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Environmental and Social Due Diligence

for
Preparation of Renewable Energy and
Energy Efficiency Investment Plan and
Bidding for Thinadhoo Island

Arnhem, August 9, 2011
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By order of Ministry of Housing and Environment for the Government of the Republic of Maldives
EXECUTIVE SUMMARY

As part of Maldives Climate Change Trust Fund (CCTF), the Government of the Republic of Maldives (GOM) recognized the need to attract investments to the renewable energy and energy efficiency sectors within its efforts in achieving carbon neutral electricity sector in 2020 in the Maldives. Within this framework, the World Bank (WB) has been asked to support the Preparation of Renewable Energy (RE) and Energy Efficiency (EE) Investment Plan and Bidding Documents for Thinadhoo Island. As a part of the Preparation of the Investment Plan, an Environmental and Social Due Diligence (ESDD) has been prepared for the solar energy investments for the slice of two-year time.

The approach to the ESDD study was based on the World Bank Guidelines. This document has been developed based on data collected during the inception mission, interviews and consultation with key stakeholders in Thinadhoo and other data from other approved impact assessments conducted earlier on the island.

The overall findings of the ESDD undertaken for the proposed solar energy project on the Island of Thinadhoo indicate that the proposed solar energy project on the roofs of the public schools represents an investment in clean, RE infrastructure, which, given the challenges created by climate change, represents a positive social benefit for society as whole. These findings are also applicable to any expansion of solar energy production within the scope of the Investment Plan 2020. However, at each new location several aspects must be assessed on ad-hoc basis.

The findings of the ESDD also indicate that the negative environmental and social impacts associated with the solar energy project are limited and can be effectively mitigated. Interviews and public consultation indicated a strong support for the project on the island. In addition, the island, and in particular its public buildings appear to be well suited to the development of solar energy project. It is therefore recommended that the solar energy project as proposed be supported, subject to the implementation of the recommended mitigation measures and management actions contained in the report.
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ABBREVIATIONS

AP     Action Plan
CCTF   Climate Change Trust Fund
EE     Energy Efficiency
EIA    Environmental Impact Assessment
EPFI   Equator Principles Financial Institutions
ESDD   Environmental and Social Due Diligence
EU     European Union
GIIP   Good International Industry Practice
IDP    Integrated Development Plan
IFC    International Finance Corporation
IPP    Independent Power Producer
kV     Kilovolts
MHE    Ministry of Housing and Environment
MW     Megawatt
NW     North-western
OECD   Organization of Economic Cooperation and Development
OHS    Occupational Health and Safety
PPP    Public Private Partnership
RE     Renewable Energy
RO     Reverse Osmosis
SIA    Social Impact Assessment
SREP   Scaling-Up Renewable Energy Programs
UNDP   United Nations Development Programme
UNEP   United Nations Environment Programme
USUL   Upper South Utilities Ltd.
WHO    World Health Organization
1 INTRODUCTION

1.1 Background

As part of Maldives Climate Change Trust Fund (CCTF), the Government of the Republic of Maldives (GOM) recognized the need to attract investments to the renewable energy (RE) and energy efficiency (EE) sectors in the Maldives within its efforts in achieving of the objective of carbon neutral electricity sector in 2020. Within this framework, the World Bank (WB) has been asked to support the Preparation of RE and EE Investment Plan and Bidding Documents for Thinadhoo Island. As a part of the Preparation of the Investment Plan, an Environmental and Social Due Diligence (ESDD) for the solar energy investments for the slice of two years has been prepared.

The Ministry of Housing and Environment (MHE) intends to support the Upper South Utilities Ltd. (USUL) to demonstrate how small island communities can move towards carbon neutrality and can increase energy security by adopting energy efficiency and renewable energy. Funding from CCTF will be used to co-finance a two-year time-slice of investments in EE and RE to reduce the carbon intensity in the electricity power system and concomitantly enhance energy security. The project will be implemented in Thinadhoo Island.

In the following the approach, the overall objectives, the specialist's details and the outline of this report are described.

1.2 Objective of the Study

The objective of the report is to:

- promote informed and environmentally sound decision making.
- fulfill the obligations of the proponent to undertake an ESDD under the World Bank guidelines.
- propose solar energy investments on the island with minimum damage to the environment.
- ensure that all the social aspects of the solar energy investment are addressed.
1.3 **Specialists Details**

The lead author of this report is an independent specialist with 20 years experience in the field of environmental management. In terms of ESDD experience Mr. Jan Rienk Bloembergen has undertaken worldwide several ESDDs. Mr. Sliman Abu Amara, the co-author of this report, has also undertaken wide research on social environmental issues in developing countries and has worked on this document in the phase of data collection and analysis.

1.4 **Methodology**

The Environmental and Social Due Diligence (ESDD) for the project will comply with WB environmental and social guidelines. Three main methods were used by the consultants in formulating this report:

- literature review of reports, documents and other relevant information about the Thinadhoo environmental and social context;
- Two site visits, including the project area
- consultations with district officials, local leaders and the people who will be affected by the project at the site

1.5 **Outline of this document**

This present report is outlined in the following way:

Chapter 2 introduces the policy, legal and administrative framework of the ESDD. It also elaborates on the relevant World Bank Guidelines. Chapter 3 includes the project description, the technical overview and aspects related to the site-location of solar energy plant. It further provide an overview of the project phasing. Chapter 4 provide insights into the baseline of Thinadhoo, such as soci-economic and environmental data. Chapter 5 includes the environmental impact assessment. Chapter 6 elaborates the social impact assessment. Chapter 7 summarizes the conclusions and recommendation of the ESDD. Chapter 8
includes the monitoring plan of the ESDD. Chapter 0 summarizes the ESDD statement. Chapter 10 lists all mitigation measures of the ESDD and Chapter 11 lists the references.
2 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

2.1 Introduction

An Environmental and Social Due Diligence (ESDD) is “a structured approach for obtaining and evaluating environmental information prior to its use in decision-making in the development process. This information consists, basically, of predications of how the environment and society is expected to change if certain alternative actions are implemented and advice on how best to manage the changes if one alterative is selected and implemented.

The basis and rationale of the ESDD has been summarized as follows:

- Beyond preparation of technical reports, ESDD is a means to a larger end – the protection of the environmental and social quality of life.
- It is a procedure to discover and evaluate the effects of activities on the environment – natural and social. It is not a single specific analytical method or technique, but uses many approaches as appropriate to the problem.
- It is not a science but uses many sciences in an integrated inter-disciplinary manner, evaluating relationships as they occur in the real world.
- It should not be treated as an appendage, or add-on, to a project, but regarded as an integral part project planning. It costs should be calculated as part of adequate planning and not regarded as something extra.
- ESDD does not ‘make’ decisions, but its findings should be considered in policy – and decision – making and should be reflected in final choices. Thus, it should be part of the decision – making processes.
- The findings of ESDD should focus on the important critical issues, explaining why they are important and estimating probabilities in language that affords a basis for policy decisions.
The regulatory framework the ESDD consists of the current and anticipated national and regional laws, international standards and World Bank Guidelines. The following section introduces the relevant these documents:

2.2 Maldivian Environmental Regulatory Structure

2.2.1 Environment Protection and Preservation Act of Maldives (Law No. 4/93)

The Environmental Protection and Preservation Act of the Maldives (Law No. 4/93) which was developed in 1993 provide the legal basis for environmental protection, preservation and conservation in the country. Being an umbrella law, it gives extensive power to Ministry of Housing and Environment (MHE) in matters concerning the environment.

2.2.2 Environmental Impact Assessment Regulation 2007

The Environmental Impact Assessment (EIA) Regulation 2007 was established under the Environmental Protection and Preservation Act (EPPA) of Maldives and provides the basic framework for the EIA process in the country. Under Article 5 (a) of the EPPA, an EIA has to be submitted to the Environmental Protection Agency of MHE by the developer of a project which may have potential impacts on the environment. Approval of the EIA has to be sought before commencement of the project. Important clauses are:

- **Clause 5b**: The Ministry of Environment, Energy and Water (currently MHE) shall formulate the guidelines for EIA and shall determine the projects that need such assessment as mentioned in paragraph (a) of this clause.
- **Clause 6**: The Ministry of Environment, Energy and Water has the authority to terminate any project that has an undesirable impact on the environment. A project so terminated shall not receive any compensation.
- **Clause 10**: The government of the Maldives reserves the right to claim compensation for all damages that are caused by activities that are detrimental to the environment. This includes all activities mentioned in Clause No. 7 (stated below) of this law as well as those activities that take place outside the projects that are identified here as environmentally damaging.
Clause 7 (a) Any type of wastes, oil, poisonous gases or any substance that may have harmful effects on the environment shall not be disposed within the territory of the Maldives.

Clause 7 (b) In cases where the disposal of the substances stated in paragraph (a) of this clause becomes absolutely necessary, they shall be disposed only within the areas designated for the purpose by the government. If such waste is to be incinerated, appropriate precautions should be taken to avoid any harm to the health of the population.

Under national EIA legislations USUL will require a project clearance from the National Authorities, namely the Environmental Policy Agency.

2.2.3 Third National Environment Action Plan (2002)

The aim of NEAP III is to protect and preserve the environment of the Maldives and to manage its resources sustainably for the collective benefit and enjoyment of present and future generations.

Main strategies of the NEAP III are:

- Continuous assessment of the state of the environment in the Maldives, including impacts of human activities on land, atmosphere, freshwater, lagoons, reefs and the ocean; and the effects of these activities on human well-being

- Development and implementation of management methods suitable for the natural and social environment of the Maldives, and maintain or enhance environmental quality and protect human health, while at the same time using resources on a sustainable basis

- Consultation and collaboration with all relevant sectors of society to ensure stakeholder participation in the decision making process

- Preparation and implementation of comprehensive national environmental legislation in order to provide for responsible and effective management of the environment

- Adhering to international and regional environmental conventions and agreements and implementation of commitments embodied in such conventions.
NEAP III specifies priority actions in the following areas:

- Climate change and sea level rise; coastal zone management;
- Biological diversity conservation; integrated reef resources management;
- Integrated water resources management;
- Management of solid waste and sewerage;
- Pollution control and management of hazardous waste;
- Sustainable tourism development;
- Land resources management and sustainable agriculture
- Human settlement and urbanization

NEAP III contains environmental policies and guidelines that should be adhered to in the implementation of the proposed project activities, especially impact assessment, stakeholder consultation, biodiversity conservation and human settlement and urbanization.

2.2.4 The Maldivian law and management

Maldives passed its new Land Act and Regulations in 2002. In 2004 there were major amendments to both acts. The Land Act is scheduled to be amended once again in the near future. It is envisaged that fundamental changes will soon be made in the present Act, facilitating a freer flow of land.

The overall responsibility for the management of land has recently been transferred to the Ministry of Housing and Urban Development (currently MHE). The responsibility for micro-planning and management of land depends on its primary-use designation, and is usually at the island-level and managed by one of the five ministries, namely:

The mandate of MHE includes, among others, the following which are relevant to sustainable land management. Annex 8 provides the complete mandate of MHE.

a. Establish a national land policy
b. Establish a national land administration mechanism and maintain a national land registry through local authorities
MHE had recently formulated a land policy which provides a coherent and integrated and consistent approach to land development. It establishes principles for the transfer, allocation and development of land for environmentally sound land management.

However, the existing Land Act, Land Law and Land Administration do not provide leverage to duly address emerging issues of land management within the framework of the new land policy. The current Land Act deals overwhelmingly with land issues in Male’. Land on the atoll is left as the provenance of Ministry of Fisheries and Agriculture and local councils. There is an urgent need to review and revise the existing Land Act, Land Law and Land Administration to ensure consistency, clarity, transparency, and comprehensiveness.

According to a study carried out by UNEP in 2007 on Sustainable Land management, several barriers were identified in the existing land law and management framework of the Maldives.\(^1\) Possible barriers to the implementation of renewable energy projects in Maldives include: (a) inadequate information on the status of land use in many islands; (b) weak land policy and legislation. Despite recent positive changes concerning land ownership and tenure, a clear, defined land law and land administration do not exist; (c) land use is not based on actual land potential and land capacity. Modern and effective tools for land use planning and land management do not exist; and (d) land use is not monitored and evaluated.

\(^{1}\) UNDP (2007) Building Capacity and Mainstreaming Sustainable Land Management in Maldives.
This aspect might affect the implementation of RE projects for individual power producers (IPPs) who will have to obey to the national land law and management. In the case of Thinadhoo, this issue is not relevant as the projects will be implemented on governmental land.

2.2.5 National Biodiversity Strategy and Action Plan

The goals of the National Biodiversity Strategy and Action Plan are:

- Conserve biological diversity and sustainable utilize 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.

