Republic of Mauritius

TECHNOLOGY NEEDS ASSESSMENT

FOR AN ENHANCED CLIMATE CHANGE ADAPTATION AND MITIGATION

TNA REPORT I

July 2012

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TECHNOLOGY NEEDS ASSESSMENT FOR CLIMATE CHANGE ADAPTATION AND MITIGATION

(June 2012)

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Foreword

It is an established fact that the threat posed by climate change is real and unequivocal. The concentration of carbon dioxide reaching 400 parts per million in the atmosphere is a clear signal that climate change is heading on a dangerous pathway and there is the urgent need for global actions. The World Economic Forum's Global Risks 2013 Report rates the rising greenhouse gas (GHG) emissions as the third global risk and the failure of climate change adaptation as the fifth global risk. Stabilization of GHG concentrations in the atmosphere and adaptation to the impacts of climate change are therefore crucial and require a series of measures, out of which the transfer of or access to environmentally sound technologies is of utmost importance. In fact, promoting the transfer of such technologies to developing countries is in line with the Article 4.5 of United Nations Framework Convention on Climate Change (UNFCCC).

The Poznan Strategic Programme (PSP) on the transfer of technologies, adopted at the 14th Meeting of the Conference of Parties to the UNFCCC in Poland in 2008, is meant to facilitate funding to developing countries for assessing their needs for environmentally sound technologies. The Technology Needs Assessment (TNA) undertaken in Mauritius has thus benefited from the above programme. The priority sectors for Mauritius which have been assessed under the TNA are the Energy sector for mitigation and Agriculture, Water and Coastal Zone sectors for adaptation. I am therefore pleased to present the following five Reports:

(i) Technology Needs Assessment for an Enhanced Climate Change Adaptation and Reduction of Greenhouse Gas Emissions in Mauritius;
(ii) Barrier Analysis and Enabling Framework for Adaptation;
(iii) Barrier Analysis and Enabling Framework for Mitigation;
(iv) Technology Action Plan and Project Ideas for Adaptation; and
(v) Technology Action Plan and Project Ideas for Mitigation.

These Reports have been prepared in consultation with relevant stakeholders and I seize this opportunity to convey my heartfelt thanks for their collaboration and their contributions. I wish to highlight that the Reports recognise the vulnerability of Mauritius to the impacts of climate change. Furthermore, its recommendations reflect our national development priorities for promoting Sustainable Development in our Country.

The technologies recommended in the TNA for the priority sectors are meant to chart a pathway for enhancing climate change adaptation and mitigation for Mauritius. The recommended technologies for priority sectors are as follows:

(i) Agriculture: Integrated Pest Management and Micro-Irrigation;
(ii) Water: Rainwater Harvesting at Residential Level and Hydrological Modelling and Desalination Technology for effective water resources management;
(iii) Coastal Zone: Dune and Vegetation Restoration, Rock Revetment and Wetland Protection; and
(iv) Energy: Utility-scale Wind Energy and Industrial and Commercial Waste Heat Recovery Using Boiler Economizer.

I wish to convey my deepest gratitude to the UNEP RISOE Centre from Denmark, the UNEP's Division of Technology, Industry and Economics (Paris) and the Environment and Development Action (ENDA) based in Senegal for their technical support and also to the Global Environment Facility (GEF) for its financial support in the realization of this project.

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1. Prime Minister's Office (Mauritius Meteorological Services , Mauritius Oceanography Institute)
2. Ministry of Energy and Public Utilities (Central Electricity Board, Water Resources Unit, Wastewater Management Authority, Central Water Authority)
3. Ministry of Finance & Economic Development (Statistics Mauritius)
4. Ministry of Public Infrastructure, National Development Unit, Land Transport and Shipping (Land Transport Division, National Development Unit)
5. Ministry of Education and Human Resources
6. Ministry of Agro Industry and Food Security (Agricultural services, Agricultural Research Extension Unit, Food and Agricultural Research Council, Forestry Service, National Parks and Conservation Service, Irrigation Authority, Farmer's Service Corporation, Sugar Cane Planter's Association and Small Planters Welfare Fund)
7. Ministry of Environment and Sustainable Development
8. Ministry of Tertiary Education, Science, Research and Technology (Mauritius Research Council)
9. Ministry of Fisheries
10. Ministry of Local Government and Outer Islands (Outer Islands Development Corporation)
11. Ministry of Tourism and Leisure
12. Ministry of Industry, Commerce and Consumer Protection
13. Central Electricity Board
14. Enterprise Mauritius
15. University of Mauritius
16. Beach Authority
17. Mauritius Sugar Industry Research Institute
18. Mauritius Agricultural Marketing Cooperative Federation Ltd
19. Indian Ocean Commission
20. United Nations Development Programme Country Office
21. Omnicane Management and Consultancy Limited
22. Energy Consulting IPA London
23. ECO-Bio-Tech
24. Association of Hoteliers and Restaurants in Mauritius
25. Mauritius Chamber of Commerce and Industry
26. Mauritius Chamber of Agriculture
27. Mouvement Autosuffisance Alimentaire
28. NGO Platform – Climate Change
29. Pesticide Action Network of Mauritius

