Ministry of Housing and Environment

National Economic Environment Development Studies

United Nations Framework Convention on Climate Change

Ministry of Housing and Environment

June , 2010

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1. Introduction

The Republic of Maldives is highly vulnerable to negative impacts of climate change and there is a matching sense of urgency of action as well as a strong political will for climate change adaptation and mitigation. The most recent document governing all development in the Maldives is the Strategic Action Plan (SAP)[1] dated 2009 that is built around the pledges of the first democratically elected government. The key themes of the SAP are good governance, social justice and economic development. All identified strategies for action in the SAP are cross-checked for climate change adaptation and mitigation. Building on the SAP, a *Briefing Paper*[2] was prepared outlining the development and financing needs of the country for the Donor's Conference held on the 28th of March, 2010.

The Briefing paper identifies five priority development areas and one of these is climate change adaptation and mitigation. The sub sectors identified under the climate change priority are water security, alternative energy, coastal security and integrating communities to enhance resilience of the islands. The same document underlines the fact that all development policies and plans must focus on increasing the resilience of the country to climate change impacts. Further, in terms of adaptation, the country has a National Adaptation Plan of Action (NAPA)[3] dated 2007 that is highly relevant and there is a strong ownership and commitment for the NAPA goals and priorities across all implementing agencies and institutions. In terms of mitigation, the Government has made a pledge to become a carbon neutral nation by 2020.

Maldives is a small country facing big problems. Climate change is impacting almost every aspect of life and existence of the Nation. Maldives vocal nation and plays a lead role in the international community advocating the protection of vulnerable states and the importance to take steps to reduce Greenhouse Gases (GHG) emissions. However, climate change impacts and risks are overwhelming and very difficult to address in a comprehensive way combining soft and hard measures, capacity and financial instruments for implementation. The long term vision of the Government and the people is to stay in the country, use the opportunities and find the way to deal with the challenges.

1.1 Maldives economy

Maldives economy registered an annual average growth of 10% per year for the past two decades. Tourism is the main industry, contributing close to 24.6% of the GDP. Fisheries and other different types of commercial activities are the other sectors that contribute most to the GDP.

Maldives has a small size economy that is dependent on tourism and fishery markets. Due to these facts, the Maldives is vulnerable to external shocks as witnessed by the economic recession following the tsunami of December 2004.

[1] Department of National Planning (DNP), Ministry of Finance and Treasury, DNP sometimes acts as a direct councilor to the President Office and is one of the oldest institutions in the country

[2] DNP

[3] National Adaptation Programme of Action, team, Ministry of Environment, Energy and Water

The 2004 Tsunami caused 82 fatalities, 26 missing (now considered dead), 2000 homes destroyed, and other massive damages. Financial damage was estimated at 62% of GDP or $470 million, aggravated by a non-tsunami budget deficit of approximately $80 million in 2005 due to a significant fall in revenue from tourism.

1.2 Geographic and demographic profile

The Republic of Maldives is a group of low lying coral islands situated in the Indian Ocean. It consists of 1192 islands on 26 natural atolls spreading across an area of roughly 107,500 sq km. For administrative purposes the atolls have been divided into 20 atolls, and recently as part of the ongoing decentralization process the Government has clustered atolls into seven provinces.

The capital of Maldives is Male', located in the central part of Maldives in North Male' Atoll. Out of the 1192 islands only 199 islands are inhabited by a population of about 298,968 according to the Census 2006. There are 93 islands operated specifically as resort islands. The islands vary in size from 0.5 sq km to 5 sq km.

Maldives is one of the lowest lying countries in the world. The average height of the islands does not exceed 1.7 m above mean sea level. Hence Maldives is recognized as one of the most vulnerable countries in the context of climate change and sea level rise. It is widely accepted that if the sea level rises one meter as predicted by the Intergovernmental Panel on Climate Change (IPCC), large part of the country will sink and vanish from the face of the earth. The population of Maldives has increased rapidly during the last few decades. However, the country still remains one of the smallest independent nations in the world.

1.3 Energy profile

As Maldives has no conventional energy resources, it is dependent on imported petroleum fuels to meet almost all of its energy needs. Due to the increased use of electricity and transportation, national energy consumption also increased in Maldives from 223,970 tons of oil equivalent (toe) in 2002 to 348,610 toe in 2008.

Nearly 80% of primary energy demand and a large proportion of power generation and transportation use diesel fuel. 60 % of the total electricity is produced and consumed by tourist resort islands. The energy consumption in Male' accounts for approximately 72% of the power generated for inhabited islands. Power demand in Male' is expected to continue to grow at a rate of about 11% per year.

Electricity in the Maldives is generated on each island separately using small diesel electricity generators. Therefore the initial investment costs and subsequent running costs of powerhouses on other smaller islands are very high. As the fuel is imported, the generation of electricity in the Maldives is expensive and sensitive to fluctuations of diesel fuel prices in the world market. The price of diesel in the local market has increased by over 270% in the last five years.

To respond to the high energy demand, to increase energy security and to reduce emissions the Government have decided to introduce renewable energy technologies. Feasibility studies indicated that solar power, wind and biomass are potential Renewable Energy (RE) sources which could be implemented in hybrid technologies to start with.

In order to respond to the continuous growth of energy demand Maldives has evolved during the years different policies and strategies. In the last decade the Goverment's main priority was rural electrification. With increasing oil prices, RE technologies became increasingly attractive. In 2005 the existing energy policy stated a target for renewable energy of 15%. In present, the National

Sustainable Development Strategies (NSDS), 2009 requires that until 2015 the percent of renewable energy has to reach the value of 50% from the total energy consumption.

The main focus of the above strategies and action plans is the power sector. Most recently the importance of energy efficiency in generation has been recognized. This assistance is taken partly due to the investment that has been made for the existing diesel generators. Replacing them will involve time, capacity development and series of pilot projects to understand how renewable energy technologies can be widened in the Maldives in a cost effective manner. Therefore a number of projects have been streamlined for developing hybrid systems in selected pilot islands.

1.4 Climate change risks

Maldives is severely constrained by its vulnerability to natural disasters and environmental hazards. Because of the small size of the islands, islanders are forced to live near the shoreline. A summary of the Climate Change related risks in the Maldives is given below based on the NAPA:

> *Nearly 80 percent of the nation is barely 1.5 meters above sea level. The global mean sea level rose 10 to 20cm during the 20th century at the rate of 1 to 2mm/year. Future sea level is projected to rise within the range of 9 to 88cm between 1990 and 2100.*
>
> *For Maldives, there is relatively high confidence in projections of maximum temperature. The annual maximum daily temperature is projected to increase by around 1.5°C by 2100. A maximum temperature of 33.5°C is currently a 20-year event. It will likely have a return period of three years by 2025.*
>
> *The present average monthly Sea Surface Temperature (SST) in the Maldives ranges from 28C to 29C, rarely increasing above 30C. An increasing trend in SST has been observed in the Maldives (Singh et al. 2001; Khan et al. 2002). The annual mean SST trends at Hulhule' and Gan are 0.2±°C and 1.1 to 1.6°C/decade respectively.*
>
> *Greater extremes of drying and heavy rainfall is projected, increasing the risk of droughts and floods especially during El Nino events (IPCC 2001). Tropical cyclones are predicted to be enhanced in intensity by 10 to 20%.*
>
> *According to the Disaster Risk Profile for Maldives (UNDP, 2006), maximum storm surge height is reported to be 1.32m with a return period of 500 years. If coupled with high tide, it could generate a storm tide of 2.30m. The probable maximum storm tide by region shows that the islands in the northeast of the Maldives could face storm tides of 2.30m in height.*
>
> *The study also reported the forecasted maximum storm tides for different regions of the Maldives based on medium and high sea level rise scenarios. Based on these assumptions, scenarios, and given that the average height of Maldivian islands is 1.5m above MSL, sea level rise would cause regular tidal inundations in most islands even at the medium prediction. The high prediction could cause inundations recurrently in almost all islands. Storm surges can create up to 2.78m waves under medium prediction, enough to completely inundate a medium to small sized island in the Maldives. A storm surge at high prediction could cause a 3.18m wave that could inundate even the largest of islands. These surges do not take into account regular monsoonal wind generated flooding which is considered the most common in Maldives (Shaig, 2006; UNDP, 2006).*

Maldives lies out of the tropical cyclone zone due to its proximity to equator. However, there have been incidents from the past where cyclonic storms have passed over Maldives and there is the probability for such events in the future. The prediction is 3 cyclones for the northern Maldives with a 500 year return period.

2. Scope of the study

The scope of the study is to bridge the gap between the national development plans and the initiatives in the climate change domain. Specifically our task is to:

- Work towards a GHG emission baseline for 2009
- Priorities and costing of adaptation to climate change in the short, medium and long term
- Priorities and costing of mitigation of climate change in the short, medium and long term
- Cross check development plans and climate change initiatives
- Identify financial and policy instruments for implementing selected climate change initiatives

NEEDS relies on stakeholder consultations, existing policy documents and studies from the Maldives and international reference documents.

3. Methodology

The NEEDS for Climate Change study in essence is a study of synthesis, building on existing studies and policies. The steps that were undertaken to implement this study were to:

- Review existing documents
- Carry out stakeholder consultation
- Analyse the collected information
- Prioritize climate change measures and identify gaps of knowledge
- Estimate costs of implementing climate change priorities
- Cross check climate change and development priorities
- Identify financial and policy instruments
- Estimate GHG emissions for 2009

1.5 Review and stakeholder consultation

The two inception tasks were to:

a.) Review of all documents, studies, policies related to climate change. The list of key documents reviewed is listed at section 11 towards the end of this document.

b.) Stakeholder consultations with various agencies and line ministries, for a full list of stakeholders consulted please see section 12 towards the end of this report.

An important element of our initial investigation was to understand how prioritization was done so far and how the different methods resulted in converging priorities. For adaptation the most ample method was implemented in the NAPA prioritizing process where the multi-criteria analysis was used. For the Disaster and Risk Assessment, the starting point for identifying priority measures was the Hyogo Framework for Action. No complete prioritizing was done for mitigation, but the sectors for intervention are rather clear and a set of criteria arose from the stakeholder discussions. Prioritizing in the National Economic Environment Development Study (NEEDS) was done based on a combination of the prioritizing methods that were most prevalent and relying on stakeholder consultations.

1.6 Analysing information

Another set of factors were traced during the review and stakeholder consultation that were centralized in an excel based template, gathering information on:

- Priorities and roles for the different stakeholders, shifts in priorities in recent years
- Costs of implementing adaptation and mitigation measures and projects in the past, present and in the future
- Policy instruments and financial instruments available to implement measures in the past present and future

A systematic check has been done in order to have a thorough understanding of the climate change development needs of the country. Analyses were conducted in order to uncover a clear red thread for adaptation and mitigation priorities, policies and measures and to pin-point any shifts in policy, overlaps or gaps in implementation, knowledge, policy instruments and financial instruments.

1.7 Costing and identifying financial and policy instruments

Costing for adaptation was done based on key documents, mainly the NAPA and the Cost Benefit Analysis (CBA) carried out in the different risk and disaster management studies that are the bases of the Resilient Island Program. Costing of mitigation was possible to a lesser extent; quoted costs are mainly relying on the ad-hoc pilot projects. Estimating the potential for mitigation is based on the Danish funded Assessment of Least-cost, Sustainable Energy Resources Report dated 2004, Technology Needs Assessment (TNA) for both energy and transport sector.

In addition to literature review and stakeholder discussions financial instruments were identified through an internet research of all International Financial Institution (IFI) active in climate change. For identifying policy instruments, best practice examples were used, mainly relying on the Nairobi Working Program for adaptation instruments and EU policy instruments for mitigation.

1.8 Estimating emissions and scenario analyses

According to Decision 17/CP.8 adopted by the Conference of the Parties: point A. Methodologies - Non-Annex I Parties should use the Revised 1996 IPCC Guidelines for National GHG Inventories, hereinafter referred to as the IPCC Guidelines, for estimating and reporting their national GHG inventories. Maldives, being included in Non-Annex I Parties and emissions were estimated relying on the 1996 Revised IPCC Guidelines for National Greenhouse Gas Inventories, tier 1, Reference Approach for the energy sector. The estimations have been done to work towards a new baseline for the Maldives for 2009 that will also contribute to the National GHG Inventory, but it is not to be mistaken with it. For emission projection scenarios, the study relies on the IPCC Special Report on Emissions Scenarios (SRES, 2000) and on the GAINS Asia study, carried out by the International Institute for Applied System Analyses (IIASA) in the framework of a European FP6 research project.

4. Adaptation

Priority	Cost in USD	Source of information
Water security including drinking water and waste water	43,700,000	Briefing Paper, 2010
Coastal protection for 4 selected islands	15,094,500	Briefing Paper, 2010
Further coastal protection for selected islands	77,046,000	NAPA, 2007 (project 10 adjusted for inflation)
Integrating Climate Scenarios into Safer/ Resilient Island strategy	2.158.964*	NAPA, 2007
Flood control measures for vulnerable islands	5.591.789*	NAPA, 2007
Housing safety, sustainable building design	2.649.746*	NAPA, 2007
Coastal protection for Male international Airport	19.600.600	NAPA and ISLE database, PO website (May 2010)
Food security	1.048.460*	NAPA, 2007
Health sector	2.230.361*	NAPA, 2007
Fisheries	1.305.174*	NAPA, 2007
Coral reef protection	1.349.655*	NAPA, 2007
Integration of communities	112, 900,025	Briefing Paper, 2010
Integrating Climate Change into Resilient Island Planning in the Maldives	<4,485,000>	Climate Change and Energy Department, MHE, LDC funded project
TOTAL SHORT-MEDIUM TERM ADAPTATION (10 yrs)	279,480,275	
Developing 9 islands into Safer/ Resilient islands	161,500,000	DHIRAM, 2009 and CBA SIP 2010 study combined
Tourism adaptation measures	n.a.	NAPA, 2007
Critical infrastructure (protection of more airports)	n.a.	Stakeholder consultation
Planting and developing mangroves and trees	n.a.	Stakeholder consultation
Waste management	n.a.	Stakeholder consultation
Increasing the evidence base of climate change impacts	n.a.	Stakeholder consultation
TOTAL LONG TERM ADAPTATION (40 yrs)	161,500,000	
GRAND TOTAL ADAPTATION	440,980,275	

Table 4:1 Summary of Priorities and Costs

1.9 Prioritizing adaptation measures

Prioritizing adaptation measures is a global challenge. The world's leading research institutes and donor agencies are working towards consensus on how to prioritize intervention internationally and nationally. Is water security or food security more important? – this is the kind of question we are trying to answer as a global community. One of the obstacles for action is competing priorities in resource scarce settings. Adaptation measures are recognised worldwide as essential and are widely known to address climate change. There are efforts internationally to exchange experience and learn from these experiences, the Nairobi Work Program being one of the important hubs of knowledge. Nevertheless, a lot of adaptation work is still based on an on-going trial and error. IPCC Fourth Assessment Report points out that in the long run adaptation alone will not be able to deal with climate change. Mitigation, sustainable development and including climate change considerations in development planning are very important for dealing with climate change.

There are several key policy documents, project proposals and studies prioritizing adaptation interventions. The following is an account of the recent key policy documents:

Document title	Risks	Criteria	Priority sector	Priority intervention
Safe Island Concept Note, 2005	Not discussed in this document	- Ease of access to an airport - Sufficient space and potential for reclamation and/or the potential for connection to another island - Viable economy and social services - Sufficient space for subsequent population growth	- Not discussed in this document	- Coastal protection - Speedy access in emergencies - Alternative modes of communication and energy in emergencies - Transport infrastructure - Establishing safe zones - Buffer stock of basic food and water - Economic viability, social services and housing - Disaster management plan
Climate Risk Profile for the Maldives, 2006	- Climate change related risks - Extreme rainfall events - Drought - High sea levels - Damaging winds - Extreme high air temperature	Not discussed in this document	Not discussed in this document	- Not discussed in this document
National Adaptation Program of Action, 2007	- Climate change related risks relying on the Climate Risk profile and SRES scenarios: - Sea level rise - Rainfall patterns - Temperature rise - Extreme events	- The 6 step NAPA method was used. The criteria for prioritizing development sectors were: - Relevance to national development - Degree of climate impact - The criteria for prioritizing adaptation activities were: - Reduce climate change effects - Reduce poverty and promote equality - Achieve synergy with national development goals and Multilateral Environment Agreements - Cost effectiveness	- Land, beach and human settlements - Coastal protection - Tourism - Fisheries - Human Health - Water Resources - Agriculture and food security - Coral reef biodiversity	- Integration of Future Climate Change Scenarios in the Safer Island Strategy - Coastal Protection of Safer Islands - Enhance adaptive capacity to manage climate change related risks to fresh water availability - Coastal Protection of Male' International Airport to Reduce the Risk from Sea Induced Flooding and Predicted Sea Level Rise - Enhance adaptive capacity to manage climate change related risks to fresh water availability - Increase the resilience of local food production through enhancing the capacity of farmers - Improve the health status of the population - Improve resilience of Island communities through sustainable building designs - Investigating alternative live bait management, catch, culture and holding techniques to reduce vulnerability of the tuna fishery sector - Protection of human settlements by coastal protection measures on safer islands - Increase resilience of coral reefs to reduce the vulnerability of islands, communities and reef dependant economic activities - Flood control measures for vulnerable Islands

Detailed Island Risk Assessment in Maldives (DIRAM) I, 2008 DIRAM II, 2009-2010	- The study includes natural hazards, economic, social, infrastructure and building vulnerability and coastal risk assessment. Climate related hazards in the natural hazards category include: - Accelerated sea level rise - Sea surface temperature rise - Changes in monsoon patterns	Not discussed in this document	Not discussed in this document	- capital investment protection - business process preservation - risk transfer and - legal and institutional strengthening
A review of the Safer Islands Programme, 2009	- Based on DIRAM I and II - Climate change increases the frequency and intensity of climate-related hazards, such as storms, floods, fires, droughts.	- scale and suitability of existing infrastructure, transportation and services - health of the natural environment/ degree of damage to ecosystems and limiting defence - the amount of existing space for redevelopment so as to avoid further damaging land reclamation - options for developing a chain of safe islands, possible connected by bridges - quality of local governance - local capacity needs - potential for livelihood diversification/ economic resilience	Not discussed in this document	- local institutional framework - public awareness - reverse impacts of man-made interventions - strengthen natural protection - new building practices - integrated island development
Strategic Action Plan on DRR and CC Adaptation and Mitigation, 2009	Not discussed in this document	Not discussed in this document	- marine ecosystem - food security - water - social infrastructure - shelter/land & coast - health - fisheries - tourism - inter-island transport	- enabling environment for good democratic governance - empowered and capable communities - resilient communities with access to technology, knowledge and other resources - risk-sensitive regional and local development
Country Brief, Donor Conference, 2010	Not discussed in this document	Not discussed in this document	- water security - coastal protection - transport sector	- fresh water and waste water systems - coastal protection - integrating communities

Table 4:2 Review of key policy documents for adaptation in chronological order

Maldives has built considerable knowledge to understand climate related risk and physical vulnerability. The various agencies and institutions have gone through the exercise of prioritizing during the NAPA development, resulting in comprehensive and thorough priority measures that stakeholders feel strong ownership of and would like to engage in implementing to date. Various projects have been implemented for rebuilding islands hit by Tsunami, increasing water security, coastal protection and protection of coral reefs and biodiversity that allowed for learning and as a result the long term vision for adaptation and survival has shifted.

