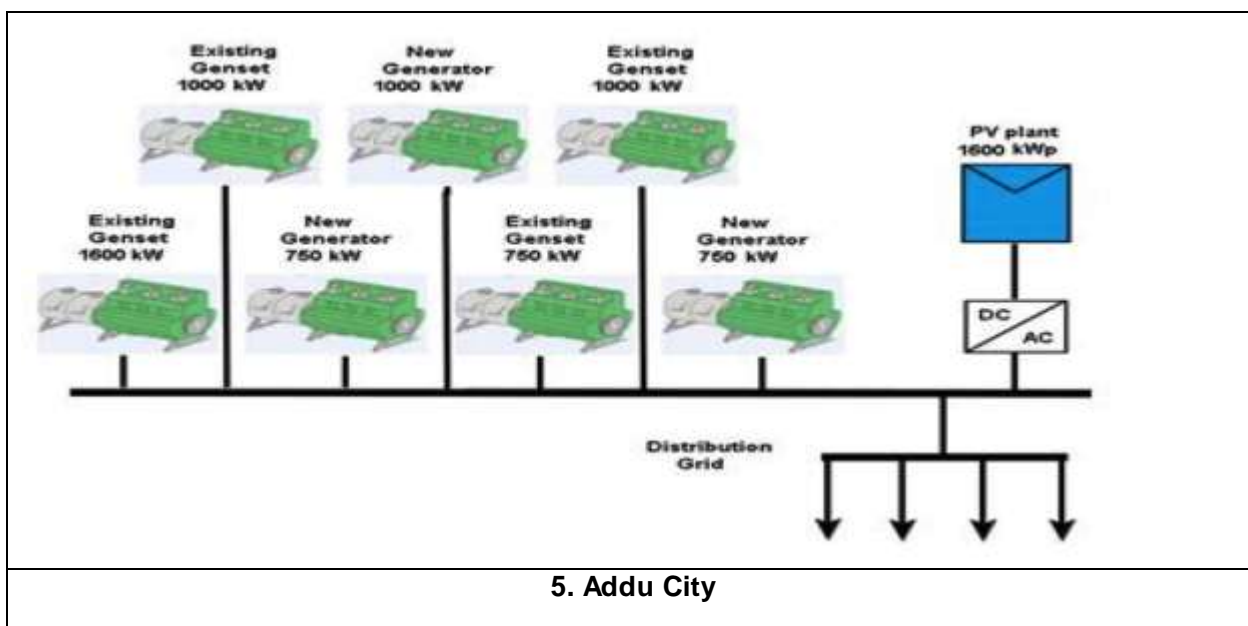
- Installation and commissioning of a 360kW capacity hybrid energy system consist of a new diesel generator (160kW), ground-mounted solar PV system (200kW), and Li-Ion based battery storage system (84kWh and 223 kW) in Goidhoo Island.
- Installation and commissioning of a 554kW capacity hybrid energy system consist of two diesel generators (existing 104kW and new 150kW), on-ground solar PV system (300kW), and Li-Ion based battery storage system (84kWh and 223 kW) in Kurendhoo Island.
- Installation and commissioning of a 200kW capacity hybrid energy system consist of a new diesel generator (100kW), rooftop and ground-mounted solar PV system (100kW), and Li-Ion based battery storage system (40kWh and 111 kW) in Buruni Island.
- Installation and commissioning of a 1100kW capacity hybrid energy system consist of two new diesel generators (500kW and 300kW), rooftop solar PV system (300kW), and Li-Ion based battery storage system (84kWh and 223 kW) in Villigili Island.

- Installation and commissioning of a 8450kW capacity hybrid energy system consist of seven existing diesel generators (3x1000kW, 3x750kW and 1x1600kW), distributed rooftop and ground solar PV system (1600kW) without battery storage system in Addu City.
- Refurbishment of existing mini-grids by replacing inefficient grid assets such as cables, distribution panels, switchgears etc.
- Capacity building of executing and implementing agencies, solar electricity committees in planning and customers in managing the electricity services.
- Efficient project management services.

Figures E.3 show proposed configurations of hybrid energy systems in target five Islands as part of this Project.

Figure E.2. Proposed System Configurations in Targeted Five Islands





4. Description of the Environment

4.1 Physical Resources

4.1.1 Physiography, Land use and Demography

136. Maldives is a country of South Asia, situated in the Indian Ocean, south-southwest of India. Geographically it lies between a latitude of 07°06'30" north to 00°41'48" south and between longitude of 72°32'30" east to 73°45'54" east, west side of India and Sri Lanka. In total there are assumed to be 1196⁵ islands and islets with a combined land area estimated to be in the region of 300 sq.km. The Islands are of extremely low elevation with average 1.8 m above mean sea level.

137. The Maldivian archipelago comprises a 860 km long, north-south orientated, chain of atolls forming a single chain that opens in the centre to form a double-chain of up to 130 km in width. In all, there are 23 atolls and 3 solitary islands that comprise this isolated nation. Strictly speaking, in oceanographic terms, the Maldives actually comprises 16 atolls, 5 oceanic faros and 4 oceanic platform reefs. The atolls found here are among the largest found on earth: with Thiladhunmathee-Miladhunmadulu (3,680 km²) and Huvadhoo (3,200 km²) being the worlds largest and second largest, respectively. They are only eclipsed in overall size by sunken atoll formations such as the 13,000 km², and largely submerged, Great Chagos Bank.

138. The islands, reefs and lagoons cover an area of around 21,000 km², with some 4,500 km² of reefs. Of these reefs, 538 are rim and oceanic reefs, covering 3,700 km² and 1,500 are patch reefs occurring within the lagoons, covering 791.92 km². Islands are, on average, very small — the vast majority being less the 0.5 km² in area. The largest islands include: Gan (5.166 km²) on Hadhdhunmathee atoll, Hithadhoo (4.673 km²) on Addu City, Fuvahulah (4.2 km²), Isdhoo (2.937 km²) on Hadhdhunmathee atoll, Kaashidhoo (2.765 km²), Gan on Addu atoll (2.649 km²), Gan on Huvadhoo atoll (2.636 km²), Hanimaadhoo (2.595 km²) on Thiladhunmathee-Miladhunmadulu atoll, Baarah (2.488 km²) on Thiladhunmathee-Miladhunmadulu atoll and Filladhoo (2.256 km²) also on Thiladhunmathee-Miladhunmadulu atoll.

⁵ It varies from document to document. In some documents it is mentioned as 1192 islands.

139. The interventions proposed under POISED project are located in five outer Islands namely: Goidhoo, Kurendhoo, Buruni, Villingili and Addu City.

140. **Goidhoo Island** is located at Baa atoll. It lies in a small separate atoll along with Fulhadu and Fehendhu. This atoll is oval in shape and small, its greatest length being 17 kilometres. Its geographic coordinates are Latitude 4°53' North and Longitude 73°00' east. It has a population of about 800 people in one single urban area. The total surface is 163.7 Ha and is located 96.2 km from Male and 26.7 km from the Atoll capital. The island has a triangular shape 2.13 km long and 1.58 km wide. As most of the islands of the Maldives are geographically isolated by large bodies of seawater, the Goidhoo is also separated from other islands by sea. Closed inhabited Island is Fehendhoo, about 1.6km west of Goidhoo. Goidhoo harbor is located at the northern side of the island. Water bodies exist within the Island, making the island unique. These water bodies were protected by the Environmental Protection Agency (EPA) for ecological significance. During harbour development process, small land area is reclaimed near one of the water bodies but still connected to the open sea via channels. Sandy beaches cover most of the coastal area with some degree of erosion around north western and north to north eastern side of the island.

141. The proposed site for PV installation is located next to the harbor on a vacant ground on northeast part of the Island. The project would need about 4500 sq.m. area from this plot. This is an open land facing ocean on one side and buildings on backward side. Other two sides are open to harbor. The land for proposed site belongs to government. The terrain is flat and soil is sandy clay. There is no vegetation on the proposed plot except 8 coconut trees. There is no encroachment on the proposed land.

142. **Kurendhoo** is on the south-western side of Lhaviyani atoll. The island is on the ocean side of the atoll. Its geographic values are Latitude 5°20,06' North and Longitude 73°27,87' East. It has a population of about 1900 people in one single urban nucleus that covers most of the land area. The total surface area is 21.3 Ha and is located 129 km from Male and 16.4 km from the Atoll capital. The island has an oval shape 660 m long and 360 m wide. Kurendhoo is also surrounded by sea and has sandy beaches around the island except the north and south ends of the island, where coastal area has been modified and some land is reclaimed using dredged sand when the harbour was dredged. Old mosque and graveyard is located on the northern end of island.

143. The proposed site for PV installation is located next to the harbor on a vacant ground on northeast part of the Island. The project would need about 4500 sq.m. area from this plot. This is an open land facing ocean on one side and buildings on backward side. Other two sides are open to harbor. The land for proposed site belongs to government. The terrain is flat and soil is sandy clay. There is no vegetation on the proposed plot except 8 coconut trees. There is no encroachment on this land.

144. The island of **Buruni** is located to the north of the Thaa Atoll, and happens to be a typical example of a small island with some reduced yet stable population that is sustained by fishing and farming activity that provides most of basic food demands. The closest inhabited island is Vilufushi. The island has a rectangular shape with major distances being 1,450 m by 340 m, a total surface of 35 Ha and a population of 580 inhabitants. The urbanized area is in the middle and consumes about one third of the total island size while the two island extremes are undeveloped. Male is about 185 km away from the Island, while the atoll capital is 42.3 km towards the south. Buruni is also surrounded by sea and has sandy beaches around the island. The harbor is located on the southern side of the island, and the land area on this side has been modified from dredged materials.

145. The proposed site for PV installation is the school complex and adjacent open land on central part of the Island. It would need about 1500 sq.m. area for PV installation. For rooftop installation, schools buildings will be used whereas for ground mounted installation, part of the football ground

(which is now abandoned) adjacent to the school will be used. The land use around proposed site is residential buildings on one side and open areas on other side with thin vegetation. The terrain is flat. About 9 trees (coconut and local invasive trees) exist in the school premises. Shoreline is about 500m away from the proposed sites. There are no other encroachments on the proposed site.

146. **Villingili** is one of the inhabited islands of Gaafu Alif Atoll. Located on the North-eastern rim of the Huvadu Atoll. Its geographic coordinates are Latitude 0°45' North Longitude 73°26' east. It has a population of about 2,460 people in one single urban nucleus. The total surface is 112.4 Ha from which some 41 Ha have been recently reclaimed. It is 379 km away from Male and the present shape is fairly rectangular with 1,565 m in length by 720 m in width. The old non-reclaimed island surface is mostly urbanized while the new reclaimed area is planned for a dense new urban infrastructure.

147. The proposed sites for PV installation are located on several places on the Villingoli Island. The proposed sites are rooftop of school buildings and hospital building. The project would need about 4800 sq.m. area on rooftop of these buildings. These buildings are located in residential areas mostly on central part of the Island. Trees exist next the buildings, which may need trimming to avoid shading. The terrain is flat and there are no historical or cultural sites around the proposed sites.

148. **Addu City** is located on the south of Maldives, in the most southern atoll. Its geographic values are 0°40' North Latitude and 73°08' East Longitude. It has a population of over 23,000 inhabitants, being the second largest habited region. Addu City refers to most southern atoll, consisting of 6 inhabited islands, where four of the inhabited islands (Feydhoo, Maradhoo-Feydhoo, Maradhoo and Hithadhoo) are physically connected by one single road, called Addu Link Road. This road also extends to the Gan Island where the Gan International Airport is placed. The other two inhabited islands (Hulhudhoo and Meedhoo) are separated from the other 4 islands by sea. Addu City is located south of the equator about 535 km from Male' City. On Addu City, the project sites are located in Feydhoo, Maradhoo and Hithadhoo islands. Hithadhoo Island is the second largest island in the Maldives with a surface area of 525.7 hectares, measuring about 8.6 km in length and 1.8 km wide at its widest point. Total land area of Maradhoo is 74.90 hectares, measuring 1.5km in length and 0.5km in width. On the other hand, total land area of Feydhoo is about 50 hectares. It is 1.5km in length and 0.56km in width.

149. The proposed site for PV installation is located on various locations on Addu City. The site for rooftop installation is a Convention center which is located on southern part of the Hithadhoo Island and periphery of the football ground will be used for ground mounted installations. The land use around convention center is open with bushes and thin vegetation whereas land use around football field is residential. The project would need about 2400 sq.m area for solar PV installations. There are no places of historical or cultural importance around the proposed sites. Coastline is about 500-800 m away from these two sites.

150. Table E.4 presents the physiographical features of the islands that form the Project area.

Table E.4: Physiographical Features of the Proposed Sites

Feature	Goidhoo	Kurendhoo	Buruni	Villigili	Addu City
Atoll /Locality	South Maalhosmadulu (B)	Faadhippolhu (Lh)	Kolhumadulu (Th)	Ga. Atoll (Ga)	Addu Atoll (S)
Atoll Capital	Eydhafushi	Naifaruru	Veymandoo	Villigili	Hithadhoo
Total Land Area (Ha.)	163.7	21.3	35.0	98.0	971.5
Population (2006)	503	1218	1130	1976	17862

Feature	Goidhoo	Kurendhoo	Buruni	Villigili	Addu City
Population Density (Nos./Ha)	03	57	32	20	19
Number of Households	77	235	182	346	>2200
Geographical Location	North-central Maldives between Latitude 4°53' north and Longitude 73°00' east	South-western side of Lhaviyani atoll between Latitude 5°20,06' north and Longitude 73°27,87' east	North of Thaa atoll between Latitude 2°33' north and Longitude 73°6' east	North-eastern rim of Ga. Atoll between Latitude 0°45' north Longitude 73°26' east	Most southern part of Maldives between Latitude 0°40' north and Longitude 73°08' east
Distance from Male (km)	96.2	129.0	184.9	380	533.7
Location of proposed sites for interventions	Plot located west of the school (G1) on Goidhoo Island.	Plot besides existing harbors (B2) on Kurendhoo Island	Roof-top of school building (B3, B4, B5) and ground space adjacent to school (B1 and B2) on Buruni Island.	Rooftop of Hospital and School Buildings on Villigili Island	Rooftop and ground installations. – 600kW at Convention Center (on roof) – 1000kW at Stadium area (on ground)
Ownership of proposed land	Island Council / Government	Island Council / Government	Island Council / Government	Island Council / Government	Addu City Council / Government
Land requirement	3000 sq.m. (G1 –open area located west of the school)	4500 sq.m. (open ground next to harbor)	1500 sq.m. (roof-top of school buildings and open space)	4800 sq.m. (roof top of school and hospital building)	24000 sq.m. (roof top of various buildings)
Land use in and around proposed site for solar power plant site	Open land surrounded by school building on one side and vegetation on other two sides and road on one side.	Open land with facing ocean on one side and buildings on backward side. Two sides are open to harbor other sides.	Residential buildings on one side and open areas on other side with thin vegetation.	Residential area.	Residential land use.
Terrain of proposed site	Plain	Plain	Plain	Plain	Plain
Distance from Coastline	1 km	1 km	0.5 km	1 km	0.5 km

4.1.2 Meteorology and Climate

151. The climate of Maldives is tropical and monsoonal. Two seasons dominate Maldives' weather: the dry season (December to April) associated with the northeast monsoon and the rainy season (May to October) brought by the summer southwest monsoon. The southwest monsoon sees the arrival of heavy rain and sometimes very windy weather, while the northeast monsoon is dry and calm. Rainfall is at it highest in the south, where 1,924 mm may fall; the north is slightly drier with an annual rainfall of 1,786 mm. The annual rainfall averages 1,800 millimeters (100 in) in the north and 2,200 millimeters (150 in) in the south.