In implementing the proposed project activities due care has to be taken to ensure that the national biodiversity strategies are adhered to. In fact, surveys were undertaken at the design stage to find out if biological resources of value and protected nature are affected by the proposed project.

There exists no emission limit for air, noise or discharges to surface water in the Republic of the Maldives standards.

2.3 National institutional context

The following provides a brief summary of ministries having a stake in the energy sector:

2.3.1 The Department of National Planning

The Department of National Planning under Ministry of Finance and Treasury is responsible for overall planning, including the energy sector.
2.3.2 **Ministry of Housing and Environment**

In 2005, the Ministry of Communication, Science and Technology (MCST) was restructured into the Ministry of Energy, Environment and Water (MEEW) and currently Ministry of Housing and Environment (MHE), gaining a better focus on the energy sector, and also on the inter-linkages between energy, the environment and water. The MHE promotes energy conservation and efficiency in production and usage and also strives to reduce the dependence on imported fossil fuels.

This ministry is mandated to regulate activities affecting the (conservation of the) environment.

2.4 **Local administrative context**

2.4.1 **Atoll Council**

Geographically, the Maldives are formed by a number of natural atolls plus a few islands and isolated reefs which form a pattern from North to South. According to the Decentralization Act 2010, the administrative divisions of the Maldives would consist of atolls, islands, and cities; each administered by their own local council, under the basic terms of home rules. For administrative purposes, the Country has been organized into seven provinces which consist of twenty one administrative divisions (20 administrative "atolls" and Male' city). Thinadhoo is in the Medhu-Dhekunu Region (Upper South). The Atoll Council deals with development and environmental management at the regional level and thus not at the island level. However, it also develops the land use plans and coordinates the cooperation between the islands. Since these legislative setting is also relatively new to the Maldives it is important to follow its development in the coming years.

2.4.2 **Thinadhoo Island Council**

The Thinadhoo Island Council is a newly elected body (February 5, 2011). This was the first ever free council election in the history of the Maldives. According to the current legal setting in the country the Council will also be involved in local environmental management. However, no clear rules have been developed or adopted at the national or local level. This is an issue to be followed up.
2.5 **World Bank Guidelines**

As a World Bank venture, this project is also subject to World Bank Environmental and Social Guidelines. It should be noted that the Thinadhoo ESDD process was strongly influenced by the World Bank guidance on ESDD. The ESDD report, however, has been reviewed for compliance with World Bank Guidelines and meets all requirements for the Project from design to implementation.

2.5.1 **Overview of World Bank Requirements**

This ESDD, as required, "commensurate with the project’s potential impacts' and contains the items required in the World Bank Operation Procedures (OP 4.01), including:

- Executive Summary
- Policy, legal and administrative framework
- Project description
- Baseline data
- Environmental and social impacts
- Analysis of Alternatives
- Environmental Management Plan (called Mitigation Plan in this document) considering
  - Mitigation
  - Monitoring (this is part of the implementation strategy within this project).
  - Capacity development and training (to ensure maintenance) (this is part of the implementation strategy within this project).
  - Implementation schedule and Cost Estimates for mitigation, monitoring and capacity building (this is part of the implementation strategy within this project).
  - Integration of Plan with the Project (see Implementation Strategy report).

- Appendices including references, data and list of associated reports and list of stakeholders interviewed.
2.5.2 World Bank Operation Policies

2.5.2.1 World Bank Operation Policy 4.10

- The World Operation on indigenous peoples, OP/BP 4.10, Indigenous Peoples, underscores the need for Borrowers and Bank staff to identify indigenous peoples, consult with them, ensure that they participate in, and benefit from Bank-funded operations in a culturally appropriate way - and that adverse impacts on them are avoided, or where not feasible, minimized or mitigated. This policy is not relevant for Thinadhoo as there are no Indigenous Peoples on the island.

2.5.2.2 World Bank Operation Policy 4.12

The World Operation Policy OP/BP 4.12 requires that involuntary resettlements be avoided or minimized where feasible by exploring viable alternative project designs. In cases in which resettlement is unavoidable, the policy requires considerable investment in planning to ensure that, through the resettlement process, displaced persons are able to improve their livelihoods and standards of living and share in program benefits. During the project resettlement planning process, communities and affected persons are given meaningful opportunities to participate in planning and implementing resettlement programs, and are assisted in their efforts to improve their livelihoods and living standards. The basic objectives of the policy are that displaced persons should benefit from the project, and that they should have their standard of living improved, or at least restored. All too often, failure to accomplish these objectives relegates displaced communities to impoverishment and stagnation. Within the framework of this project on Thinadhoo OP 4.12 will not be triggered.

2.5.3 EHS Guidelines

The World Bank provides guidelines which promotes minimal resources consumption, including energy use and the elimination or reduction of pollutants at the sources. (known as the ‘EHS Guidelines’). Over the past year, these EHS Guidelines have been in the process of being updated. As of April 30 2007, new versions of most of the EHS Guidelines are officially in use. The EHS Guidelines are technical reference documents with general and industry
specific examples of Good International Industry Practice (GIIP). Pollution control systems are required to meet these specified emission limits.

Performance Standard 3 on Pollution Prevention and Abatement. The EHS Guidelines contain the performance levels and measures that are normally acceptable to World Bank and are generally considered to be achievable in new facilities at reasonable costs using available technology. The General EHS Guidelines contain information on cross-cutting environmental, health, and safety issues potentially applicable to all industry sectors. The guidelines are designed to be used together with the relevant industry sector guideline(s).

**General EHS Guidelines** (April 2007) refer to those issues given below:
1. Environmental
   1.1 Air Emissions and Ambient Air Quality
   1.2 Energy Conservation
   1.3 Wastewater and Ambient Water Quality
   1.4 Water Conservation
   1.5 Hazardous Materials Management
   1.6 Waste Management
   1.7 Noise
   1.8 Contaminated Land

2. Occupational Health and Safety
   2.1 General Facility Design and Operation
   2.2 Communication and Training
   2.3 Physical Hazards
   2.4 Chemical Hazards
   2.5 Biological Hazards
   2.6 Radiological Hazards
   2.7 Personal Protective Equipment
   2.8 Special Hazard Environments
   2.9 Monitoring
3. Community Health and Safety
3.1 Water Quality and Availability
3.2 Structural Safety of Project Infrastructure
3.3 Life and Fire Safety
3.4 Traffic Safety
3.5 Transport of Hazardous Materials
3.6 Disease Prevention
3.7 Emergency Preparedness and Response

4. Construction and Decommissioning
4.1 Environment
4.2 Occupational Health & Safety
4.3 Community Health & Safety

Not all of these aspects are relevant for the solar project on Thinadhoo. Therefore, the ESDD will focus on those elements that are relevant for solar energy projects.

Table 2.1  Emission guidelines for small combustion facilities (3MWth – 50 MWth) in mg/Nm³ or as indicated

<table>
<thead>
<tr>
<th>Combustion technology/fuel</th>
<th>Particulate matter (PM)</th>
<th>Sulfur dioxide (SO₂)</th>
<th>Nitrogen oxides (NOₓ)</th>
<th>Dry flue gas, excess O₂ (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>WB/IFC</td>
<td>EU/NL</td>
<td>WB/IFC</td>
<td>EU/NL</td>
</tr>
<tr>
<td>Engine</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liquid</td>
<td>50 – 100</td>
<td>50</td>
<td>1.5 – 3.0 % sulfur</td>
<td>200</td>
</tr>
<tr>
<td>Boiler</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liquid</td>
<td>50 – 150</td>
<td>5</td>
<td>2000</td>
<td>200</td>
</tr>
<tr>
<td>Solid (biomass)</td>
<td>50 – 150</td>
<td>5</td>
<td>2000</td>
<td>200</td>
</tr>
</tbody>
</table>
Table 2.2  Noise level guidelines WHO

<table>
<thead>
<tr>
<th>Receptor</th>
<th>One hour $L_{Aeq}$ (dB(A))</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Daytime 07:00 – 22:00</td>
</tr>
<tr>
<td>Residential, institutional, educational</td>
<td>55</td>
</tr>
<tr>
<td>Industrial, commercial</td>
<td>70</td>
</tr>
</tbody>
</table>

2.6  International agreements and conventions

The following table includes the international conventions ratified by the Maldives:

<table>
<thead>
<tr>
<th>Convention</th>
<th>Date of ratification/accession</th>
</tr>
</thead>
<tbody>
<tr>
<td>United nations framework convention on Climate change, 9 May 1992</td>
<td>09 November 1992</td>
</tr>
<tr>
<td>Montreal Protocol on substances that deplete the ozone layer, 16 September 1987</td>
<td>16 May 1989</td>
</tr>
<tr>
<td>Convention on Biological Diversity, 5 June 1992</td>
<td>9 November 1992</td>
</tr>
<tr>
<td>Stockholm Convention on persistent organic pollutants, 22 May 2001</td>
<td>17 October 2006</td>
</tr>
</tbody>
</table>

2.7  Public Participation in the ESDD

There are usually two forms of public involvement in the ESDD process. The first is direct involvement of the affected public or community in public consultations during the ESDD study. These consultations allow the developer to provide information to the public about the project and to determine what issues the public wishes to see addressed. The extent and results of these consultations are included in the documented ESDD report.
The second level of involvement is at the discretion of MHE and USUL and takes place after the ESDD report and addendum, if any, has been prepared and after the applicant has provided the information needed for adequate review by MHE, USUL and the public.

Community interaction and transparency is a critical area of focus for the success of this development and the second level of involvement described above is possible.
3  PROJECT DESCRIPTION

3.1  Introduction

The solar energy project in the size of 150-200 kW as the first step in the overall implementation of the Investment Plan will be developed in the years 2011-2013. Thinadhoo the ideal and most logical PV would be the fixed PV plants (not tracked) on the roofs of public buildings, in particular on public schools and potentially the power house station. Fixed solar panels provide the technological fit to the solar conditions on the island are also technically easier to handle. Fixed PV plants are generally set at an inclination that will receive the greatest irradiation throughout the course of a year. This inclination level largely depends on the latitude at which the panels are installed, and are sometimes adjusted for summer or winter optimization. Thus, they do not utilize tracking to continuously follow the sun and therefore do not perform as well as tracking PV systems. However, tracked PV systems are not required for the climate of and the energy demands of Thinadhoo.

3.1.1  Technical Overview

The project covers design, manufacture, supply, installation and commissioning of a total of 150 kW of Solar PV power, integrated in the rooftops of the buildings of 2 schools:

- Aboobakkar school
- New school

The starting point of the project is 150 kW. Depending on availability of funding and the performance of the contractor an optional 50 kW can be added. The total size of the southward roofs of both schools is 1021 m².

The project covers design, manufacture, supply, installation and commissioning of a total of 150 kW of Solar PV power, integrated in the rooftops of the buildings of 2 schools:

- Aboobakkar school
- New school
The project will start with 150 kW roofmounted PV at two schools on Island of Thinadhoo, Maldives. However, depending on availability of additional funds and performance of contractor an extension of the project up to 200 kW could be considered.

3.1.1.1 Site location

The solar panels will be placed on the roof of the schools, namely the Aboobakuru School and the New School. The grid network is distanced 20 meters from the backyard of the schools. 150 kW can be fed in into the low voltage (LV) network without major problems. Both schools are connected to LV network (see grid map and the exact site-location on Annex III). The load carrying potential of the buildings is also suitable to carry the solar panels.

Aboobakuru School was built in 2003. It is built according to modern building standards and its overall conditions are very good. It 35 feet high and the roof inclination is 45 degree. It is ca. 20 meters distanced from the grid and it has a total 95mx51m open space of 40ft x 143ft total school space.

The New School was been built in 2011 and it is the most new building on the island. It is built according to modern building standards and its overall conditions are excellent. It is 23 feet high and the inclination of each roof is 45 degree. It is 20 m. closed to the grid network and it has a free area of 36 m/23 m of 74f x 239ft total school space.

The total size of the southward roofs of both schools is 1021 m².

Area for storage and meeting room is available at the Power House Station, owned by USUL.
3.1.1.2 SYSTEM DESCRIPTION

The Photovoltaic (PV) Grid connected system consists of 3 main components:

- Arrays of modules on the roofs
- Module mounting structures on the roofs
- Power Conditioning Unit (PCU) including grid integration, metering and control

The system has a lifetime of 25 years. System availability has to be at least 97%.

3.1.1.3 PV modules

The PV modules will be positioned on the rooftops of the school buildings in the optimal position to acquire the sunlight and withstand the load of wind. Modules will be in a fixed position, without tracking systems or concentrators. The exact PV technology is not specified and can be selected by the bidders.

The PV modules will be installed in such a way that there is an optimum architectural integration with the buildings; the division of the PV modules over the rooftops is up to the bidder.