From the analyses of the key documents listed above and based on the stakeholder consultation two main lines of thinking emerge for adaptation prioritizing in the Maldives:

1. Set of interventions that target immediate needs and actions in various sectors,

2. Longer term vision to increase resilience of the country by developing safer islands.

The immediate priorities, relief needs, addressing those most vulnerable include measures such as providing drinking water in case of prolonged dry spell or drought, coastal protection measures, actions against erosion for islands on the red list, ensuring critical infrastructure to the country such as the coastal protection for Male' International Airport. Adaptation measures for the short, medium and long term are clearly outlined in the NAPA and formulated into 12 projects in 8 priority sectors as listed in the table above. The *Briefing Paper* prepared for the Donor's Conference held on the 28th of March, 2010, highlights the most immediate needs for financing for climate change clustering them and narrowing them down. The Briefing Paper relies on the NAPA and the SAP.

The second type of intervention is based on **the long term vision** to stay in the country and increase resilience of the country to climate change. To achieve this, the Government strives to develop selected safer islands, acknowledging that increasing safety and resilience to the same level in all islands at the same time is both physically impossible and economically unfeasible. This concept was first stated in the strategy document called the Safer Island Strategy in 2002. The goal is sustainable development on selected islands that will ensure both a higher level of safety/ resilience and a higher level of basic social services, such as education and health. The concept has evolved in a number of ways in the past years:

- There are **lessons learned from earlier interventions** and much more is known and understood today about the fine linkages of the island ecosystems that humans are part of, therefore there is a different thinking today of what measures work well for which goals. To give one example, building a harbour or land reclamation if incorrectly done may interfere with the drainage of the island and in turn cause the pollution of the ground water or loss of coral reef that serves as the best and most natural protection to flooding through waves. As a result of past experiences there is a deep understanding today that development does not always mean resilience and interventions must be carefully chosen.
- The best way to build resilience on the islands is through a combination of **hard and soft measures**, with **flexible solutions**, especially in case of ground breaking measures the exact impact of which is not known and cannot be fully anticipated.
- While there is a **clear concept for safe/resilient islands** and there is a list of themes that one must look at when identifying measures, the exact measures need to be identified separately for each island in a highly consultative process. **Each island has specific characteristics and personality, and each island needs to rely on its own Safe Island Plan.**
- In the long run protecting the most vulnerable people living in small communities in remote islands should be through **integrating communities** through a nationwide accessible public transport system. In this way higher safety and better services will be made accessible, and migration to these islands will become attractive but relocation of people will not be necessary.

Adaptation measures to tourism industry are essential short and long term actions, as tourism is the main industry and the key source of income of the country. Tourism industry interventions have been noted as essential by several stakeholders. The reason is that the country cannot afford loss of tourism revenues due to climate change impacts. As long as there is no alternative source of revenue and the economic base is not diversified, this would cause economic downturn and all the problems that come along with that.

1.10 Challenges for adaptation

In spite of all the progress that has been made for prioritizing adaptation, a number of challenges and concerns remain. These challenges are not peculiar to the Maldives, they are part of a learning curve that the global community is facing. More clarity on decision-making on some of these issues will likely aid the country in informed decision-making and in raising financing for adaptation.

- A lot of the risk assessment work carried out in the Maldives is a combined assessment of disaster risk and climate risk. While it is clear that climate change is increasing the frequency and magnitude of hazards, more clarity is needed when reporting and classifying the risks. For example flooding is a climate risk in one document (Climate Risk Profile) and is treated as a disaster risk and kept separately from climate related hazards in other documents (DHIRAM I and II). From the point of view of prioritizing measures for adaptation and raising financing for adaptation, there needs to be further clarity about what adaptation is and adaptation funds need to come in addition to other types of financial instruments. The same challenge is there for other types of development aid funded projects that go on long before adaptation funding started. These include various infrastructure projects, health care projects, water and waste management projects, etc.
- There is a criterion for selection of safer islands and the risk assessments carried out give valuable information for choosing islands. However, the selected islands keep changing seemingly in an arbitrary manner. There is a strong drive and demand for urbanization in some islands that is a strong driver for governance to try and develop these islands; however the conditions on these are often contrary to the indications of the climate risk profile or criteria suggested in the safer/resilient island concept for selection. While it is clear that investments on any given island need to be at the cross point of safety considerations and the urban development drive, more clarity is needed as to how these considerations are weighed in the decision-making process.
- Adaptation in tourism and climate change liability is part of corporate responsibility of business developers. The Ministry of Tourism reports that the payback period of investments into resorts is less than five years and there is no requirement or practice for considering the climate liability when investing. With such short pay-back periods investors are left to their own judgement to decide on the extent of investments and the priority measures to be implemented for adaptation in the resort islands. While these investments do happen on the resorts that strive for sustainability, an additional element of control and incentive would be beneficial to the country and helpful to the industry.

1.11 Costing short to medium term adaptation

The total cost for short and medium term adaptation is as stated below. The present section is a detailed explanation of the immediate interventions needed and the rationale they rest upon.

ADAPTATION Total costs for SHORT AND MEDIUM term measures: up to 10 years	USD 279,480,275

1.11.1 Water security

Priority	Cost in USD	Source of information
Water security including drinking water and waste water	43,700,000	Briefing Paper, 2010

Table 4:3 Water Security Priorities and Costs

Starting with the most recent costing and working backwards, taking a look at the Briefing paper, the costing of 3 interventions for adaptation is to be found. These interventions are considered most urgent today by the Government.

Water security includes access to safe drinking water, sewage and waste water treatment. NAPA identified similar types of intervention but costing them much lower, accounting 900,000 USD for fresh water security and 1.5 million USD for sewage systems. In the past couple of years, water shortage has become a more significant issue and the National Disaster Management Centre (NDMC) has been occurring real cost of about 1 million USD on the most immediate relief actions this past year. A significant percentage of 1 million USD was utilised to provide supply desalinated water from Male' to the respective affected islands.

According to the NAPA water security is threatened by climate change impacts:

> *The freshwater aquifer lying beneath the islands is a shallow lens, 1 to 1.5m below the surface and no more than a few meters thick. Surface freshwater is lacking throughout the country with the exception of a few swampy areas in some islands. Traditionally people depended on shallow wells to get access to the groundwater lens for drinking water. However, 90% of the atoll households now use rainwater as the principal source of drinking water. Thickness of the groundwater aquifer in the islands is determined by net rainfall recharge, size of the island and permeability of the soil column. The freshwater aquifers already stressed from over-extraction face the risk of total depletion if dry periods extend. As the islands have a precarious hydrological system, with the predicted sea level rise and during periods of wave-induced flooding, there is a very high risk of saltwater intrusion into the freshwater lens (NAPA, 2007).*
>
> *Although the global average precipitation is projected to increase during the 21st century, a marginal decline in precipitation is projected for the Indian Ocean region (Nurse and Sem 2001). The predicted changes in precipitation have the potential to impact on rainwater harvesting across all the atolls and in particular the northern atolls. Drinking water shortages during dry periods is a significant challenge for the atoll population even at present. Water shortages were reported by 30% of the atoll population in 2004 (MPND 2005).*
>
> *The NAPA process has identified that the inappropriate treatment and disposal of wastewater in the Maldive islands is an important area that has to be addressed in terms of adaptation to climate change. This would address the identified adaptation strategies for water resource protection, promoting healthy lifestyles and islands and protection of the coral reef biodiversity in the Maldives. The Indian Ocean Tsunami of 2006 caused the destruction of the poorly constructed sewerage systems in the impacted islands of Maldives. This lead to*

contamination of the freshwater resources and caused subsequent health problems. This event demonstrates what similar impacts from climate change would cause.

1.11.2 Coastal protection

Priority	Cost in USD	Source of information
Coastal protection for 4 selected islands	15,094,500	Briefing Paper, 2010
Further coastal protection for selected islands	77,046,000	NAPA, 2007 (project 10 adjusted for inflation)
Total short and medium term coastal protection	92,140,500	

Table 4:4 Costal Protection Priority and Costs

Coastal protection is another topic treated in the NAPA as well as in the Briefing Paper. The interventions proposed in the briefing paper are similar to the ones listed under NAPA project number 2. Both measures have the same goal, to implement hard measures at 5 respectively four islands, and research and demonstrate engineering solutions on one island. The costs of the above mentioned measures are also similar. However in the NAPA there is an additional project that builds on the first one and is about further coastal protection for selected resilient islands or communities. As a comparison, another figure that comes up for coastal protection measures for three islands for which a detailed CBA was carried out together with a review for the safer island program is 46 million USD when adding up costs of the highest protection scenario.

Quoting the NAPA to show the vulnerability of islands:

> *Over 80% of the total land area of the Maldives is less than 1m above MSL. The highest point recorded in the country is a beach ridge at Fuvahmulah with an elevation of 4m above MSL (MHAHE 2001). As future sea level is projected to rise within the range of 9 to 88cm between 1990 and 2100, the islands of Maldives would be submerged in the projected worst case scenario (NAPA, 2007). The coral islands that make up the Maldives are morphologically unstable and change in their size, shape, elevation and position on reef platforms over time. The beaches of these islands are particularly dynamic with substantial seasonal changes. At present, the total beach area is estimated at 13km or 5% of the total land area and the coastline of the Maldives is estimated to be 2,300km long (Shaig 2006). The small size of the islands forces people to live next to the sea. At present, 44% of the settlement footprints of all islands are within 100m of coastline. This translates to 42% of the population and 47% of all housing structures being within 100m of coastline. More than 50% of the housing structures in 121 islands are within 100m of coastline (Shaig 2006).*

1.11.3 Other short and medium term priorities formulated in NAPA

According to stakeholders further NAPA priorities and costing are still relevant when looking at short and medium term intervention.

Priority	Cost in USD	Source of information
Integrating Climate Scenarios in to Safer/Resilient Island Strategy	2.158.964*	NAPA, 2007
Flood control measures for vulnerable islands	5.591.789*	NAPA, 2007
Housing safety, sustainable building design	2.649.746*	NAPA, 2007
Coastal protection for Male international Airport	19.600.600	NAPA and ISLE database, PO website (May 2010)
Food security	1.048.460*	NAPA, 2007
Health sector	2.230.361*	NAPA, 2007
Fisheries	1.305.174*	NAPA, 2007
Coral reef protection	1.349.655*	NAPA, 2007

* all costs quoted from NAPA are adjusted for inflation and are at 2010 Consumer Price Index. We can define CPI as *updated cost/base period cost and multiplied by 100.*

Table 4:5 Other Short and Medium term Priorities formulated in NAPA and Costs

The first recommended step to increase island resilience is to integrate climate scenarios into planning at island level, hence the first priority in the list. In order to increase safety of buildings it's important to develop and implement safe building codes at least in safe zones of the islands that lay at higher elevations.

The GMR Male' International Airport and other regional airports in the country are critical infrastructure for the Maldives, this being the gateway of Maldives to the world, the option for emergency relief to be able to reach the country, import and export of goods and entry of tourists to the country. The GMR Male' International Airport is vulnerable to flooding events, erosion and sea level rise, similarly to other islands in the Maldives. Unfortunately, due their low elevation and proximity to coastline, the infrastructure of all five main airports are highly vulnerable to damage from severe weather related flooding and future climatic change.

The NAPA priorities are reasoned in the following way in the document:

> *Climate change will impact agriculture and food production in the Maldives through sea level rise, salt intrusion into the ground water aquifer, salinization of soil and flooding caused by increased rainfall. In addition, the heavy import dependency of the Maldives for almost all of the food requirements makes the Maldives vulnerable to climate change impacts on the agriculture sector of other countries. The NAPA process has identified increased local food production as a key adaptation measure to tackle such food security issues posed by climate change.*

> *Both the Maldives' First National Communication to the UNFCCC and the NAPA process in the Maldives has identified outbreaks of vector-borne diseases as a major impact of climate*

change and climate variability. Climate related diseases such as dengue and scrub typhus are major communicable diseases of public health concern in the Maldives. In December 2006 the country had its first outbreak of Chikungunya, another climate related vector-borne disease. The Maldives NAPA projects that the incidence of these vector-borne diseases in the Maldives will increase with the predicted climate change, particularly changes in temperature and rainfall regimes.

The ability of Maldives to manage its fisheries is crucial to sustain livelihoods and social and economic well being. The fishery catches almost 150,000t of tuna every year with fish exports valued at US$88 million. The fishing activity itself provides direct employment for about 16,000 people and thousands more in post-harvest activities. The fisheries contribution to annual GDP is more than 7 percent. Direct vulnerability of live bait availability to changes in coral reef ecosystem is evident, therefore it is imperative that alternative ways and means of live bait is sought to adapt to climate change.

The low elevation, small size and unconsolidated nature of coral islands makes the islands highly reliant on the biological and geomorphologic functioning of the reef environment for their stability. Much of the economic base such as tourism and fisheries, and livelihood of most Maldivians are directly linked to the coral reefs. The stability and survival of coral reefs has been questioned with the predicted climate change, particularly the risks associated with the Sea Surface Temperature (SST) rise and Sea level rise (SLR).

Reviewing the recently approved Global Environment Facility (GEF) – Least Develop Country (LDC) funded Resilient Island Development project goals it is clear that the project collides some of the NAPA projects identified, focusing on soft measures to increase resilience. The grant contribution is 4,485,000 USD and it represents approximately 50% co-financing. This is the first NAPA project being approved and financed. Therefore the grant amount will be subtracted when calculating the total short to medium term costs of priority adaptation measures.

1.11.1 Integrating communities

Priority	Cost in USD	Source of information
Integration of communities	112, 900,025	Briefing Paper, 2010

Table 4:6 Integrating Communities Priorities and Costs

The third adaptation measure mentioned in the Briefing Paper as an immediate adaptation need is **a transport system** for community integration. Ensuring a transport system facilitates access to basic services and aids economic growth. This measure is not identified in the NAPA and it is linked to the goal of the Government to move away from forced population consolidation without compromising the protection of the most vulnerable and remote communities. The rationale for choosing this adaptation measure quoting from the Briefing Paper is:

"The impacts of sea induced hazards and predicted climate change impacts will be felt most by those islands that are not developed, and those that are most vulnerable due to poverty and inaccessibility to critical services. Interconnectivity of the islands in the Maldives in order to provide critical services is a must in building resilient communities, and in order to do this the Maldives needs to build critical infrastructure for the delivery of services. [...] Because it is socially unviable to relocate people to other islands, a nationwide maritime ferry system gives mobility of the people that is imperative for development and provides a safer and more secure environment for islanders."

While there is a strong argument for the need for a nationwide transport system, it is questionable to what extent this is a climate change adaptation priority and to what extent it is a development need.

Nationwide transport system is a national priority that is discussed as a priority for adaptation. Due to the fact it is presented here.

1.12 Costing long term adaptation measures

ADAPTATION **Total costs for LONG term measures: up to 50 years**	**USD 161,500,000**

1.12.1 Costs of Safer/Resilient Islands

Long term development priorities for adaptation are critical infrastructure development and further measures for resilient islands in selected islands from the Atolls. DHIRAM study looks at ten selected islands, while the CBA for the Safer Island Program looks at three of the DHIRAM islands in detail. The islands chosen in these studies are not based on the climate risk profile of the Maldives, thus arguably may be missing the point of maximizing resilience with the funds available.