152. The location of the Maldives near the equator and surrounded by sea means that there is very little temperature variation throughout the year. The temperature of Maldives ranges between 24 and 33 °C (75.2 and 91.4 °F) throughout the year. Annual average daily maximums of 30.4°C and average daily minimums of 25.9°C are typical. Although the humidity is relatively high, the constant sea breezes help to keep the air moving.

153. **Goidhoo Island** has an equatorial climate with high humidity and temperature between 26°C and 30°C all year. The country is influenced by the monsoon flows. This Island experiences a stronger northeast monsoon from December through April than areas located to the north and south of the archipelago. The southwest monsoon lasts from May through October, November being a transition month with characteristics of both monsoon flows. The average annual rainfall in Island is 2,000 mm. There is a low range of temperature and humidity during the year. Mean temperature has a variation range of about 3°C (27°C-29°C) and the variation range of the mean humidity is about 4% (75%-79%). The average minimum humidity is 65% and average high 88%. The average minimum temperature is 26°C and the average maximum temperature is 30°C.

154. Climate of **Kurendhoo** Island is tropical with warm and humid conditions year round tempered by the monsoon that affects the region during the summer months.

155. **Buruni** has an equatorial climate with high humidity and temperature between 27°C and 29°C all year. The country is influenced by the monsoon flows. Buruni is located in the South –Central (latitude 2°N to 3°N) part of Maldives. In this area the northeast monsoon and west monsoon are weaker than at the north of the Male area, where the wind potential is higher. Mean temperature varies about 3°C (27°C-29°C) and mean humidity about 3% (75%-78%). The average minimum humidity is 65% and average maximum value 89%. The average minimum temperature is 26°C and the average maximum temperature is close to 30°C.

156. Similar to Buruni, **Villingili** also has an equatorial climate with high humidity and temperatures between 26°C and 30°C all year. The country is influenced by the monsoon flows. Villingili is located in the South of Maldives. Mean temperature varies about 3°C (27°C-29°C) and mean humidity about 5% (75%-80%). The average minimum humidity is 66% and the average maximum value 89%. The average minimum temperature is 26°C and the average maximum temperature is close to 30°C.

157. **Addu City** has an equatorial climate with high humidity and temperatures between 26°C and 30°C all year. The country is influenced by the monsoon flows. Addu City is located in the South of Maldives. Mean temperature varies about 3°C (27°C-29°C) and mean humidity about 4% (74%-78%). The average minimum humidity is 66% and the average maximum value 88%. The average minimum temperature is 26°C and the average maximum temperature is close to 30°C.

158. The Maldives is outside the main area of tropical cyclones and therefore gales are uncommon and cyclones are very rare. However, during the southwest monsoon season strong winds and storms may hit the archipelago and can cause severe damage. On average, it is reported that thunderstorms hit the Maldives on 23 days per year and strong winds on 12

days per year. In May 1991 tidal waves, created by violent monsoon winds, caused damage to thousands of houses, jetties and piers and flooded arable land with seawater.

159. A climate risk profile for Maldives⁶ 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 Maldives indicate that sea level is likely to have increased by 36 centimeters and the frequency of severe short sea level rise resulting from storm surge (2.2 meters above mean sea level) will increase from a one in 580-year event to a one in 5-year event by 2050. The project will provide solar PV systems with resilience to climate change through compact and preassembled systems resistant to marine environment.

160. Noise is an important environmental attribute for diesel generation projects as noise is generated from operation of DG sets. Data on measured noise levels is not available for the proposed sites and surroundings because currently EPA is in the process of establishing the noise levels at Island level. Major contributors to the ambient noise levels are commercial and industrial activities and vehicular traffic. At project sites and surroundings noise is expected within the stipulated limits of World Bank guidelines limits for Rural and Residential areas (55 dB(A) during day, and 45 dB(A) during night). This is because commercial activities and traffic around project site are very less and there is no industrial activity.

161. Background noise levels in isolated villages will generally be between 35-45 dB(A) across the day. At 50-60 m downwind of an operating DG sets (within powerhouse) the noise will be around 40-45 dB(A), equal to or less than the night-time guideline limit of 45 dB(A). Since there are no houses within 80 m of the existing powerhouses, impacts due to noise from DG sets is negligible.

4.1.3 Geology, Soils and Mineral Resources

5 The soils of the Maldives are geologically young and consist of substantial quantities of the unweathered coral parent material, coral rock and sand. In most of the places, soils are coarse in texture and shallow in depth with a top layer of brown soil (0 to 40 cm in depth) followed by a transition zone on top of the underlying parent material of coral reef limestone. In some low-lying areas and areas subjected to significant mechanical breakdown from human activity, fine deep soils are found with accumulated deposits of clay. In a lagoon environment (locally called kulhi) the depth of the clay may be substantial due to the accumulation of material from marine and biological sources over a long period of time. In many places, top layers of the soils have a weakly developed structure and at times a 30 cm thick hard-pan layer cemented with calcium carbonate is present, preventing penetration of the roots of most plants except large trees. The water-holding capacity of the soil is very poor due high porosity and very high infiltration rates.

6 The soils of the Maldives are generally alkaline with pH values between 8.0 and 8.8. This is mainly due to the presence of excess calcium and, soils containing higher levels of humus, as in depressions and lagoons, are less alkaline. The soils are generally poor and deficient in nitrogenous nutrients, potassium and several micronutrients particularly iron, manganese and zinc. Though the phosphorus content of the soils is high it is present mostly in the form of calcium phosphate and, thus, remains unavailable to plants.

4.1.4 Water Resources

⁶ Climate Risk Profile of Maldives prepared by MEE, 2006, and Disaster Risk Profile of Maldives prepared by UNDP, 2006

7 There are no rivers or streams in any of the islands of Maldives, and only a few wetlands or freshwater lakes locally known as Kulhi exist in a few islands. The country's freshwater resources exist as groundwater in basal aquifers, generally unconfined in nature and extending below sea level in the form of a thin fresh water lens. They are vulnerable to saline intrusion owing to the freshwater-seawater interaction and need to be carefully managed to avoid over-exploitation.

8 Outer Islands depend mainly on rainwater for drinking and cooking and groundwater for most other domestic needs. Rainwater is tapped from roofs and collected and stored in various types of tanks. All the islands have individual household as well as community tanks. However, the situation is different in the capital island Male' where the whole population has access to desalinated water distributed through a piped network. In Male' it is common for people to use desalinated water for drinking as well as for domestic purposes due to high contamination of groundwater. Male' people use bottled water for drinking these days. As in Male', many islands are now facing groundwater problems caused by human activities such as over abstraction and sewage pollution.

9 Although Maldives has few surface water resources, in the form of freshwater lakes known as kulhis, and although rainwater is harvested and stored in household and community rainwater tanks, the vast majority of the country's water resources are stored as groundwater. The country's islands are very low-lying – there is no point in the country higher than 3m above sea level – and the water table is found at very shallow depths – usually no more than 2m below the ground surface. In addition, the freshwater lens on each island is usually very thin.

4.2 Ecological Resources

4.2.1 Flora and Fauna

10 Flora and fauna of Maldives is limited in diversity. There is a wide variety of vegetation types throughout the islands of Maldives. Indigenous vegetation includes a variety of root crops, fruit trees such as mangoes, breadfruit, and a variety of citrus, and native vegetables and grasses. In the settled areas of the atolls, much of the native vegetation has been cleared for coconut plantations, home gardens, villages, and commercial crops. A significant percentage of the country is now under coconut and *Panicum* grassland.

11 The coral substance of the Maldivian islands and their salinity have resulted in the non-existence of dense forests. While thick growths of almond are restricted to larger islands; coconut palms, breadfruit, screwpines, banyan, and lesser vegetation are omnipresent. Mangroves thrive in brackish waters and inland depressions, and different species of grass and sedge grow along the shorelines. Fruits including bananas, papaya, watermelons, mangoes, pineapples, jujubes, custard apples, and lime; and vegetables like green chilli, small onions, pumpkins, cucumber, tomatoes, brinjals, cabbages and gourds are cultivated. Cereals such as millet and maize; and roots and tubers like taro, yam, sweet potatoes, and cassava are also grown domestically. Tropical flowers are found in abundance, either in the wild or cultivated in gardens. *Hibiscus tiliaceus*, *Cordia subcordata*, *Thespesia populnea*, and *Calophyllum inophyllum* are among a large variety of local timber grown for domestic consumption. The casuarina (*Casuarina equisetifolia*), a large, fast-growing evergreen, is being promoted by the Ministry of Agriculture as excellent windbreakers to shelter weaker plants from the damaging effects of sea spray.

12 The sea surrounding the Maldives unfolds an exotic realm of marine life. Innumerable species of possibly all colours, shapes, and sizes – from 14-meter-long whale sharks to microscopic plankton, from gentle hawksbill turtles to the stunningly beautiful yet deadly scorpionfish – can be found right from the tepid waters of the ocean surface to the cold, dark

abyss thousands of kilometers below. The coral reefs encircling the islands themselves offer a cornucopia of spectacular underwater life. Even the sandy shores are home to molluscs like razor shells and clams, many kinds of worms, and scavenging crabs. Of the 100-odd species of birds found in the Maldives, around a fifth of them are residents, the rest being migratory. As in other oceanic islands, sea birds are prolific, with Laridae (gulls and terns), the most conspicuous. Graceful aerialists, the terns are especially well-known for their spectacular transcontinental migrations. A non-pelagic species of this highly gregarious family is the beautiful white, or fairy tern, found in the southernmost atoll of Seenu. Noddy terns, noted for their exceptional tameness are common throughout the archipelago. Wading shore birds such as plovers, snipes, and sandpipers concentrate along shorelines taking crustaceans, or probing for marine worms and fleas. Great and lesser frigate birds, masters of aerial piracy; and perhaps the most impressive of the lot, the truly pelagic tropic birds, typically breed on the numerous uninhabited islands. The large grey heron and the rarely seen Maldivian little heron are among the 13 recorded species of Ardeidae (herons and bitterns) found here. While rose-ringed parakeets, one of the noisiest residents, and kestrels are confined to the central atoll of Kaafu; crows, parasitic koels, and white-breasted waterhens are ubiquitous, found on almost all the islands. The limited mammalian population includes giant fruit bats (flying foxes), rats, and tree shrews (Tupaia). Cats and goats are the only domestic animals. Of snakes, only two species are known to exist. Rest of the fauna is made up of lesser animals such as lizards, including the widely distributed agamids and skinks; scorpions; and insects dominated by beautiful butterflies, paper wasps, and large rhinoceros beetles.

13 The marine environment is rich with 248 different species of corals over 1100 species of demersal and epidemic fish fauna including sharks, 285 species of marine algae, 187 species of coral over 400 species of mollusks, over 145 species of crabs, 48 species of shrimps and 83 species of echinoderms exists. Among the many marine families represented are *Pufferfish, Fusiliers, Jackfish, Lionfish, Oriental Sweetlips, reef sharks, Groupers, Eels, Snappers, Bannerfish, Batfish, Humphead Wrasse, Spotted Eagle Rays, Scorpionfish, Lobsters, Nudibranches, Angelfish, Butterflyfish, Squirrelfish, Soldierfish, Glassfish, Surgeonfish, Unicornfish, Triggerfish, Napoleon wrasses, and Barracudas*.

4.2.2 Forests and Protected Areas

14 The islands of Maldives are small, low lying and isolated with limited natural vegetation that is distributed relatively uniform following the pattern of salt tolerant bushes at the edge and larger trees and coconut palms further inland. Native plants of the islands can be ecologically grouped into five categories of vegetation (Adams 1988 cited in P4SD, 2011). They are *beach pioneers, littoral hedge, sub-littoral thicket, climax forest and mangrove and swamp forests* (P4SD, 2011).

15 In terms of terrestrial environment, the forest area of Maldives is 1000 ha⁷. Number of plants ranges from 583 vascular plant species out of which 323 are cultivated and 260 are natively or naturalized. These plants include 214 flowering plants and 5 ferns and over 300 species may be used in traditional medicine. Terrestrial mammalian fauna of the Maldives is limited and very little of the local terrestrial invertebrate fauna are documented. Additionally 13 mangroves belonging to nine genera have been identified. Associated with mangroves are 6 species of plants and 37 species of fungi.

16 Maldives' protected area network consists of national parks, terrestrial and marine parks and reserve protected areas. The country has declared 39 protected areas⁸ of which 25 are marine protected sites, 9 marine species are protected from fishing or collecting and 23 birds

⁷ Estimated by Global Forest Resources Assessment of 2005. However, the Agricultural Development Master Plan (2006-2020) of the Maldives estimated the forest areas being 3716ha.

⁸ State of Environment Report of Maldives, 2011

are also protected. Table 6 present the list of protected area of Maldives. None of these areas has been assigned an IUCN category. The terrestrial protected area encompasses a total area of 317.1 ha, which represents less than 2% of terrestrial cover.