Modules used must be certified by an accredited certifying company for the following standards (or equivalent):

- IEC 61215 or 61646 (performance) and 61730 (safety)
- UL 1703 Standard for Flat-plate Photovoltaic Modules and Panels
- CE marking
- EST Series EST-460, EST-22V, EST-22H, EST-110 (Electrical Safety Test)
The modules have to be fit for the following climatic conditions:

<table>
<thead>
<tr>
<th>Month</th>
<th>Air temperature °C</th>
<th>Relative humidity %</th>
<th>Daily solar radiation horizontal kWh/m²/d</th>
<th>Atmospheric pressure kPa</th>
<th>Wind speed m/s</th>
<th>Earth temperature °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>26.8</td>
<td>78.0%</td>
<td>5.76</td>
<td>101.1</td>
<td>4.1</td>
<td>28.6</td>
</tr>
<tr>
<td>February</td>
<td>27.0</td>
<td>74.7%</td>
<td>6.69</td>
<td>101.1</td>
<td>4.0</td>
<td>28.9</td>
</tr>
<tr>
<td>March</td>
<td>27.2</td>
<td>75.8%</td>
<td>6.82</td>
<td>101.0</td>
<td>3.2</td>
<td>29.5</td>
</tr>
<tr>
<td>April</td>
<td>27.5</td>
<td>77.7%</td>
<td>6.25</td>
<td>101.0</td>
<td>3.5</td>
<td>29.9</td>
</tr>
<tr>
<td>May</td>
<td>27.6</td>
<td>76.9%</td>
<td>5.51</td>
<td>101.0</td>
<td>4.4</td>
<td>29.7</td>
</tr>
<tr>
<td>June</td>
<td>27.2</td>
<td>76.7%</td>
<td>5.33</td>
<td>101.0</td>
<td>3.9</td>
<td>29.5</td>
</tr>
<tr>
<td>July</td>
<td>26.8</td>
<td>77.5%</td>
<td>5.35</td>
<td>101.1</td>
<td>3.3</td>
<td>29.3</td>
</tr>
<tr>
<td>August</td>
<td>26.6</td>
<td>79.4%</td>
<td>5.54</td>
<td>101.1</td>
<td>3.2</td>
<td>29.1</td>
</tr>
<tr>
<td>September</td>
<td>26.6</td>
<td>78.6%</td>
<td>5.84</td>
<td>101.1</td>
<td>3.6</td>
<td>29.0</td>
</tr>
<tr>
<td>October</td>
<td>26.7</td>
<td>78.6%</td>
<td>5.88</td>
<td>101.1</td>
<td>4.2</td>
<td>28.8</td>
</tr>
<tr>
<td>November</td>
<td>26.7</td>
<td>78.2%</td>
<td>5.96</td>
<td>101.1</td>
<td>4.1</td>
<td>28.6</td>
</tr>
<tr>
<td>December</td>
<td>26.7</td>
<td>79.1%</td>
<td>5.55</td>
<td>101.1</td>
<td>3.6</td>
<td>28.6</td>
</tr>
<tr>
<td>Annual</td>
<td>26.9</td>
<td>77.6%</td>
<td>5.87</td>
<td>101.1</td>
<td>3.7</td>
<td>29.1</td>
</tr>
</tbody>
</table>

These conditions will be used as a reference to calculate the annual yield of systems proposed by bidders. Full module specifications therefore must be made available for calculations.

Modules have a lifetime of 25 years. A warranty is required for an electrical production of at least 90% of nominal capacity during the first 10 years and at least 80% during the remaining years based on the initial performance measurement report which can be verified by an independent party.

The total output in kW over throughout the lifetime is related to the total cost of ownership is an important selection criteria for bidding. Performance rates over the lifetime and throughout the temperature range therefore should be as high as possible. The solar modules used shall be grouped in an optimum number of strings with module-to-module cable connections.

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2 Information from Retscreen® International Clean Energy Project Analysis Software
MODULE MOUNTING STRUCTURE

The mounting structure fixes the modules to the rooftop. The mounting structure shall position the modules in an optimum direction for maximum yield and allow for air to pass on both sides of the module to cool them. The mounting structure has a lifetime of 25 years and can withstand the climate conditions of the Maldives during that period, requiring no maintenance or a minimum amount of it. The mounting material has to be a corrosion resistant material such as stainless steel or aluminum due to the location close to the sea.

The mounting structure has to be tailored to the roof and both mounting structure and solar modules have to comply with the maximum load of the roof, including additional loads during mounting or service.

JUNCTION BOXES CABLES AND CONNECTORS:
Have to comply with standard IEC60332-1 and IEC 61984.

POWER CONDITIONING UNIT:
For each school, there will be one PCU including grid connection, metering and control. Inverters, metering and control equipment have to be placed inside the schools in a confined space with appropriate air conditioning, accessible only by authorized personnel.

INVERTERS:
The inverter has to fit the DC output of solar modules to the AC power used in the grid (400/230 V, 50. Inverters have to be certified by an accredited certification company according to standard UL 1741 (Inverters, Converters, and Controllers for Independent Power Systems) or equivalent. Inverters have a lifetime of at least 10 years.

SYSTEM BILL OF MATERIALS:
Bidder shall submit details of make, Quantity, relevant standards, technical catalogues etc complete for all the equipments included in its offer to meet the overall technical and operational requirements of the system.
SPARE PARTS:
One set of essential spares for the system being offered shall be included in the offer and details of the offered spares are to be included with the technical bid.

3.2 Associated on-site infrastructure

The solar panels in the case of Thinadhoo will be placed on the roof of the schools. Therefore, any installations at school should not occur during school working hours and ideally should be carried out the holiday period. Both schools have internal yards of at least 3000 m² and both schools have a recreation closed halls. This would satisfy the space need on-site for the solar panels infrastructure. This is especially the case if construction would occur during the holiday period where the recreation halls could be used as storage space for the panels. During the site visit the ideal grid connection from each roof has been identified at the backyard of the school with a distance of max. 20 meters from the network. 150-200 kW can be fed in into the low voltage (LV) network without major problems. Both
schools are connected to LV network (see map on Annex I). The roofs measurements are included in Annex II. The load carrying potential of the buildings is also suitable to carry the solar panels.

Associated on-site infrastructure would include:

- The PV installation requires an inverter to transform the DC current into AC. This inverter with possible panel could be mounted in a cupboard or compartment of 1 x 0.5 x 2 meters.
- A cable is required to connect the inverter with the LV network. Such a cable normally is buried at 1 meter depth to prevent damage due to digging. Bearing the short distance of the roofs to the grid, digging would not create any danger but safety majors must be taken through the grid connection related construction including digging.
- Besides kWh metering no other metering is required
- Separate inverters for each PV installation (in total 2 inverters).
- A permanent on-site control room for operational and maintenance functions which will require a footprint of max. 2 m². This will include, an energy control centre, telecoms and security. At all school visited there was no lack of space for the location of the on-site. Both schools have sufficient backyard spaces.
- A water abstraction point from existing boreholes on-site will be used for water supply for construction activities, and later on during operation for the supply of on-site ablution facilities and as cleaning water for the solar modules.

3.3 **Do nothing/ No-go alternative**

The No-go alternative assumes that the solar energy project is not developed on Thinadhoo and the existing status quo is preserved. The opportunity costs associated with the no-go option would include the loss of potential benefits to the local economy and the contribution of the project towards national targets for the generation of clean electricity.
3.4 **Project Phasing**

Due to the small scale of project size, the project could be established in a single development phase. Construction could be undertaken in modular sections. This modular approach will entail that the majority of the construction workers will be required on-site throughout the entire construction period, thus maximizing associated employment opportunities. This approach will also enable the plant to become operational as soon as the first section has been installed, thus providing an increasingly growing number of operational employment opportunities during the construction phase. Pending the requisite approvals and licensing, the proponent envisages the commencement of construction during the course of 2011-2012.

3.4.1 **Construction phase**

The implementation of the proposed solar plant project (150-200 kW) and the construction of the associated infrastructure (including the building-complex and grid-connection) will take approximately 2-4 months to complete. As indicated above the installation of PV units will be carried out section by section). The construction of each section involves the following clustered activities:

- Building roof surveying and site preparation;
- Civil works (roof works, possible trenching, foundation establishment, concrete work);
- Laying of cables;
- Assembly of the mechanical and electrical systems;
- Commissioning.

A of storage area (combined footprint of ca 500m²) will also be required to accommodate the storage and assembly of PV components, as well as the storage and maintenance of civil engineering construction equipment. All schools and the power house have this space; however schools could only provide the space in their recreation halls during the holiday period. A workshop/training area for the training of USUL staff could be provided at USUL.

The total construction capital expenditure associated with the establishment of the solar energy project is estimated to be in the region between 700,000 and 850,000 US Dollar. This
includes all costs associated with establishment of the solar panel project. Contractors will have to undertake the work associated with the construction phase. A tendering process to appoint contractors will be carried out, but construction should only then be started once environmental approval and an operating license having been obtained.

A solar panel installation of the size of 150-200 kW in a developing country involves on average 15-20 direct construction employment opportunities for an uninterrupted period of approximately 2-4 months. The section-by-section approach to construction will also ensure that the majority of construction workers will be employed throughout the construction period, thereby maximizing the available employment opportunities at any given time during the 2-4 months construction phase. Approximately 10% of the employment opportunities will be available to skilled personnel (engineers, electricians, mechanics, skilled machine drivers, management and supervisory), 40% to semi-skilled personnel (drivers, equipment operators), and ~50% to low skilled personnel (construction laborers, security staff).

In this regard, a local recruitment target will be given preference in employment opportunities. However, the majority of contractors usually prefer to make use of their own skilled and semi-skilled staff. The majority of direct employment opportunities for members of local communities may therefore be limited the low skilled work categories and some semi-skilled categories. In terms of accommodation, on-site labor camp could be planned, depending on the availability of suitable accommodation in Thinadhoo.

In terms of transport, the components of the solar energy project and the required construction material will be transported to the site via boats and then roads. Given the section-by-section construction approach, transport movements will be spread max. over the 1-2 months of the construction phase, with the possible exception of the initial and final movement of material and equipment onto and off the site. Taken over a minimum 2-4 month construction period averages out to approximately 1 trip per week. Additional traffic movement would be associated with the daily transportation of workers onto and off the site. The number of trips associated with the transport of workers to and from the site cannot be quantified at this moment. However, the majority of the local low skilled and a portion of the semi-skilled workers are likely to be not provided with transport due to the small size of the island.
3.4.2 Operational phase

The operational lifespan of the proposed solar energy project is estimated at 20-25 years. Replacing old components and/or installing new technology may extend the operational phase. The solar energy project will be operational 7 days a week and activities consist largely of cleaning and electrical equipment (mainly inverters). Maintenance will be carried out at six months intervals for each PV System. Taking the local weather conditions and the lack of dust, Cleaning of the PV panel units will be planned to ensure that each unit is cleaned at an interval of 24 weeks (depending on weather and site conditions).

From USUL staff approximately 2 full time employees should be employed at the solar energy project, each for one building. The positions will be for semi-skilled personnel. The wage bill associated with the operational phase is estimated to be in the region of 350-500 $ US Dollar per month. A power plant installation of this size does not provide a full time position for a high skilled technician. USUL might require hiring on ad-hoc basis assistance from Male or abroad.

USUL should make preferential use of local labor in as far as possible. In this regard, a local recruitment target could go up to 100%. However, this would require training and capacity building at USUL which will be indentified and listed in the implementation strategy of this project.

3.4.3 Decommissioning phase

The lifespan of the solar energy plant and its components is approximately 20-25 years. The foundations of the PV Systems will be designed so that they can be removed and the site can be rehabilitated. However, a retrofit using more advanced technology and the existing foundations is likely at the end of the operational lifespan. If no retrofit takes place the foundations will be fully removed and the site rehabilitated to the original state prior to construction. In addition, the materials used in a solar energy plant, such as steel, gold, stainless steel, germanium, copper have considerable value, and should be recovered after decommissioning.
3.5 **Other Solar energy project on the Maldives**

Although the Maldives' equatorial exposure to sunlight would seem to make the country especially conducive to solar power, this source has scarcely been tapped to date. Solar heating is used primarily in the resorts, where approximately half of all hot water is solar heated. Current development could speed up, although some resorts have begun to generate power using solar PV, for example at Soneva Fushi, where 70 kW have been installed, with plans to quadruple the size of the system. Another example related to a solar energy powered, off-grid, water purification project started in the Maldives in January 2005 that provides local bottled drinking water to be sold to the community on the island of Kulhudhuffushi. The project is a joint venture between Solco and a local Maldives company. The units use solar power to draw the water up and pass it through a system of reverse osmosis units to remove all pathogens, metals and dissolved solids, using just 20% of the power of a standard reverse osmosis unit.

Also, currently a solar powered diving boat with capacity for 10 divers with diving gear, is being designed and built by solar marine which is a partnership with Coastline Investments, a boat building company and Renewable Energy Maldives. The boat is a 10m catamaran and will have a speed of 20 knots.