The above mentioned studies contain measures that deal with a combination of disaster mitigation and climate adaptation. While disasters and climate change are clearly related, they are not the same. Climate change increases the likelihood and the severity of natural hazards, but natural hazards are there with or without climate change. Climate Risk Profile, DHIRAM and CBA study have slightly different ways of treating climate change related risks, for example sea level rise, flooding or draughts might be solely or only partly attributed to climate change. The Safe Island Program and concept has been recently reviewed in the CBA study with the purpose of increasing resilience of the islands regardless the source of the hazard. At the time of writing this report it was possible to source information from the draft CBA study.

Text Box: Excerpt from the CBA study

The typical Safe or Resilient Island Program actions should consider incorporating one or more of the following items, but should not limit to these:
1. The establishment of the local institutional framework for the SIP, to include the appointment of a local SIP representative / focal point (supported through training) to act as liaison between local and national level stakeholders. Training and support will have to be a continuous activity occurring at regular intervals to account for changes in circumstances and personnel. It should not be a one-off input at the beginning.
2. A public awareness and education programme to cover disaster and climate risk, early warning, appropriate response, as well as the part that everyone needs to play in protecting the environment.
3. Measures that reverse impacts of man-made interventions on the environment: for example, this may require addressing the impacts of land reclamation, and installing proper drainage.
4. Measures that strengthen natural protection, for example:
a. By ensuring that reefs are protected and healthy;
b. Introducing Environmental Protection Zones that extend from the coastline beneath sea level to include reefs; and
c. Re-vegetating coastlines to provide buffers against waves and wind and ensuring their protection from future exploitation and degradation.
5. Provisions to ensure that any new building practices on islands are most appropriate and do not damage the natural environment: For instance, a strategy of building vertically is less damaging than reclaiming land. Similarly harbour developments, as part of the Government's plans to improve transportation networks, should be subject to full feasibility studies and EIAs to gauge the optimal location, design and method of construction.
6. Strong linkages with island level development activities to maximise the populations' resilience to disaster and climate impacts. For example, by:
a. Strengthening health care;
b. Protecting water supply from contamination;
c. Increasing rainwater harvesting;
d. Ensuring that building codes require buildings to be raised on a plinth; and
e. Making sure land-use plans reduce and do not create risk.

Except for intervention number 3 listed above all others are recurrent from NAPA goals and priorities. Therefore using costing of Safer Island Programme on these islands as a proxy for climate

change adaptation measures will give a good indication of the magnitude of the longer term adaptation measures needed in the Maldives.

Scenarios	Adaptation cost USD	Benefits USD	Net benefits USD
9 islands in case of single event in 20 years	161,500,000	93,330,000	-68,170,000
9 islands in case of two events in 50 years	161,500,000	134,670,000	-26,830,000

Table 4:7 Adaptation and benefits for 9 islands (source: DHIRAM II and CBA combined)

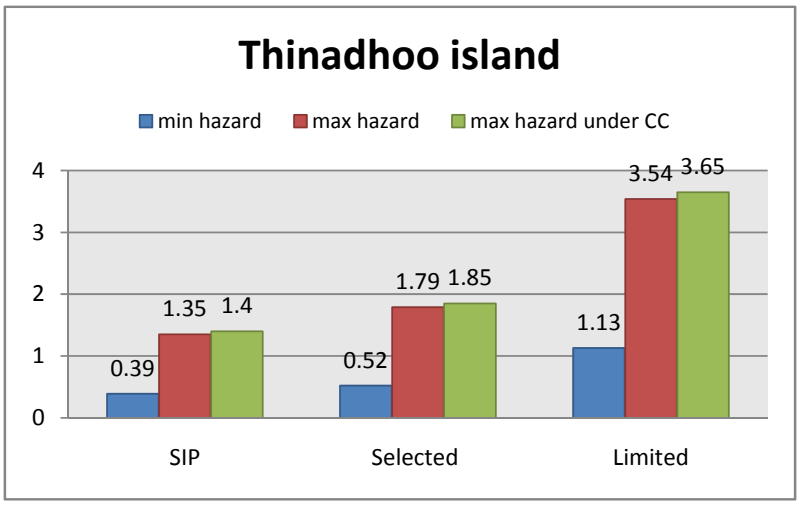
As the net benefits of protection are negative in the DHIRAM studies, further investigation on the Costs and Benefits of these investments was needed.

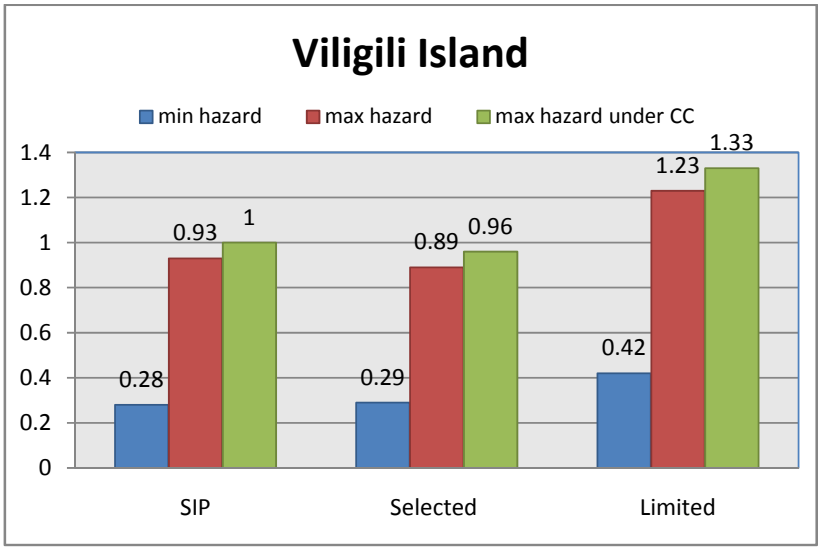
1.12.1 Cost Benefit Analyses, a tool for decision makers

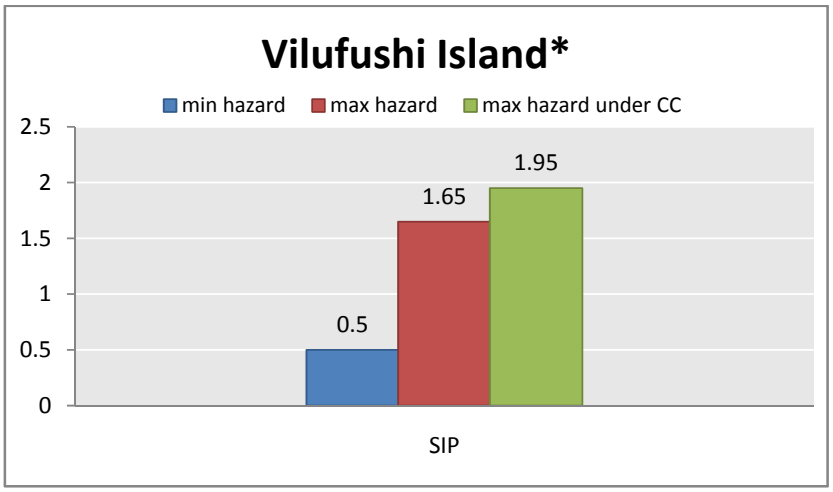
The CBA studies three islands, where different scenarios are considered for hazards, the minimum hazard occurrence, and the maximum hazard occurrence under climate change scenario. The Cost Benefit Ratio is calculated for all scenarios for option of Safe Island Protection, selected Safe island protection and limited protection. The Benefit Cost Ratios signifies that benefits outweigh the costs of the protection measures whenever the ratio is above 1 and the investments are worthwhile to be pursued. The ratios are likely to become higher with an increase in the hazards, since the more hazards there are the more losses and the higher the value of protection measures.

The ratios should be informing decision-makers on the extent of expenditure and the type of measures worthwhile to be pursued in climate change adaptation (disaster risk mitigation). These figures are always indicative, since there are losses and benefits that cannot be captured in monetary values, there are inherent uncertainties in calculation methods, estimations used for certain costs, etc. The following graphs show BCR for the 3 hazard scenarios taking into account 3 degrees of protection going from maximum protection to limited protection from left to right.

Legend for reading the different protection measures in the diagrams bellow:
SIP: Safe Island Protection, maximum protection
Selected: Selected Protection measures
Limited: Limited Protection measures







*only the complete Safe Island Protection measures option was developed and calculated for Vilufushi at the time of the writing of this report

1.12.1 Impacts and costing of extreme weather events

The purpose of this subchapter is to provide an overview of the magnitude of losses that occur in case of extreme weather events in the Maldives, all referring to a onetime occurrence of the event. In 2004, the disastrous Indian Ocean tsunami destroyed the nation's economic and social infrastructure, with losses exceeding 62 percent of Gross Domestic Product (GDP), or 470 million USD according to the estimates of the Department of National Planning (DNP, 2010).

Islands	Tsunami (USD)	Swell wave or Storm surge(USD)	Rainfall flooding (USD)
Kulhudhuffushi	7,592,291.67	2,414,083.33	157,541.67
Funadhoo	1,655,833.33	360,666.67	5,583.33
Thulusdhoo	1,434,375.00	533,166.67	15,833.33
Kudahuvadhoo	1,425,250.00	399,500.00	5,833.33
Gan	6,679,000.00	2,126,291.67	34,416.67
Viligilli (before reclamation & coastal protection)	2,816,916.67	360,666.67	17,500.00
Thinadhoo	1,630,583.33	189,375.00	75,833.33
Feydhoo	3,752,541.67	385,458.33	75,250.00
Hithadhoo	6,924,500.00	166,208.33	223,833.33
Vilufushi	1,685,708.33	183,833.33	0.00
TOTAL	35,597,000.00	7,119,250.00	611,625.00

Table 4:8 Summary of tangible losses from natural hazards in the study islands (DHIRAM II, executive summary)

1.12.2 Tourism

Tourist resorts are like a country within a country, dwelling in separate islands from inhabited islands, following the one island one resort concept. Tourism is the main industry in the Maldives, accounting in 2008 for 27 percent of GDP, 29 percent of the Government revenue and more than 24,000 jobs. By the end of 2009 a total of 96 islands were constructed into resorts and further 62 are in various stages of preparation. The growth in this sector has been 12% annually and there were 683,000 touris arrivals in 2008 which is more than double the country's total population (SAP, 2009).

Climate change influences the viability and profitability of tourism, both directly and indirectly. In the Maldives one resort is one island and these small tropical tourist resorts are among the most vulnerable and least defensible in the world. The resort islands are vulnerable due to their smallness, low elevation and geographical dispersion. The NAPA details vulnerability of tourism in the following way:

> *The tourist resort islands are extremely small with 73 out of the 87 resorts being less than 0.1km^2 while the largest tourist resort is just 0.5km^2 (Shaig, 2006). The average elevation of tourist resorts is 1.5m above MSL. The tourist resorts are distributed along a length of 830km. The tourist resorts are already experiencing damage to the environment and natural resources that are consistent with climate change.*
>
> *One of the most important assets of tourist resorts is beaches with 70% of tourists visiting the Maldives primarily for beach holidays. Sea level rise would disrupt tourism through loss of beaches. Already 45% of tourist resorts have reported varying degrees of beach erosion (MHAHE, 2001). Saltwater intrusion will impact the groundwater lens in resorts affecting the tropical vegetation. The present investments in tourist resort infrastructure exceed US$1 billion and loss, or even under-utilization, of such infrastructure due to climate variability and change will devastate the Maldivian economy. Vulnerability of tourism to extreme events is evident as shown by the combined cost to tourist resorts and loss of Government revenue from the tourism sector as a result of the Indian Ocean tsunami in excess of US$300 million (MPND, 2005).*
>
> *Corals are very vulnerable to SST, and when they are bleached, there is loss in biodiversity and in the natural defense system of the island against waves and erosion. One of the main*

reasons for tourists traveling to the Maldives is diving, thus coral bleaching events will have significant implications for the tourism sector.

Though there is knowledge about efforts by the tourism industry to carry out adaptation measures, such as protecting the beaches and the reefs, there is no comprehensive record of these efforts. Such a database, including an account of the efficacy and costs of adaptation measures, would likely increase knowledge of the potential adaptation measure the tourism industry could implement. Ministry of Tourism has in view the completion of the present environmental regulation with climate change- related requirements. The implementation of such legislation is likely to increase the adaptation efforts in the country. As of now it is not in the direct business interest of the resorts to invest in adaptation as a priority, since the payback period of investments is less than 5 years and climate risks are likely to be felt in a much longer, 20 to 50 years life-span.

The NAPA foresees actions for the tourism sector that would be essential, but these are not costed:

- Strengthen tourism institutions to coordinate climate response in the tourism sector.
- Incorporate climate change adaptation measures to upcoming resorts
- Develop climate change adaptation policy and strategy for tourism.
- Protect beaches and tourist infrastructure.

1.12.3 Other long term adaptation measures

Long term planning is the key to meaningful measures and action. Measures need to focus away from end of pipe line solutions and take action to solve the cause of problems. The previous mentioned adaptation measures only cover two main issues. The remaining gaps that have not been covered thus far and come from stakeholder consultations and review of literature are:

- Protecting more international airports, not only Hulhule, these are critical infrastructure central for the country to connect to the world
- Protecting and developing mangroves and trees in urban areas to keep the islands cooler and to protect beeches from erosion. These measures are soft measures and are relatively inexpensive but are worth considering and keeping in mind for the long term.
- Increasing the evidence base: professional monitoring of climate change impacts and creation of a database that track changes in the climate and their actual impact, so that there is scientific evidence to rely on. Safeguarding the country in the long term calls for understanding and documentation climate change impacts. In the future this will put Maldives in the position to argue their case for compensation.
- Emphasise on solving the waste management issue that is further damaging the coral reefs that are the natural defence mechanisms of the islands and is polluting the water lenses. Waste management is an issue that is dealt separately, outside of climate change considerations, but once its resolved, it will bring benefits to resilience (several stakeholders stressed the importance of solving this issue).

5. Mitigation

1.13 GHG emissions in 2009

There is an emission baseline established and calculated for 1994 for the first National Communication, 2001. The baseline emissions are calculated only for the energy and the waste management sector for the two most common GHG, carbon dioxide and methane. The reason for excluding other sectors is in part lack of data but also the fact that energy, comprising also the fuel consumption for transport, is by far the main emitting sector. The main economic activities in the Maldives are tourism and fishing with hardly any processing, agriculture due to the limited availability of land. The total net GHG emissions for 1994 were 0.13 Mt CO_2 and per capita emissions 0.54 t CO_2 equivalents.

1.14 Emissions from the energy sector 2009

The inventories listed below have been produces by the NEEDS study and are not the official GHG inventories of the Maldives for the national communications.

Emissions were estimated relying on the 1996 Revised IPCC Guidelines for National Greenhouse Gas Inventories, tier 1, Reference Approach for the energy sector. 2009 fuel import and export data was provided from Custom's Service, which allowed us to perform the calculations since Maldives energy and transport sector relies almost solely on imported fuel. The detailed data is included in Annex 1. Estimated total emissions from the energy sector in 2009 are 0.93 Mt CO_2 equivalents.

Fuel type	Fuel qty 10^3 t	Gg CO_2
Crude Oil	0.00101	0.00
Natural Gas Liquids	0.0103	0.03
Gasoline	28.3227	87.05
Jet Kerosene	3.48544	-61.73
Other Kerosene	0.93591	2.98
Gas / Diesel Oil	280.257	890.44
Residual Fuel Oil	0.00021	0.00
Bitumen	0.00175	0.01
Lubricants	2.4924	7.27
Petroleum Coke	0.02355	0.07
Other Oil	0.14849	0.43
Other Bit. Coal	0.420347	1.01
Oil Shale	0.001763	0.00
Peat	0.149405	0.15
TOTAL	**316.226**	**927.71**

Table 5:1 Contributions to CO2 emissions by fuel in 2009 and in 1994

1.15 Emissions from the waste management sector 2009

Following the 1996 revised IPPC guidelines for emissions calculation, 2.78 Gg CH_4 emissions were estimated for 2009. The underlying assumption for this estimation is that a mere 40% of the generated total waste ends up at a landfill site, most of this goes to Thilafushi landfill, the site nearby Male'. Much of the waste is burned in open air, buried or dumped in the ocean in the Maldives. Estimations for emissions from open air burning of waste were not calculated, thus this figure might be on the low side. Considering that the Global Warming Potential of Methane is 25 times higher than that of CO_2 the emissions from waste sector in 2009 are equivalent to 69.88 Gg CO_2, or 0.69 Mt CO_2.