Table E.5: List of Nationally Designated Protected areas of Maldives

Designation / Name	Atoll
Marine Protected Area	
Vilingili Thila	North Maalhosmadulu Atoll
Dhigali Haa/Horubadhoo Thila	South Maalhosmadulu Atoll
Fusheevuru Thila	Faadhipolhu Atoll
Kureddhoo Kandu Olhi	Faadhipolhu Atoll
Makunudhoo Kandu Olhi	Male' Atoll
Rasfaree (and enclosed reef)	Male' Atoll
Thamburudhoo Thila	Male' Atoll
Gaathugiri/Ad'dhashugiri	Male' Atoll
Giraavaru Kuda Haa	Male' Atoll
Dhekunu Thilafalhuge	Male' Atoll
Kollavaanee	Male' Atoll
Emboodhoo Kandu Olhi	Male' Atoll
Guraiddhoo Kandu Olhi	Male' Atoll
Lankan Thila	Male' Atoll
Mayaa Thila	Ari Atoll
Orimas Thila	Ari Atoll
Mushimasmigili Thila	Ari Atoll
Kudarah Thila	Ari Atoll
Karibeyru Thila	Ari Atoll
Faruhuruvalhibeyru	Ari Atoll
Miyaru Kandu	Ari Atoll
Vattaru Kandu	Ari Atoll
Lhazikuraadi	Mulaku Atoll
Filitheyo Kandu	North Nilandhe Atoll
Fushi Kandu	South Nilandhe Atoll
Eidhgali area	Adhoo Atoll
Angafaru	
Hanifaru	
South Ari Atoll	
B. Goidhoo Marshy Area	
Corbin wreck area	
B. Bathala	
B. Mendhoo	
Mangrove Protected Area	
Huraa	Male' Atoll
Hithadhoo (Eidhgali Kulhi)	Adhoo Atoll
Island Protected Area	
Hurasdhoo	Ari Atoll dhekunuburi
Olhuqiri	Maalhosmadulhu dhekunuburi
Hithaadhoo	Huvadhoo Atoll uthuruburi

Source: Environmental Protection Agency of Maldives, State of Environment Report 2011

4.2.3 Ecology of the Sub-Project Site Locations

17 The sites proposed in five sub-projects, for interventions under POISED project are away from these protected areas. Among the five islands where project will be implemented only Hithadhoo (Addu City) has protected area i.e. *Eidhgali Kulhi*, which is a mangrove protected area. It was declared protected by EPA in 2004. It is situated on the northern end of Hithadhoo. The area is locally known as Odessa and most significant environment of this area is found to be the coral reef system especially on the eastern side. Local community uses the area for various purposes such as recreation (picnics), fishing, farming, and in some cases

collect resources for traditional medicines. The area provides habitats to about 31 species of birds, most of them believed to be migratory birds and 24 plant species. Local, regional or national significant ecologically important sites do not exist in Feydhoo or Maradhoo. However, in Feydhoo there are few semi-wet areas known as “olhu”. These semi-wet areas are used for growing yam. Kuredhi, Hirundhu, magoo and coconut trees are common types of vegetation found in the three islands. Residential areas in Hithadhoo contain a large variety of introduced species usually planted in household backyards. The main road of Feydhoo contains some medium sized trees sparsely distributed on the southern half of the island, mainly planted by individuals and Addu City Council for aesthetic purposes. Lot of mango and banana trees exists in Feydhoo, grown in household backyards.

18 In Goidhoo, large area of the Island was covered with forest vegetation distributed all along the island. The most dominant type of vegetation on the island was coconut groves. Vegetated area is larger than the residential area. Some area of the island is used for agricultural purpose where land plots are allocated for community needs for agricultural purpose. Both vegetables and fruits are grown on the island. Banana, papaya and mango are some of the fruit trees being cultivated in Goidhoo. During field visit, swampy areas were observed and the water bodies locally known as “kulhi” were observed which provides habitats to fish, birds and crabs.

19 In Villigili, one of the most noticeable ecological features is water bodies, known as Kulhi. The three kulhi in the island provides habitats to some fish species, crabs and some migratory birds. These three kulhi also minimise flood impacts. Although coconut palms and large trees such as breadfruit trees exist in the island, less vegetation can be seen from the island.

4.3 Socio-economic Environment

4.3.1 Demography

20 In the Maldives, where only less than 1 percent of the total area is land suitable for human habitation, population growth has far serious consequences than many other countries. Population of Maldives grows about 1.76 percent per annum and had alarmingly increased inward migration to the capital city for better livelihood causing major environmental implications. The Maldives population reached 319,740 by 2010 in which 56 percent is comprised of children and youth. One third of the population lives in the capital, Male', which has an area of less than 2sq.km. The rest of the population is scattered over approximately 193 islands. The average population size of these islands is 900 and the average household size is 6.5. Maldives has a relatively young population with almost 41 present under 15 years of age and around 3 percent over 65 years of age. With regard to human development trends, the country ranks high among the Asia-Pacific countries.

21 Table E.6 present the demographic details of each targeted island.

Table E.6: Island-wise Detail of Demographic Features

Feature	Goidhoo	Kurendhoo	Buruni	Villigilli	Addu City
Atoll /Locality	South Maalhosmadulu (B)	Faadhippolhu (Lh)	Kolhumadulu (Th)	Ga. Atoll (Ga)	Addu Atoll (S)
Atoll Capital	Eydhafushi	Naifaruru	Veymandoo	Villigili	Hithadhoo
Total Land	163.7	21.3	35.0	98.0	971.5

Feature	Goidhoo	Kurendhoo	Buruni	Villigilli	Addu City
Area (Ha.)					
Population (2006)	503	1218	1130	1976	17862
Sex Ratio	1.31	1.13	1.04	1.07	1.24
Population Density (Nos./Ha)	03	57	32	20	19
Number of Households	77	235	182	346	>2200
Average household size	5.4	5.2	6.2	5.7	5.0
Annual population growth	-0.8	0.2	21.8	-2.2	0.2

Source: <http://planning.gov.mv/YearBook2011/yearbook/Population/3.3.htm>

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

4.3.2 Economic Development

23 The economy of Maldives is largely based on fishing and tourism; both sectors are fragile and vulnerable to external factors as well as natural disasters. Maldives' economic base is extremely narrow and dominated by tourism accounting over 27 percent of GDP in the recent years. Following the tourism sector, fisheries, agriculture, construction and commerce play a significant role in the Maldivian economy by contributing 5-10 percent of the GDP each. The Asian tsunami of 2004 severely affected the Maldivian economy, causing major destruction of infrastructure and assets, especially those in the tourism and fisheries sector.'

24 In 2009, due to the global crisis, GDP growth was reduced more than the expected of 1.3 percent. This was mainly due to the turbulence in the tourism sector, which reduced its growth rate to 0.5 percent. In addition, the construction sector growth rates decreased to 24.2 percent in 2009 from earlier high ranging from 20 percent. Similarly, the transport and communication and government administration experienced a decline in real growth rates in 2009, compared to earlier years, growing in real terms only by 1.1 and 12.5 percent respectively. However, the latest GDP estimates of 2010, real GDP is estimated to have grown by 4.8 percent in 2010 due to stronger than expected performance of the tourism sector.

25 During the consultation it is reported that about 15-20% of monthly income goes to the electricity consumption. Life in Maldivian Islands revolves around strong values of family, and has a well developed historic and contemporary national identity.

4.3.3 Historical and Cultural Values

26 The proposed project sites and the surrounding areas are for mainly agricultural and non-residential land use, and have no important historical or cultural sites. Except in Kurendhoo Island, where an old mosque and graveyard exist on the northern end of island, there are no records of archeological findings in the locations of the project areas. On

Kurendhoo Island, locations of the proposed sites are away from the old mosque and graveyard.

5. Anticipated Environmental Impacts And Mitigation Measures

5.1 Impacts and Mitigation Measures Due to Pre-construction Activities

5.1.1 Physical Environment

27 The locations of the proposed sites for ground solar PV installations on are open plot free from any encroachments covered by thin vegetation. For roof-top installations public buildings are selected. The project facilities do not encroach any of the environmentally sensitive areas. Also there are no sites of any archaeological importance in and around the project facilities. All the selected sites are accessible by existing roads, therefore there is no need for construction of new roads/wahrfs. Therefore impacts associated with project siting on physical environment are negligible.

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

29 The equipments to be procured and installed by the Project will comply with international standards for noise as well as escape of polluting materials. The new diesel generator will be designed to comply with World Bank Group's EHS guidelines for small combustion facilities and EHS guidelines for ambient noise both for day time and night time.

30 The Project will use compact and preassembled systems to minimize the impacts. Therefore no adverse impacts due to the Project design are anticipated. To ensure that all the environmental mitigation measures are implemented, the EMP will be included in the bidding documents.

5.1.2 Climate Change Adaptation

31 Climate risk profile for Maldives indicates that the main impacts of climate change are expected to be high sea levels, extreme rainfalls, extreme winds, and extreme high air and water temperatures. Best estimates of long-term, systematic changes in the average climate for Maldives indicate that sea level is likely to have increased by 36 centimeters and the frequency of severe short sea level rise resulting from storm surge (2.2 meters above mean sea level) will increase from a one in 580-year event to a one in 5-year event by 2050.

32 The project will provide solar PV system (most of the PV systems will be mounted on the structures above 3-4 m) and other project facilities with resilience to climate change through compact and preassembled systems resistant to extreme weather conditions. It will not be affected by the change in sea level. Table E.7 provide the summary of project features, by subproject, addressing green house emissions and climate change adaptations.

Table E.7: Project Features addressing Climate Change

Subproject Type	Climate Change	
	GHG Emission Reduction	Adaptation / Resilience
Solar Panels	Renewable energy source – fossil fuel savings.	Solar PV designed to improve resilience in extreme weather events.

Diesel Generator	Fuel efficiency and cleaner production which reduce carbon emissions from power plant.	Large fuel stock as a buffer against isolation in extreme weather events.
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Source: PPTA Consultant Assessment

5.1.2 Biological Environment

33 The project will need cutting/trimming of few trees (less than 10 trees in each of five Islands mainly coconut trees) from the proposed sites. The loss of trees will be compensated by planting additional trees as per government requirements. Although Maldives has a large protected area network, none of these areas is located in the impact area of sites proposed for the interventions (solar power plants) under POISED Project in five outer islands of Maldives. Therefore there will not be any impacts of the fauna.

34 The sites proposed for interventions in all the five islands are accessible by existing wharfs and roads. The existing wharfs and roads are in good conditions and there is no need for upgrading or constructing new wharfs and roads for the project. Therefore there are no impacts on flora and fauna associated with new associated facilities.

5.1.3 Social Environment

35 The project will require about 3.75 Ha of land area for installation of proposed facilities. The land proposed for on-ground solar PV installation is owned by the government/island council and it will be transferred to the Project as per national regulations. To ensure the livelihood of affected people due to loss of crops, roof area etc. there is possibility that the affected people will be employed by the project. Since project will be implemented on government land, there will be no relocation issue.

5.2 Impacts and Mitigation Measures Due to Construction Activities

5.2.1 Physical Environment

36 Impacts on topography due to installation of solar plant on ground and roof-top of public buildings will be insignificant. The PV panel will be visible on ground for solar plant and individual buildings. This small change in topography will be visible in the habitation. This change will be permanent.

37 No topographical changes are envisaged due to access to the sites. The proposed sites are accessible by existing access roads and wharfs and these existing facilities will be used to transport materials and equipments.

38 Small change in topography is anticipated due to construction activities such as excavation and cutting of trees. Temporary negative impacts on the appearance of the project area and its vicinity are anticipated due to supply, storage and haulage of construction material and movement of equipments and machineries. However, the proposed project is modest in its material requirements, thus impact will only be moderate. The impacts will be minimized by the selection of suitable storage areas for materials with minimum visibility from residences and roads with screening where necessary. In installation phase there will be no impact on soil quality of the area.

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

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

162. A number of temporary impacts could also arise during construction. However, these will be controlled and can be minimized.

163. *Dust, Noise and Vibration:* During the construction phase, the activity would involve excavation for the PV array footing, movement of vehicles carrying the construction materials along the haul roads. Although all the sites are accessible, the movement of vehicles and excavation work would give rise to emission of dust particles thereby affecting air quality marginally at the sites. The impact will be transitory in nature and therefore is assessed as of low significance. Covering of stockpiles, minimising double handling and drop loads as well as sprinkling of water during excavation will reduce the dust emission to a great extent.

164. During the construction phase, the major sources of noise pollution are movement of vehicles carrying the construction material and equipment to the sites. Most of the access roads to the sites are motorable and project traffic would be negligible. The major work of the construction is expected to be carried out during the daytime. Apart from vehicles bringing in materials to the sites, construction works for the PV plant will not require powered equipment. As such, noise emissions will be minor. As the predominant land use at most of the sites for ground mounted solar PV installation is open/unused, there will be few residential areas exposed to noise generated during the construction phase and the noise produced during the construction period will have negligible impact on residents. However roof-top installations is planned on buildings which are sensitive receptors themselves i.e. hospitals, schools, office buildings etc.

165. While the impact of noise and vibration cannot be avoided altogether, impacts will be minimized by prohibiting all work between 22:00 hours and 06:00 hours. Vehicles and machineries will undergo periodic checks and maintenance to ensure they are in good running condition and comply with air quality and emission regulations. Solar panel installations at schools and colleges should be scheduled to avoid class disturbance. Since there are no vacant periods at the hospital, installation of solar panels should be scheduled during the busy periods of the day, avoiding early mornings and evenings.

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

167. As stated above, the environmental disturbances during construction will be small and transient, such as dust, noise, incremental traffic loads on the roads, and gaseous emissions created by trucks and heavy construction equipment.

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

- Selection of construction techniques and machinery seeking to minimize ground disturbance and noise vibrations.
- Proper maintenance and operation of construction equipment.
- Operation of machinery generating high levels of noise during road upgrades and solar panel installations will be restricted to between 6:00 am and 10:00 pm in areas where there are nearby residences. Solar panel installations at schools and colleges should be scheduled to avoid class disturbance. Since there are no vacant periods at the hospital, installation of solar panels should be scheduled during the busy periods of the day, avoiding early mornings and evenings.
- Existing roads and tracks used for construction and maintenance access to the line / site wherever possible to minimize increase in airborne dust particles.
- Soil excavated from foundation footings disposed of at designated places.
- Fuel and other hazardous materials securely stored above high flood level.
- Construction activities only undertaken during the day and local communities informed of the construction schedule.
- Protect /preserve topsoil and reinstate after construction completed.
- Safe handling and disposal of phased out equipments.
- Contractor to arrange for health and safety training sessions.
- Implementation of effective environmental monitoring and reporting system using checklist of all contractual environmental requirements.

5.2.2 Biological Environment

42 Clearing of land by cutting and trimming of some trees on surrounding areas will have some adverse impacts on the environment. Cuttings of trees will be compensated by planting additional trees in the ratio of 1:10. Necessary budget will be provided for planting trees. Cutting and planting of trees will be done in coordination with local council office and EPA. No impacts on fauna are anticipated due to construction activities. Following mitigation measures will be implemented by the contractor -

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

5.2.3 Social Environment

43 The construction will require not more than 30 workers, who will reside outside the Project sites. No groundwater will be tapped at the Project site as these sites have low groundwater potential. The water required for construction (concrete mixing) and consumption will be brought in from outside sources. Domestic wastewater generated by the construction workers would not be more than 10 cubic meters per day per site and will be treated either in a small centralized package treatment plant or by individual septic tanks, one for each toilet.

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

- Construction activities only undertaken during the day time and local communities informed of the construction schedule.