At this moment, a very important demonstrative project is being carried out at House of the Maldivian President which was roofed with solar panels for electricity production.
4 BASELINE DESCRIPTION

4.1 Introduction

This section introduces the environmental, social and economic state of the art of Thinadhoo Island. This information has been based on data collection during the inception visit and on other official documents and EIAs carried out on the island.

4.2 Geographic and economic data

Thinadhoo Island is located on the western rim of Gaafu Dhaalu atoll, at approximately 72° 59’ 50” E and 0° 31’ 49” N, about 410 km from the nation’s capital Male’ and 4.5 km from the nearest airport, Kadedhdhoo (Table 4-1).

Table 4-1 Location map of Thinadhoo
It is one of the few inhabited islands facing the western Indian Ocean and exposed to the southwest monsoon related wave action. The island forms part of the natural atoll called Huvadhoo Atoll, which is considered the second largest atoll in the world. Thinadhoo is the Atoll capital amongst 10 other inhabited islands. It’s nearest inhabited islands are Madaveli (7.5 km) and Hoadedhdhoo (9 km). Huvadhoo atoll is the nearest Atoll in Maldives to the equator and sits along the southern half of the laccadive–chargos ridge, exposing the entire Atoll to direct wave action from Indian Ocean. However, it’s location in the heart of the doldrums makes the island relatively safe from major climatic hazard events.

4.2.1 Built environment

Thinadhoo has 1357 allocated plots, 73 living plots, and 177 plots available. About 35% of the total land area has been reclaimed, and about 10% of the land area is vegetated. The remaining area is densely urbanized and consists of household plots, public utilities and facilities, a network of roads and sports areas. According to the new land use plan, a new residential area is being built in the northwestern part of the island for population consolidation. Most house stocks in the residential areas are masonry built using traditional construction techniques. However, there are two-storey houses recently built as well. The key facilities of L. Gan Island have 4 schools, 1 regional hospital in the center of the island. Thinadhoo also has a large sports ground which attracts approximately 2000 visitors to the island each year for several weeks. There are discussions about future other expansion and land claim plans.

4.2.2 Population

The current population of the island is around 7,000 people, about 1,000 of which appear to be workers who have come to the island from other areas in Maldives and laborers from overseas. There are about 1,100 households on the island. The average household size in Thinadhoo is 6.1 persons (Census 2006). The population density is about 62.6 persons per hectare. 12 plots are presently under construction and 51 plots are in the final stages of allocation. Some of the existing buildings are vacant, however. The number of households has grown rapidly following the recent allocation of plots from newly reclaimed land.
The working age population (between 16 and 65) comprises 59% of the island population. The dependent population is at 41% of the population, which comprises of 35% children and 6% elderly people.

The gender ratio of working age population is 0.8 compared to the 1.0 and 1.3 for children and the elderly, respectively. As noted above, this reflects the temporary migration of men for employment outside the island.

The Census 2006 estimates the population born outside Thinadhoo in 2006 at 873 persons (20 % of total population). It shows that most migrants are from Gaafu Dhaalu, Gaafu Alifu and Seenu Atolls. However, it is likely that the figure for Seenu Atoll reflects persons born in Hithadhoo Regional Hospital.

4.2.3 Economic data: vulnerability and poverty

Estimating the island economy is a difficult task in the Maldives since there is not enough local economic data to undertake such an assessment. Much of the statistical data are aggregated at the national level. Hence, the value for GDP – the widely used measure for economic performance – is only available at the national level. There is no established mechanism to measure the inputs and outputs from a local island economy. In an UNDP study in 2009, the total estimated value of the Thinadhoo economy was estimated between Rf600 and Rf700 million.³

According to the Poverty and Vulnerability Assessment of 2004, the income poverty index of Thinadhoo is 0.5 where the Gaafu Dhaalu Atoll average is 0.7 and the national average is 1.0. As the index is measured on a scale 1-10, where the higher the score, the higher the vulnerability, a score of 0.5 indicates that the performance of Thinadhoo is good in terms of poverty and vulnerability compared to the atoll average and national average.

4.2.4  **Sectoral employment**

Thinadhoo's economy is primarily based on the fishing industry. Thinadhoo is known as one of the main fishery islands in the southern atolls of Maldives. Other key industries include manufacturing, whole sale and retail trade, construction and transportation. Manufacturing activities including boat building, tailoring, carpentry and, food production and processing. These activities contribute to the export income of the island. Whole sale and retail trade also contribute to the export sector through re-exports to nearby islands and through retail to visitors.

The key employers are the Government (civil service), fishing vessel owners and traders. Thinadhoo Island is considered a regional hub to the Gaafu Alifu and Gaafu Dhaalu Atoll. It is strongly linked to the islands of these atolls, particularly Gaafu Dhaalu Atoll, as a re-export centre and a service centre. A variety of goods are imported wholesale from Male' and re-exported to nearby islands. Thinadhoo's economy is also highly reliant on Male'. The presence of the Regional Hospital and atoll school seems to provide opportunities to expand trade activities targeting temporary visitors from nearby islands. In addition, the presence of a regular ferry service between the islands of Gaafu Dhaalu Atoll has boosted the re-export activities and general business growth on the island.

According to Census 2006, the total number of economically active population is 1755. Amongst these, 1406 are employed and 349 are unemployed. The economically not active population is reported as 965 and the labor force participation rate is 60.6%. The crude unemployment rate is reported as 20%, indicating a large number of voluntarily unemployed persons on the island. In terms of the employment structure, much of the employment is in public administration (34%), manufacturing (17%) and fishing (15%) - Together, these three sectors account for 66% of the employed population.

Fishery is a significant source of income on the island. According to the fishermen, 300 fishermen live and work on Thinadhoo involving a large part of the households. There are 11 fishing boats, with anywhere between 14 and 30 fishermen associated with each. The main activities are ocean fishing for tuna (skipjack and yellowfin, about 7-8 tonnes/day) and reef fishing for fish, lobster and shellfish. About 50% of the fisheries products are sent to the capital and 50% stay on the island for local consumption. There is a tuna processing plant on
the island dealing with Katsubushi (tuna is cooked and smoked). There are also 2 small aquarium fish businesses on the island. Colorful reef fishes, including damselfishes, angelfishes, butterfly fishes, moorish idols, lion fishes, surgeon fishes and some invertebrates are captured around the island or on reefs nearby and shipped to Male before they are sent to Hong Kong. Fishermen say that the fishing is decreasing the last two years around this island and it is now necessary to go further from the island for good fishing.

According to the UNDP (2009), the differences between the estimated values for the investment and monthly income per sector are very large. For instance, in the fishery sectors it amounts 3,100,100.00 (thousands Rufiyaa) followed by public administration 2,090,000.00 (thousand Rufiyaa); and manufacturing 740,000.00 (thousand Rufiyaa).

4.2.5 Tourism

At present no tourist attractions are located on Thinadhoo. There are three resorts in the area on neighboring islands and several others either under construction or planning but not on Thinadhoo. Due to its location, Thinadhoo does have potential for tourism. In recent year several shops and restaurants have been opened and there is an increased economic development. However, there is no local policy on this issue.

A carbon neutral Thinadhoo would certainly contribute to the attractiveness of the island for day tourists from nearby resorts. This will very likely also depend on improving the service sector on the island and also to a large extent on the policy of the council and its promotional activities.

4.2.6 Land use

A summary of the main features of the present land use is provided below.

---

4 Estimated income for salaried employees only and is based on average income multiplied by the number of employees.
— Thinadhoo is a highly urbanized settlement with a population density of 62.6 persons per hectare.
— The settlement footprint covers 90% of the total habitable land area. As a result almost all land available is currently being used for housing, economic establishments and socioeconomic infrastructure on the island.
— The harbor contains a large proportion of the islands business establishments.
— The key economic infrastructures on the island are the harbor, power house, fish market, oil storage and supply facilities and communications infrastructure. All these facilities, except communication infrastructure, are located within 100 m of the coastline.
— The majority of the land is utilized for housing and urban services.
— Land allocation in the past did not consider land for economic activities. It was only recently that land was identified specifically for fish processing, fish market and light industries. Prior, land was only allocated as housing plots and business establishments had to rent or utilize fragmented housing plots. Hence, about 85% of the businesses are established within housing plots.
— A new waste disposal site has been established on the northern tip of the island.

4.3 Socio-cultural background

Thinadhoo is known in the Maldives for openness for innovation. This has also been demonstrated in the interviews with several stakeholders, including fishermen, who expressed their high interests and support of the transition efforts of Thinadhoo towards carbon neutrality and RE.

The island is also known for its business mentality. Throughout the last decade, the island has established itself as a regional trade hub and it has also developed bilateral trade connections with Sri Lanka. The growing consumerism is pretty evident on the island. Watching TV and listening to radio are part of the daily lives of the Thinadhoo community. The number of satellite dishes, telephones and fax machines is increasing, indicating an increasing openness of the island population toward the rest of the world. The main recreational activities within the island community are soccer, volleyball and netball, the latter is most common among women on the island.
The island is also famous for its political activism. It was one of the leading islands in the political resistance in 1960th. The overall impression is that the average person has a good political awareness.

In the Maldives, households are generally based on the extended family system. It is quite common to find the extended family living under one roof. The family authority often rests on the patriarch of the family, usually the eldest son in the family. He carries the responsibility of overseeing the affairs of the entire family when enough experience and maturity has been shown in family duties. A key feature of the island society is that it respects family and communal values. Significant amount of caring is shown towards each other by members of the family and strong bond exists between large family groups. At times of difficulty, family members almost always seem to support each other.

4.4 State of the art of environmental protection

While Thinadhoo has a low incidence of historical natural disasters, the present environmental characteristics in the island have a number of weaknesses which may expose the island to future hazards. However, Thinadhoo has undergone substantial human modifications including land reclamation, dredging activities and coastal infrastructure development projects. At present the island is almost rectangularly shaped with widths ranging from 745 m to 900 m and lengths ranging from 1590 m to 1351 m. The total surface area of the island at present is 115.5 ha (1.16 km²). The island is oriented in a north-south direction.

The original island had a land area of approximately 39 ha (0.39 km²) and had a wetland area covering 16 ha (0.16 km²). The land reclamation process which started in the 1980’s reclaimed the entire wetland area and parts of the reef flat. Approximately 71 ha or 61% of the present island is reclaimed and the island of Thinadhoomaahutta or Maahutta has also been joined to form the present Thinadhoo.

The reef of Thinadhoo is fairly large with a surface area of 1150 ha (11 km²) extending to about 7.5 km in a northeast-southwest orientation. Thinadhoo is now the only island within the reef system following the joining of the only inhabited island (Thinadhoomaahutta).
Thinadhoo is located on the southern tip of reef system, next to a major reef entrance (Thinadhoo Kandu). The depth of the reef flat is quite shallow averaging less than -1 m MSL. The distance between the island shoreline and oceanward reef rim varies from 83 m in the southwest corner to 200 m in the west. The average distance to reef edge is approximately 170 m.

Due to fast urban expansion and land claim, the shallow lagoon to the west of the island has been dredged to provide fill for the reclamation and to deepen the harbor area. The dredging may have removed some of the sand that was part of the sand supply system of the island and its absence may mean that erosion during westerly and NW winds is a risk. Together with the harbor works in the west, the normal sand movements around this side of the island are likely to have been severely disrupted. An inspection of the erodible status of the shorelines around the island found that about 27% of the island is eroding, 59% is neutral and 13% is accreting.

There are no marine or terrestrial protected areas near Thinadhoo\(^5\). On the NW part of the island there remains a significant patch of vegetation. Immediately to the east of the dump is a small enclosed lagoon (see Table 4-3) dominated by *Rhizophora* and a few *Pemphis* mangroves. This is a natural and sensitive ecological feature of the island and seems in relatively good condition, though it has been polluted from the nearby dump with rubbish and probably by leachates. Its waters have blue-green algae growing within them and the salinity seems to be about half of the salinity of seawater (not measured). There are other small patches of natural vegetation in the west and south, largely dominated by coastal trees and shrubs (*Pemphis*, *Pandanus*, *Hibiscus vines* and *Scaevola*). *Pemphis* is found at the top of the beach at various locations around the island.

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\(^5\) Environmental Impact Assessment, GDh Thinadhoo wastewater collection, treatment and disposal system, 22 December 2010.
One day was spent for a survey on the ecological situation on the island. Flora and fauna were investigated to check potential impact by construction equipment during the
construction of RE facilities. Additional discussions with local people were carried out aiming at obtaining information on the existence of terrestrial and marine animals. The first conclusions are that the amount of animals is minimal. In generally, very few animals could be observed, rabbits, birds, grey heron (Ardea cenereaa), stilt (Himantopus) and bats.