Sector	Gg CO_2
Energy and transport	927.71
Waste	69.88
Total	997.59

Table 5:2 Estimated total net emissions 2009

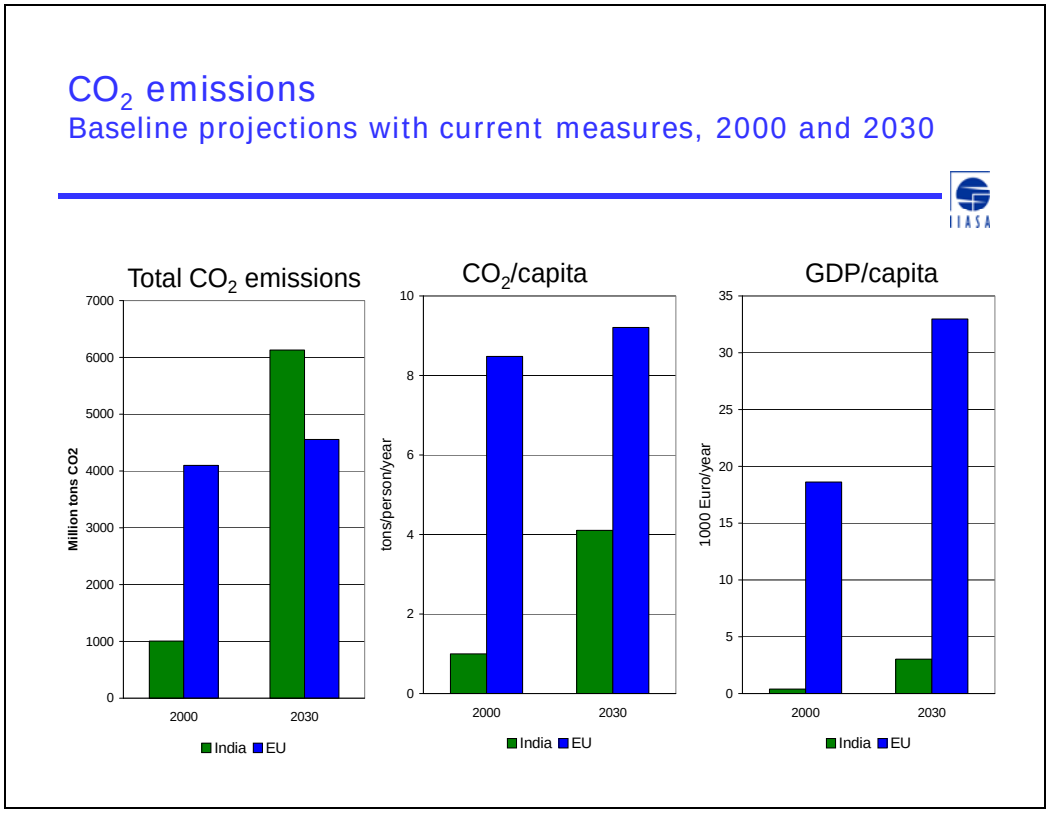
It is likely that the emissions are somewhat higher; reaching somewhat above 1 Million ton of CO_2 equivalents as these emission calculations do not include agriculture and other sectors, nor do they account for sinks.

1.16 Emission scenarios and projections

The IPCC Special Report on Emissions Scenarios (SRES, 2000) projects an increase of global GHG emissions by 25 to 90% (CO_2-eq) between 2000 and 2030 with fossil fuels maintaining their dominant position in the global energy mix to 2030 and beyond. More recent scenarios without additional emissions mitigation are comparable in range.

Emission scenarios for Maldives are hard to predict for a number of reasons: the country is small and even if economic growth and development will persist, it have to take alternative, non-traditional forms, due to the lack of land availability. For the same reason, Maldives will reach its carrying capacity in terms of population and built infrastructure relatively soon, which will also put a natural boundary on emissions. At the same time, Maldives is striving to move away from fossil fuel in energy and transport and increase sinks to keep emissions down.

Following as emission forecast for neighboring India for the 2030 horizon. Emissions in India are expected to increase 6 folds in 30 years, while a 6 fold increase in emissions has been forecasted for the Maldives in a mere 15 years.



Source: Markus Anman, International Institute for Applied System Analyses, IIASA, GAINS- Asia project, 6th Framework Research, 2008

Figure 5:1 CO_2 emissions in India and Europe

1.17 Priorities for mitigation

At the inception workshop of the project in March, 2010, priority mitigation measures were identified as subject of assessment during the study. A multi-criteria analysis was used in determining the priorities. The participants agreed on scores and weights on criteria (socio-economic benefits, technology transfer, finance and investment requirements and environmental benefits) to be applied in order to prioritize the different mitigation measures. The overall result led to the identification of the following mitigation priorities:

- Renewable Energy
- Waste to energy conversion
- Energy efficiency
- Transportation (improving fuel efficiency)
- Sink enhancement (mangroves)

Considering that energy and transport are the two main emitting sectors in the Maldives, the choices listed above are natural. Waste to energy is a preferred option because waste management is a big problem in the Maldives and solving it would also benefit adaptation.

When climate change was first depicted as a global threat most efforts went into combating it. Therefore there is knowledge of technologies, abatement costs and progress towards global consensus on priorities for mitigation. Maldives has committed to carbon neutrality, commitment made at COP15, Copenhagen. The President's Office in cooperation with the line ministries is busy preparing a Carbon Neutral Plan and should be ready in 2011. However, this being a recent

commitment and a matter that has not been a major concern in the past, there is relatively less known in the Maldives about measures and costs for mitigation as compared to adaptation.

1.18 Challenges for mitigation

Some of the key challenges for mitigation in the Maldives identified during stakeholder consultations and review of literature and policy are as follows:

- Carbon neutrality may be difficult due to the much dispersed energy generation, 60% of energy is generated independently by resorts (NEEDS workshop in March 2010).
- At the same time the Ministry of Tourism feels there is uneven pressure on tourism industry as it is, requiring high standards for environmental protection and waste management. It will be very difficult to implement further environmental protection measures for mitigation or adaptation at the resorts due to the fact that at community level there is a lack of a matching effort to practice environmental protection and mismanagement of waste. This lack of a matching effort will impact the resort nevertheless.
- There is no plan or finalized policy for carbon neutrality and there is a lot of pressure for action because of the limited time-frame. The Energy Policy dated last year is now under major revision that will likely correct RE targets upward, as these were rather lenient in the previous policy.
- Information and essential data on the availability of renewable energy sources and on appropriate options of RE technologies is limited. Their financial viability in the Maldivian context is also limited.
- Limited capacity of key players in the Government sector. The institutional mechanisms necessary to support the development, implementation and management of RE and Energy Efficiency (EE) applications in the framework of the national policy on energy are lacking. Limited trained technical staff to assess, plan, implement and monitor RE technologies and EE technologies
- Non-availability of reliable RE technology hardware in the local market and connected to this high maintenance cost of most RE technologies

1.19 Potential for renewable energy sources

The potential for RE presented in this chapter and subchapter relies on a few key documents, most importantly on the Danish funded Assessment of Least-cost, Sustainable Energy Resources Report dated 2004, TNA Energy and TNA Transport.

The islands are abundant in RE but currently, only a few applications have been implemented. Solar power is used for navigational lights (marking reefs and harbour entrances), hot water for some homes, and in some resorts. Meanwhile handful of solar-wind-diesel hybrid systems has been installed. There is considerable scope for using RE sources such as Solar photovoltaic, Wind, Biomass, and Municipal Solid Waste and Oceanic energy. Among the feasible RE technology, Oceanic energy is most expensive and will not be considered for the purposes of this report.

1.19.1 Technology options/alternatives

After an economical analysis based on 12% International Rate of Return (IRR) the figures show the following options as most viable:

- Wind-diesel are sound investments on a number of islands;
- Thermal solar utilisation is promising;
- PV systems need subsidies;
- Household digesters are very sound investments;

- Biomass boilers for fish canning industry must be investigated;
- Utilisation of biogas from Thilafushi seem to be very favourable;
- CHP on biomass might be good, if suitable sites may be found.

System	Investment	Without subsidy		With subsidy (FIRR=12%)		
		NPV	IRR	subsidy	NPV	IRR
	USD	USD	%	%	USD	%
Wind-diesel hybrid 60 households	225000	180330	15			
Wind-diesel hybrid 40 households	125000	70806	12			
Thermal solar heating (per m2)	833	1826	26			
PV-strand alone	12500	-5593	0	70	2739	12
Wind/Solar/Diesel	120800	-86283	-4	60	24300	12
Solar/Diesel	148333	-86284	-6	70	25052	12
Household biogas digester	366	2777	86			
Biomass boiler	833333	2856470	37			
CHP on landfill gas	482500	2267126	48			
CHP on biomass	2750000	4548150	22			

1.19.2 Application of Alternatives

Below is presented an overview of places for implementation of the alternatives and some comments related to the development of scenarios and the subsequent evaluation of implementation potential

	Resource	Product	Place	Scenario Potential
	Wind			
1	Wind-diesel hybrid	Electricity. Options: ice production/desalinization	Islands in windy belts (above 5.5 m/s at 40 m height)	Electricity supply financial viable for islands with more than 40 households. Viable for smaller islands if subsidized
	Solar			
2	Thermal solar heating	Hot water	Resort, and residential	Up to full coverage on resort. Many residential
3	PV-stand alone	Electricity	Resorts	Path/street lighting on resorts
4A	Wind/Solar/Diesel	Electricity	Islands in windy belts (above 5.5 m/s at 40 m height)	Electricity supply on smaller islands (<= 25 households). Subsidy needed
4B	Solar/Diesel	Electricity	Communities	Electricity supply on smaller islands (<= 25 households). Subsidy needed
	Biomass			
5	Household biogas digester	Biogas and reduce waste problems	Islands and households except majot towns	Penetration: 25% in 5 years, 80% in 15 years
6	Biomass boiler	Steam / hot water	Canning factory	Substitution of diesel based steam at canning factory

7	CHP on landfill gas	Electricity/heat	Thilafushi	Substitute diesel based electricity
8	CHP on biomass	Electricity on small scale steam turbine	Islands with more than 4000 inhabitants and potential for SME absorption cooling / desalination	2-4 majors islands

According to economical calculation in order to be financial viable with a Financial International Rate of Return (FIRR) of 12%, PV projects require subsidy of almost 70%, wind-diesel systems requires 38% subsidy.

1.19.3 Wind energy

1.19.3.1 Wind potential

A Wind Resource Map has been made by United States National Renewable Energy Laboratory (NREL) via satellite and also wind energy measurements have been conducted for 14 months. Small differences have been registered between those measurements and the Wind Resource Map made by NREL as seen in the table below.

	Site 1			Site 2			Site 3		
	Villingili	NREL	NREL Correction factor	Meedhoo	NREL	NREL correction factor	Eydha-fushi	NREL	NREL Correction factor
	m/s	m/s		m/s	m/s		m/s	m/s	
Average	5.69	6.5	1	5.34	6.2	1	5.2	6.42	1

Table 5:3 Wind Potential

Also, hourly mean wind speed and wind direction data are available for a period from January 1993 to May 2004, only a few years are missing.

1.19.3.2 Potential utilization of wind

Wind energy at level 50 m:

Site 01 Villingili	244 W/m2, 5.9 m/s	NREL Wind Map 300-325 W/m2
Site 02 Meedhoo	201 W/m2, 5.6 m/s	NREL Wind Map 275-300 W/m2
Site 03 Eydhafushi	184 W/m2, 5.3 m/s	NREL Wind Map 325-350 W/m2

Even though the measurements indicate lower wind energy potential than expected recommendations have been made to proceed with the measurements and apply for funding of a pilot hybrid wind/diesel project.

1.19.4 Solar energy

1.19.4.1 Solar potential

The annual global radiation is 2054 kWh/m^2. Measurements have been made at GMR Male' International Airport during a three month period and the direct solar radiation measured has a peak close to 1000 W/m^2 and the annual daily average is ~ 200 W/m^2.

The determination of the performance of PV systems is relative straight forward in case of grid connected systems where the demand of the grid is large compared to the production of the PV system. The performance of stand-alone systems with batteries is dependent on the size of batteries and demand compared to the size of the panel area. However, a typical performance is two third of a

grid connected system. The determination of the performance of solar heating systems is more difficult as the performance is very much dependent on the actual demand.

1.19.4.2 Potential utilization of PV

PV systems are at the moment not economically feasible with a solar energy price of around 0.66-0.83 USD / kWh. Only few systems exist mainly on boats and in connection with telecommunication.

Under Maldivian weather conditions a grid connected PV system with a panel efficiency of 10% will have an annual performance of approximately 135 kWh/m². A standalone PV system may have up to approx. 95 kWh/m². Considering that the efficiency of traditional electricity production is in the order of 30-35 % (Stobbe and Andersen, 2003) then oil savings may be 385-450 kWh/m² for a grid connected system and up to 270-320 kWh/m² for a stand-alone system.

1.19.4.3 Potential utilization of thermal solar heating

The "cold" water temperature in Maldives in September 2004 was 29°C. Because the demand for domestic hot water at a higher temperature may increase in time, the main potential for utilization of solar heating is at resorts.

The calculated potential for new solar heating systems is approx. 4,800 m².

Name of the Resort	Rooms at resort	Water heated by Solahart (%)	Collector area m² *
Alimatha Aquatic Resort	102	90	73.4
Bandos Island Resort	225	100	180
Bolifushi Resort	55	100	44
Club Med Kanifinolhu Resort	250	88	176
Dhigufinolhu Island Resort	100	80	64
Dhonvelhi Beach & Spa	24	100	19.2
Komandoo Island Resort	45	100	36
Kuredu Island Resort	300	90	216
Veligandu Huraa	56	100	44.8
Villu Reef Beach & Spa Resort	68	100	54.4
Total	1225	95	908

The annual savings of the solar heating systems may therefore be enhanced to 600-950 kWh/m².

The efficiency of the electricity production normally used for heating of hot water is in the order of 30-35 % (Stobbe and Andersen, 2003). So the amount of saved oil in terms of energy is 1,700-3,170 kWh/m². As the annual bed capacity utilisation rate (Stobbe and Andersen, 2004) is estimated to be 69%, the savings is reduced to 1,170-2,190 kWh/m². In total the annual potential is thus 6.3-11.8 GWh ≈ 530-1000 ton oil ≈ 630-1200 m³ oil.

The price of small solar heating systems available on the market is 1015 USD /m² including installation for a 2 m² system and 633 USD /m² including installation for a 4 m² system. In the following calculations a mean value of 833 USD/m² is used.

The price of a traditional electrical heated domestic hot water tank should be subtracted from the price of the solar heating system, as the solar heating system replaces the traditional DHW tank. However, the price of these domestic hot water tanks is not known, and therefore not subtracted.

Total price of implementing 5,400 m² thermal solar heating is 5,400 x 833 USD /m² = 4500 USD. Application on large surfaces may lead to a better price, but this is not considered in the quoted price.

With an oil price of 440 USD per m³ the annual savings is in the order of 275000 - 533400 USD and the simple payback time will be in the order of 8-16 years. As the lifetime of solar heating systems normally is set to 20 years, the investment in solar heating systems is profitable. However, a price of 632 – 1015 USD/m² incl. installation for solar heating systems is a high price in the Maldives and may hinder fast penetration of solar heating systems.

Subtraction of a traditional domestic hot water tank and effects of large volume orders is believed to lower the simple payback time by around 2 years.

1.19.5 Waste management and energy

Some waste management technologies result in energy generation. Waste management is one of the most urging problems that need a solution in the Maldives. Current practices including open air burning, littering and ocean dumping are no longer acceptable. The islands being dispersed the transport of waste to regional hubs is very expensive. Therefore the current waste management policy of the Maldives is to treat as much as possible on the islands. About 80% of the waste generated on the islands is organic and can be treated on the islands by either composting or bio digestion. Some waste streams will have to be lifted and taken to a regional treatment facility which may be an incinerator, a waste to energy plant a landfill (land-reclamation site) or another treatment solution identified in the ongoing and future feasibility studies.

1.19.5.1 Biogas

Island- based solution for biogas generations are cheap and convenient but quite labour intensive.

Biogas digesters at different scales	Up to 4 households	30 Households	100 Households	350 Households
Technical solution	Inverted water tank	Tubular plastic digester	Fixed dome	Fixed dome
Capital cost estimate in USD	2,000	10,000	100,000	400,000

Source: User Pay Framework for Island Waste Management, 2010

Table 5:4 Biogas technology investment costs

1.19.5.2 Waste to energy

Regional treatments incinerators or waste to energy options are likely to emerge as options. These are relatively expensive waste treatment options, but require less land then the conventional treatment and in this sense are favored in the Maldives. The feasibility of these technologies are dependent on economies of scale, Maldives being a very small population and geographically dispersed, costs are likely to be high.

1.19.5.3 Biomass potential

The total accessible biomass potential resource has been established as almost 20,000 toe. If the difficult accessible resource at the un-inhabited islands is left out, then the remaining resource potential is equivalent to 10-15% of the primary energy requirement (if the transport sector is not taken into consideration).

Resource overview	Amount	Energy contents	Comment
ton/year		toe/year	
Inhabited Islands			
Solid agro waste	42,098	7,964	Easily accessible
Animal waste/household	15,000	193	Easily accessible
Household waste	4,563	588	Easily accessible/sorting required
Male Villingili			
Solid agro waste	2,735	517	Easily accessible/requires sorting
Organic waste	29,149	3,760	Easily accessible/requires sorting
Landfill gas		900	Being tested (400-1,380)
Un-inhabited islands			
Solid agro waste	29,373	5,556	Difficult to access
Organic waste	0	0	
Total		~ 19,500	

Table 5:5 Biogas potential

An increase of the potential could be achieved with planting of energy crops and trees in islands that are of marginal values and are suitable for these kinds of plantation. As source of biomass fuels coconuts, sugar, cane, palm oil and other similar plants could be used. Currently, there is no estimation regarding bio-fuels potential in Maldives.

1.19.5.4 Biomass utilisation

The present utilisation represents 4,626 toe, which is 24% of the known and accessible potential, or 2-4% of the total primary energy requirement in the Maldives. It is only the solid agro / wood fuel type of waste and biomass which is presently used. This represents an easy accessible resource, which could be further utilised.