- Construction workforce facilities to include proper sanitation, water supply and waste disposal facilities.
- Protect /preserve topsoil and reinstate after construction completed.
- Contract provisions specifying minimum requirements for workers camps.
- Provide protection gears.
- Contractor to prepare and implement a health and safety plan including safety manual.
- Contractor to arrange for health and safety training sessions.

168. Since there are no cultural resources near the project sites, there will be no impacts on physical cultural resources through the implementation of various project components. However the EMP contains a 'chance find' provision in case such are encountered during excavation of the sites and installation of the plant.

5.3 Impacts and Mitigation Measures from Operation

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

5.3.1 Physical Environment

46 No topographical changes are envisaged during the operation phase of the solar power plants. The existing access routes will be utilised during the operation and maintenance of the power plants.

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

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

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

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

51 During operation phase battery of Solar Power Plant will have to be replaced after 7-8 years. Although the batteries to be used for power plants are Lithium-ion batteries, it may contain some heavy metal and sulphuric acid. If the batteries are discarded in the surroundings then there will be soil contamination with lead and sulphuric acid in the area. To mitigate these impacts use of long life lithium-ion batteries with more charge-recharge cycle are proposed for the Project. Also the replaced batteries will be stored in leak proof battery collection system and will be sent to authorised handlers / manufacturers for recycling and

further management. Only dry batteries will be transported to avoid possible leakages. The handling, storage and disposal of used batteries shall be done in compliance with Waste Management Policy and Waste Regulations (2013) of Maldives as well as in compliance with Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and their Disposal (1989).

52 Storage and handling of fuel, residual oil from separator and lubricating oil storage will be an issue and the current practices at power plants are inadequate. As part of new installations these practices need to be improved. FENAKA and STELCO will prepare and implement a plan for fuel and oil storage and handling. This will include (i) improvements to the existing bunded structure at the fuel storage tanks so that it will be protected from rain and will store spilt or leaked fuel for pump-out and proper disposal; (ii) redesign and construction of the existing oil-separator; and (iii) construction of a bunded concrete area for the storage of empty lubricant oil drums. Additionally, work practices and site environmental management needs to match and this requirement to ensure that no fuel, oil or other lubricant is allowed to enter the external environment.

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

5.3.2 Biological Environment

54 With proposed level of interventions, impacts on modified or natural habitats are not envisaged. Also no significant impacts anticipated on biological environment due to operation of solar power plants. Wastewater generated from cleaning of solar panels will be collected for sediment removal before discharging to the water bodies, therefore impact on aquatic life is not expected.

5.3.3 Social Environment

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

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

5.4 Impacts and Mitigation due to Decommissioning

57 The Project's solar PV panels are expected to have an economic life of 25 years. The suppliers will accept the decommissioned solar PV panels for recycling based on the thin-film technologies and their update. Dismantling of the PV panels will be handled by suppliers that offer the best price for used PV panels in the future. Similarly the project will require the use of batteries which will need proper disposal and recycling of the lead and the acid that is contained in the batteries after 7-8 years of operation. To control these possible impacts, it is proposed that suppliers will handle the disposal of the batteries. As part of procurement procedures, EA will ensure that supplier has environmental friendly system in place for safe disposal/management of used batteries.

5.5 Cumulative Impacts of Sub-Projects

58 The solar power plants proposed in five sub-projects are mostly located adjacent to the existing diesel generation power stations, which consist of diesel generators and diesel

storage tanks. While the facilities will result in a number of new solar array structures, these will be no higher than 3 m and visual impact on neighboring properties will be limited by providing adequate fencing along the plant boundaries.

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

F. ANALYSIS OF ALTERNATIVES

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

61 Alternative sites (2-3 in each Islands) were considered, but the proposed selected sites in each island were considered the best locations for the solar power plants as these are adjacent to the existing generation diesel power generation plants, easy access to distribution network, providing existing facilities (network, access roads), security and operational workforce that will reduce capital and operating costs. The land at selected sites has low environmental or residential values, given the current land use and existing power generation operations. The project's technical team is reviewing the technical aspects and conceptual designs of potential PV panels and battery suppliers and the best configurations that would meet desired locational requirements would be selected

G. CONSULTATIONS AND INFORMATION DISCLOSURE

1. Consultations

62 ADB's SPS (2009) requires projects to carry out meaningful public consultation on an ongoing basis. Public consultation will: (i) begin early and carry on throughout the project cycle; (ii) provide timely disclosure of relevant information, understandable and accessible to people; (iii) ensure a free and un-intimidated atmosphere without coercion; (iv) ensure gender inclusiveness tailored to the needs of disadvantaged and vulnerable groups; and (v) enable the incorporation of all relevant views of affected people, and stakeholders into project decision making, mitigation measures, the sharing of development benefits and opportunities and implementation issues. The PMU and any appointed environmental assessment consultants will be open to contact/consultation by the public on environmental assessment

matters during sub-project IEE and desktop environmental assessment preparation and design investigations.

63 All communication handouts shall be written in Dahevi and all consultations will be documented. All relevant views raised during consultation shall be reported in the environmental assessment report, and considered in sub-project design and reflected in the environmental management plan as appropriate. Attendance sheets and notes of consultations shall be included in the environmental assessment report as proof that consultation/s had been held.

2. Information Disclosure

64 Information disclosure will follow the procedure for ADB environment category B sub-projects. It is the policy of the ADB to have environmental assessment reports made available/accessible to the general public. The following EA-related documents will be posted on the ADB website: i) draft EARF, before Project appraisal; ii) Final or updated EARF, upon receipt; iii) overall project IEE report and EMP. Hard copies of the EARF and IEE reports (in English and Dahevi) will be made available for perusal at the ADB Office, at MEE head office in Male, at FENAKA /STELCO island offices, at Island council offices in each Islands and at other locations accessible to stakeholders (to be determined by the EA).

3. Summary of Stakeholder/ Community Consultations Undertaken

65 As part of initial environmental examination for selected five sub-projects, stakeholders and community consultations were carried out during field visits i.e. in May 2013 (inception stage) and August 2013 (feasibility stage). The details of such consultation carried out during field visits are presented in Table G.1 and Table G.2. In total 30 officials from various agencies, i.e., the Ministry of Energy and Environment (MEE), the Environmental Protection Agency (EPA) of Maldives, Maldives Energy Authority, Waste Management Agency of Maldives, FENAKA (state water, sewerage and electricity utility company), State Electrical Company Limited (STELCO) and the members of Island Councils from targeted islands, women groups, community leaders etc., were consulted during the field visits. The consultations included both discussions with stakeholders and discussions with island/atoll level authorities.

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

Table G.1: List of Stakeholders Consulted during Field Visits to five Islands

Sl. No.	Name, Designation and Organization
1.	Ahmed Ali, Director General, Ministry of Environment and Energy (MEE), Maldives
2.	Akram Waheed, Maldives Energy Authority, MEE, Maldives
3.	Mohamed Mustafa, Director, Environment Protection Agency (EPA), Maldives
4.	Fathimath Reema, Assistant Director, EIA Section, EPA, Maldives
5.	Ahmed Murthaza, Assistant Director, Waste Management Section, EPA, Maldives
6.	Mohamed Amir, President, Goidhoo Island Council, B. Atoll, Maldives
7.	Ibrahim Nazim, Vice President, Goidhoo Island Council, B. Atoll, Maldives
8.	Ahmed Ibrahim, Councilor, Kurendhoo Island Council, Th. Atoll, Maldives
9.	Mohamed Abdullah, Councilor Kurendhoo Island Council, Th. Atoll, Maldives
10.	Saud Hussain, Council President, Villingili Island, Ga. Atoll, Maldives

11.	Ahmed Hillary, Project Officer, Villingili Council, Ga. Atoll, Maldives
12.	Moosa Abdhul Gadhira, Councilor, Buruni Island, Th. Atoll, Maldives
13.	Mohamed Simnaaz, Councilor, Buruni Island, Th. Atoll, Maldives
14.	Abdulla Sadiq Mayor, S. Hithadhoo Island, Addu City Council, Maldives
15.	Hassan Fahumi, Councilor, S. Hithadhoo Island, Addu City, Maldives,
16.	Muthalif Sahrief, Planning Officer, Addu City Council, Addu City, Maldives
17.	Ahmed Saif, Engineer, STELCO, Maldives
18.	Aisath Munza, Assistant Director, STELCO, Maldives
19.	Faath'imath Waheedha, Assistant Director, STELCO, Maldives

67 **Summary of Stakeholder Consultation:** Consultant team had meetings with officials from EIA Section of EPA and discussed national requirements and decision of EPA on proposed Project. EPA Officials informed that EPA has issued its decision to MEE on 5 priority sub-projects. Since proposed intervention on five Islands involves installations of solar PV system, EIA is not required as per government regulations. However if any sub-project involves uprooting of more than ten (10) trees, then an EIA would be required. Consultant informed EPA officials that project will fulfill government and ADB's SPS requirements and an IEE including EMP would be prepared to mitigate any anticipated impacts due to the Project.

68 Options for safe disposal of used batteries have also been discussed with officials from EPA and Waste Management Section. EPA officials informed that recently Government has come up with a regulation on waste management. The used batteries should be handled and disposed as per the provisions of this regulation. Consultant assured EPA officials that project will be implemented in full compliance with government requirements and options for the safe disposal of used batteries such as sending back to the suppliers, sending to authorized recyclers in neighboring countries etc. would be analyzed and a suitable mechanism for safe handling and disposal of the used batteries would be included in the project environmental management plan. The cost associated with safe handling and disposal of used batteries would be analyzed in the overall project cost.

69 Consultant team also had meeting with Director General of Energy Department of MEE (executing agency) and discussed project schedule, government and ADB environmental safeguard documentation requirements. Director General assured that EA would follow ADB and Government requirements to mitigate any adverse impacts on environment due to this Project.

70 Scope of Project and locations of the proposed sub-projects sites on five islands were discussed with the members of the Island Councils from targeted islands. Council members assured their full cooperation to the sub-projects. However they raised concern over physical implementation of the sub-projects and its maintenance as they had experienced in the past with similar projects, which was implemented on some of the islands as part of post tsunami renewable energy project (2006). The pilot projects were implemented and currently some of them are non-functional due to lack of adequate maintenance plan including budget provisions in the project cost for the maintenance of solar PVs system and disturbance to nearby communities from noise generated by wind blades.

71 People from local communities including women groups were selected randomly to get their views on the proposed sub-projects. First they were briefed about the sub-project scope and then asked whether they heard about the project and what they think about the project. Findings are summarized in Table G.2.

Table G.2: Summary of Stakeholder/ Community Consultation Undertaken During Visits of Sample Sites

Date / Venue / No. of participants	Issues discussed / remarks ⁹
18 August 2013 / Council Office and Local Café, Ga. Villigili Island/ 20	<p>Information about existing power generation system, status of land proposed for solar PV system, presence of environmental sensitive areas on and around the proposed sites, existing capacity of council /FENAKA staff in managing environmental issues were discussed and assessed. Council President informed that proposed land belong to Government that can be used for proposed installations.</p> <p>Most of the local people consulted indicated that they are aware of the project (since project team visited the island previously), while few people informed that they have not heard such a project going to be implemented in the island. All the people consulted said that they support the project and indicated other locals will show their full support such a project if it will be implemented. However, some questioned about future of the project (whether it will be materialized), as they have seen survey teams visiting the island on many projects but only few projects has been implemented. Consulted people indicated that project will reduce dependence on diesel fuel and it will be sustainable and environment friendly. Furthermore, they highlighted that it will reduce noise pollution and smoke, thus reducing rainwater contamination (impurities). In addition to this, local community expects reduction in electricity price (tariff) by the end of project. No major concerns were raised by the local community</p>
19 August 2013/ Council Secretariat and local shops, Th. Buruni Island / 14	<p>Most of the people consulted indicated that they are aware of the project and pointed out the project is much waited project and will be beneficial for the community. Local community questioned about future of the project (whether it will be materialized?) since they have come across survey teams who visited the island but only few projects had been implemented in the island. Some questioned whether the PV solar systems can provide continues electricity to all and indicated they need electrical energy without any interruption. Community also highlighted that the power generated from the system should reach to all the people and should be provided at a cheaper rate. Local community indicated that they have no concerns at this stage, since it is a new project and said even trees needs to be removed, the project should go ahead, since implementation of the project will reduce carbon emission. 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 and council member informed that there are no sensitive areas near the proposed sites.</p>
23 August 2013/ Council Secretariat and local Café, Kurendhoo Island /18	<p>Most people consulted indicated that they heard about the project but do not have much information, while some have not heard about the project. Some questioned whether the PV solar systems can provide continues electricity. All the people consulted said that they support the project and indicated that it will be a good project since it will reduce smoke. This will improve rainwater quality. Community also expects electricity price reduction after implementing the project. Few indicated that it would be an issue since one of the outdoor play areas is located at one site selected for PV installation. Council indicated that when the land use plan gets approved, the playground area would be located on one side of the road. The local community raised no other major concerns. However, council members raised the issue of used battery, how it will be handled. Council requested to come-up with a proper management plan, since at the national level also there is no proper mechanism to handle</p>

⁹ Queries raised by people were answered to their satisfaction and it was assured that their concerns will be addressed in the process of project design.

Date / Venue / No. of participants	Issues discussed / remarks ⁹
	hazardous waste and there is no monitoring mechanism.
24 August 2013/ Council Office and local shops, B. Goidhoo Island /13	Local communities are aware about the Project. Some questioned whether the PV solar systems could provide enough electricity for the entire population and the energy will be continues? All the people consulted said that they support the project and indicated that it will be a good project, since it will be sustainable and environment friendly, thus reducing dependence on diesel fuel for power generation. No major concerns were raised by the local community.
22 August 2013/ Addu City Council Secretariat /26	Local communities from Hithahdoo, Maradhoo and Feydhoo: were consulted to get their views on the proposed project. Some of the people consulted indicated that they were aware of the project, while others have indicated they have heard about such projects from TV and Radio but not aware such a project going to be implemented in Addu city. All the people consulted said that they support the project and indicated other locals will show their full support for the project. However, some questioned about future of the project (whether it will be materialized) and said it is important to implement the project regardless of the political disagreements. Local community also raised the question whether the PV solar systems can provide continues electricity to all and indicated they need electrical energy without any interruption and highlighted that they are experiencing power cuts frequently (even on the day people were consulted). Some people also pointed out in future diesel oil price will go up and by implementing PV solar energy project will help to reduce electricity price. Local community indicated that they have no concerns about the project and requested to implement the project without any delay.

72 In summary local communities and island council leaders are well aware of and fully support the proposed sub-projects, as the installation of solar power system will bring benefits to the Islands in terms of improved and sustainable electricity supply, improve the overall economy situation by saving in cost of imported diesel and some employment opportunities. Appendix 2 shows the photographic record of the consultations undertaken during preparation of the IEE for five sample sub-projects. Attendance sheet of consultation is provided in Appendix 5.