The soil exists of coral sand and is very poor. The vegetation on the reclaimed land mainly exits of poor grass.

4.4.1 Overall environmental conditions

The existing overall environmental conditions of Thinadhoo are poor. The island has been highly modified by reclamations, urbanization, dredging and harbor development. Sewage is being disposed of through a multitude of official and unofficial outfalls that empty usually with a few meters of the beach. There are signs of eutrophication around the island. The main environmental factors affecting this island are:

1. Reclamation, harbor development and dredging which has changed the mechanisms of sand movements around the island. It can be expected that natural seasonal movements of sand have been lost and that the island will go through a long term period of readjustment. This could mean ongoing issues of erosion (See Table 4-4).

2. Sewage is affecting the groundwater quality and effluent being disposed of in the near-shore waters is leading to increasing issues with overgrowth of algae and sea grasses.

3. Rubbish and waste is a problem around the island, and particularly in the NW and along the north coast. Disposal is uncontrolled and occurs around the island at the top of the beach. Even the official dump site is not handling waste/rubbish correctly which results in leakage into the surrounding waters.

4. There are few areas of natural vegetation left around the island, like a minimal coastal strip in the west. The enclosed lagoon and costal vegetation in the north deserve protection.
4.4.2 Waste management

Although there is an ‘official’ waste/rubbish dump on the NW part of the island it is poorly controlled and rubbish is spilled / is pushed into the intertidal area and is being mobilized by waves and currents. The dump is about 20m wide and 80-90m long and contains unsorted rubbish mixed together including plastics, organic wastes, green waste, metals, wood, fabric and discarded appliances. Rubbish is also being dumped by about 14% of households at many uncontrolled seaside locations around the island. In one location in the north, rubbish from a shipyard is being thrown on the top of the beach. The rubbish that is being mobilized by the sea is resulting in polluted and anoxic areas of the near-shore environment, particularly in the north of the island and parts of the SE.
About 70% of the households on the island have a septic tank constructed of bricks or concrete and about 13% use a toilet connected directly to the sea. The septic tanks are old and leaking into the land and groundwater. The septic tanks in households in the older, original part of the island are in turn connected to a small bore gravity effluent sewerage system (BCL, 2010c). The collection network is in poor condition, has insufficient slope to functioning correctly and in some locations is blocked as a result of direct connections from the toilet (i.e. no septic tank). There are 10 official effluent outfalls around the island, though two of these in the north were blocked by the reclamation, and there are no new connections in the new settlements within the reclaimed area. In addition to the official effluent outfalls there are at least 22 unofficial outfalls, particularly in the south and west of the island (see location of recorded outfalls. The outfalls all discharge waste into the near-shore waters within the area of the house reef, usually within a few meters of the shore.

4.4.3 Drink water resources

The main source of water for drinking and cooking is rain water collected in tanks. There is now a new Reverse Osmosis (RO) desalination plant on the island. The public buildings have been connected lately. The households will be connected before October 2011. The groundwater available in the older parts of the island is used for bathing and washing, but is not potable.

4.5 Energy supply

As know the energy supply on the island is provided by a diesel powered plant. In Table 4-5the existing power house is shown. The power house includes three diesel engines with a capacity of 600 kW, 720 kW and 1000 kW. During our inception visit, we witnessed that the only the largest one was operating.
The diesel engines are cooled by water. The water again is cooled in a radiator by air. The supply of the water is rain water. There is no water discharge to the soil or the sea. So impact on water is not the case.

4.5.1 **Air emissions**

According to USUL emission measurements have not been carried out yet on the island. Therefore, air emissions were calculated based on fuel consumptions. For 2009 and 2010 the following fuel consumptions in liters were registered.

**Table 4-6: Fuel consumptions existing power house**

<table>
<thead>
<tr>
<th></th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>103,669</td>
<td>111,187</td>
</tr>
<tr>
<td>February</td>
<td>96,976</td>
<td>103,567</td>
</tr>
<tr>
<td>March</td>
<td>114,186</td>
<td>120,467</td>
</tr>
<tr>
<td>April</td>
<td>111,447</td>
<td>115,300</td>
</tr>
<tr>
<td>May</td>
<td>111,183</td>
<td>118,450</td>
</tr>
<tr>
<td>June</td>
<td>108,107</td>
<td>110,994</td>
</tr>
</tbody>
</table>
Based on data of Mitsubishi Heavy Industries for diesel engines the following air emissions are estimated:

- **NOx**: 16.2 g NOx/L
- **PM10**: 0.46 g PM10/L
- **SO2**: not measured and not known.
- **CO**: 2.8 g CO/L
- **CO2**: 2.7 kg CO2/L.

The emissions in 2009 and 2010 based on the fuel consumptions are shown in Table 4-8:

<table>
<thead>
<tr>
<th>Components</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOx</td>
<td>20.9</td>
<td>22.3</td>
</tr>
<tr>
<td>PM10</td>
<td>0.6</td>
<td>0.6</td>
</tr>
<tr>
<td>CO</td>
<td>3.6</td>
<td>3.9</td>
</tr>
<tr>
<td>CO2</td>
<td>3.5</td>
<td>3.7</td>
</tr>
</tbody>
</table>

The CO2 emissions are 760 g/kWh and are in the same range as a new high efficient coal fired power plant.

There were no noise emission measurement data available, so the noise level was estimated. The noise level in the power house was high and was at a level that it nearly...
hurts. The operators are wearing mufflers during their shifts. During the visit the main entrance door was open. The sound pressure level at a distance of 100 m was estimated at about 70 dB(A). The nearest houses are at a distance of about 125 m. The level is too high based on the Guidelines for Community Noise, World Health Organization (WHO), 1999. Those guidelines prescribe a level of 55 dB(A) during daytime and 45 dB(A) during nighttime.

The existing power house is located at the southwest corner of Thinadhoo. At the same place the RO-water plant is located. At the site there is enough space to install a wind turbine or a small boiler for firing biomass or waste.
5 ENVIRONMENTAL IMPACT ASSESSMENT

5.1 Introduction

The following includes the assessment of environmental impact of the solar energy plant in Thinadhoo:

5.2 Construction phase

The main impact of solar panels in the construction phase, especially on roofs, relates safety issues and noise created on the roof of building. Public buildings, especially schools, will have difficulties to function in the period of installation. Another possible impact is created during the infrastructure on-site, e.g. laying the grid connection cables as mentioned above in section 3.2.

5.2.1 Properties adjacent to solar energy project site

Both schools are stand-alone buildings and have no direct link to adjacent buildings. All public schools have direct access to the road and are directly connected to the required network. This means that the installation of the solar panels would not have any impact on any properties adjacent.

5.2.2 Properties potentially affected by grid connection

Both schools are stand-alone buildings and have a direct grid connection. All grids on the island are underground, including at the schools. The distance from the grid to the solar energy installations would not exceed 20 meters and will not require digging on the roads. This means that the grid connection would not have impact on any other properties.
5.2.3  **Noise and dust**

During the construction and the monitoring work on the roofs of the schools noise and some limited dust will be created. This will affect the work and normal function of the school.

**MITIGATION**

To avoid the noise on the roofs of the buildings, the contractor will either receive working hour's limitations that fit the working hours of the schools or ideally carry out the construction work during the holidays. Only limited stress on resources and traffic disruptions might occur.

Contractor should make provisions to provide OHS orientation training to all employees to ensure they are apprised of basis site rules of work at/on the site and of personal protection and preventing injury to fellow employees.

5.2.4  **Increased risk to stock, crops, pasture, game and farming infrastructure**

Due to the rather limited number and period of construction work on the island, the impact is rather Low. The nature of the construction works indicates that no toxic or hazardous materials will be used, apart from fuel oils for vehicles, which will be properly stored. Construction wastes will be sorted out by the contractors for recycling. The residual wastes will be properly handled by the relevant municipal units for waste disposal.

5.2.5  **Damage to (farm) land**

The finding of the ESDD indicate that there is no significant impacts associated with required control room (size of maximum 2 m² each) to be located on the schools and the associated transmission line link with the network. However, in future solar energy projects on the island, an assessment of each new location will be required.

There is no farm land on the island. Issues to non-farm land have been addressed in sections 4.2.6. The conclusion is that no damage to any land would occur through the installation and the grid connection of the solar energy project.
Table 5-1: Summary of environmental impacts during construction phase

<table>
<thead>
<tr>
<th>Impact</th>
<th>Significance No mitigation</th>
<th>Significance With mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Damage to Properties adjacent to solar energy project site</strong></td>
<td>Low</td>
<td>Low (negative impacts)</td>
</tr>
<tr>
<td><strong>Damage to Properties potentially affected by grid connection</strong></td>
<td>Low</td>
<td>Low (negative impact)</td>
</tr>
<tr>
<td><strong>Impact of noise and dust</strong></td>
<td>High (negative impact)</td>
<td>Low (negative impact)</td>
</tr>
<tr>
<td><strong>Loss of agricultural; residential and commercial land associated with</strong></td>
<td>Low</td>
<td>Low (negative impact)</td>
</tr>
<tr>
<td><strong>construction related activities</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Increased risk to stock, crops, pasture, game and farming infrastructure</strong></td>
<td>Low</td>
<td>Low (negative impact)</td>
</tr>
</tbody>
</table>

5.3 Operational phase

Unlike thermal power plants, the operation of the project 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. The largest impact could be visual. However, as the project site and the surrounding areas have no natural beauty, visual impairment would not be a problem. With an old design of solar photovoltaic arrays, reflected sunlight may cause problems if the system is close to a road and is facing in a direction in which the reflected sunlight may cause problems. This problem will not occur in this project as its solar photovoltaic panels are of new design, which can absorb sunlight and eliminate sunlight reflections.
On Thinadhoo near to the equator the panels should be placed as horizontal as possible. Just the rain water should flow from the panels to avoid pollution of the panel. The best location for solar panels is public buildings. Most public buildings have flat roofs and people will not be disturbed by sun reflection. The impact will be minimal and negligible.

5.3.1 **Health and safety issues**

The primary environmental, health, and safety issues associated with solar energy involve how they are manufactured, installed, and ultimately disposed of (see below 3.4.3). In particular, the manufacturing of photovoltaic cells often requires hazardous materials such as arsenic and cadmium. Even relatively inert silicon, a major material used in solar cells, can be hazardous to workers if it is breathed in as dust. Workers involved in manufacturing photovoltaic modules and components must consequently be protected from exposure to these materials. However, none of these potential hazards is much different in quality or magnitude from the innumerable hazards people face routinely in an industrial society. Through effective regulation, the dangers can very likely be kept at a very low level. In addition, the relevant risks essentially concern workers at the cell manufacturing plant (in this case Germany), and therefore this issue falls outside the scope of the ESDD.

5.3.2 **Land use and visual impacts**

Due to their size, and the presence of numerous highly geometric and sometimes highly reflective surfaces, solar energy facilities may create visual impacts. However, being visible does not necessarily imply that they are visually intrusive. Aesthetic issues are by their nature highly subjective. Proper siting decisions can help to avoid aesthetic impacts to the landscape. Siting decisions will be taken in consultation with all local stakeholders.

In the case of Thinadhoo, the solar panels in this project will be placed on public buildings and will not use any additional land. There will be no impact. In case future projects are being developed on other locations, for instance on the shallow sea costs, then there is a need to reassess this issue.
5.3.3 Carbon footprint

The primary environmental, health, and safety issues associated with solar energy involve how they are manufactured, installed, and ultimately disposed of. Energy is required to manufacture and install solar components, and any fossil fuels used for this purpose will generate emissions. It is therefore important to compare how much fossil energy input is required for solar systems compared to the fossil energy consumed by comparable conventional energy systems. Although this varies depending upon the technology and climate, studies have found that the energy balance for solar energy facilities is generally favorable and is improving with each successive generation of technology, including PV technology.

Table 5-2: Summary of environmental impacts during operational phase

<table>
<thead>
<tr>
<th>Impact</th>
<th>Significance No mitigation</th>
<th>Significance With mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health and safety issues</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>(negative impacts)</td>
<td>(negative impacts)</td>
</tr>
<tr>
<td>Land use and visual impacts</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>(negative impact)</td>
<td>(negative impact)</td>
</tr>
<tr>
<td>Carbon footprint</td>
<td>Medium/High</td>
<td>Medium/High</td>
</tr>
<tr>
<td></td>
<td>(Positive impact)</td>
<td>(positive impact)</td>
</tr>
</tbody>
</table>

5.4 Decommission phase

Decommissioning of solar panels is very likely to involve the disassembly and replacement of the existing facilities with more modern technology. This is likely to take place in the 20-25 years post commissioning. All of the components of the solar panels can be reused or recycled. Dismantling of the PV panels will be handled by some suppliers that offer the best price for used PV panels in the future.
MITIGATION

In case the solar panels are not replaced by new ones, all structures and infrastructure associated with the Thinadhoo solar energy plant should be dismantled and transported off-site on decommissioning;

Table 5-3: Summary of environmental impacts during decommissioning phase

<table>
<thead>
<tr>
<th>Impact</th>
<th>Significance</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dissemination of old panels (waste management)</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>(negative impacts)</td>
<td>(negative impacts)</td>
</tr>
</tbody>
</table>

5.5 Biofuels (biodiesel)

5.5.1 Air emissions

The air emissions for biofuels and diesel are the same but the CO₂ emission of biofuels is not counted. Depending on the proportion of biofuel in the fuel for the diesel engines the CO₂ emission will be influenced. The NOₓ, PM₁₀ and CO emissions will fall within the WB guidelines. Biofuels do not contain sulfur so the SO₂ emission will be lower than in the existing situation.