1.19.5.5 Demand and potential utilisation

Making priorities between the potential forms of utilizing biomass is difficult, as the potential use of one does not necessarily exclude another option. Nevertheless, comments and recommendation have been made as seen in the following table:

Application	Comment / Recommendation
Steam/hot water from biomass	Simple well tested technology – but requires access to significant amount of biomass
Electricity / steam from biomass (Small scale steam turbine)	High investment cost, and significant requirement for biomass. Probably a future option.

Ice production from steam (Absorption cooling)	Simple well-tested technology – but requires access to significant amount of biomass. Should be demonstrated.
Desalination (MSF type) (Steam based e.g. through steam boiler or excess heat after steam turbine)	Simple well tested technology – but requires access to significant amount of biomass. Should be demonstrated.
Absorption refrigeration (Household)	Commercially available – should be tested in demo project.

1.19.5.6 Landfill Gas

Landfill gas extraction is found to be possible and feasible at the Thilafushi landfillsite, this is the only site that collects waste from Male' Urban Region and from some of the tourist resorts. Two Regional Management Centers are present at HD. Klhudhufushi and S. Hithadhoo. Waste from other islands is not brought here. Due to this fact these Regional Management Centers are not currently used at full capacity. A study has been conducted by the Danish funded study series on LFG production in 2003. The goal of the project was to identify the total quantity of waste. In 2003 the total amount of waste dumped was estimated at 89,253 tons and the total quantity of the waste deposited was estimated at 642,073 tons. Since then, reliable waste surveys were carried out, including a waste survey in the tourism sector in 2009 and a waste audit in Male in 2008. Adding up recent waste management data shows that an estimated total amount of 114,000 tons of waste is generated in 2009 in the Maldives including tourist resorts, urban and rural areas and excluding industrial waste. It is safe to assume that no more than 40% of this amount ends up in Thilafushi landfill. Thus the LFG predictions in the mentioned study are overstated.

However **Landfill gas test pumping** was performed and these show reasonable gas yields in 2003. The tests were performed without a clay cover, thus the effective yields are expected to be higher during project implementation.

		WELL 1				WELL 2			
Month	**Day**	**m3/h**	**CH4 %**	**CO2 %**	**O2 %**	**m3/h**	**CH4 %**	**CO2 %**	**O2 %**
March	20	0,0	57,0	40,0	0,0	0,0	51,0	45,0	0,0
March	24	7,9	52,0	45,0	0,4	7,9	42,0	37,0	0,8
March	29	4,0	52,0	45,0	0,7	4,0	53,0	45,0	0,1
April	5	11,1	53,0	40,0	0,7	11,1	54,0	37,0	0,0
April	22	11,1	57,0	40,0	0,0	10,3	58,0	40,0	0,0
April	27	8,7	44,5	38,0	1,2	9,5	51,0	40,0	0,0

Table 5:6 Landfill gas test pumping

The theoretical calculation for one landfill cell with two wells predicted nearly 200,000 m^3 landfill gas per year requiring a flow from each of the two wells foreseen at some 12 m^3/hour. The income generated by LFG projects depends on the gas amounts generated. The total cost of landfill gas extraction in this study was estimated at 6,200,000 USD excluding the cable system to connect to the end consumers.

1.20 Potential for energy efficiency

The government of Maldives is currently dedicated to develop and implement an energy conservation and efficiency solution. However, currently there is no agency that is active in assessing the technical and economic potential of improving energy efficiency of electricity consuming appliances.

The following measures are currently being implemented, as stated in National Energy Policy issued by the Ministry of Housing and Environment:

> *The Government will develop and implement a program for energy conservation and efficiency for the power generation sector. Energy management plans and auditing will be used to evaluate options for energy saving and efficiency.*
>
> *The Government will create incentives for long-term investment in cost effective energy efficiency measures regarding energy savings in business.*
>
> *The Government will raise awareness, enabling businesses to make more energy efficient choices through provision of better information on energy use and climate change*
>
> *The Government will set regulatory frameworks that will drive improvements in the energy efficiency of commercial buildings and products.*
>
> *The Government will conduct energy audits and assessment for all government buildings.*
>
> *The Government will identify areas for improvement, recommend measures and establish an energy efficiency program throughout all sectors in their operations, energy consumption in public buildings.*
>
> *From 2010, the Government will set energy efficiency standards for all new products and services that the Government procures.*
>
> *The Government will provide tax and duty incentives for energy efficient equipment and appliances.*
>
> *The Government will develop building standards and regulations to support and guide energy savings in all types of buildings. With this regard, an energy code will be incorporated with the existing building code and other permitting procedures of the government.*

1.21 Mitigation in the transport sector

"In depth Technology Needs Assessment on Transport Sector" (TNA Transport), Ministry of Environment, Energy and Water, 2007 is the most significant study to rely on for exploring possibilities in the transport sector.

Transport is a significant economic and polluting sector in the Maldives, representing 18% of GDP, 31% of total fuel consumption and growing at 9% yearly. Public transport be it land or see is limited to operation of a few ferries to link the main island of Male' to a few neighbouring islands. 80% of cargo arrives to Male' and is distributed from there throughout the country. Recently the pressure of cargo transport in Male' was somewhat reduced due to opening other ports for international cargo arrival regionally (S. Hithadhoo and Hd. Kulhudhufushi) and other terminals in the Male Urban Region (TNA Transport, 2007).

The most significant road transport is in Male'. The capital city has 59 km of paved road and a highly congested unregulated traffic. Male' Urban Region has 22,303 vehicles of total of which 77% are motorbikes and 9% four wheel cars, 94% of these are operated in Male. Vehicles in the atolls outside of Male' Urban Region account for only 8% of the total number of vehicles in the Maldives. There only 2 roads for inter-island transport of a total of 14 km long. Thus, road-transport is only significant in the Male' Urban Region (TNA Transport, 2007).

In terms of identifying mitigation solutions for the country TNA Transport remains at a general level, revealing a mix of technology options and policy instruments but not concluding on specific solutions, aside from a couple of solutions that are clearly technologically and economically viable. These technology options are:

- Integrated public Mini Bus services for Male', Hulhumale, Addu Atoll, Laamu Atoll, Fuahmulah and Kulhudhufushi road network with 16 to 20 seater high roof mini buses, based on a careful root planning
- Integrated ferry transport system for Male' Urban region to replace the existing spoke and hub system, where all ferries must always transit Male', the hub
- Developing integrated ferry services in other atolls as well as between atolls to reduce the ad-hoc and movement of boats used under full capacity would reduce GHG emissions
- Congestion control of transport in Male' through electronic toll collection system is a convenient technology that may be feasible in spite of the high initial costs with implementing this technology
- Increasing fuel efficiency in transport

The technology options for alternative fuels, use of emission neutralizers, alternative lean burn engine configurations, use of fuel-efficient vehicles and vessels is discussed in detail but not in a conclusive manner, the authors recommending that further research is needed to establish the feasibility and viability of any of these options.

1.22 Enhancing sinks

Some extent of carbon sequestration is believed to be possible through Land Use- Land Use Change and Forestry (LULUCF) practices. Extending and protecting mangroves is important from a number of viewpoints, their value as carbon sinks being just one. Other reasons to protect these are their biodiversity conservation value, their value in cooling the islands and their function of protecting the shores from erosion.

Mangroves have the propensity to sequester carbon from atmosphere and store it in their wetland substrate. The Maldives is known for rich biodiversity of mangroves although the density and area under mangroves are relative less. From 1190 islands it is known that in 150 islands such diverse ecology exists. The total area under mangroves is estimated to be 12 percent the land area of Maldives. Compared to other islands in the Indian Ocean mangrove diversity is highest in Maldives with 13 identified species (Saleem, 2002).

The initiatives for wetland and mangrove protection are still limited in the Maldives; the National Planning Council has recently approved a project of 100,000 Euros and further projects are being currently proposed to tap into the EU Trust Fund pledged to the country. A further project has been identified for conservation of wetland habitats for climate change mitigation and adaption with a budget of USD 2.8million (Maldives Climate Change Trust Fund No. TF 71418 Concept Paper)

The potential of sequestration through changes in agricultural practices is explored in the study Framework Guidance for the Agricultural Sector and the Soil Carbon. Land scarcity and the disperse nature of the geography of the Maldives is making this option less attractive. As population grows and the country develops agriculture will be an increasingly challenging sector. The study compares availability of cropland as follows:

Maldives	Asia excluding the Middle East	The world
11	143	251

Table 5:7 Ha of cropland available/ 1000 population, 1999 data

1.23 Discussion on costing mitigation

Based on the existing studies and the stakeholder consultations it was possible to highlight potential for mitigation measures but did not allow us to do a comprehensive costing of mitigation measures. The Carbon Neutrality Plan will deal with establishing mitigation measures and costing them, this project is commissioned and the Plan is forthcoming in 2011. Thus far mitigation measures have been implemented in an ad hoc manner. An account of ongoing and planned investment is given in the chapter on financial instruments, chapter 8.

A way of capping mitigation costs of the country is to calculate how much the country would have to spend in order to off-set its entire emissions by buying carbon credits on the market. This is an easy and straightforward way of calculating the maximum amount of money that is reasonable to spend on mitigation. Whenever mitigation in the Maldives costs more than this, it makes economic sense for the Maldives to go on the international market and buy credit. This exercise is useful to give a feel about the total mitigation costs but should be read keeping in mind that carbon credit prices are subject to demand on the market and that implementing RE and EE measures are not done for the sole purpose of reducing emissions, but also for other reasons, such as energy security, etc. Calculating with about USD 15 per carbon credit, the equivalent of 1 ton CO_2 reduction, the total cost of off-setting emissions in 2009 in the Maldives would have been USD 15 million.

There have been a couple of papers and rough estimations carried out for achieving carbon neutrality, that put the costs to USD 110 million yearly, this is a figure quoted by the Government in various international meetings and the press.

The following is an account of the cost estimates for mitigation available to us:

MITIGATION		
Short term grant financing needed to initiate Renewable Energy investments, financing 4 hybrid diesel-solar-wind power plants	4,905,820 USD	Briefing Paper, 2010
Landfill Gas Extraction	6,200,000 USD	Landfill Gas investigation; Least cost, Sustainable Energy Resources, Maldives, 2004

6. Institutional framework

The Republic of Maldives is in the process of setting up an institutional structure that will efficiently support integration of climate change priorities into the national agenda. Due to current growing importance of climate change the President has a personal advisor for climate change policy. Under the cabinet of the Ministry there is a National Planning Council (NPC) to approve all development projects, but for all Climate Change related projects, there is a newly established Climate Change Advisory Council (CCAC) that has to be consulted. Although the CCAC is not yet fully operational, the input of this expert body into development of projects is expected to aid integration of climate change into development in the near future.

The problem with operation of the CCAC now lies in a very complex and demanding mandate that puts pressure on key climate experts of the country who already have multiple responsibilities and virtually no physical time left to fulfill all their obligations. The way to address this issue would be to supplement capacity and allow key people to operate at the envisioned strategic level and put their expertise at work efficiently for the climate governance of the country.

Under the structure of the councils come the line Ministries, the Ministry with most responsibilities for climate change is the MHE, having in subordination the Climate Change and Energy Department (CCED), and the National Disaster Management Centre (NDMC). Many agencies and departments of various other Ministries such as Ministry of Transport and Communication are also involved and are aware that they have a role in climate change adaptation and/or mitigation. Some of these the roles are not clearly defined yet as some of these institutions are relatively young, elected after the 2008 elections. DNP under the Ministry of Finance and Treasury takes up numerous development projects and works on checking and monitoring projects for technical content working in cooperation with the NPC.

Climate change governance needs coordination and focus. Although a quite transparent institutional structure is in place, mandates, roles and responsibilities need to be refined. Operational institutions and institutional capacity are very important to legislating and enforcing legislation.

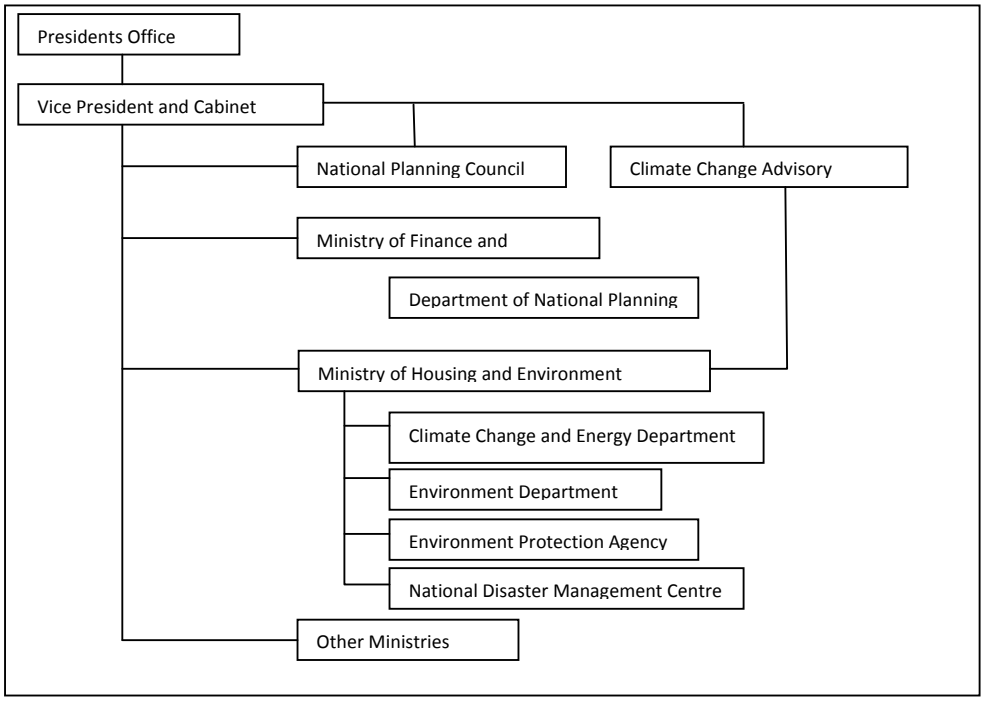


Figure 6:1 Institutional setup for climate change governance

7. Development and climate change

The most recent document governing all development in the Maldives is the **SAP** dated 2009 that is built around the pledges of the first democratically elected government. The five key pledges are:

- Nationwide transport system
- Affordable living costs
- Affordable housing
- Affordable and quality healthcare for all
- Prevention of Narcotics Abuse and Trafficking

The key themes of the SAP are good governance, social justice and economic development. All identified strategies for action in the SAP are cross-checked for short term climate change adaptation and mitigation issues. There is a need to feed back into concrete strategies of intervention for climate change in all the development areas.

The following cross check highlights development goals that are also priority adaptation and mitigation issues providing some discussion on how objectives might work together.

Development Goal	Climate Change adaptation priority	Climate change mitigation priority
Nationwide transport system	To increase resilience of remote and poor communities	To decrease emissions by reducing ad-hoc maritime transport and air transport
Affordable housing	Increasing safety of housing will increase the price of housing, thus adaptation to climate change will work against this development goal	Increasing energy efficiency of buildings reduces costs of housing and reduces emissions
Affordable and quality healthcare for all	This goal is cross-cutting with the reduction of risk from vector-borne diseases associated with climate change impacts.	-
Good Governance – Regional Development and Decentralization	All adaptation and mitigation measures are positively impacted by decentralization, bringing environmental governance closer to the local level. Decentralization would be especially helpful for provision of public services such as water and energy, ensuring regional governance.	
Economic Development - Tourism	Tourism will need to consider climate change liability and start putting efforts into beach protection, biodiversity and reef protection, these measures are identified in the NAPA.	It is a priority for island resorts to work towards becoming carbon neutral.
Economic Development - Fisheries	Sustainable resource utilization, a goal formulated in SAP reinforces adaptation to climate change.	-
Economic Development - Agriculture	Improving national food security will improve resilience of the country.	There is some potential for carbon soil projects that may be explored and may work well with development and adaptation goals.
Economic Development - Environment	All adaptation priorities are mentioned as development goals	Carbon neutrality is a development goal
Economic Development – Water and Sewage	Ensuring access to safe drinking water and protecting natural fresh water resources are both adaptation and development	Increase role of RE in providing safe drinking water.

	goals.	
Economic Development – Energy		RE, EE are both development and mitigation goals.
		Affordability of energy is a development goal that comes somewhat in contradiction to the mitigation goals, since RES is still at higher price compared to conventional energy, however this is expected to change in the future as oil prices soar and RE technologies become more and more competitive.
Other Areas – Disaster Risk Management	Climate change adaptation and disaster risk mitigation are closely linked.	

Table 7:1 Development Goals and Climate Change Priorities cross-checked

The SAP outlines policy that prompted the drafting of various bills and pieces of legislation at the time of writing of this report. The country is waiting for these to pass the chamber of parliament so that development can be planned, administrated, implemented. However these bills do not always pass the parliament, as happened most recently with the bill on Decentralization.

Building on the SAP, a *Briefing Paper*[4] was prepared outlining the development and financing needs of the country for the Donor's Conference held on the 28th of March, 2010. The Briefing paper identifies 5 priority development areas and one of these is climate change adaptation and mitigation. The subsectors identified under the climate change priority are water security, alternative energy, coastal security and integrating communities to enhance resilience of the islands. The same document underlines the fact that all development policies and plans must focus on increasing the resilience of the country to climate change impacts.