H. GRIEVANCE REDRESS MECHANISM

1. Grievance Redress Mechanism

169. In order to receive and facilitate the resolution of affected peoples' concerns, complaints, and grievances about the project's environmental and social safeguards performance a Grievance Redress Mechanism (GRM) is proposed for the project. When and where the need arises, this mechanism will be used for addressing any complaints that may arise during the 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 is not impeding access to the Maldivian judicial or administrative remedies. EA through IA will appropriately inform the affected people about the mechanism before commencement of any civil works.

2. Proposed GRM Mechanism

140. The following seven-step mechanism is proposed for grievance redress of environmental and social matters in construction and operation of various project components uses existing island/village administrative structures (affected persons/organisations/village groups), any of which can be complainants.

141. The IA's project management unit (PMU) will have a designated staff member to address all potential complaints from the public for both construction and operation phases of the project. Any complaint will be recorded and investigated by the PMU working with the construction and operations managers (as appropriate) of PIUs at individual sub-project components. A complaints register will be maintained which will show the details and nature of the complaint, the complainant, the date and actions taken as a result of the investigation. It will also cross-reference any noncompliance report and/or corrective action report or other relevant documentation.

142. When construction 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 person details at the PMU. All corrective actions and complaints responses carried out on site will be reported back to the PMU through field level PIUs. The PMU will include the complaints register and corrective actions/responses in its progress reports to the ADB.

143. In the whole progress, the Maldives national agencies (EPA for environment related grievances and Ministry of Housing and Infrastructure for social/resettlement related grievances) will be always available to public complaints and advice on the PMU's performance for grievance redress.

144. On receipt of a complaint in any form (in person, telephone, written) the PMU complaints officer will log the details in a complaints register. PMU will forward complaint to the contractor/construction manager/operations manager (as appropriate) within 48 hours. The contractor or managers will respond to the PMU within 1 week with advice on corrective actions taken or put in train. PMU will review and find solution to the problem in consultation with village chief and relevant local agencies. Then PMU will report back to the village chief and affected persons within a week time. If the complainant is dissatisfied with the outcome, or have received no advice in the allotted time period, he or she can take grievance to Island Council. Island Council will refer matter to the relevant national agencies (EPA, MOHI). National agency refers to an internal committee and reports back to AP/village chief about outcome. If unresolved or at any time if complainants is not satisfied, he or she can take the matter to appropriate court. Both successfully addressed complaints and non-responsive issues will be reported to the ADB by the PMU.

73 Table H.1 presents the steps and corresponding time frame for proposed grievance redress mechanism. Figure H.1 shows the proposed Grievance Redress Mechanism.

Table H.1: Grievance Redress Process

Stage	Process	Duration
1	Affected Person (AP)/village elected chief takes grievance to PMU through PIU	Any time
2	PMU review and find solution to the problem in consultation with village chief and relevant agencies	2 weeks
3	PMU reports back to village chief/AP	1 week

If unresolved		
4	AP/village chief take grievance to Island Council	Within 2 weeks of receipt of decision in step 3
5	Island Council refers matter to relevant national agency (EPA/MoHI/Legal Department)	2 weeks
6	National agency refers to an internal committee	4 weeks
7	National agency reports back to AP/village chief	1 week
If unresolved or at any stage if AP is not satisfied		
AP/village chief can take the matter to appropriate court		As per judicial system

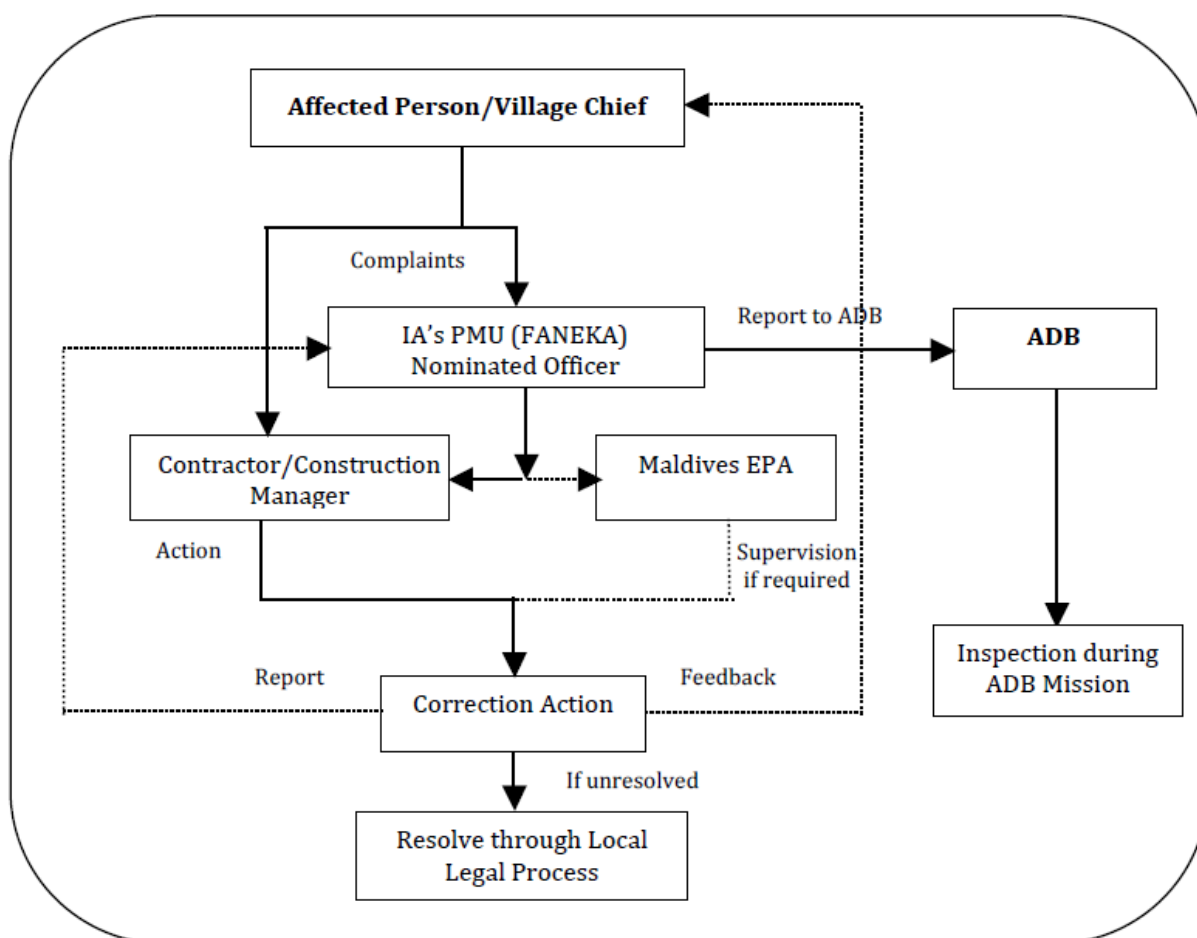


Figure H.1: Proposed Grievance Redress Mechanism

I. ENVIRONMENTAL MANAGEMENT PLAN

1. Mitigation Measures

74 The major adverse effects of construction stage are change in topography, visual impacts, increased traffic, ground disturbance and health and safety of workers. The main environmental effects during operation are management and disposal of used batteries. If the

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

75 The cutting of trees and clearing of the topsoil will have a definite impact on the vegetative site in appearance. The Project will attempt to limit the amount of organic material removed from the site, limiting the construction environmental impact. Any organic material removed from the surface will remain on site and be placed in the southeast corner of the property. Used batteries will be stored in leak proof designated areas and it will be sent to authorize dealers for further treatment and safe disposal. An environmental management plan showing the stage-wise potential impacts and proposed mitigation measures and responsible agency has been prepared in a matrix form and presented Table I.1. The EMP will be updated following detailed design.

2. Monitoring and Reporting

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

76 An EMP will be part of the overall project monitoring and supervision, and will be implemented by the project management consultant (PMC) with oversight from the implementing agency. Environment Expert of PMC will be responsible to update EMP followed by design phase. Updated EMP will be approved by EA compliance with it will be monitored by IAs. Progress on the preparation and implementation of an EMP will be included in the periodic project progress reports. Specific monitoring activities defined in the IEE and EMP will be carried out by engineering, procurement and construction (EPC) contractor and supervised by PMC and monitored by implementing agency. The executing agency will submit semi-annual environmental monitoring reports on EMP implementation for ADB's review.

77 In general, the overall extent of monitoring activities, including their scope and periodicity, should be commensurate with the project's risks and impacts. The implementing agency with the support from PMC is required to implement safeguard measures and relevant safeguard plans, as provided in the Project agreement. Complaints and problems from affected people /communities will be monitored and resolved in accordance with grievance redress mechanism proposed for this Project.

78 Table I.2 provides the environmental monitoring plan outlining parameters and frequency of monitoring.

Table I.1: Environmental Management Plan (applicable to all subprojects)

Project activity /stage	Potential impact	Proposed mitigation measure	Mitigation Cost	Institutional responsibility	Implementation schedule
A. Pre-construction					
Location	Encroachment into precious ecological and protected areas	Careful site selection to avoid encroachment of ecological sensitive areas including protected areas and areas of historical and cultural importance.	Project Cost	EA, IA through PMC	Detailed design
	Topography and visual impacts	Careful selection of site away from inhabited areas.	Project Cost	EA, IA through PMC	Detailed design
Access	Impacts due to construction of new access roads and wharfs	Proposed sites are accessible by existing wharf and road network. Therefore no need to construct new access roads or wharfs. In case requirement arises for new roads/wharfs, this EMP will be updated to address associated impacts.	Project Cost	EA, IA through PMC	Detailed design
Project design	Negligence of environmental mitigation measures	Ensure that EMP is included in the bidding documents	Project cost	EA, IA through PMC	Tendering process
	Updating EMP	Mitigation measures defined in this EMP will be updated and incorporated into the detailed design to minimize adverse impacts	Project cost	EA, IA through PMC	Detailed design
		Prepare environmental contract clauses for contractors, namely the special conditions (e.g. reference EMP and monitoring table)	Project cost	EA, IA through PMC	Tendering process
Climate Change	Risk of climate change	Provided solar PV plants with resilience to climate change through compact and preassembled systems resistant to marine/coastal environments.	Project cost	EA, IA through PMC	Detailed design
Equipment design	Release of toxic chemicals and gases in receptors (air, water,	• The new diesel generator will be designed to comply with World Bank's	Project Cost	EA, IA through	Tendering

Project activity /stage	Potential impact	Proposed mitigation measure	Mitigation Cost	Institutional responsibility	Implementation schedule
and selection	land) Noise from equipment/ machineries	EHS guidelines for small combustion facilities and EHS guidelines for ambient noise both for day time and night time. • PCBs should not be used in transformers and other project facilities or equipment.		PMC	process
Statutory clearances/ permits	Delay in the project process	Ensure that all necessary permits and clearances i.e. environmental permit from EPA, Island Environment Authority) are obtained prior to commencement of civil work.	Project Cost	EA, IA through PMC	Prior to commencement of civil work
Involuntary resettlement or land acquisition	Social inequities	Compensation paid for temporary/ permanent loss of productive land as per entitlement framework and its process, if necessary.	Project Cost	EA, IA through PMC	Prior to commencement of civil work
Site clearing	Cutting/trimming of trees and removal of vegetative cover	Compensatory afforestation as per government policies.	To be included in EPC Contractor cost.	EPC Contractor & PMC	Preparation of site prior to civil work
B. Construction					
Construction of access road	- Increase in airborne dust particles - increased land requirements for temporary accessibility	All proposed sites are accessible with existing road. These roads will be used for construction and maintenance access to the sites wherever possible to avoid dust emission. In case new access roads required, it will be limit to the minimum width required to avoid land acquisition.	To be included in Contractor cost.	EPC Contractor, EA/IA through PMC	During civil work construction
Installation of Solar Panels, and Storage of construction material and movement of	Topography and visual impacts	Selection of suitable storage areas for materials or plant with minimum visibility from residences and roads with screening where necessary.	To be included in EPC Contractor cost.	EPC Contractor & PMC	During civil work construction

Project activity /stage	Potential impact	Proposed mitigation measure	Mitigation Cost	Institutional responsibility	Implementation schedule
vehicles					
Construction activities	Generation of dust by construction activities	<ul style="list-style-type: none"> - Vehicles carrying soil, sand, or other fine materials to and from the sites must be covered. - Water will be spread on construction sites and access roads each day. 	To be included in EPC Contractor cost.	EPC Contractor & PMC	During civil work construction
Construction debris and wastewater	<p>Adverse impacts on surrounding environment due to construction waste.</p> <p>Pollution of water bodies due to disposal of waste material into water bodies.</p>	<p>Construction waste that cannot be reused will be regularly transported offsite for disposal, and not allowed to accumulate on site over long periods.</p> <p>Provision of adequate drainage system including controlled collection and preliminary treatment of wastewater.</p>	To be included in EPC Contractor cost.	EPC Contractor & PMC	During civil work construction
Movement and operation of construction equipments	Noise generated from operation and movement of trucks and cranes	<ul style="list-style-type: none"> - Construction techniques and machinery selection seeking to minimize ground disturbance. - Machines noise level not more than 85 dB(A) at avg. 8 hrs. 	To be included in EPC Contractor cost.	EPC Contractor (preparation and implementation) PMC (approval)	During land clearing and civil work construction
	Visual impacts from storage and haulage of construction material	Selection of suitable storage areas for materials or plant with minimum visibility from residences and roads with screening where necessary.	To be included in EPC Contractor cost.	EPC Contractor (preparation and implementation) PMC (approval)	During land clearing and civil work construction
Transportation of equipments and construction material.	Dust and particulate emission from movement of construction vehicles transporting equipments and construction material.	<ul style="list-style-type: none"> - Truck wheels cleaning - Road covering (if possible), cleaning and spraying water (if necessary) and watering 	To be included in EPC Contractor cost.	EPC Contractor	During land clearing and civil work construction
Cutting of trees and clearing / trimming of trees and vegetative cover	Loss of trees and vegetative covers	<ul style="list-style-type: none"> - Removal of only those trees, which are necessary. - Transplanting of trees if this is possible. - Prohibiting illegal cutting of trees by 	To be included in EPC Contractor cost.	EPC Contractor	During land clearing and civil work construction