List of Acronyms

AAP	Africa Adaptation Programme
BPO	Business Process Outsourcing
CCD	Climate Change Division
CDM	Clean Development Mechanism
CEB	Central Electricity Board
EKC	Environmental Kuznets Curve
EOI	Expression of Interest
ESA	Environmentally Sensitive Area
ESPA	Energy Supply Purchase Agreement
EST	Environmentally Sound Technology
FAR	Fourth Assessment Report (of IPCC)
GDP	Gross Domestic Product
GHG	Greenhouse Gas
HDI	Human Development Index
ICT	Information and Communication Technologies
ICZM	Integrated Coastal Zone Management
IPCC	Intergovernmental Panel on Climate Change
IPM	Integrated Pest Management
IPP	Independent Power Producer
IW	Inception Workshop
LDC	Least Developed Country
MCA	Multi-Criteria Analysis
MDG	Millennium Development Goal
MEA	Multilateral Environmental Agreement
MEO	Mauritius Environment Outlook
MID	Maurice Ile Durable
MoESD	Ministry of Environment and Sustainable Development
MSP	Multi-Stakeholder Process
NAPA	National Adaptation Plan of Action
OM	Operating Margin
PV	Photovoltaics
ROM	Republic of Mauritius
SIDS	Small Island Developing State
SNC	Second National Communication
SSDG	Small-Scale Distributed Generation
SST	Sea Surface Temperature
TAP	Technology Action Plan
TFS	Technology Fact Sheet
TNA	Technology Needs Assessment
UNFCCC	United Nations Framework Convention on Climate Change

Executive Summary

Mauritius is a Small Island Developing State (SIDS), and although its total emission of greenhouse gases is insignificant in global terms, it is extremely vulnerable to the impacts of climate change. Consequently, the TNA project in Mauritius has focused predominantly on adaptation to climate change, wherein three out of the four sectors analysed in this report deal with adaptation technologies. The Energy Industries has been identified as the priority mitigation sector because it accounts for around 60% of all national GHG emissions.

Being an island state, the coastal zone is of strategic importance in terms of its tourism industry, and location of large segments of its population and public infrastructure. This makes adaptation to climate change on the coastal zone of prime importance. Fresh water is yet another key sector for the socio-economic development of Mauritius. With Mauritius going through an intense period of drought, the detrimental impacts of climate change and climate variability are already being felt on water supply. Adaptation in the water sector is, therefore, of very high importance.Since agriculture, especially the production of vegetables is highly dependent on rain and is already impacted negatively by climate change and climate variability, adaptation in the agriculture sector is also covered by the TNA project.

The choice of priority sectors in the TNA project is consistent with national development priorities, while taking into account the inherent vulnerabilities of climate change impacts on an island state. The sectoral consideration in the climate-development nexus of Mauritius is clearly revealed in its Second National Communication under the UNFCCC, as well as flagship projects like the Africa Adaptation Programme (AAP), Maurice Ile Durable (MID), and the Adaptation Fund (AF) project on coastal zones. While all these projects deal with climate change from a policy and strategic perspective, the TNA project brings complementarity in terms of nationally appropriate technology options.

In sum, this TNA report has assessed the technology needs for adaptation in the water, agriculture and coastal zone sectors, and mitigation technologies in the energy Industries. A multi-stakeholder process (MSP) has been adopted for the identification and prioritisation of technological options using a linear additive Multiple Criteria Analysis (MCA) framework. All relevant information for prioritising technologies was provided in Technology Fact Sheets. The criteria proposed by MCA4Climate were used in MCA, and indicators were defined by local stakeholders. The technologies that have been retained for developing the Technology Action Plan (TAP) are summarised below for each sector:

SECTOR	TECHNOLOGIES RETAINED FOR TAP
WATER	• Desalination • Rainwater harvesting • Hydrological model
AGRICULTURE	• Up-scaling of locally proven Integrated Pest Management technologies • Micro irrigation (gravity fed drip & mini and micro sprinkler irrigation) • Decentralised rapid pest and disease diagnosis service (plant clinic)
COASTAL ZONE	• Restoring coastal vegetation • Wetland protection • Dune restoration • Rock revetment
ENERGY INDUSTRIES	• Wind (utility scale) • PV (>1 MW) • EE Boilers (heat recovery)

1. Introduction

1.1 Objectives of the TNA project

The current TNA differs from the one carried out for Mauritius in 2004 by proposing an applied process to leverage funding for the implementation of prioritised technologies for climate change mitigation and adaptation. The main focus will be onTAPs which will pave the way forthe transfer of environmentally-sound technologies,andtheir diffusion and adoption.Once the TNA report has prioritised mitigation and adaptation sectors in the beneficiary country, and prioritised technology options in these sectors, an analysis of barriers to technology uptake will lead on the formulation of a framework and action plan for overcoming these barriers. The purpose and objectives of the TNA project are given below.