The National Environmental Action Plan for 2009-2013, comes in the support of all adaptation and mitigation goals already identified, placing special attention to developing Resilient Islands, protecting coral reefs, protecting and restoring wetlands, providing safe drinking water, protecting groundwater, protecting the seas, and not in the least working towards carbon neutrality through renewable energy and a carbon neutral transport system. Besides other, broader goals, the Sustainable Development Strategy reiterates the goals listed above. Both documents are prepared by the UNEP.

It is clear from the account above that the development agenda driving the country places great importance on building resilience and on carbon neutrality. However, it is fair to note that the country is facing basic development challenges. Due to the geography and disperse nature of settlements it is an economic and technological challenge to provide basic services to all at affordable levels, such as assuring electrification, water, waste water services, transport services health and education.

[4] NDP

8. Financial instruments

Financial instruments are means by which financing is ensured to investments and projects. Typically these fit into the category of grants, loans, budget allocations, subsidies, tax credits and tax cuts or some combination of these instruments.

1.24 National budget

Budget allocation for adaptation and mitigation is limited. In fact the Government is struggling with a budget deficit. In terms of financial instruments currently operational, there is an import tax levy for renewable energy technologies. There is budget spending for water security, coastal protection and other emergency interventions administered through the NDMC. These interventions are decided on a case by case basis by the NPC. Line ministries and relevant agencies draw up 3 year budget plans for their own spending that is reviewed by the NPC and allocations are usually a fraction of the submitted budget.

A report of national budget expenditure for adaptation was not possible since the budget was not available at the time of writing of the report.

1.25 Private investment

The country is preparing to attract and absorb private investments or set up Private Public Service agreements for providing utilities, including energy. How private parties will take up on this opportunity is still unknown. There are currently private investments undertaken in RE wind projects and these investments are encouraged by an import tax levy on RE technologies. Nevertheless, the profitability of providing utility services at the economies of scale typical to Maldives with 350,000 inhabitants dispersed in 198 inhabited islands is still to be revealed.

1.26 Loans

For renewable energy projects a revolving fund, Financing Renewable Energy for Small Application (FRESA), for loans of USD 250,000 was established through the Renewable Energy Development Technical Assistant Project (REDTAP)implemented by the UNDP. Maldives graduation from Least Developed Countries (LDC) means that there will be reluctance from countries to provide grant financing, the alternative for funding will be soft loans of about 2% interest rate and 10 years payback period.

1.27 Grant financing

The recent and successful donor coordination event co-organized by the Government and the Maldives government pledged 319 million USD to the Maldives, one of the 5 priority areas for investment is climate change. EU Trust Fund has recently committed 6.5 million USD. Significant financing is expected to arise as a result of the Copenhagen Accord.

Financing instruments sought are international donors, such as the UN agencies, especially GEF, SIDS and UNDP funds, the World Bank, IMF, ADB, EU Fast Track financing program and EU Trust Fund; and the bilateral financing programs of Japan, USA, Iceland, India, Australia, New Zeeland, Russia and several European countries. Of the 12 identified projects in the NAPA, there is only one under implementation that combines several of the 12 projects into the Resilient Islands project.

There is a heavy reliance on external funding, mainly international and bilateral grant financing for development projects in the Maldives. For decreasing this dependence in the future, the Government has initiated to increase the tax base and to attract private partners and investors.

Maldives is on its way to graduate from the status of an LDC country.

Financing is sought for climate change priorities as grants and/or soft loans from:

- IFI and Donor Agencies such as the UN agencies, especially GEF, SIDS and UNDP funds, the World Bank, ADB, IMF, EU Fast Track financing program and EU Trust Fund.
- bilateral financing programs of Japan, USA, Iceland, India, Russia, Australia, New Zealand and several European countries
- tap into the Clean Development Mechanism (CDM) of the Kyoto Protocol is an operational financing instrument available to the Maldives for mitigation projects

1.28 Decision making cycle for development projects

Private parties and administration at any level, line ministries can propose a climate change adaptation or mitigation project. The proposals are reviewed by the National planning council that is under the Ministry of Finance and Treasury. NPC seeks the expert opinion of the DNP of the Ministry of Finance and Treasury for the proposed project. If the DNP advises positively about the project the NPC might or might not endorse a certain project proposal. At this stage the project goes to the Ministry of Foreign Affairs that seeks financing for it, or it is funded by the national budget and in this case it goes to implementation. Projects that are implemented through national budget or donor funds or credits are financially administered by the Ministry of Finance and Treasury.

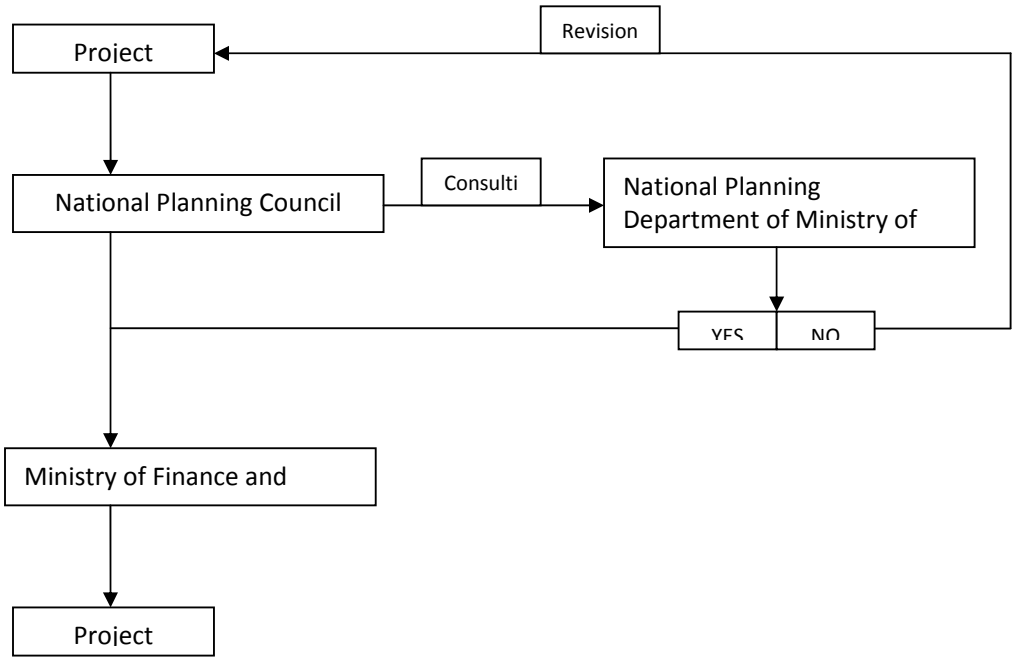


Figure 8:1 Decision making cycle for development projects

1.29 Ongoing and proposed projects

Financial instrument/ type	Purpose of financing	Project value	Status of financing	Priority sector or intervention
LDC fund for Adaptation, UN Grant	Integrating Climate Change into Resilient Island Planning in the Maldives, concept based on NAPA	Project value: USD 9,336,212	Inception phase of project implementation	Resilient Islands
UNDP, UNESCAP Grant	Early Warning Dissemination and response		50% completed	Disaster Risk Reduction
UNESCAP, DANIDA	Regional Integrated Multi-hazard Early Warning System (RIMES)		30% completed	Disaster Risk Reduction
UNICEF, Veolia Water Force France, International Red Cross	Desalination plants and water tanks		Phase 1 under implementation	Water security
Government Funded Subsidy	To provide water tanks to all houses in 45 islands		95% complete	Water security
World Bank	Development of GIS maps		On-going	Increasing evidence base
French bilateral fund Grant	Maldives Climate Mapping	USD 1,855,200	On-going	Increasing evidence base
EU Trust Fund, managed by the World Bank Grant	Mangrove and wetland restoration for climate change adaptation	USD 123,680	Funds Allocated, Approved by NPC	Mangrove and wetland

Table 8:2 Ongoing Adaptation Project

From the list of the ongoing projects for adaptation one can see that some key adaptation priorities such as coastal protection, food security, protection of critical infrastructure such as airports, protection of coral reefs, flood control measures, integrating communities, adaptation measures in the fisheries, the health sector and protection measures for the tourism sector are not being financed right now. Recently, long term measures are receiving attention. Special focus is placed upon climate change impact monitoring projects, climate change impact databases and mangrove protection. There is an overabundance in hard measures, these falling almost exclusively under water security, increasing resilience and disaster risk reduction.

Financial instrument/ type	Purpose of financing	Project value	Status of financing	Priority sector or intervention
Japan Government Loan	Coastal protection, 3 islands	USD 18,780,000	Approved by the NPC To be submitted for financing in the 2010 round	Coastal protection
Japan Government Loan	Coastal protection for Male international airport	USD 19,600,000	Approved by NPC To be submitted for financing in the 2010 round	Coastal protection
Government of Maldives National budget allocation	Climate Resilient Urban area at GDh Madaveli - Hoadedhoo	USD 6,375,000 *	Under review by the National Planning Council	Coastal protection
Government of Maldives National budget allocation Indian Exim Bank - Supplier Credit Scheme	Maldives public infrastructure project, including harbour construction, shore protection, sewage system and roads	USD 32,387.5	Approved by NPC	Coastal protection
Madhajeeth Univeristy	Climate Research Facility Maldives	USD 1.5 million	Work on going for MoU	Research

* source for the information is the Climate Change and Energy department at MHE, figure is quoted much higher on the website database of the President Office.

Table 8:3 Proposed and upcoming projects for adaptation

This table shows that upcoming projects focus on coastal protection, as an immediate response to erosion and rising sea levels and these are hard measures mostly.

Financial instrument/ type	Purpose of financing	Project value	Status of financing	Priority sector or intervention
UNDP implemented project Grant	Renewable Energy Technology Development and Application	Project value: 2,763,780 USD GEF: 750,000 USD UNDP Maldives: 369,000 USD The balance is Maldives own contribution	Close to completing implementation	RES- general
Madsen, MARE, Sweeden Private investment	75 KW Wind Farm, Hinnavaru		EIA in progress, under implementation	RES- wind
Green Energy, Switzerland Private Investment	Renewable Energy Project		MoU signed	RES - wind
JAPAN Grant Aid for solar photovoltaic, Grant	Solar Photovoltaic, 400 KW	USD 11 million	MoU signed	RES- solar
Suzlon, India Private investment	25 MW Wind Farm, Addu Atoll		MoU signed, Approved by NPC	
EU Trust Fund, managed by the World	Mangrove and wetland restoration for climate	USD 123,680	Funds allocated, Approved by NPC	Mangrove and wetland

Bank Grant	change adaptation		
Rotschild Group Private Banking group	Development of Carbon Neutral Plan	MoU signed	Planning

Table 8:4 Ongoing Mitigation Measures

The table of ongoing projects in mitigation shows that the development for RE has been ad-hoc from a variety of funds and the size of the projects is at pilot scale so far. There is presently no waste to energy project financed. The technology relies on very high temperature gasification. Usually waste streams with high organic content need a lot of pre-treatment to get dried before they can be burned. The investment costs are high for such installations and the lower the input the higher the operation costs. Nevertheless centralized incineration is a good technological solution for certain waste streams in the Maldives at the regional level. Waste to energy plants would be a stretch. Waste to biogas is a very good option. Biogas is just starting up in the Maldives with small pilot projects. This is a technology that is as a feasible option for RES with a lot of benefits to the communities, such as a better waste management and generation of cooking gas. One reason for this may be the relative high labour intensity of this technology. There is further a lot of unused potential in measures for energy efficiency and transport.

Financial instrument/ type	Purpose of financing	Project value	Status of financing	Priority sector or intervention
Private investment sought	Wind Farm Project K. Thilafushi		Approved by NPC	RES - wind
Falcon Energy Private investment	75 MW Wind Farm, K. Gaafaru	200 million USD	Approved by NPC	RES - wind
JICA	Fresh water and solar power	78,988 USD	Approved by NPC	RES- solar
UN WHO	Greening the hospitals	16,000 USD	Under development	Energy Efficiency
India government Grant	Assistance for an energy consultant	USD 240,000	Approved by NPC	
UNEP (Ozone)	HCFC Phase-out	USD 37,000	Proposed	Energy Efficiency (Air-condition and Refrigeration)

Table 8:5 Proposed and upcoming projects for mitigation

Upcoming projects and investments for mitigation are developed much in the same ad-hoc way as the ones under implementation and in the same sectors.

Financial instrument/ type	Purpose of financing	Project value	Status of financing
ADB Loan	Regional Development Phase II: Environmental Infrastructure and Management	USD 3,903,000	On-going
World Bank Loan	Maldives Environmental Management Project, focusing on waste management	USD 8 million	Project is currently being implemented for more than an year
Islamic Development Bank	Waste water	89,950,000 USD	62% completed
Government of Maldives Public Sector investment Program 2010- 2012	Sewage network upgrading, K. Dhoonidhoo	194,553 USD	Under review by NPC
IFC	Privatization of Male waste water and waste management	1.7 million USD	On going, not submitted to NPC

Table 8:6 ongoing projects for environmental infrastructure, especially waste and waste water

These projects, though not directly related to climate change, will have indirect benefits to adaptation, aiding water security through protection of water lenses, and other adaptation measures through protection of the coral reefs.

Not listed in the project lists are the projects proposed by CCED of the MHE for the allocation of the Climate Change Trust Fund, as the status of these was not clear at the timing of writing the report. The proposed projects include:

- Component 1: Road Map for Carbon Neutral Maldives (USD 0.5 million)
- Component 2: Conservation of Wetland Habitats for Climate Mitigation and Adaptation (USD 2.8 million)

1.30 Review of the key financial instruments

1.30.1 Financial instruments pledged specifically to the Maldives

The list below is not complete; it is the compiled information that was revealed to us during stakeholder consultation:

Financial instrument	Purpose of financing program	Funds pledged	STATUS
USA, bilateral grant financing	Climate change	4.5 million USD	Pledged funds at the Donor Conference on 28th of March, 2010, not allocated to specific projects
EU Trust Fund, managed by the World Bank Grant	Climate change adaptation and mitigation	USD 8.8 million	Funds pledged, not allocated to specific projects The originally submitted projects are being reviewed and revised to include WB comments
Global Climate Change Alliance EU Grant	Climate change mitigation and adaptation, especially Safer/ Resilient Communities Program	3.8 million Euro	Project documentation is being prepared

Table 8:7 Financial pledges specific to the Maldives

1.30.2 Key Financial Instruments available to the Maldives

The following is a review of the main donor funds available out there. These funds are common pots of money for which the Maldives is eligible but by no means is it the single country to be able to tap these funds, all countries eligible may apply and may compete for these funds

Funds	Type of Fund (loan/grant) / Donor(s)	Purpose / objectives/ priorities	Allocated resources	Other information/ Link
Global Environmental Facility – Country support programme	Grant/ International	GEF projects in climate change help developing countries and economies in transition to contribute to the overall objective of the UNFCCC. This support to minimize climate change damage by reducing the risk, or the adverse effects, of climate change. Climate change mitigation: The GEF supports projects that reduce or avoid greenhouse gas emissions in the areas of renewable energy, energy efficiency, and sustainable transport. Climate change adaptation: The GEF supports interventions that increase resilience to the adverse impacts of climate change of vulnerable countries, sectors, and communities.		1. GEF Structure and Organization http://www.gefcountrysupport.org/report_detail.cfm?projectId=140 2. Instrument for the Establishment of the Restructured Global Environment Facility, 2004. http://thegef.org/GEF_Instrument3.pdf 3. GEF website, climate change page. http://thegef.org/interior_right.aspx?id=232 and http://www.gefcountrysupport.org/report_detail.cfm?projectId=166
Maldives Climate Change Trust Fund	Grants/ International	The Government of Maldives, the European Union (EU), and the World Bank Group signed a tripartite Memorandum of Understanding establishing a new Trust Fund designed to build resilience to climate change in the Maldives. The development objectives of the Trust Fund Program are to: 1. Strengthen knowledge and leadership in the Government of Maldives to deal with climate change issues both domestically and internationally; 2. Build adaptive capacity and climate resilience in key sectors through tangible pilot interventions; 3. Promote energy efficiency and increase energy access through renewable energy generation and distribution through low carbon options and public-private partnerships; and 4. Improve policy and institutional capacities in the public and private sectors to deal with adaptation and mitigation interventions that bring both developmental and climate change benefits.	US$8.8 million	http://doreview.blogspot.com/2010/04/european-commission-and-world-bank.html