Project activity /stage	Potential impact	Proposed mitigation measure	Mitigation Cost	Institutional responsibility	Implementation schedule
		construction workers for domestic uses. -Planting of trees in coordination with the Island Authorities of target island			
Public access	Hindrance to public access due to project construction activities	<ul style="list-style-type: none"> - Consultation with residents to reach agreements - Development of temporary access roads and traffic diversion plan, if required - Adequate safety measures like traffic controller, erect and maintain barricades, signs, markings, flags, lights etc. 	To be included in EPC Contractor cost.	Contractor, PMC, Island Council	During land clearing and civil work construction
Occupational Health and Safety	Impacts on workers health due to working with trucks and piling cranes, Building construction, high voltage work	<ul style="list-style-type: none"> - Provide Safety Manual - Provide Safety Plan - Supervision and Inspection - Protection PPEs/gears - Fuel and other hazardous materials securely stored at least 100m away from the high tide line. <p>To minimize health impacts, following additional measures would be implemented.</p> <ul style="list-style-type: none"> - Construction activities only undertaken during the day and local communities informed of the construction schedule. - Construction workforce facilities to include proper sanitation, water supply and waste disposal facilities. - Protect /preserve topsoil and reinstate after construction completed. - Contract provisions specifying minimum requirements for workers camps. - Contractor to prepare and implement a health and safety plan including safety manual. 	To be included in EPC Contractor cost.	Contractor (preparation and implementation) PMC (approval)	During land clearing and civil work construction

Project activity /stage	Potential impact	Proposed mitigation measure	Mitigation Cost	Institutional responsibility	Implementation schedule
		<ul style="list-style-type: none"> - Contractor to arrange for health and safety training sessions. - World Bank's EHS guidelines will be followed to ensure health and safety of workers. 			
Construction activities	Unexpected environmental impacts	If unexpected environmental impacts occur during project construction phase, the PMC will update the EMP, and the environmental protection measures will be designed and resources will be utilized to cope with these impacts.	Project cost	EA, PMC	During construction
C. Operation and Maintenance					
Reflection and glare from Solar arrays	Visual impacts and glare	Design of solar arrays to absorb incident solar radiation. Proper orientation of arrays.	To be included in EPC Contractor O&M cost.	EPC Contractor	During tendering, operation and maintenance
Cleaning of Solar Panels	Wastewater Generated from cleaning of solar panels	Provision and cleaning of adequate drainage system.	To be included in EPC Contractor O&M cost.	EPC Contractor	During operation and maintenance
Natural Disasters	Damage from cyclones and strong winds.	Design of foundations and racking system to withstand powerful cyclones and strong winds, which will reduce any potential hazard of panels being lifted up and blown onto adjacent properties.	To be included in EPC Contractor O&M cost.	EPC Contractor	During construction and operation and maintenance
Health and Safety	Health hazards in the event of accidents (cyclones, weather related events) and emergency	Emergency Response Plan Health and Safety Plan World Bank's EHS Guidelines will be followed.	O&M Cost	EPC Contractor	Emergency during operation and maintenance
Disposal and management of batteries	Impacts from used batteries and panels	Adequate storage and handling system.	O&M Cost	EPC Contractor	During operation and maintenance

Project activity /stage	Potential impact	Proposed mitigation measure	Mitigation Cost	Institutional responsibility	Implementation schedule
Operation of project facilities	Unexpected environmental impacts	If unexpected environmental impacts occur during project operation phase, the IA will update the EMP, and the environmental protection measures will be designed in compliance with World Bank's EHS Guidelines and resources will be utilized to cope with these impacts.	O&M Cost	IA	During operation
D. Decommissioning					
Dismantling of PV panels	Impacts from disposal of PV panels and batteries.	Contract agreements with PV panel suppliers for dismantling and disposal of panels and batteries.	Maintenance cost	EA	Post operation

Table I.2: Environmental Monitoring Plan

Environmental Features	Aspect to be Monitored	Time and Frequency of Monitoring	Location	Monitoring Cost (USD)	Responsible party (Implementation/ Supervision)
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Environmental Features	Aspect to be Monitored	Time and Frequency of Monitoring	Location	Monitoring Cost (USD)	Responsible party (Implementation/ Supervision)
Construction stage					
Noise	Noise levels in dB(A)	At the start of concerned activities. At least 3 times during construction period.	- Project site - Front main road	2000*3 =6000	EPC Contractor & PMC
Air	Emission of dust and particulate matter, NOx and SOx	At the start of concerned activities. At least 3 times during construction period.	- Project site - Front main road	3000*3=9000	EPC Contractor & PMC
Physical Works Progress	As specified in contractors' plan	Project site Monthly	Project Site	Project Cost	EPC Contractor & PMC
Occupational Health and Safety	As specified in project OHS plan prepared by Contractor	Project site Weekly	Project Site	Project Cost	EPC Contractor & PMC
Operation Stage					
Occupational Health and Safety	As specified in project OHS plan prepared by Contractor	Project site Weekly	Project Site	Project Cost	IA
Noise	Noise levels in dB(A)	At least 2 times in a year	Project site	2000*2 =4000	IA
Air	Emission from DG sets (SPM, NOx and SOx)	At least 2 times in a year	Project site	3000*2 =6000	IA
Escape of Hazardous Pollutants from transportation of used batteries	Monitoring of routes of transportation of used batteries.	Once in a year.	Shipping route	Project Cost	IA

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

3. Implementation Arrangement

79 The main institutions that will be involved in environmental management activities are the Ministry of Finance and Treasury as the executing agency (EA); Ministry of Environment and Energy (MEE), STELCO and FENAKA as implementing agencies (IAs) of the Project, project management consultant (PMC), EPC contractor(s), and line agencies including the Environment Protection Agency (EPA) and Waste Management Division within EPA. The project management unit (PMU) and project implementation units will be established for implementing the project.

80 The EA will submit environmental assessment report to EPA or Island Authority, as applicable for review and approval as per the Act No. 4/93 of Maldives. If required EA with support from PMC environmental expert will update this IEE and EMP to meet the EPA requirements.

171. Efficient project implementation related to the turnkey contract will be provided by the PMC, and will include preparation of bidding documents; assistance during the bidding process; and supervision of the project design, supply, construction, and commissioning. The PMC will have expertise on implementation and supervision of PVP projects.

172. EA has overall responsibility for all aspects of the Project. EA through support of IAs (MEE/FENAKA/STELCO) and PMC will be responsible for day-to-day management of technical aspects of the project. PMC will be responsible to update EMP followed by design phase and he will also be responsible to approving contractors' management plan, emergency plan, and occupational health and safety plan as well as to ensure on-ground implementation of the environmental management plan. EA will ensure the environmental management and monitoring budgets are available and utilized as necessary for timely implementation of EMP.

81 The existing capacity of EA/IAs in managing project level environmental aspects needs strengthening to ensure compliance with ADB and Government requirements to implement the Project. It is recommended that EA will have a safeguard officer in the project organization structure who will be primarily responsible for ensuring that the EMP is properly implemented. PMC will provide training to EA/IAs staff on managing the environmental issues associated with project. EA will ensure the environmental management and monitoring budgets are available and utilized as necessary for timely implementation of EMP. Cost of capacity building is included in the capacity building component of the Project.

82 The Contractor(s) will be informed their responsibility to comply with the EMP and the requirements of ADB. There are specific responsibilities for EMP compliance during construction phase that will rest with the Contractor who will be monitored by the environmental staff of the project. The Contractor(s) will be required to have one staff with experience in environmental management. This staff will be responsible for preparing plans such as emergency preparedness plan; occupational health and safety plan, day-to-day implementation of EMP.

4. Environmental Management Budget and Resources

83 The cost of all compensation and rehabilitations works will be an integrated part of the overall sub-project cost, which will be borne by the Project. The preliminary estimated cost of the environmental management in five target islands including implementation and monitoring is US\$ 125,000 as detailed in Table I.1 and Table I.2.

J. CONCLUSION AND RECOMMENDATION

84 The environmental impacts associated with implementation of proposed hybrid energy systems with a combined capacity of 10664 (8164kW- diesel generation and 2500kW-solar generation) in five targeted islands have been assessed and described in the previous sections of this document. The findings establish that the project sites are not located in a sensitive ecosystem, and have no historical and cultural value. This nature of the project site coupled with the clean nature of renewable energy hybrid power generation ensures that the Project will not cause any significant, lasting environmental impacts during construction, operation and decommissioning. Only minor and transient environmental disturbances would be experienced at the project sites during construction and operation, and they will be minimized through implementation of the EMP. The EMP will be updated in case of any change in project design followed by detailed design stage. It is then recommended that the Project be considered environmentally feasible and that this IEE is adequate to justify environmental and social feasibility of the five sub-projects proposed to be implanted under Phase 1 of the Project. There is no need for further analysis and this environmental assessment of the five sub-projects is considered complete.

85 It is concluded that proposed hybrid systems will not have any significant long-term adverse environmental impacts; in fact the project will create long-term environmental benefits by reducing CO₂ emissions. Besides reduction in CO₂ emission, the project will also prevent associated pollutants from combustion of fossil fuels entering the regional airshed. The measures listed in IEE and EMP, when implemented, will fully comply with ADB's SPS 2009 and Government requirements.

86 For the sub-projects to be implemented in the subsequent phases of the Project under long term sector road map strategy, EA with the help of consultants will prepare sub-project specific IEEs including EMP in compliance with requirements outlines in the Project's EARF.

APPENDIX 1: LOCATIONS MAPS OF SUB-PROJECT SITES

Figure 1: Location of Project Components on Goidhoo Island Map



Figure 2: Location of Proposed Sites on Kurendhoo Island Map



Figure 2a: Map of the Kurendhoo Island



Figure 2b: Photograph of Proposed Site



Figure 2c: Location map of the proposed site (Site D) on Island Map of Kurendhoo Island

Figure 3: Location of Interventions on Buruni Island Map

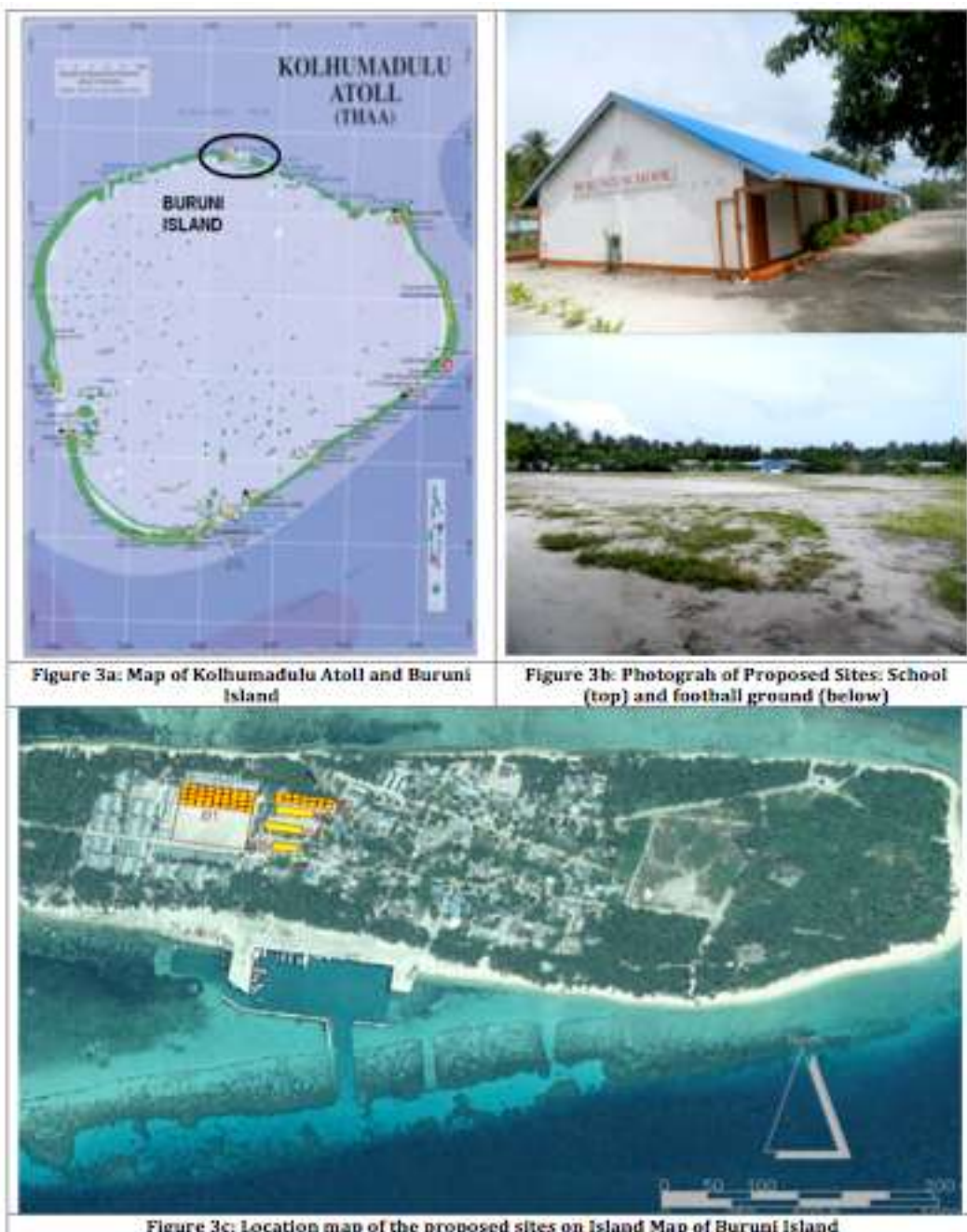


Figure 4: Location of Proposed Interventions on Villingili Island Map

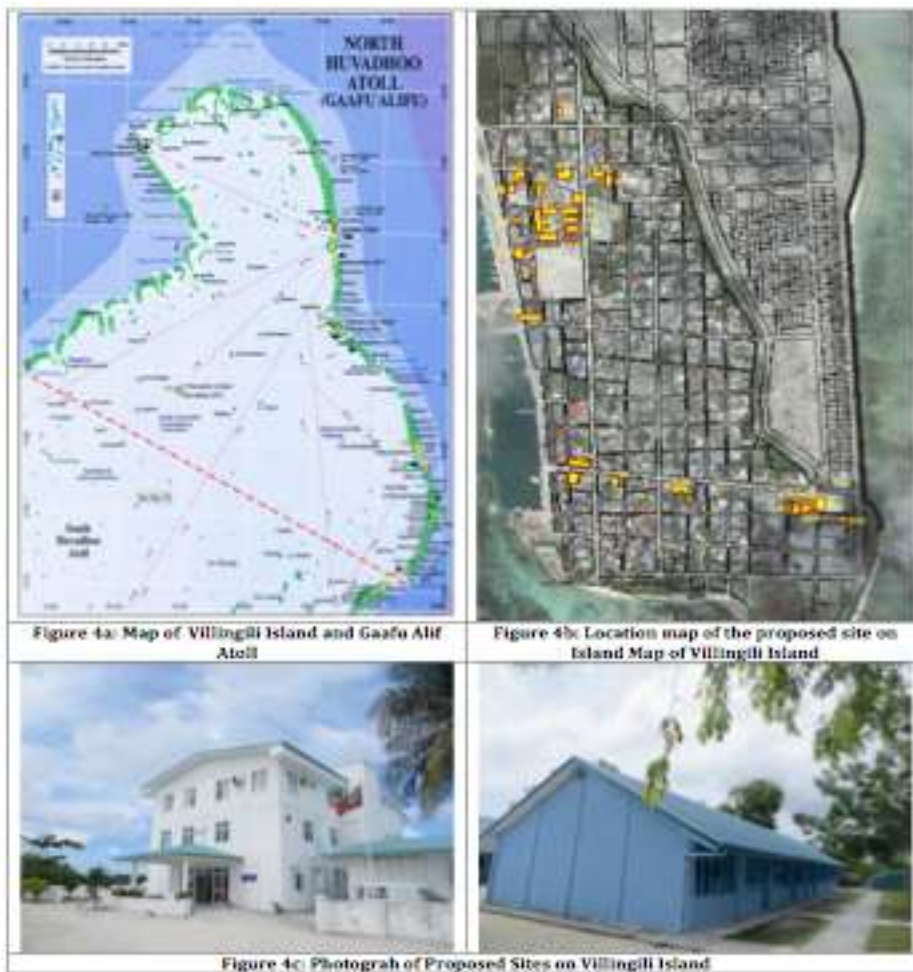


Figure 5: Location of Proposed Interventions on Addu City Map



Figure 5a: Map of Addu City



Figure 5b: Photograph of Proposed Sites on Addu City Map



Figure 5c: Location map of the proposed sites Convention Centre (Left) and Addu City School (Right)