5.5.2 Noise

As the power house situation will not change, the noise emission will not change. Biofuels do not change the noise level of the diesel generators.
5.5.3 **Sustainable production**

The main challenge of biofuels is the sustainable production of biofuels. In Malaysia and many other countries large areas of rain wood have been cut to plant palm trees and produce palm oil. This has great impact on the environment in those countries and on the social environment. Close monitoring and certification of the product is required to obtain sustainable biofuels. As the Maldives have little experience with environmental management it is not recommended to go for biofuels.

5.5.4 **Land use**

The biofuels will be fired in the existing power house. There is no change in land use.

**Table 5-4: Summary of environmental impacts of biodiesel during operational phase**

<table>
<thead>
<tr>
<th>Impact</th>
<th>Significance No mitigation</th>
<th>Significance With mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Air emissions</strong></td>
<td>Low (negative impacts)</td>
<td>Low (negative impacts)</td>
</tr>
<tr>
<td><strong>Noise</strong></td>
<td>Low (negative impacts)</td>
<td>Low (negative impacts)</td>
</tr>
<tr>
<td><strong>Sustainable production</strong></td>
<td>Low (negative impact)</td>
<td>Low (negative impact)</td>
</tr>
<tr>
<td><strong>Land use</strong></td>
<td>Low (Positive impact)</td>
<td>Low (positive impact)</td>
</tr>
</tbody>
</table>
6 SOCIAL IMPACT ASSESSMENT

6.1 Introduction

The key activities in the Social Impact Assessment (SIA) process embodied in the guidelines include:

- Describing and obtaining an understanding of the proposed intervention (type, scale, location) and the communities likely to be affected and determining the need and scope of the SIA;
- Collecting baseline data on the current social environment and historical social trends;
- Identifying and collecting data on the SIA variables and consultation with affected individuals and communities;
- Assessing and documenting the significance of social impacts associated with the proposed intervention;
- Identifying alternatives and mitigation measures.

In this regard the study involved:

- Review of the most recent demographic data;
- Review of relevant planning and policy frameworks for the area;
- Site specific information collected during the site visit to Thinadhoo and interviews with key stakeholders;
- Review of information from similar projects;
- Identification of social issues associated with the proposed project.

The following section includes an assessment of social issues throughout the construction and operational and decommissioning phase:
6.2 Construction Phase

6.2.1 Creation of local employment, training, and business opportunities

Potential positive impacts:

- Creation of employment and business opportunities, and the opportunity for skills developed and on-site training.

Bearing the small size of the island that the island is already connected to power, we do not expect any substantial impact on long-term employment or business opportunities due to the implementation of the project on the island. In terms of business opportunities for local companies, the expenditure of max. 700,000-850,000 US Dollar during the construction phase will create business opportunities for the island economy. However, given the technical nature of the project and high import content associated with the PV chosen the opportunities for the local economy of Thinadhoo are likely to be limited (e.g. construction material-sand and cement). The non-component related expenditure (unquantified) during the construction phase will create business opportunities for the regional and local economy. However, given the technical nature of the project, and the high import content associated with solar technology, the opportunities for the local economy will be limited to the local service industry and to employment of non-skilled labor.

The sector of the local economy that is most likely to benefit from the proposed development is the local service industry. The potential opportunities for the local service sector would be linked to accommodation, catering, cleaning, transport and security, etc. Construction workers will be accommodated in guest houses or by people who want to rent out their houses. In addition, a proportion of the local wage bill earned by construction workers over the 2-4 months construction phase is also likely to be spent in the local and regional economy. The injection of income into the area in the form of rental for accommodation and wages will create opportunities for local businesses on Thinadhoo. However, bearing in mind the very small size of the island and the few basics or limited possibilities for spending money on the island would rather limit the total expenditure of the foreign workers on the island to the minimum needed, namely food and accommodation. The benefits will however be confined to the construction period (2-4 months).
Given the level of skills levels at USUL, the implementation of a skills training programme is regarded as crucial if the 100% local employment is to be met or approached to any meaningful extent. Experience from other projects worldwide has shown that civil works are typically outsourced to contractors and that these contractors typically prefer to make use of their own skilled and semi-skilled staff. Therefore, in order to meet the 100% stated employment target will need to contractually require contractors to employ locals from Thinadhoo, ideally those already employed at the existing power station and USUL staff. However, unless a skills-training programme is implemented the chances of meeting this target may be compromised. In addition, it is safe to assume that the majority of direct employment opportunities for members of the Thinadhoo community will be limited to some semi-skilled and low skilled opportunities.

**MITIGATION**

The contractor would give preference to the local community for semi and unskilled job opportunities.

The contractor will be required to implement on-site training and skills development programme for USUL staff, the power station staff and possibly additional local staff. The aim of the programme should be to enable the existing staffs to enroll into a smooth transition and also to maximize the number of people from local communities and the broader Thinadhoo area employed during the life-time of the project on all technical levels of the project.

6.2.2 **Impact of construction workers on local communities**

The presence of construction workers poses a potential risk to family structures and social networks. While the presence of construction workers does not in itself constitute a social impact, the manner in which construction workers conduct themselves can impact on local communities. The most significant negative impact is associated with the disruption of existing family structures and social networks. This risk is linked to potentially risky behavior, mainly of male construction workers, including:

- An increase in alcohol and drug use;
- An increase in crime levels;
- The loss of partners and/or wives to construction workers;
— An increase in teenage and unwanted pregnancies;
— An increase in prostitution;
— An increase in sexually transmitted diseases (STDs), including HIV.

Due to the rather limited number of involved workers on the island, the impact is rather low.

MITIGATION
— Project developers would give preference to the local community for semi and unskilled job opportunities.
— USUL should consider the establishment of a Monitoring Forum (MF) in order to monitor the construction phase and the implementation of the recommended mitigation measures. The MF should be established before the construction phase commences, and should include key stakeholders, including representatives from local communities, local Councilors, fishermen and the contractor(s). The MF should also be briefed on the potential risks to the local community associated with construction workers;
— USUL will establish grievance redress mechanism with the representation of the Island and Atoll Council and the local communities. The aim of the mechanism is to ensure that consultation, disclosure and community engagement continues throughout construction of the project. USUL should be the first contact for grievance followed by the Island and Atoll Council. USUL will document the grievance and send it to the appropriate agency/office for action. In this manner, common grievances can be handled quickly and more effectively. The Island Council will also follow-up to ensure the grievances have been adequately resolved. A summary of grievances will be forwarded to the World Bank on request. Throughout the preparation and implementation of the project, the public will be fully informed of their rights and the procedures for addressing complaints, whether verbally or in writing. In order to avoid going through a lengthy and formal procedure of logging-in of complaints and waiting for the redress, care will be applied to prevent grievances from occurring by fully disclosing and consulting all provisions to the public. Key principles of resettlement and the nature of the project that will be summarized in a document and made available upon request to the public during project implementation. In order to mitigate for any possible disputes and conflicts during the project implementation
process, complaints and grievances comprising the Project will be addressed at first USUL, Island and Atoll Council.

— USUL and the contractor(s) should, in consultation with representatives from the MF, develop a code of conduct for the construction phase. The code should identify which types of behavior and activities are not acceptable. Construction workers in breach of the code should be dismissed. All dismissals must comply with the Maldivian labor legislation;

— If needed, USUL and the contractor should implement an HIV/AIDS awareness programme for all construction workers at the outset of the construction phase; The literature related to HIV/AIDS be displayed in the contractor's office and labor camp (if any); free condom distribution could be another measure.

— The movement of construction workers on and off the site should be closely managed and monitored by the contractors. In this regard the contractors should be responsible for making the necessary arrangements for transporting workers to and from site over weekends or after hours;

— The contractors should make the necessary arrangements for allowing workers from outside the area to return home over weekends and/ or on a regular basis. This would reduce the risk posed to local family structures and social networks.

6.2.3 Influx of job seekers to Thinadhoo

As was indicated in section 4.2.4 it is very difficult for the locals in Thinadhoo to find work on their own island and much of the youth is moving to Male or to tourist's resorts to find jobs. The findings of the SIA also indicate that the population of Thinadhoo support for the project is largely motivated by its potential to create employment opportunities for their community during both the construction and operational phases. With regard to the construction phase, Project developers will give preference to the local community for semi and unskilled job opportunities.

Field interviews indicated that economically motivated in-migration and subsequent labor-stranding have been a significant problem in parts of the Maldives. While limited economic opportunities have largely prevented in-migration into Thinadhoo thus far, opportunities
associated with the touristic sector in the nearby resorts have lead to significant in-migration of people from Sri Lanka and Bangladesh as well as other south Asian countries over the past few years. Competition over employment opportunities, housing, etc. could result in violently xenophobic attacks. These potential risks include foregoing employment opportunities to members of the Thinadhoo community, as well as creating potential resentment, animosity and tension.

**MITIGATION**

Key to mitigating this potential risk would be the rigorous implementation of a maximum local employment recruitment policy. As was argued in Section 3.4.1 this target can only be met or meaningfully approached if a skills-training programme is implemented in advance of the commencement of the construction phase.

<table>
<thead>
<tr>
<th>Impact</th>
<th>Significance No mitigation</th>
<th>Significance With mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creation of employment and business opportunities</td>
<td>Low (positive impact)</td>
<td>Medium (positive impact)</td>
</tr>
<tr>
<td>Presence of construction workers and potential impacts on family</td>
<td>Medium (negative impact for a community as whole)</td>
<td>Low (negative impact for a community as whole)</td>
</tr>
<tr>
<td>structures and social networks</td>
<td>Medium (negative impact of Individuals)</td>
<td>Low (negative impact of individuals)</td>
</tr>
<tr>
<td>Increased risk of stock theft, poaching and to damage to island</td>
<td>Low (negative impact)</td>
<td>Low (negative impact)</td>
</tr>
<tr>
<td>infrastructure associated with construction workers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased risk of fires associated with construction related activities</td>
<td>Low (negative impact)</td>
<td>Low (negative impact)</td>
</tr>
</tbody>
</table>
6.3 **Operational Phase**

6.3.1 **Creation of job opportunities and training**

Given the level of skills levels at USUL, the implementation of a skills training programme is regarded as crucial if the 100% local employment is to be met or approached to any meaningful extent. Experience from other projects worldwide has shown that civil works are typically outsourced to contractors and that these contractors typically prefer to make use of their own skilled and semi-skilled staff. Therefore, in order to meet the 100% stated employment target will need to contractually oblige contractors to employ locals from Thinadhoo, ideally those already employed at the existing power station and USUL staff. However, unless a skills-training programme is implemented the chances of meeting this target may be compromised. In addition, it is safe to assume that the majority of direct employment opportunities for members of the Thinadhoo community will be limited to some semi-skilled and low skilled opportunities.

The operational phase will create opportunities for skills development and training. Based on information from similar studies, it is expected that the proposed solar energy facility will employ approximately 2 full time employees over a 25-year period. The wage will range between $ 350 and 500 $ US dollars depending on level of skills. Due to the need for specialized skills it may be necessary to import the required operational and maintenance skills from other parts of the Maldives or even overseas. However, bearing in mind that the current power station employs 11 workers who provide financial support for their families including parents. An inquiry provided that each employee supports, on average, 10 other persons on the island. A long term change in the energy infrastructure on the island without providing this group with the required training would have medium negative impact on this group.

In addition there is a need to provide the USUL staff with the required training related to the switch from conventional energy to solar energy.

All of the security positions can be filled by local residents. However, it will be possible to increase the number of local employment opportunities through the implementation of a skills
development and training programme linked to the operational phase. Such a programme would support the strategic goals of promoting local employment and skills development.

**MITIGATION**

The contractor will make an assessment of the capacities of USUL staff to run the solar plant independently.

USUL will enroll its assigned staff in technical training to be prepared for the operational phase.