Global Climate Change Alliance	Grant/ International	The Global Climate Change Alliance (GCCA) is an initiative of the European Union. Its overall objective is to build a new alliance on climate change between the European Union and the poor developing countries that are most affected and that have the least capacity to deal with climate change. The GCCA does not intend to set up a new fund or governance structure, but will work through the European Commission's established channels for political dialogue and cooperation at national and international level. The purpose of the GCCA is to deepen dialogue and step up cooperation with partners on Climate Change. The specific objectives are: 1. To provide a platform for dialogue and exchange that will help countries to integrate development strategies and climate change and provide a basis for a converged post-2012 climate change agreement. 2. Help countries participate in global climate change mitigation activities that contribute to poverty reduction. 3. Provide technical and financial support that targets five priority areas and related actions: (a) adaptation to climate change, (b) reducing emissions from deforestation, (c) enhancing the participation of poor countries in the CDM, (d) promoting disaster risk reduction, and (e) integrating climate change into poverty reduction efforts.	The European Commission earmarked € 50 million in additional funding from the Environment and Natural Resources Thematic Programme (ENTRP) for the GCCA over the period 2008 – 2010 (with an allocation of €10 in 2008, 20 in 2009 and 20 million in 2010). Under the 10th European Development Fund, intra-ACP (African, Caribbean and Pacific countries) funding of €40 million is allocated to the GCCA in priority for regional action, in addition to €180 million for Disaster Risk Reduction. Sweden pledged €5 million in 2008 and Czeck Republic pledged €1.2 million in 2009.	http://sites.google.com/a/climatefundsupdate.org/climate-funds-update/listing/global-climate-change-allianc
Adaptation Fund	Grant/Loan	The Adaptation Fund was established to finance adaptation projects and programmes in developing countries that are Parties to the Kyoto Protocol. The Fund is to be financed with a share of proceeds from clean development mechanism (CDM) project activities and receive funds from other sources. The share of proceeds amounts to 2% of certified emission reductions (CERs) issued for a CDM project activity. The overall goal of all adaptation projects and programmes financed under the Fund will be to support concrete adaptation activities that reduce the adverse effects of climate change facing communities, countries, and sectors.	As at 31 January 2010, the Funds Held in Trust amount to USD eq. 33.03 million	http://www.climatefundsupdate.org/listing/adaptation-fund
Cool Earth Partnership	Grants/ Government of Japan	Assistance will be provided to developing countries that are already making efforts to reduce greenhouse gas emissions to enable them to achieve economic growth in ways that will contribute to climate stability, on the basis of policy consultations between Japan and those countries. This assistance will take two main forms: 1. Assistance for adaptation to climate change and improved access to clean energy: up to US$ 2 billion (JPYen 250 billion). This will take the form of grant aid, technical assistance and aid through international organizations to address the needs in developing countries. A new scheme of grant aid, "Program Grant Aid for Environment and Climate Change", will be created as a component of this package. In addition, and in the context of improved access to clean energy, a feasibility study on rural electrification projects with geothermal energy and "co-benefit" projects	US$ 10 billion (JPYen 1,250 billion) over 5 years	http://www.mofa.go.jp/policy/economy/wef/2008/mechanism.html

		that address climate change will be conducted. 2. Assistance for mitigation of climate change: up to US$ 8 billion (JPYen 1 trillion). A "Climate Change Japanese ODA Loan" with preferential interest will be created to provide loans amounting to JPYen 500 billion for the purpose of implementing programs to address global warming in developing countries. Through capital contribution and guarantee by the Japan Bank for International Cooperation (JBIC Asia and Environment Facility), trade and investment insurance by Nippon Export Investment and Insurance, and government support (projects to be implemented through the New Energy and Industrial Technology Development Organization), together with private funds, up to JPYen 500 billion will be provided for projects to reduce GHGs emissions in developing countries. In this context, the Asian Clean Energy Fund (at the ADB) will be utilized to promote energy conservation in the Asian-Pacific region.		
Environmental Transformation Fund - International Window	Grant/ Government of the United Kingdom	The Environmental Transformation Fund – International window (ETF-IW) is initiatives that supports development and poverty reduction through environmental protection, and helps poor countries respond to climate change. The ETF-IW objectives, are: 1. Contribute to a successful global deal on climate change: i. By generating experience to inform, support and influence the development and implementation of an efficient, effective and equitable financing framework as part of a new global deal. ii. By raising ambition, capacity and confidence in developing countries. 2. Transform the way in which developing countries approach climate change, by piloting financial approaches which demonstrate how low carbon growth and climate resilience are compatible with countries' overall development paths. 3. Contribute to the international institutional reform agenda by putting climate resilient development and low carbon growth at the heart of the work of the multilateral development banks. 4. Support strategic coordination and coherence across the international financing system for climate change by providing a forum for discussions between donors and recipients about appropriate financing mechanisms and tools for low carbon and climate resilient development. 5. Leverage additional finance from other donors and the private sector for climate change. 6. Maximise co-benefits in poverty reduction and sustainable management of natural resources.	Pledged: £800 million was pledged in the 2007 UK Budget. Deposited: The deposits by DFID and DECC were £100m in 2008/09 and £200m in 2009/10.	http://www.climatefundsupdate.org/listing/environmental-transformation-fund

Global Energy Efficiency and Renewable Energy Fund	Grants/ Loans/ European Commission	1. Obtain benefits from accelerated deployment of energy efficiency and renewable energy technologies. 2. Achieve high leverage of public finance by offering preferential returns to private funds. 3. Achieve high degree of financial sustainability.	**Pledged:** European Commission, Germany and Norway have committed about €108 million over the period: 2007-2011. Of these: EC: €75 million (plus €5 million to the Technical Support Facility of GEEREF). Germany: €24 million. Norway: €9 million. **Deposited:** €22.5 million. **Targeted:** Mobilisation of risk capital from the private sector of at least €300 million up to €1 billion (Leverage factor: 12.5)	http://www.geeref.eu
International Climate Initiative	Grant/Loans - Government of Germany	The German ICI will provide financial support to international projects supporting climate change mitigation, adaptation and biodiversity projects with climate relevance. It aims to ensure that such investments will trigger private investments of a greater magnitude. It also aims to ensure that financed projects will strategically support the post-2012 climate change negotiations. For this purpose, it will support multilateral activities and funds focusing on adaptation and forest management. Topics: the development and implementation of national and local emissions reduction strategies, renewable energies and energy efficiency, emissions reduction in the transport sector, substitution of refrigerants that also contribute to global warming, testing innovative project mechanisms (CDM/JI), conservation, sustainable use and restoration of globally significant carbon sinks, habitats and climate-relevant biodiversity, synergies between climate change mitigation and biodiversity conservation, implementation of selected parts of national and regional programmes for adaptation to climate change, establishment of monitoring and accounting systems to review and evaluate mitigation activities.	**Pledged:** The ICI will mobilise resources from private companies (compliance buyers) under the framework of the European Union Emission Trading Scheme (EU ETS). In 2008, the German government auctioned 8.8% of its allowable emission permits to businesses. Approximately 30% of the revenue earned from this sale is intended to finance climate change-related projects. This is expected to amount to € 400 million/year for domestic and international use. € 120 million/year is earmarked for developing countries and countries in transition. Of this, half is intended for sustainable energy projects and the other half for adaptation to climate change impacts and biodiversity projects. **Deposited**: In 2008 and 2009 a total of 240 million euro (120 each year) was available for the International Climate Initiative for developing and newly industrialised countries, but not all of them have been disbursed. Funds are not retained between years. Any balance of the annual allocation that is not spent on projects goes back to the Federal Treasury.	International Climate Protection Initiative
Least Developed Countries Fund	Grants/ The Global Environment Facility (GEF)	The objective of the Least Developed Countries Fund (LDCF) is to address the special needs of the 48 Least Developed Countries (LDCs), which are especially vulnerable to the adverse impacts of climate change. This includes preparing and implementing National Adaptation Programmes of Action (NAPAs) to identify urgent and immediate needs of LDCs to adapt to climate change.	**Pledged:** As of 7th May, 2009, nineteen contributing participants have pledged contributions to the LDCF. The total amount pledged to date is US$ eq. 176.47 million[i]. **Deposited:** As of 7th May, 2009, seventeen out of nineteen contributing participants have paid. The total amount deposited to	http://www.climatefundsupdate.org/listing/least-developed-countries-fund

			date is USD eq. 135.45 million.	
Pilot Program for Climate Resilience	Grants/ The World Bank	Within the framework of the SCF, targeted programs with dedicated funding (known as 'SCF Programs') can be established to provide financing to pilot new development approaches or scaled-up activities aimed at a specific climate change challenge or sectoral response. Resources will be mobilized and pledged to specific SCF Programs to be financed within the SCF. A pilot program for climate resilience is proposed to provide incentives for scaled-up action and transformational change in integrating consideration of climate resilience in national development planning consistent with poverty reduction and sustainable development goals. This program is known as the **Pilot Program for Climate Resilience (PPCR).** The Pilot Program for Climate Resilience (PPCR) is designed to provide programmatic finance for national climate resilient national development plans. The PPCR aims to provide transformational and scaled-up support for both the development and implementation of such plans. Furthermore, its purpose is to provide lessons over the next few years that might be taken up by countries, the development community, and the future climate change regime, including the Adaptation Fund. This experience will be gained through scaled-up interventions covering the full range of sectors and sources of financing, and with sufficient resources to move quickly from planning to action. The PPCR will build upon National Adaptation Programs of Action (NAPAs), will be implemented in a manner consistent with the Paris Declaration of Aid Effectiveness, and will complement existing adaptation funds which continue to serve essential roles in tackling climate change. The PPCR objectives are laid out in the PPCR design document (PPCR/SC.1/CRP.1) and are summarized here: (a) Pilot and demonstrate approaches for integration of climate risk and resilience into development policies and planning; (b) Strengthen capacities at the national levels to integrate climate resilience into development planning; (c) Scale-up and leverage climate resilient investment, building on other ongoing initiatives; (d) Enable learning-by-doing and sharing of lessons at country, regional and global levels.	Total funds deposited ('funds held in Trust') for the PPCR amount to USD eq. **128.6 million**. The total funds available to support PPCR Sub-Committee's funding decisions amount to USD 112.2 million.	http://siteresources.worldbank.org/INTCC/Resources/Strategic_Climate_Fund_final.pdf
Special Climate Change Fund	Grants/ The Global Environment Facility (GEF)	The overall objective of the fund is to implement long-term adaptation measures that increase the resilience of national development sectors to the impacts of climate change. Projects must focus on long-term planned response strategies, policies, and measures, rather than short-term (reactive) activities. The SCCF should serve as a catalyst to leverage additional resources from bilateral and other multilateral sources.	**Pledged:** As of May 7, 2009, 13 contributing participants have pledged contributions to the SCCF. The total amount pledged to date is US$ eq. 121.07 million. **Deposited:** As of May 7, 2009, 11 out of 13 contributing participants have paid. The total	http://www.gefweb.org/interior.aspx?id=192&ekmensel=c57dfa7b_48_60_btnlink

			amount deposited to date is US$ eq. 100.53 million.	
Strategic Climate Fund	Grants/ Loans / The World Bank	The **Strategic Climate Fund (SCF)** is one of the two (along with the **Clean Technology Fund**) multi-donor Trust Funds within the Climate Investment Funds (CIF). The SCF is quite broad and flexible in its scope and will serve as an overarching fund for various programs to test innovative approaches to climate change. The SCF is an umbrella vehicle for the receipt of donor funds and disbursements to specific funds and programmes aimed at piloting new development approaches or scaling up activities aimed a specific climate change challenge or sectoral response. The objectives of the SCF are to: (a) promote international cooperation on climate change and support progress towards the future of the climate change regime; (b) provide experience and lessons in responding to the challenge of climate change through learning-by-doing; (c) promote and channel new and additional financing for addressing climate change through targeted programs to be established as part of the SCF or through separate funds like the CTF or other funds addressing climate change, such as the Forest Carbon Partnership Facility; (d) utilize the skills and capabilities of the MDBs to raise and deliver concessional climate financing at a significant scale to unleash the potential of the public and private sectors to achieve meaningful reductions of carbon emissions and greater climate resilience; (e) provide incentives for scaled-up action and transformational action (both mitigation and adaptation) and for solutions to the climate change challenge and poverty reduction in developing countries, consistent with poverty reduction and sustainable development strategies that are robust to climate change; (f) provide incentives to maintain, restore and enhance carbon-rich natural ecosystems to prevent these carbon sinks from becoming sources of increased emissions, and to enhance all the services they provide, including climate resilience or adaptive capacity, and thereby support sustainable development; (g) complement other multilateral financial mechanisms, such as the GEF and the Adaptation Fund, and bilateral sources of financing and seek co-financing where appropriate; and (h) maximize co-benefits of sustainable development, particularly in relation to the conservation of biodiversity, natural resources ecosystem services and ecological processes.	The cumulative funding decisions made by the SCF Trust Fund Committee amount to approximately **USD 20 million**, of which USD 7 million represents the Country Programming budget approved as part of the CIF Administrative Budget—USD 4 million for the PPCR, USD 2 million for the FIP and USD 1 million for the SREP. The SCF Trust Fund Committee approves allocation of SCF resources for administrative budget, while the SCF Sub-Committees approve SCF financing for programs and projects under the respective targeted programs.	http://siteresources.worldbank.org/INTCC/Resources/Strategic_Climate_Fund_final.pdf
Strategic Priority on Adaptation	Grants/ The Global Environment Facility (GEF)	The overall objective of the SPA is to support pilot and demonstration projects that show how adaptation planning and assessment could be practically translated into full-scale projects. The SPA aims to address local adaptation needs and generate global environmental benefits in the focal	**Deposited:** $ 50 million via the GEF Trust Fund	http://gefweb.org/uploadedFiles/AdaptationBooklet.pdf

		areas in which the GEF works: biodiversity, climate change, international waters, land degradation, and persistent organic pollutants. Projects should be integrated into national policy and sustainable development planning, on the basis either of information provided in National Communications, or of in-depth national studies, including NAPA.		
Carbon Market Initiative (CMI)	Grants/ Loans – Asian Development Bank	Carbon Fund set up in 2007 that aims to provide upfront cofinancing, technical support, and marketing support for clean energy projects eligible for CDM.	$150 million Asia Pacific	http://www.adb.org/clean-energy/cmi.asp
East Asia Climate Partnership	Grants/ Loans – KOIKA – Korea International Cooperation Agency	Through the "East Asia Climate Partnership", Korea has committed itself to a 200 million USD assistance package (2008-2012) for developing countries in East Asia and beyond. KOICA, which has 18 years of experience in development cooperation, is the implementation agency for this partnership and will be delivering all its expertise and enthusiasm to create another success story through a win-win synergy between climate action and development.	200 million USD assistance package (2008-2012)	http://www.koica.go.kr/english/aid/Climate/index.html
South Asia Enterprise Development Facility	IFC	The mission of IFC is to promote sustainable private sector investment in developing and transition countries, helping to reduce poverty and improve people's lives. IFC finances private sector investments in the developing world, mobilizes capital in the international financial markets, helps clients improve social and environmental sustainability, and provides technical assistance and advice to governments and businesses. IFC's South Asia Enterprise Development Facility (IFC-SEDF) is a multi-donor funded facility managed and operated by IFC. SEDF is one of the 11 regional programs being managed by IFC worldwide. Set up with the objective of promoting the growth of SMEs in the region, IFC-SEDF is funded by IFC and the Governments of Netherlands and Norway, European Commission, DFID (UK), CIDA (Canada) and ADB. IFC-SEDF provides increased access to finance and quality business development services to projects in Bangladesh, Nepal, Bhutan, North East India, Sri Lanka and Maldives. IFC-SEDF also supports value addition to firms through tailored enterprise and organisation-specific technical assistance, capacity building programs, training, research, etc., and helps create an enabling business environment.		www.ifc.org. and www.sedf.org.
UNESCAP	Grants/ Loans - United Nations Economic and Social Commission for Asia and the Pacific	The Committee on Environment and Development addresses the following issues ▪ Integration of environmental sustainability in development policy ▪ Policies and strategies for the use of sustainable planning and the use of water resources ▪ Regional cooperation for enhanced energy security and the sustainable use of energy resources		http://www.unescap.org/esd

Table 8:8 Review of the key financial instruments

9. Policy instruments

Policy instruments are diverse including legal requirements (command and control), technology transfer, and market based instruments, research, environmental liability provision, green procurement, voluntary schemes and agreements, public disclosure and others. This section will go through main adaptation and mitigation priorities and highlight policy instruments adequate to achieving these. The discussion relies on the documents reviewed and stakeholder consultations.

Maldives has a relatively young democratic government and environmental governance still has scope for development. For example there are strategies and action plans, such as the Energy Policy (presently under revision), the SAP sector strategies or policies for transport, housing, environment and waste management also exist. However framework legislation is missing in these sectors, there is no legal instrument governing energy generation, energy tariff setting, let alone RE and EE promotion. Similarly, on the environment front there are three governing laws among which the Environmental Protection and Preservation Act No. 4/93 is most important and is general framework law. Of the 6 environmental regulations two are important to mention, namely the Environment Impact Assessment (EIA) Regulation from 2007 and the Regulation on the Protection and Conservation of Environment in the Tourism Industry. These legislations give general guidance to protecting environment and biodiversity but do not go into setting threshold limits for emissions and discharges, the monitoring systems, implementation and policy cycles, for this further legislating is needed.

The Maldives is working on a reform to the taxation both to increase the tax base and work towards lowering the budget deficit but also to create incentives for certain behaviours. One example that is already implemented and is attracting private investors is the levy of the import tax on RE technology. At the same time, tax could be increased on diesel oil and other types of fossil fuel. Thus, there is a two-way pressure on the fiscal reform:

- On the one hand there is a need to provide tax levies and subsidies to increase the attractiveness of investment in providing affordable basic utility services, such as water, energy, sewage and waste management and
- On the other hand there is a need to increase the tax base on businesses, including profit tax and various green taxes to increase national budget revenue and ensure incentive for green corporate behaviour.