APPENDIX 2: PHOTOGRAPHS (FIELD AND CONSULTATIONS)

A. Photographs (site and consultations)



Site K-1 for Solar PV Installation on Kurendhoo Island



Site K-2 for Solar PV Installation on Kurendhoo Island



Site K-3 for Solar PV Installation on Kurendhoo Island



Meeting with Island Council Members and Stakeholders from Kurendhoo Island



One of the Sites (G-1) for Solar PV Installation on Goidhoo Island



School Building-One of the sites (G-6) for Roof-top Solar PV Installation on Goidhoo Island



Public Building-One of the sites for Roof-top Solar PV Installation on Villingili Island



Hospital Building-One of the sites for Roof-top Solar PV Installation on Villingili Island



One of the Sites for Solar PV Installation on Buruni Island



Meeting with Island Council Members and Stakeholders from Buruni Island



Meeting with Island Council Members and Stakeholders from Addu City Council



SAARC Convention Building-One of the sites on Addu City

APPENDIX 3: REA CHECKLLISTS

A. Rapid Environmental Assessment (REA) Checklist

SOLAR ENERGY

Instructions:

- (i) The project team completes this checklist to support the environmental classification of a project. It is to be attached to the environmental categorization form and submitted to the Environment and Safeguards Division (RSES), for endorsement by Director, RSES and for approval by the Chief Compliance Officer.
- (ii) This checklist focuses on environmental issues and concerns. To ensure that social dimensions are adequately considered, refer also to ADB's (a) checklists on involuntary resettlement and Indigenous Peoples; (b) poverty reduction handbook; (c) staff guide to consultation and participation; and (d) gender checklists.
- (iii) Answer the questions assuming the "without mitigation" case. The purpose is to identify potential impacts. Use the "remarks" section to discuss any anticipated mitigation measures.

Country/Project Title: Maldives/ Outer Islands for Sustainable Energy Development (**Solar Energy System Installations on 5 Outer Islands**)

Sector Division: South Asia Energy Division (SAEN)

Screening Questions	Yes	No	Remarks
A. Project Siting Is the Project area adjacent to or within any of the following environmentally sensitive areas?			The scope of the sample project includes installation of solar PV plants with a combined capacity of 2500 kilowatt peak (kWp) and energy storage and control systems on five outer islands of Maldives. The sites for ground PV installations are located on open ground away from settlements and for roof-top solar PV installations public buildings are proposed. There are no environmental sensitive areas reported in and around the proposed sub-project sites.
▪ Physical cultural heritage site		X	
▪ Located in or near to legally protected area		X	
▪ Located in or near to special habitats for biodiversity (modified or natural habitats)		X	
▪ Wetland		X	
▪ Mangrove	X		Coastline has thin Mangroves vegetation along the coastline, which is about 0.5 km away from the proposed site in Khurendhoo Island while no impact by the sample project expected.
▪ Estuarine		X	
▪ Offshore (marine)		X	The project sites are located on small Islands. All components will be installed on main land in the Island. Coastline if about 0.5 km away from the proposed sites.

Screening Questions	Yes	No	Remarks
B. Potential Environmental Impacts Will the Project cause...			
▪ large scale land disturbance and land use impacts specially due to diversion of productive lands?		X	Only small-scale change in land use is anticipated due to installation of solar panels on rooftop of buildings and on ground.
▪ involuntary resettlement of people? (physical displacement and/or economic displacement)		X	
▪ disproportionate impacts on the poor, women and children, Indigenous Peoples or other vulnerable groups?		X	
▪ noise, vibration and dust from construction activities?	X		Minor short-term impact due to noise generated from construction activities is expected. Suitable mitigation measures are included in the EMP.
▪ an increase in local traffic during construction?	X		Transportation of construction equipment and construction material will increase the local traffic during construction. Mitigation measures are included in EMP.
▪ environmental disturbances such as soil erosion, land contamination, water quality deterioration, air pollution, noise and vibrations during construction phase?	X		Short-term disturbance due to noise from construction activities.
• aesthetic degradation and property value loss due to establishment of plant and ancillary facilities?		X	
▪ changes in flow regimes of the water intake from surface water or underground wells due to abstraction for cooling purposes?		X	
▪ pollution of water bodies and aquatic ecosystem from wastewater treatment plant, from cooling towers, and wash-water during operation?		X	Quantity of wastewater generated will be negligible which will be collected and disposed off after preliminary treatment.
▪ a threat to bird or bat life from colliding with the project facilities and/or being burned by concentrated solar rays?		X	
▪ industrial liquid (dielectric fluids, cleaning agents, and solvents) and solid wastes (lubricating oils, compressor oils, and hydraulic fluids) generated during construction and operations likely to pollute land and water resources?		X	
▪ Soil/water contamination due to use of hazardous materials or disposal of broken or damaged solar cells (photovoltaic technologies contain small amounts of cadmium, selenium and arsenic) during installation, operation and decommissioning?	X		Possible. Waste generated during construction will be handled of carefully. Operation and maintenance arrangements for replacement and removal of damaged cells will be provided.
▪ noise disturbance during operation due to the proximity of settlements or other features?		X	
▪ visual impacts due to reflection from solar collector arrays resulting in glint or glare?		X	Solar panels will be installed with a tilt angel to avoid glare and reflection.

Screening Questions	Yes	No	Remarks
<ul style="list-style-type: none"> large population influx during project construction and operation that causes increased burden on social infrastructure and services (such as water supply and sanitation systems)? 		X	Only small scale influx during construction. Local labor would be employed to the extent possible during construction.
<ul style="list-style-type: none"> social conflicts between local laborers and those from outside the area? 		X	
<ul style="list-style-type: none"> risks and vulnerabilities related to occupational health and safety due to physical, chemical, biological, and radiological hazards during construction, installation, operation, and decommission? 		X	
<ul style="list-style-type: none"> risks to community health and safety due to the transport, storage, and use and/or disposal of materials and wastes such as explosives, fuel and other chemicals during construction, and operation? 	X		Health and safety risks from storage and disposal of used batteries anticipated. Mechanism to handle and disposal of used batteries will be provided in EMP.
<ul style="list-style-type: none"> community safety risks due to both accidental and natural causes, especially where the structural elements or components of the project are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning? 		X	Controlled access will be provided.

A Checklist for Preliminary Climate Risk Screening

Country/Project Title: Maldives/ Outer Islands for Sustainable Energy Development (Solar Energy System Installations on 5 Outer Islands)

Sector : Renewable Energy

Subsector: Solar

Division/Department: SAEN/SARD

Screening Questions		Score	Remarks ¹⁰
Location and Design of project	Is siting and/or routing of the project (or its components) likely to be affected by climate conditions including extreme weather related events such as floods, droughts, storms, landslides?	1	Yes, the project areas are subject to cyclones and tsunami.
	Would the project design (e.g. the clearance for bridges) need to consider any hydro-meteorological parameters (e.g., sea-level, peak river flow, reliable water level, peak wind speed etc)?	0	
Materials and Maintenance	Would weather, current and likely future climate conditions (e.g. prevailing humidity level, temperature contrast between hot summer days and cold winter days, exposure to wind and humidity hydro-meteorological parameters likely affect the selection of project inputs over the life of project outputs (e.g. construction material)?	1	Change in solar radiation will affect the operation of the solar power plant
	Would weather, current and likely future climate conditions, and related extreme events likely affect the maintenance (scheduling and cost) of project output(s) ?	0	
Performance of project outputs	Would weather/climate conditions, and related extreme events likely affect the performance (e.g. annual power production) of project output(s) (e.g. hydro-power generation facilities) throughout their design life time?	1	Solar generation is largely depends on availability of solar intensity.

Options for answers and corresponding score are provided below:

Response	Score
Not Likely	0
Likely	1
Very Likely	2

Responses when added that provide a score of 0 will be considered low risk project. If adding all responses will result to a score of 1-4 and that no score of 2 was given to any single response, the project will be assigned a medium risk category. A total score of 5 or more (which include providing a score of 1 in all responses) or a 2 in any single response, will be categorized as high risk project.

Result of Initial Screening (Low, Medium, High): ____ Medium ____

Other

Comment: _____

Prepared by: _____

¹⁰ If possible, provide details on the sensitivity of project components to climate conditions, such as how climate parameters are considered in design standards for infrastructure components, how changes in key climate parameters and sea level might affect the siting/routing of project, the selection of construction material and/or scheduling, performances and/or the maintenance cost/scheduling of project outputs.

B. Rapid Environmental Assessment (REA) Checklist

Instructions:

- (i) The project team completes this checklist to support the environmental classification of a project. It is to be attached to the environmental categorization form and submitted to the Environment and Safeguards Division (RSES) for endorsement by the Director, RSES and for approval by the Chief Compliance Officer.
- (ii) This checklist focuses on environmental issues and concerns. To ensure that social dimensions are adequately considered, refer also to ADB's (a) checklists on involuntary resettlement and Indigenous Peoples; (b) poverty reduction handbook; (c) staff guide to consultation and participation; and (d) gender checklists.
- (iii) Answer the questions assuming the "without mitigation" case. The purpose is to identify potential impacts. Use the "remarks" section to discuss any anticipated mitigation measures.

Country/Project Title:

Maldives/ Outer Islands for Sustainable Energy Development (**Addition of Diesel Generation on 5 Outer Islands**)

Sector Division:

South Asia Energy Division (SAEN)

SCREENING QUESTIONS	Yes	No	REMARKS
A. Project Siting Is the Project area adjacent to or within any of the following environmentally sensitive areas?			The sample sub-projects will introduce diesel generation by adding new DG sets as well as by replacing existing non-efficient diesel generators with a total capacity of 8.16MW in five outer islands of Maldives. These diesel generators would be installed on existing powerhouse. There are no environmental sensitive areas reported in and around the proposed project sites.
▪ Cultural Heritage Site		X	
▪ Protected Area		X	
▪ Wetland		X	
▪ Mangrove	X		Coastline has thin Mangroves vegetation along the coastline, which is about 0.5 km away from the proposed site in Khurendhoo Island while no impact by the sample project expected.
▪ Estuarine		X	
▪ Buffer Zone of Protected Area		X	
▪ Special Area for Protecting Biodiversity		X	
B. Potential Environmental Impacts Will the Project Cause...			
▪ impairment of historical/cultural monuments and other areas, and loss/damage to these sites?		X	
▪ encroachment into precious ecosystem (e.g. sensitive habitats like protected forest areas or terrestrial wildlife habitats?		X	
▪ dislocation or involuntary resettlement of people?		X	

SCREENING QUESTIONS	Yes	No	REMARKS
▪ disproportionate impacts on the poor, women and children, Indigenous Peoples or other vulnerable groups?		X	
▪ aesthetic degradation and property value loss due to establishment of plant and ancillary facilities?		X	
▪ risks and vulnerabilities related to occupational health and safety due to physical, chemical, biological, and radiological hazards during project construction and operation?	X		Mitigation measures proposed in EMP will limit these impacts. (Handling and disposal of phased DG sets and disposal of used oil, and noise and emission from DG sets)
▪ noise and dust from construction activities?		X	Not expected since project include only replacement of non-efficient DG sets and installation of new DG sets in existing powerhouses.
▪ short-term soil erosion and silt runoff due to construction?		X	
▪ fugitive dust during transportation, unloading, storage, and processing of coal, and polluted runoff from coal storage?		X	
▪ risk of oil spills, which could pollute surface and groundwater and soil?	X		Mitigation measures proposed in EMP will limit these impacts. (Handling and disposal of phased DG sets and disposal of used oil)
▪ hazards in gas pipeline operation and gas storage at power plant sites?		X	
▪ changes in flow regimes downstream of the water intake due to abstraction for cooling purposes?		X	
▪ pollution of water bodies and aquatic ecosystem from wastewater treatment plant for boiler feed, bleed-off from cooling towers, boiler blowdown and wash-water, and effluent from ash pond?		X	
▪ air pollution from fuel gas discharged into the atmosphere?		X	
▪ public health and safety hazards due to solid waste disposal in sanitary landfills (see Matrix of Impacts and Measures for Solid Waste Disposal)?	X		Used oil and disposal of phased out DG sets may cause adverse impacts. Measure are included in the EMP.
▪ large population influx during project construction and operation that causes increased burden on social infrastructure and services (such as water supply and sanitation systems)?		X	No additional population influx due to project activities.
▪ social conflicts if workers from other regions or countries are hired?		X	
▪ risks community safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel and other chemicals during construction and operation?	X		Disposal of phased out DG sets and collection and disposal of used oil from DG sets during operation may cause adverse impacts. Mitigation measures proposed in the EMP will control these impacts.
▪ community safety risks due to both accidental and natural hazards, especially where the structural elements or components of the project (e.g. ash pond) are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning?		X	

A Checklist for Preliminary Climate Risk Screening

Country/Project Title: Maldives/ Outer Islands for Sustainable Energy Development (Addition of Diesel Generation on 5 Outer Islands)

Sector : Energy

Subsector: Thermal Energy

Division/Department: SEAN/SARD

Screening Questions		Score	Remarks ¹¹
Location and Design of project	Is siting and/or routing of the project (or its components) likely to be affected by climate conditions including extreme weather related events such as floods, droughts, storms, landslides?	0	
	Would the project design (e.g. the clearance for bridges) need to consider any hydro-meteorological parameters (e.g., sea-level, peak river flow, reliable water level, peak wind speed etc)?	0	
Materials and Maintenance	Would weather, current and likely future climate conditions (e.g. prevailing humidity level, temperature contrast between hot summer days and cold winter days, exposure to wind and humidity hydro-meteorological parameters likely affect the selection of project inputs over the life of project outputs (e.g. construction material)?	0	
	Would weather, current and likely future climate conditions, and related extreme events likely affect the maintenance (scheduling and cost) of project output(s) ?	0	
Performance of project outputs	Would weather/climate conditions, and related extreme events likely affect the performance (e.g. annual power production) of project output(s) (e.g. hydro-power generation facilities) throughout their design life time?	0	

Options for answers and corresponding score are provided below:

Response	Score
Not Likely	0
Likely	1
Very Likely	2

Responses when added that provide a score of 0 will be considered low risk project. If adding all responses will result to a score of 1-4 and that no score of 2 was given to any single response, the project will be assigned a medium risk category. A total score of 5 or more (which include providing a score of 1 in all responses) or a 2 in any single response, will be categorized as high risk project.