6.3.2 **Development of infrastructure for the generation of clean, renewable energy**

Thinadhoo currently relies on subsidized diesel-powered energy to meet almost 100% of its energy needs. This situation is not sustainable bearing in mind the soaring diesel prices and the lack of national capital to further subsidize the diesel. The establishment of a clean, renewable energy facility will therefore reduce, at the first step albeit minimally, Thinadhoo’s reliance on diesel-generated energy and the generation of carbon emissions into the atmosphere. Therefore, the proposed development of the solar energy project also represents an investment in infrastructure for the generation of clean energy, which, given the challenges created by climate change, represents a High social benefit for society as a whole.

6.3.3 **Impact on overall energy prices on the island**

The overall impression on the island that there is full support for the introduction of RE into the island, however, Stakeholders meetings and consultations have indicted the fears that the introduction of RE into the island might affect the overall electricity prices on the island. This concern has been in particular raised by the most vulnerable group on the island namely the fishermen. This group expects that in case electricity price will be increasing, they will not be able to pay it and thus they expect governmental subsidy.
MITIGATION

A clear and transparent public communication plan must be adopted throughout the project, this could be done through flyers, interviews in local newspapers and online information developed to address these concerns. A template communication plan is attached to this document in Annex II.

Table 6-2: Summary of social mitigation measures during operational phase

<table>
<thead>
<tr>
<th>Impact</th>
<th>Significance No Mitigation</th>
<th>Significance With Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creation of employment and business</td>
<td>Low</td>
<td>Medium</td>
</tr>
<tr>
<td>opportunities</td>
<td>(positive impact)</td>
<td>(positive impact)</td>
</tr>
<tr>
<td>Impact on tourism</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>(positive and negative)</td>
<td>(positive and negative)</td>
</tr>
<tr>
<td>Promotion of renewable energy projects</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>(positive impact)</td>
<td>(positive impact)</td>
</tr>
</tbody>
</table>

6.4 Assessment of Cumulative impacts

There appear to be no guidelines for solar facilities. The Australian Wind Farm Development Guidelines (Draft, July 2010) indicate that the cumulative impact of multiple wind farm facilities is likely to become an increasingly important issue for wind farm developments in Australia. This finding is also likely to apply to solar energy project, and is also likely to be the case in Thinadhoo. The key concerns in terms of cumulative impacts are, as in the case of wind farms, also likely to be linked to visual impacts and the impact on rural, undeveloped landscapes.

The Scottish Natural Heritage (2005) describes a range of potential cumulative landscape impacts associated with wind farms on landscapes. The issues raised in these guidelines as to what defines a cumulative impact are also regarded as pertinent to solar facilities, specifically given that the key issue of concern is likely to relate to the impact on rural,
undeveloped landscapes. The relevant issues raised in the by Scottish Natural Heritage include:

- Combined visibility (whether two or more wind farms (solar facilities) will be visible from one location);
- Sequential visibility (e.g. the effect of seeing two or more wind farms (solar facilities) along a single journey, e.g. road or walking trail);
- The visual compatibility of different wind farms (solar facilities) in the same vicinity;
- Perceived or actual change in land use across a character type or region; and
- Loss of a characteristic element (e.g. viewing type or feature) across a character type caused by developments across that character type.

The guidelines also note that cumulative impacts need to be considered in relation to dynamic as well as static viewpoints. The experience of driving along a tourist road, for example, needs to be considered as a dynamic sequence of views and visual impacts, not just as the cumulative impact of several developments on one location.

The viewer may only see one wind farm (solar facility) at a time, but if each successive stretch of the road is dominated by views of a wind farm (solar facility), then that can be argued to be a cumulative visual impact (National Wind Farm Development Guidelines, DRAFT - July 2010). It is reasonable to assume that these issues will also apply to solar thermal plants.

Research on wind farms undertaken by Warren and Birnie (2009) also highlights the visual and cumulative impacts on landscape character. The paper notes that given that aesthetic perceptions are a key determinant of people’s attitudes, and that these perceptions are subjective, deeply felt and diametrically contrasting, it is not hard to understand why the arguments become so heated. Because landscapes are often an important part of people’s sense of place, identity and heritage, perceived threats to familiar vistas have been fiercely resisted for centuries. The paper also identifies two factors that are important in shaping people’s perceptions of wind farms’ landscape impacts. The first of these is the cumulative impact of increasing numbers of wind farms (Campbell, 2008). The research found that if people regard a region as having ‘enough’ wind farms already, then they may oppose new
proposals. The second factor is the cultural context. This relates to people’s perception and relationship with the landscape. In the context of Thinadhoo, the majority of inhabitants cannot have a strong connection with, and affinity for the large, undisturbed open spaces that are not characteristic of the landscape of the island. The inhabitants of the island are more connected to the sea due to the rather small size of the island.

The concerns raised with regard to wind farms and the impact on landscapes are also likely to apply to solar facilities. The impact of solar facilities on the landscape is therefore not likely to be a key issue in Thinadhoo, specifically given Maldives's and especially Thinadhoo's strong commitment and good understanding we encountered during the inception visit to the need of RES on the island.

However, since the solar panels will be placed at school roofs the cumulative impact would be positive as this would involve the youth in the island and increase their understanding and awareness of RES. The visibility factor of the panels to the population would increase their awareness and understanding of RES energy. Examples would be the football stadium and the recently built public school. Both roofs are suitable for solar panels. However, in order to avoid any miscommunication or misunderstanding with the school, it is important to enroll the school board in the decision-making.

**MITIGATION**

The establishment of more than one large solar facility in an area is likely to have a positive cumulative impact on the areas sense of place and the landscape. However, USUL and the environmental authorities should consider the overall cumulative impact in consultation with affected people. Since the solar panel will be placed on a school roof a consultation with the school board, the school kids and the parents board is indispensable. USUL will provide a written letter from the school stating their support and backing of the solar panel project on the school roofs prior to the installation.
Table 6-3: Summary of social mitigation measures cumulative impacts

<table>
<thead>
<tr>
<th>Impact</th>
<th>Significance No Mitigation</th>
<th>Significance With Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cumulative impact</td>
<td>Medium (positive impact)</td>
<td>High (positive impact)</td>
</tr>
</tbody>
</table>

6.5 **Assessment of No-Development Option**

The No-Development option would represent a lost opportunity for Thinadhoo and the Maldives is to supplement current energy needs with clean, renewable energy. Given the complete dependency of the Maldives including Thinadhoo on imported fossil fuels, this would represent a High negative social and economic cost.

6.6 **Decommissioning Phase**

Dismantling of the PV panels will be handled by some suppliers that offer the best price for used PV panels in the future. The decommissioning phase is therefore likely to create additional, construction type jobs, as opposed to the jobs losses typically associated with decommissioning. Typically, the major social impacts associated with the decommissioning phase are linked to the loss of jobs and associated income. This has implications for the households who are directly affected, the communities within which they live, and the relevant local authorities. When and if the solar panels are finally decommissioned, the impacts are likely to be limited due to the relatively small number of permanent employees (11) affected. The potential impacts associated with the decommissioning phase can also be effectively managed with the implementation of a retrenchment and downscaling programme. With mitigation, the impacts are assessed to be low (negative).

**MITIGATION**

— USUL should also investigate the option of establishing an Environmental Rehabilitation Trust Fund to cover the costs of decommissioning and rehabilitation of disturbed areas. The Trust Fund should be funded by a percentage of the revenue generated from the sale of energy over the 20-25 year operational life of the facility.
— USUL should investigate the option of relocating employees to other solar energy projects when the Thinadhoo solar energy installation is decommissioned;
USUL should ensure that retrenchment packages are provided for all staff who stand to lose their jobs when the solar energy installation is decommissioned;

### Table 6-4: Summary of social mitigation measures in decommissioning phase

<table>
<thead>
<tr>
<th>Impact</th>
<th>Low (positive and negative)</th>
<th>Low (positive and negative)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Costs of decommissioning</strong></td>
<td>Medium (negative impact)</td>
<td>High (positive impact)</td>
</tr>
<tr>
<td><strong>Loss of jobs</strong></td>
<td>Medium (negative impact)</td>
<td>Medium (positive impact)</td>
</tr>
<tr>
<td><strong>Waste from old panels</strong></td>
<td>High (negative impact)</td>
<td>Low (negative impact)</td>
</tr>
</tbody>
</table>
7 CONCLUSIONS AND RECOMMENDATIONS

The findings of the ESDD indicate that the development of the proposed project will not have any significant environmental impacts that cannot be mitigated. The proposed investment will create employment and business opportunities for during both the construction and operational phase of the project. However, potential opportunities for members from the local communities in the area are likely to be limited. In order to enhance the local employment and business opportunities the mitigation measures listed in the report should be implemented. USUL, in consultation with the Thinadhoo Island Council should also investigate the opportunities of establishing a community trust. The revenue for the trust should be derived from the income generated from the sale of energy. The mitigation measures listed in the report to address the potential negative impacts during the construction phase should also be implemented.

The proposed development also represents an investment in clean, RE infrastructure, which given the challenges created by climate change, represents a positive social benefit for society as a whole. The findings of the SIA also indicate that, given the local context, low tourism potential, existing land uses but relatively high population density and the future land claims land and expansion plans of the island, the solar energy project is likely to have low (negative) cumulative impact.

This report also concludes that there are no problems regard to availability of land for the project implementation through the construction and operational phase. All public buildings are stand-alone and have direct access to the grid. The schools and the power house have the land required for the implementation of the solar project on governmental land. Damages to land adjunct through grid-connection is not possible.
8 PROPOSED MONITORING PLAN

8.1 Introduction

Two types of monitoring are recommended for this project. The first covers the specific works to be undertaken during the construction and operation activities on Thinadhoo and covers mitigation measures and safety of the public and workers. It deals with the day to day activities during all phases of the implementation and operation of the project.

The second type of monitoring concerns the possible yield of solar energy project. It is broader in its scope and is expected to include monitoring undertaken by a centralized agency on the islands included in this project, as well as others that have different systems and controls. The monitoring plan is summarized below in Table 8-1.

8.2 Monitoring during Construction

Project monitoring should focus on ensuring that the following tasks are carried out during implementation:

1. All mitigation measures are being complied with by the Contractor
2. Safety of the public and workers is ensured
3. Complaints and events are properly recorded and resolved
4. Proper information disclosure is carried out with the island council and the public.

8.3 Monitoring during operations

Ongoing monitoring during operation of the solar system unites should be appropriate and not place undue burden on the recipient communities. It should focus on environmental safety using measures that are accessible to the local councils as complex monitoring beyond their means is unlikely to be sustained in the long term. If lighting bulbs are replaced close monitoring is necessary for disposal. The monitoring during operations focuses on visual inspections that could be used to alert MHE. If any issues should arise, further investigations may be undertaken by them.
Inspections of the area of the noise impacted area by the wind turbines could be made by the council after start-up and at different wind speeds in the first year, using a simple noise measurement device measuring the noise levels at certain locations near to the resident’s houses.

There is a risk that the solar panel project proposed could be poorly maintained or bypassed if they are deemed too expensive to operate. The facilities operator should keep a daily log of operations, disruptions, maintenance and any issues that might arise. A summary of this information should be issued to the USUL management monthly, and be copied to MHE for action if any significant problems need to be addressed. The following table, include and environmental monitoring proposal:

Table 8-1 Environmental monitoring proposed during construction and operational

<table>
<thead>
<tr>
<th>Measures</th>
<th>Location(s)</th>
<th>Frequency</th>
<th>Methods</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Construction Phase</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meeting records</td>
<td>Island Office</td>
<td>As required</td>
<td>Record of all attendees and summary of outcomes of all meetings with authorities and public</td>
<td>Contractor /Utility</td>
</tr>
<tr>
<td>Complaints register</td>
<td>Island Office</td>
<td>On-going</td>
<td>Establishment of complaints register and mechanisms for ensuring all grievances connected to the project are addressed</td>
<td>Contractor (oversight by EPA / MHE)</td>
</tr>
<tr>
<td>Equipment maintenance</td>
<td>Work areas</td>
<td>Weekly</td>
<td>Checklist for all equipment maintenance and condition reports</td>
<td>Contractor</td>
</tr>
<tr>
<td>Solid waste management</td>
<td>Work areas</td>
<td>Weekly</td>
<td>Checklists of inspections of all work areas to ensure wastes are disposed of properly</td>
<td>Contractor</td>
</tr>
<tr>
<td><strong>Operation Phase</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
9  ENVIRONMENTAL AND SOCIAL IMPACTS STATEMENT

The finding of the ESDD undertaken for the proposed Investment Plan on the Island of Thinadhoo indicate that the proposed development represents an investment in clean, RE infrastructure, which, given the challenges created by climate change, represents a positive social benefit for society as a whole. The findings of the ESDD also indicate that the negative environmental and social impacts associated with the solar energy project are limited and can be effectively mitigated. In addition, the island, and in particular its public buildings appear to be well suited to the development of solar energy project. It is therefore recommended that the facility as proposed be supported, subject to the implementation of the recommended mitigation measures and management actions contained in the report.
### SUMMARY MITIGATION MEASURES