There are policy instruments that will no doubt help **adaptation** and some of these are already being considered:

- Improved building code to address issues of increased safety
- Requirement of conducting EIA for infrastructure projects including coastal protection and land reclamation, as this seems not to have been the common practice up to now (CBA)
- 2001 environmental requirements for resorts to be further amended for climate change adaptation requirements, including consideration for climate change liability of investments, beach protection, biodiversity protection, etc.
- Include climate change considerations into land use planning as a legal requirement
- Legislate and promote corporate social responsibility and make climate change adaptation one of these responsibilities. Most investments will have a shorter payback period than 20 – 50 years, the time-line in which the impacts of climate change will be felt, but building an adaptation fund or investing in adaptation measures is always possible. Such policies need

careful design in order not to drive investment away from the country by increasing operation costs.

Policy instruments to aid **mitigation**:

- Bill to implement renewable energy feed in tariffs and other RE promoting policies
- Mandatory electric appliance labelling for energy efficiency
- Setting up a national mechanism for carbon trading and linking it to international markets or applying a carbon tax, or a mix of these.
- 2001 environmental requirements for resorts to be further amended for climate change mitigation requirements, including incentives for RE, EE and perhaps a cap on emissions or emissions tax
- Instruments to be considered for the transport sector include
    - Fuel taxes
    - Port dues differentiation
    - Higher import duty on vehicles and emission taxes
    - Banning the import of reconditioned vehicles
    - Traffic management information technology – electronic congestion and toll collection system
    - Market based options for carbon credit point trading

10. Lessons learned

The NEED Study is a synthesis research of already available resources relevant policy, research, database, and making a structured account. In this sense availability of and access to data in certain areas is key to the successful conclusion of the study, these include and do not limit to:

- NAPA prioritizing and costing adaptation
- TNA for the main sectors such as Energy and Transport prioritizing and costing mitigation
- It is helpful if TNAs include details on feasibility of options and abatement cost curves which was not the case in the Maldives
- Tracking and database of past, ongoing and future projects related to climate change and their costs
- Centralized database on financial instruments (grants, soft loans, credits) the country has access to
- Budget lines referring to climate change projects, or a system for tagging projects funded from national budget for climate change adaptation and mitigation

Stakeholder consultation is a very important part of the research which may be done in interviews or workshops. During this phase of the assignment it is important to get insight about

- Long and short term priorities for both mitigation and adaptation
- How the institution/person perceives its own role in combating climate change or increasing resilience to climate change
- What would the person implement from the perspective of his/her own institution if a pot of money was available for climate change
- What went really well and what went really wrong in past interventions?
- What perceptions/ priorities/ policies are changing?
- Concrete questions about costs, financial instruments and policy instruments

One of the challenges of the study and therefore the relative weakness is in the mitigation sector. This is partly due to lack of data and partly to shifting energy and mitigation policy that is not yet formulated into concrete plans.

Another challenge but also the attractive part of the assignment was the need to have a thorough understanding of all development and climate change related policies, actions, costs, legislation and at the same time be able to synthesise and structure information. Using excel spreadsheets to organize information into the research areas of risk analyses, priority setting criteria, priority sectors and action, costing, financial instruments and policy instruments was a helpful tool in identifying trends, gaps and contradictions. This information is presented in a synthesised manner in the report.

The guidance from the Energy and Climate Department of the MHTE and from the UNFCCC was essential for figuring out the way to deal with the challenges and channelling the focus in the right direction. It was very helpful in the process that all stakeholders had a very high awareness and understanding of climate change mitigation and adaptation.

11. Annex 1: documents reviewed

Third National Environment Action Plan - Ministry of Housing, Transport and Environment;2009

National Energy Policy - Ministry of Housing, Transport and Environment Republic of Maldives;2010

First National Communication of Maldives to the UNFCCC - Ministry of Home Affairs, Housing and Environment. 2001

Energy Supply and Demand, Technical Report - **Fund for Danish Consultancy Services Assessment of Least-cost, Sustainable Energy Resources Maldives–** Submitted by Energy Consulting Network. April 2003;

Solar Resource Assessment for Sri Lanka and Maldives - Prepared by Dave Renné, Ray George, Bill Marion and Donna Heimiller - *National Renewable Energy Laboratory,* Chris Gueymard - *Solar Consulting Services.* August 2003;

Wind Energy Resource Atlas of Sri Lanka and the Maldives – prepared by D. Elliott, M. Schwartz, G. Scott, S. Haymes, D. Heimiller, R. George for the U.S. Agency for International Development. August 2003;

Biomass Survey, Technical Report - Fund for Danish Consultancy Services Assessment of Least-cost, Sustainable Energy Resources Maldives – Prepared by Energy Consulting Network. April 2004;

Landfill Gas, Landfill gas investigation - Assessment of Least-cost, Sustainable Energy Resources – Maldives – prepared by Energy Consulting Network for Ministry of Communication, Science and Technology, Maldives. December 2004;

Assessment of Least-cost, Sustainable Energy Resources Maldives, Final Report - Fund for Danish Consultancy Services - Prepared by Energy Consulting Network. 23 December 2004;

National Adaptation Programme of Action (NAPA) – Ministry of Environment, Energy and Water. 2006;

Climate Risk Profile for the Maldives - Report Prepared by John E. Hay, New Zealand. April 2006;

Seventh National Development Plan (2006 – 2010) – Ministry of Planning and National Development. 2007;

Maldives Climate Change In-Depth Technology Needs Assessment - Energy Sector – Prepared by Commerce Development and Environment for Ministry of Environment, Energy and Water. July 2007;

In depth technology needs assessment on transport sector – Ministry of Environment, Energy and Water. September 2007;

Maldives Energy Balances and Indicators 2003-2005 - prepared by Energy Consulting Network for Ministry of Environment, Energy and Water (MEEW). September 2007;

Detailed Island Risk Assessment in Maldives (vol 1, 2, 3) - Natural Hazard and Physical Vulnerability Assessment Report - Dr. Jianping Yan, Disaster Risk Management Specialist and Team Leader, Mr. Ahmed Shaig, Environmental Specialist, Mr. Mohamed Aslam, Natural Hazard Specialist. July 2008;

"Aneh Dhivehiraajje" – The Strategic Action Plan 2009 – 2013, National Framework for Development 2009 – 2013 - The Government of Maldives**.** 2009;

Maldives National Strategy for Sustainable Development – April 2009;

Strategic National Action Plan for disaster risk reduction and climate change adaptation (2010 – 2020) – interim draft prepared by Antonio L. Fernandez. 14 august 2009;

A review of the safer islands programme and cost benefit study of mitigation and adaptation measures in three islands in the Maldives – prepared by Courtenay Cabot Venton, Paul Venton and Ahmed Shaig for the United Nations Development Programme Maldives and Government of Maldives, Department of Housing, Transport and Environment. August 2009;

Detailed Island Risk Assessment in Maldives - Social and Economic Assessment Report - DIRAM team. August 2009.

Maldives Framework Zero Carbon Building Guidance, The Carbon Advisory Service Ltd, Imperial College London, December 2009

A plan for Carbon Neutrality, Mark Lynas and Chris Goodall

Modelling of Renewable Energy Systems in the Maldives, Julie Camerlynk, under supervision of dr. W.G.J.H.M. van Sark, Department of Science, Technology and Society, Utrecht University, The Netherlands

What do the Appendices to the Coppenhagen Accord tell us about global greenhouse gas emissions and the prospects for avoiding a rise in global average temperature of more than 2 degrees C?, Nicholas Stern, Crtistopher Taylor, Policy Paper, Center for Climate Change Economics and Policy Grantham Research Institute on Climate Change and the Environment, United Nations Environment Program, March 2010,

The allocation of adaptation funding, Rhona Barr, Samuel Fankhauser and Kirk Hamilton, Polciy Paper Center for Climate Change Economics and Policy Grantham Research Institute on Climate Change and the Environment, February 2010

Briefing Paper, Maldives Donor Conference 2010, National Department for Planning, Ministry of Finance and Treasury, Maldives

Special Report Emission Scenarios SRES, IPCC, 2000

Action Pledges: Making a difference on the ground, The Nairobi Work Programme on impacts, vulnerability and adaptation to climate change, UNFCCC, 2007

Feasibility Study: Small Scale Waste to Energy Incineration, IT Power India Pvt., prepared for the Environment Research Centre, Ministry of Environment, Energy and Water, December 2007

User Pay Framework for Island Waste Management, Waste, Live and Learn, Green Partners, prepared for the Ministry of Housing, Transport and Environment, MEMP project, May 2010

Revised IPCC Guidelines for Calculation of Greenhouse Gas Inventory, Volume on Energy; volume on Waste, worksheets for Energy, IPCC, 1996

12. Annex II: Stakeholder Consultations

Names are given in the order of the meetings in course of stakeholder consultation:

Name	Position	Organization
Amjad Abdulla	Director General	Climate Change Department, Ministry of Housing and Environment
Ali Shareef	Assistant Director	Climate Change Department, Ministry of Housing and Environment
Zammath Khaleel	Environment Analyst	Climate Change Department, Ministry of Housing and Environment
Ahmed Ali	Assistant Director	Energy Department, Ministry of Housing and Environment
Hussen Naeem	Senior Technical Officer	Resilient Island Project (funded by UNDP/ GEF), Ministry of Housing and Environment
Gordon Ewers	Technical Advisor	Maldives Environmental Management Project (funded by World Bank), Ministry of Housing and Environment
Ibrahim Mohamed Rasheed	Under-Secretary	President's Office
Aminath Shauna	Deputy Under-Secretary	President's Office
Ahmed Nasheed	Utilities Development Consultant	President's Office
Ali Hassan	Managing director	Northern Utilities Ltd
Ali Majid	Director of projects	Northern Utilities Ltd
Mohamed Didi	Manageing Director	South Central Utilities
Abdulla Shahid	Chief Coordinator and Minister of State	NDMC, Ministry of Housing and Environment
Hussain Zahir	Senior Reef Ecologist	Marine Research Centre, Ministry of Fisheries and Agriculture
Shahama Abdul Sattar	Fisheries Biologist	Marine Research Centre, Ministry of Fisheries and Agriculture
Shafiya Naeem	Senior Research Officer	Marine Research Centre, Ministry of Fisheries and Agriculture
Ali Rasheed	Managing Director	Waste Management Corporation Ltd
Abdul Azeez Yoossuf	Board Member	Waste Management Corporation Ltd
Mohamed Imad	Assistant Executive Director	Department of National Planning, Ministry of Finance and Treasury
Ismail Shafeeq	Permanent Secretary	Ministry of Finance and Treasury
Dr. Hussain Niyaaz	Additional Secretary	Department of External Resources, Ministry of Foreign Affairs
Dr. Jorges M Luna	WHO Representative to the Maldives	World Health Organization (WHO)
Yolando Velasco	Head of National Communications Unit	United Nations Framework Convention for Climate Change

13. Annex III: Fuel Import Data

TOTAL IMPORTS OF FUELS IN 2009, Statistics Section, Maldives Customs Data

NAME	UNIT	QUANTITY
Other Coal, Not Agglomerated, Nes	Kgs	120.00
Peat (Incl. Peat Litter)	Kgs	149,405.00
Tar Distilled From Coal, Lignite Or Peat, And Other Mineral Tars	Kgs	420,226.82
Marine Gas Oil (Diesel)	M/T	280,256.74
Aviation Gas	M/T	25,495.28
Kerosine Oil	M/T	935.91
Lamp Fuel	Ltr	150,095.04
Spirits (Petrolium)	Ltr	9.12
White Spirit	Ltr	10,099.30
Insect Repellent (Liquid Candle Oil)	Ltr	12,477.85
Lubricating Oil	Ltr	2,543,329.60
Petroleum Ether (For Industrial Use)	Ltr	46.64
Liquid Fluid (Petrileum Naptha)(Lighter Fuel)	Ltr	435.05
Insect Repellent	Kgs	1,763.63
Fuel Oil	Ltr	1,117.56
Waste Oil, Nes	M/T	0.21
Propane, Liquefied	M/T	11,537.76
Propylene , Liquified	Ltr	160.34
Petrol	M/T	28,322.65
Gas Cartridge For Stove	Nos	827.00
Hexane-1	Kgs	0.50
Petroleum Jelly	Kgs	23,299.51
Paraffin Wax, Containing <0.75% Oil	Kgs	256.81
Bitumen And Asphalt; Natural Asphaltites And Asphaltic Rocks	Kgs	1,750.00

14. Annex IV: Worksheet GHG from fuel combustion 2009

A	B	C	D	E	F	G [b]	H	I	J	K	L	M	N	O	P
Production	Imports 10^3 t	Exports	International Bunkers	Stock Change	Apparent Consumption	Conversion Factor (TJ/10^3 t)	Apparent Consumption (TJ)	Carbon Emission Factor (t C/TJ)	Carbon Content (t C)	Carbon Content (Gg C)	Carbon Stored (Gg C)	Net Carbon Emissions (Gg C)	Fraction of Carbon Oxidised	Actual Carbon Emissions (Gg C)	Actual CO_2 Emissions (Gg CO_2)
					F=(A+B -C-D-E)		H=(FxG)		J=(HxI)	K=(J/1000)		M=(K-L)		O=(MxN)	P=(Ox[44/12])
	0.00101				0.00	42.3	0.04	20	0.85	0.00		0.00	0.99	0.00	0.00
					0.00		0.00		0.00	0.00		0.00		0.00	0.00
	0.0103				0.01	44.2	0.46	17.2	7.83	0.01		0.01	0.995	0.01	0.03
	28.3227				28.32	44.8	1,268.86	18.9	23,981.40	23.98		23.98	0.99	23.74	87.05
	3.48544		22.94575		-19.46	44.59	-867.74	19.5	-16,920.84	-16.92		-16.92	0.995	-16.84	-61.73
	0.93591				0.94	44.75	41.88	19.6	820.89	0.82		0.82	0.99	0.81	2.98
					0.00		0.00		0.00	0.00		0.00		0.00	0.00
	280.257				280.26	43.33	12,143.54	20.2	245,299.42	245.30	0.00	245.30	0.99	242.85	890.44
	0.00021				0.00	40.19	0.01	21.1	0.18	0.00		0.00	0.99	0.00	0.00
					0.00		0.00		0.00	0.00	0.00	0.00		0.00	0.00
					0.00		0.00		0.00	0.00	0.00	0.00		0.00	0.00
					0.00		0.00		0.00	0.00	0.00	0.00		0.00	0.00
	0.00175				0.00	40.19	0.07	22	1.55	0.00	0.00	0.00	0.99	0.00	0.01
	2.4924				2.49	40.19	100.17	20	2,003.39	2.00	0.00	2.00	0.99	1.98	7.27
	0.02355				0.02	31	0.73	27.6	20.08	0.02		0.02	0.98	0.02	0.07
					0.00		0.00		0.00	0.00		0.00		0.00	0.00
	0.14849				0.15	40.19	5.97	20	119.36	0.12		0.12	0.99	0.12	0.43
							12,693.98		255,334.10	255.33	0.00	255.33		252.70	926.55
					0.00		0.00		0.00	0.00		0.00		0.00	0.00
					0.00		0.00		0.00	0.00	0.00	0.00		0.00	0.00
	0.420347				0.42	25.8	10.84	25.8	279.80	0.28		0.28	0.98	0.27	1.01
					0.00		0.00		0.00	0.00		0.00		0.00	0.00
					0.00		0.00		0.00	0.00		0.00		0.00	0.00
	0.001763				0.00	9.4	0.02	29.1	0.48	0.00		0.00	0.98	0.00	0.00
	0.149405				0.15	9.76	1.46	28.9	42.14	0.04		0.04	0.98	0.04	0.15
					0.00		0.00		0.00	0.00		0.00		0.00	0.00
					0.00		0.00		0.00	0.00		0.00		0.00	0.00
							12.32		322.42	0.32	0.00	0.32		0.32	1.16
					0.00		0.00		0.00	0.00	0.00	0.00		0.00	0.00
							12,706.30		**255,656.53**	**255.66**	**0.00**	**255.66**		**253.01**	**927.71**
							0.00		0.00	0.00	0.00	0.00		0.00	0.00
					0.00		0.00		0.00	0.00		0.00		0.00	0.00
					0.00		0.00		0.00	0.00		0.00		0.00	0.00
					0.00		0.00		0.00	0.00		0.00		0.00	0.00

(a) If anthracite is not separately available, include with Other Bituminous Coal.

(a) If anthracite is not separately available, include with Other Bituminous Coal.
(b) Please specify units.

(a) If anthracite is not separately available, include with Other Bituminous Coal.

15. Annex V: Worksheet GHG from land filling, 2009

Revised 1996 IPCC methodology							
Sources:							
Waste management data relying on Male audit, 2007; Waste to Energy study 2007							
and the Tourism Waste Survey 2009							
MSWT	MSWF	MCF*	DOC	DOCf	F	R	Gg Methane/year
Gg/year	assumed	default	calculated	default	default	observed	
113.88	0.40	0.80	0.15	0.77	0.50	0.00	**2.80**
*** deep unmanaged landfill assumed for Methane Correction Factor**							
DOC calculation for the Maldives							
waste stream	DOC % in weight	% by weight	total kg waste per capita*	kg waste per capita per stream	DOC fraction to disposal		
paper and textile	40	5	1.0234	0.0512	0.0205		
Garden	17	30	1.0234	0.3070	0.0522		
Food	15	30	1.0234	0.3070	0.0461		
wood and straw	30	10	1.0234	0.1023	0.0307		
		75			0.1494		
*** including waste generated by the tourism sector**							