Result of Initial Screening (Low, Medium, High): Low

Other Comments: _____

Prepared by: _____

¹¹ If possible, provide details on the sensitivity of project components to climate conditions, such as how climate parameters are considered in design standards for infrastructure components, how changes in key climate parameters and sea level might affect the siting/routing of project, the selection of construction material and/or scheduling, performances and/or the maintenance cost/scheduling of project outputs.

C. Rapid Environmental Assessment (REA) Checklist
Instructions:

- (i) The project team completes this checklist to support the environmental classification of a project. It is to be attached to the environmental categorization form and submitted to Environment and Safeguards Division (RSES) for endorsement by Director, RSES and for approval by the Chief Compliance Officer.
- (ii) This checklist focuses on environmental issues and concerns. To ensure that social dimensions are adequately considered, refer also to ADB's (a) checklists on involuntary resettlement and Indigenous Peoples; (b) poverty reduction handbook; (c) staff guide to consultation and participation; and (d) gender checklists.
- (iii) Answer the questions assuming the "without mitigation" case. The purpose is to identify potential impacts. Use the "remarks" section to discuss any anticipated mitigation measures.

Country/Project Title:

 Maldives/ Outer Islands for Sustainable Energy Development
(Refurbishment of Grids on 5 Outer Islands)
Sector Division:

South Asia Energy Division (SAEN)

Screening Questions	Yes	No	Remarks
A. Project Siting Is the Project area adjacent to or within any of the following environmentally sensitive areas?			No new locations. All work to be carried out on existing system which involve rehabilitation and upgrading of existing power distribution system. The scope include replacement of grid assets i.e. cable, poles, distribution transformers, and switchgear).
▪ Cultural heritage site		X	
▪ Protected Area		X	
▪ Wetland		X	
▪ Mangrove	X		Coastline has thin Mangroves vegetation along the coastline, which is about 0.5 km away from the proposed site in Khurendhoo Island while no impact by the sample project expected.
▪ Estuarine		X	
▪ Buffer zone of protected area		X	
▪ Special area for protecting biodiversity		X	
B. Potential Environmental Impacts Will the Project cause...			
▪ encroachment on historical/cultural areas, disfiguration of landscape and increased waste generation?		X	
▪ encroachment on precious ecosystem (e.g. sensitive or protected areas)?		X	
▪ alteration of surface water hydrology of waterways crossed by roads and resulting in increased sediment in streams affected by increased soil erosion at the construction site?		X	
▪ damage to sensitive coastal/marine habitats by construction of submarine cables?		X	
▪ deterioration of surface water quality due to silt runoff, sanitary wastes from worker-based camps and chemicals used in construction?		X	

Screening Questions	Yes	No	Remarks
▪ increased local air pollution due to rock crushing, cutting and filling?		X	
▪ risks and vulnerabilities related to occupational health and safety due to physical, chemical, biological, and radiological hazards during project construction and operation?		X	
▪ chemical pollution resulting from chemical clearing of vegetation for construction site?		X	
▪ noise and vibration due to blasting and other civil works?	X		Possible during the construction phase. Measures will be included in the EMP.
▪ dislocation or involuntary resettlement of people?		X	
▪ disproportionate impacts on the poor, women and children, Indigenous Peoples or other vulnerable groups?		X	
▪ social conflicts relating to inconveniences in living conditions where construction interferes with pre-existing roads?		X	
▪ hazardous driving conditions where construction interferes with pre-existing roads?		X	
▪ creation of temporary breeding habitats for vectors of disease such as mosquitoes and rodents?		X	
▪ dislocation and compulsory resettlement of people living in right-of-way of the power transmission lines?		X	
▪ environmental disturbances associated with the maintenance of lines (e.g. routine control of vegetative height under the lines)?		X	
▪ facilitation of access to protected areas in case corridors traverse protected areas?		X	
▪ disturbances (e.g. noise and chemical pollutants) if herbicides are used to control vegetative height?		X	
▪ large population influx during project construction and operation that cause increased burden on social infrastructure and services (such as water supply and sanitation systems)?		X	
▪ social conflicts if workers from other regions or countries are hired?		X	Not anticipated; consultations indicate broad public support for project.
▪ poor sanitation and solid waste disposal in construction camps and worksites, and possible transmission of communicable diseases from workers to local populations?		X	
▪ risks to community safety associated with maintenance of lines and related facilities?		X	
▪ community health hazards due to electromagnetic fields, land subsidence, lowered groundwater table, and salinization?		X	
▪ risks to community health and safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel and other chemicals during construction and operation?		X	
▪ community safety risks due to both accidental and natural hazards, especially where the structural elements or components of the project (e.g., high voltage wires, and transmission towers and lines) are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning?		X	

A Checklist for Preliminary Climate Risk Screening

Country/Project Title: Maldives/ Outer Islands for Sustainable Energy Development (Refurbishment of Grids on 5 Outer Islands)

Sector : Energy

Subsector: Distribution

Division/Department: SAEN / SARD

Screening Questions		Score	Remarks ¹²
Location and Design of project	Is siting and/or routing of the project (or its components) likely to be affected by climate conditions including extreme weather related events such as floods, droughts, storms, landslides?	0	
	Would the project design (e.g. the clearance for bridges) need to consider any hydro-meteorological parameters (e.g., sea-level, peak river flow, reliable water level, peak wind speed etc)?	0	
Materials and Maintenance	Would weather, current and likely future climate conditions (e.g. prevailing humidity level, temperature contrast between hot summer days and cold winter days, exposure to wind and humidity hydro-meteorological parameters likely affect the selection of project inputs over the life of project outputs (e.g. construction material)?	0	
	Would weather, current and likely future climate conditions, and related extreme events likely affect the maintenance (scheduling and cost) of project output(s) ?	0	
Performance of project outputs	Would weather/climate conditions, and related extreme events likely affect the performance (e.g. annual power production) of project output(s) (e.g. hydro-power generation facilities) throughout their design life time?	0	

Options for answers and corresponding score are provided below:

Response	Score
Not Likely	0
Likely	1
Very Likely	2

Responses when added that provide a score of 0 will be considered low risk project. If adding all responses will result to a score of 1-4 and that no score of 2 was given to any single response, the project will be assigned a medium risk category. A total score of 5 or more (which include providing a score of 1 in all responses) or a 2 in any single response, will be categorized as high risk project.

Result of Initial Screening (Low, Medium, High): _____ **Low** _____

Other Comments: _____

Prepared by: _____

¹² If possible, provide details on the sensitivity of project components to climate conditions, such as how climate parameters are considered in design standards for infrastructure components, how changes in key climate parameters and sea level might affect the siting/routing of project, the selection of construction material and/or scheduling, performances and/or the maintenance cost/scheduling of project outputs.

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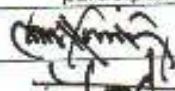
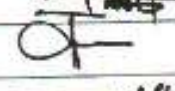
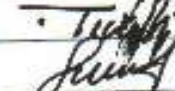
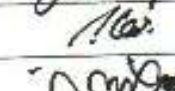


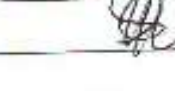

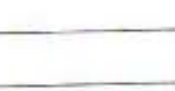

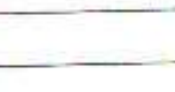
APPENDIX 5: PUBLIC CONSULTATION ATTENDANCE SHEET

TA-8268 MLD: Preparing Outer Islands for Sustainable Energy Development

Lh. Kuyendhoo

23/08/2013



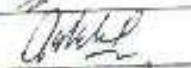
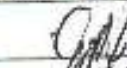


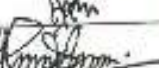
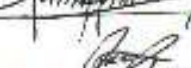
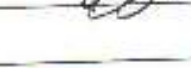

LIST OF PARTICIPANTS

Sl. No	Name of the Participant	Occupation	Signature (if agreed by the participants)
1	AMMED IBRAHIM	COUNCILOR	
2	MOHAMED ABDULLA	"	
3	MOHAMED A. SAEED	"	
4	MOHAMED HUSSEIN	"	
5	MOHAMED ARTIF	"	
6	Abdull Wahaab	S. m. officer.	
7	Mohamed Rameez	COUNCILOR	
8	Abdulla Mohamed	Ativilaage	
9	Ismail Madheeb	Naifaruqe	
10	Ahmed Mohamed	Medhuniqe	
11	ABOU SHARAF	RANVELI	
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B. Guitboe

24/8/2013

LIST OF PARTICIPANTS

Sl. No	Name of the Participant	Occupation	Signature (if agreed by the participants)
1	Mohamed Ushan	Hudhuveli	
2	Ahi Nizam	Azadhi	
3	Hassan Yasir	Assyri	
4	Ibrahim Nozeer	Anonage	
5	Ahi Rasheed	Blue rose	
6	Mohamed Nizam	Assyri Malas	
7	Ibrahim Shameer	sterling	
8	Aishath Azleema	council member	
9	Mohamed Amir	President	
10	Ibrahim Nazim	V. president	
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GA. VILLINGILI

15/8/2013


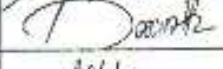
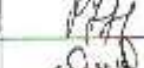

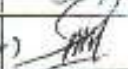

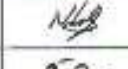
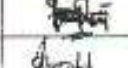
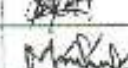
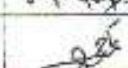
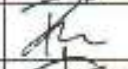


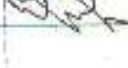

LIST OF PARTICIPANTS

Sl. No	Name of the Participant	Occupation	Signature (If agreed by the participants)
1	Saud Humair	Council President	
2	Ahmed Hillmy	Project officer	
3	Ibrahim Ismail	Council member	
4	Saud Hassan	Council President	
5	Mohamed Hakeel	Haleveli	
6	Mohamed Ameeth	Heenacmange	
7	Shazeel Ab Meer	GA. Villingili (Maintenance) School	
8	Ameena Mohamed	Asareehyaa	
9	Moosa Rahaa	Farima	
10	Iyyas Hassan	Kudhiruvage	
11	Ahmed Zivaan	Busthanhiyas	
12	Wahed Ibrahim	Kaburumange	
13	Ibrahim Zakir	Violet Villa	
14	Nasir Ali	Dhoothi	
15	Mohamed Nizam	Irumathcege	
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Th. Buruni

19-8-2013

LIST OF PARTICIPANTS

Sl. No	Name of the Participant	Occupation	Signature (if agreed by the participants)
1	Moosa Abdul Gader	Councilor	
2	Mohamed Simnazz	Councilor	
3	Mohamed AIP	Councilor	
4	Hawwa Rishmy	M.S. Officer	
5	Ismail Hassan	Villagers Villa	
6	Eesaa Rookh	Fenaka (Engineer)	
7	Suhana	Beachless	
8	Kadhreja Muneer	Beach Villa	
9	Salim Ahmed	Fenaka (Technician)	
10	Shiyar	Handhuvareege	
11	Mandhosh	Aasman Villa	
12	Ahmed Ali	Naseemage	
13	Mohamed	Ireenage	
14	A. Latheef Mohamed	Handhuvareege	
15	Ibrahim Rasheed	Dheefrunge	
16	Mohamed A. Sathar	Naazahseyri	
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S. Hiladha

22/8/2013

LIST OF PARTICIPANTS

Sl. No	Name of the Participant	Occupation	Signature (If agreed by the participants)
1	Ahmed Ali	lecturer	Ahmed
2	ABDUL MASEETH	Kalavannag	A.P.
3	Abdulla Ali	Surveyor	Abdulla
4	Mossa Ahmed Didi	Veenavilla	Mossa
5	Abdulla Sadig	Mayor	Abdulla
6	Hassan Shahid	Deputy mayor	Hassan
7	Hussain Fahmy	Councillor	Hussain
8	Abdulla Thaqib	Councillor	Abdulla
9	Haseena Ali	Admin. officer	Haseena
10	Jaleel	A. Director	Jaleel
11	Fazna Abdulmajeed	Surveyor	Fazna
12	Mussane Fahmy		Mussane
13	Mudhalib Sharaf	Planning Officer	Mudhalib
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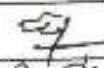


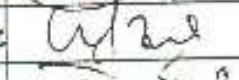

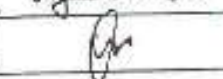
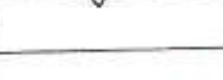

S. Maradibo 22/8/2013

LIST OF PARTICIPANTS

Sl. No	Name of the Participant	Occupation	Signature (If agreed by the participants)
1	Ibrahim Ahmed	Maryrose	
2	Hassan Zareer	Atir aage	
3	Ahmed Anees	Nayaa	
4	Ahmed Saeed	Saamara	
5	Sharaf	DIAMOND VILLA	
6	Abdull Azeer	Relandhi	
7	Ali Muneer	Nika.	
8	Mohamed Nazeer	Dhilshandhi	
9	Hussain Siraj	Sunlight Villa	
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S. Feydhoo
22/8/2013

LIST OF PARTICIPANTS

Sl. No	Name of the Participant	Occupation	Signature (If agreed by the participants)
1	Hassan fathia	Aminath manzil	
2	Santadhiye	Magnumathkeeye	
3	Abdul Razag	Kadhee jamanzil	
4	Wafir	Mirusuwa	
5	Mohamed Saad Modhuina		
6	Ali Moosa	Higaa laage	
7	Uthman Didi	Hiriga	
8	Mohamed Zahid Dhanfaga		
9	Ali Didi	Bashimaye	
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