The following table summarizes the mitigation measures for the solar energy project:

**Table 10-1: Summary of Mitigation Measures**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Impacts</th>
<th>Significance without mitigation</th>
<th>Mitigation</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Construction phase</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Project location                | • Disruption to households to install solar panels and electric cables  
• Disruption of access on roads | Low (negative)                   | • Contractor keeps public informed  
• USUL will contact school board and receive consent prior to the start of the installation.  
• Activities are done efficiently and cleaned up promptly  
• Centralized components are placed in areas designated as for public use in consultation with leaders | • Temporary  
• Any one location will experience disruptions for a short time |
<p>| Location &amp; design of solar panels | • Damage to terrestrial ecology               | Low (negative)                  | • All solar panels are placed on roofs of public buildings                 | • Storage space is required during the construction phase               |
| Erosion &amp; sand                  | • Disturbances to beaches lead to             |                                 | • Sand removed will be stockpiled and the area                             | • Impacts will be                                                        |</p>
<table>
<thead>
<tr>
<th>Category</th>
<th>Impact</th>
<th>Mitigation</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>extraction</td>
<td>Possible damage to near shore ecology</td>
<td>Time taken for activities on coastlines and near shore areas will be minimized to limit damage. Contractor will record original conditions and monitor each site during activities.</td>
<td>temporary as long as time is kept low and areas are restored.</td>
</tr>
<tr>
<td>Flora &amp; fauna</td>
<td>Damage to near shore ecosystems with localized loss of cover</td>
<td>Large trees (&gt;0.5m diameter) will not be removed by the activities.</td>
<td>Impacts are temporary.</td>
</tr>
<tr>
<td>Protected or sensitive ecology</td>
<td>Damage of sensitive habitats as mangroves, wetlands and enclosed lagoons</td>
<td>No project activities are permitted within these areas.</td>
<td>Impacts are not expected because the areas are not involved.</td>
</tr>
<tr>
<td>Noise</td>
<td>Noise generated by machinery disrupts social activities</td>
<td>Contractor should deliberate with authorities on the public on acceptable working hours or schools holiday. All machinery will be kept in good condition and will meet western industry noise standards. Public complaints register copied to EPA, MHE and island council.</td>
<td>Noise will be localized and reduced quickly.</td>
</tr>
<tr>
<td>Access/traffic</td>
<td>Disruptions to local traffic while cars transporting the panels</td>
<td>Contractor prepares a schedule of activities to indicate areas and timing of disruptions if any.</td>
<td>Temporary. Sequentially limited to small areas.</td>
</tr>
<tr>
<td>Topic</td>
<td>Impact</td>
<td>Action</td>
<td>Notes</td>
</tr>
<tr>
<td>------------------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>Cultural property</td>
<td>• Damage to areas of cultural and historical significance</td>
<td>• No areas of cultural or historical significance within the pilot area</td>
<td></td>
</tr>
<tr>
<td>Stress on resources &amp; infrastructure</td>
<td>• Use of island facilities during construction leads to overloading of</td>
<td>• Contractor will prepare a plan of requirements prior to start activities and deliberate with authorities</td>
<td></td>
</tr>
<tr>
<td></td>
<td>facilities, scarcity of resources and antagonism between public and</td>
<td>• Complaints register established and used to address grievances</td>
<td>• Impacts will be temporary</td>
</tr>
<tr>
<td></td>
<td>contractor</td>
<td>• Public complaints register copied to EPA and MHE</td>
<td>• Opportunities for local benefits exist</td>
</tr>
<tr>
<td>Distribution of benefits/creation of local employment,</td>
<td>• Antagonism if foreign workforce used instead of local laborers</td>
<td>• Contractor will use local laborers on the activities as much as possible</td>
<td></td>
</tr>
<tr>
<td>training</td>
<td>• Inputs to the local economy</td>
<td>• Payments to local laborers will be at legal rates</td>
<td>• Temporary</td>
</tr>
<tr>
<td>Impact of construction workers on local community</td>
<td>• Risk to family infrastructure</td>
<td>• Contractor will include on-site training for USUL staff</td>
<td>• Positive impacts</td>
</tr>
<tr>
<td></td>
<td>• Increase of crime</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Unwanted pregnancies</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Risk of HIV/Aids</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operations phase</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Climate change</strong></td>
<td><em>Renewable energy will have a positive impact on climate change</em></td>
<td><em>None</em></td>
<td><em>The project will contribute positively to climate change</em></td>
</tr>
<tr>
<td><strong>Protected areas &amp; species</strong></td>
<td><em>No impacts</em></td>
<td><em>Low (negative)</em></td>
<td><em>No mitigation</em></td>
</tr>
<tr>
<td><strong>Flora &amp; fauna</strong></td>
<td><em>Disposal of ashes and residuals of the biomass boiler to land cancels out benefits of the pilot to climate change</em></td>
<td><em>Low</em></td>
<td><em>Project design is changed so that residuals will be disposed abroad on a certified disposal</em></td>
</tr>
<tr>
<td><strong>Noise</strong></td>
<td><em>Solar panels do not cause any noise</em></td>
<td><em>Low</em></td>
<td><em>None</em></td>
</tr>
</tbody>
</table>
| **Human health & safety** | *Residuals disposed in landfill lead to pollution of groundwater and near-shore marine areas*  
*Equipment is bypassed because they fail or are too expensive to operate* | *Low* | *Public awareness on the need and methods for maintaining RE equipment*  
*Attention to maintenance of cables and equipment* | *Impacts are long term*  
*Improvements are expected if the systems are maintained well* |
| **System failures** | *Components break down due to poor maintenance or other incidents* | *Medium* | *Attention to maintenance schedules*  
*Contractor trains operators and management and prepares manual for operating and maintenance* | *Included in the investment* |

<p>| Decommissioning phase |</p>
<table>
<thead>
<tr>
<th>Human health &amp; safety</th>
<th>• Solar panels decommissioning includes many chemical components</th>
<th>Medium (negative)</th>
<th>• Provide decommissioning materials and folders to USUL</th>
<th>• Included in the investment</th>
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<tbody>
<tr>
<td>Costs</td>
<td>• Costs of decommissioning are not high but also not low</td>
<td>Medium (negative)</td>
<td>• USUL should set a trust fund for the costs through the life-time of the project</td>
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<tr>
<td>Loss of jobs</td>
<td>• Employed staff at plant will loose jobs</td>
<td>Medium (negative effect)</td>
<td>• USUL will develop a training programme for staff</td>
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</table>
### REFERENCES

#### 11.1 Interviews

The following stakeholders were interviewed/consulted:

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
<th>Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Marjam Shabar</td>
<td>Centre Manager, Social Service Worker</td>
<td>Family and Children Service Centre</td>
</tr>
<tr>
<td>2. Hussein Fasaheith</td>
<td>Counselor</td>
<td>&quot;</td>
</tr>
<tr>
<td>3. Hussein Rashed</td>
<td>Counselor</td>
<td>&quot;</td>
</tr>
<tr>
<td>4. Mahfouza Hfahd</td>
<td>Counselor</td>
<td>&quot;</td>
</tr>
<tr>
<td>5. Mariyam Dhiya</td>
<td>Affiliated</td>
<td>&quot;</td>
</tr>
<tr>
<td>6. Anwar Fathmete</td>
<td>Affiliated</td>
<td>&quot;</td>
</tr>
<tr>
<td>7. Ahmed Saruvash Adam</td>
<td>Managing Director</td>
<td>Upper South Health Services Corporation Ltd</td>
</tr>
<tr>
<td>8. Mohamed Hassan Didi</td>
<td>Member of South Huvadhu Atoll Council</td>
<td>Secretariat of the South Huvadhuatholhu Atoll Council</td>
</tr>
<tr>
<td>9. Mohamed Shareef</td>
<td>State Secretary</td>
<td>National Office, Upper South Region</td>
</tr>
<tr>
<td>10. Ali Ikram</td>
<td>Island Counselor</td>
<td>Thinadhoo Council Office</td>
</tr>
<tr>
<td>11. Ahmed Gais</td>
<td>Counselor</td>
<td>Atoll Council</td>
</tr>
<tr>
<td>12. Ahmed Naseen</td>
<td>Island Counselor</td>
<td>Thinadhoo Council Office</td>
</tr>
<tr>
<td>13. Mohamed Illyas</td>
<td>Island Counselor</td>
<td>&quot;</td>
</tr>
<tr>
<td>14. Kinanth Mohamed</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>15. Ali Shaam</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>16. Hawlafth Ali</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>17. Hassan Abdulla</td>
<td>Founder Member</td>
<td>CHOCO (NGO)</td>
</tr>
<tr>
<td>18. Saruvash Aclan</td>
<td>Chairperson</td>
<td>&quot;</td>
</tr>
<tr>
<td>19. Ibrahim Shiyam</td>
<td>Program Coordinator</td>
<td>&quot;</td>
</tr>
<tr>
<td>20. Hassan Hassan</td>
<td>Director</td>
<td>&quot;</td>
</tr>
<tr>
<td>21. Ibrahim Mohamed</td>
<td>Coordinator</td>
<td>HAND (NGO)</td>
</tr>
<tr>
<td>22. Mohamed Akther</td>
<td>Public Relations</td>
<td>&quot;</td>
</tr>
<tr>
<td>23. Not shared</td>
<td>10 fishermen</td>
<td>&quot;</td>
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</tbody>
</table>
11.2 Minutes of Meetings

- 60 household's and private sector survey
- Minutes of the kick-off meeting of the project
- Minutes of the meeting with Island Council
- Minutes of meeting with Family and Children Service Centre
- Minutes of meeting with Atoll Council
- Minutes of meeting with representatives of non-governmental organizations.

11.3 Printed resources

— Environmental impacts from the solar energy Technologies;
— World Bank Operation Policies 4.01, 4.10 and 4.12, available online at www.worldbank.org

11.4 Maps

Thinadoo Map, source Google Maps
ANNEX I: GRID MAP OF THINADHOO AND SITE LOCATION

New School

Power house

Aboobakuru School
ANNEX II: SIZE OF THE ROOFS OF THE PUBLIC SCHOOLS
ANNEX III: TEMPLATE FOR COMMUNICATION PLAN

Introduction

Having a communication plan in place is an essential component for good project management. This document ensures that all stakeholders are equally informed of how, when, and why communication will happen. Communication is often a very effective way to solve problems, deal with risks, and ensure that tasks are completed on time.

Successful communication plans will identify stakeholders, the information to be communicated, and how this information will be communicated. They will leave nothing to chance.

In the communication plan, you should at least include the following key elements:

- **A brief background for the communication plan:**

  This section should include background information on the objective of Thinadhoo to become carbon neutral in 2020. In other words, there is need to explain briefly why the island needs to become carbon neutral in 2020.

- **Stakeholder Analysis:**

  The second stop that must be taken care of is the stakeholder analysis. Without this vital information, the communication plan will lack force and direction. Stakeholders are those individuals who have interest and influence in the project. These are the people that will be communicated with during the project lifecycle. In this section you include information on which stakeholders are to be addressed and how they should be addressed. In the case of Thinadhoo this would be the fishermen, householders, school board and children. Each group of stakeholders has different level of education and understanding. Each group needs to be analyzed. A matrix can also be sufficient.
• **Clearly stated objectives:**

Before undertaking the task of putting together a communication plan, it is important to ensure vital preliminaries are in place. Be sure that the project objectives and scope and communication objectives have been clearly stated.

The objectives of the communication plan should clearly be targeting the maintaining and strengthening of the social acceptance of solar energy on the island and the need to carbon neutrality in 2020.

• **The strategy for going about communicating:**

In this section all possible communication materials and means (such as TV, radio, newspapers, flyers, events, workshops) needs to be listed with a clear objective for each material. Each material needs to be addressing a specific target group.

• **Potential issues and risks:**

One final analysis that is helpful to have performed is the risk analysis - as this is one of the places where communication will be vital. Potential issues could arise from the list of the social impact assessment that their impact was classified as medium and high. These issues must be considered and be addressed properly in the communication plan.

Risks could be when the mitigation measures recommended would require special attention in term of communication. Another potential risk associated with the installation of solar panels and social acceptance is during the testing period, and the testing would run through technical problems. This might damage the trust and confidence of average citizens. This risk needs to be taken into consideration.

• **The budget:**

Communication materials require some investment and budget must be allocated from day one. Not allocating a budget risk that the communication plan would not be given any priority.
The size of the budget will be depending on the ambitious of USUL and the availability of funding.

The impact of such strategy should be monitored and measured. What worked? What didn't work? Incorporate these findings into your next plan. The measurement happens usually through survey before and after the communication materials have been practiced.