1.1.1 Purpose of TNA project

The purpose of the TNA project is to assist participant developing country Parties **identify and analyze priority technology needs,** which can form the basis for a portfolio of environmentally sound technology (EST) projects and programmes **to facilitate the transfer of, and access to,** the ESTs and know-how in the implementation of **Article 4.5 of the UNFCCC.**

1.1.2 Immediate objectives of TNA project

1. To **identify and prioritize** through country-driven participatory processes, **technologies** that can contribute to **mitigation and adaptation** goals of the participant countries, while meeting their national sustainable development goals and priorities (TNA);

2. To **identify the barriers** that hinder the acquisition, deployment, and diffusion of the prioritized technologies for mitigation and adaptation; and 3. To develop Technology Action Plans (TAP) that **specify activities and enabling frameworks to overcome the barriers** and facilitate the transfer, adoption, and diffusion of selected technologies in the participant countries

1.1.3 Ultimate objective of TNA project

The ultimate objective of the TNA project is to enable the beneficiary country to develop fully budgeted adaptation and/or mitigation technologies in priority sectors to support sustainable development.

1.2 Brief introduction about the national circumstances

The economic development has progressed significantly over the past decades, and the country has attained a GDP per capita around US$ 6,700 in 2009. From 1999 to 2009, GDP in real terms grew on average by 4.7% per annum. However, growth rate for 2009 was 3.1% lower than the 5.1% growth registered in 2008, largely due to the global economic crisis. The economy expanded by around 4.1% in 2010, with positive growth in all sectors. This is expected to go up slightly to 4.2% in 2011. The sectors that have contributed to the economic development of Mauritius constitute tourism, financial services, construction and manufacturing sectors.

Due to changes in international trade regime, the on-going economic reform programme in Mauritius aims at putting the economy on a higher growth trajectory by moving away from an economy based on trade preferences to that based on global competitiveness and a wider range of employment opportunities. This new orientation has seen the emergence of new economic sectors such as Information and Communication Technology (ICT), Business Process Outsourcing (BPO), seafood sector, real estate, energy industries as well as health and education hubs. The share of the services sector in the economy was around 69% in 2009, revealing the transition to a service-based economy.

The social development of Mauritius can be gauged through its status as an upper-middle-income country with a HDI of 0.85. The rapid socio-economic development of Mauritius has been accompanied by several environmental challenges, such as coastal erosion and loss of biodiversity, among others. A review of these challenges and their implications is provided in the Mauritius Environment Outlook (MEO) Report 2010.i

A bird's eye view of national circumstances (social, environmental and economic) can be obtained by looking at progress made in achieving the MDGs. Mauritius is doing well in areas of the MDGs like poverty alleviation, universal primary education, and on some aspects of gender equality. It has eradicated malaria, is combating HIV/AIDS and also the prevalent problems of non-communicable diseases such as diabetes, heart and lung diseases and mental illness. Access to safe drinking water and basic sanitation are largely in place, but the country still needs to progress on reversing trends on GHG emissions and loss of threatened animal and plant species. These trends have been analysedin MEO 2010 that discusses the achievements on MDG Goal 7: "Ensure Environmental Sustainability" in details.

1.3 National sustainable development strategies

Mauritius has ratified numerous MEAs that have been translated at the national level in changes and amendments in national legislations.1Some of the main outcomes of the various global conferences held that have had positive impacts on Mauritius as a SIDS are:Agenda 21, the Barbados Plan of Action, the Johannesburg Plan of Implementation, and the Mauritius Strategy. Further, MEO 2010 reflects a growing recognition of environmental issues as an integral part in the pursuit of sustainable development.2

There are several policies, strategies and action plans that support sustainable development to differing extents. The main ones are summarized at Annex 1. In order to mainstream sustainable development at all levels, Mauritius has embarked on the Maurice Ile Durable (MID) initiative. MID is emerging as the model for sustainable development for Mauritius, and it has highest political support. National consultations leading to a MID Green Paper and the deliberations of multi-stakeholder working groups on six issues of national priority – i.e. Education, Energy, Environment, Employment and Equity - have been completed.3A MID Policy and Strategy is expected to be finalized in the first quarter of 2012.

1.4 National climate change policies and actions

To date there are no overarching national climate change policies and actions regarding both adaptation and mitigation. This does not imply that government is not making efforts to bridge this gap. Since 1991,

1 Some of the main MEAs are: Ramsar Convention, The Nairobi Convention, The Montreal Protocol, The Convention on Biological Diversity; The UN Convention on the Law of the Sea (UNCLOS);The United Nations Framework Convention on Climate Change (UNFCCC).

2 In order to achieve its objective, the AAP has the following outputs: (i) Dynamic, long-term planning mechanisms to manage the inherent uncertainties of climate change introduced; (ii) Leadership capacities and institutional frameworks to manage climate change risks and opportunities in an integrated manner at the local and national levels strengthened; (iii) Climate-resilient policies and measures implemented in priority sectors implemented; (iv) Financing options to meet national adaptation costs expanded at the local, national, sub-regional and regional levels; and (v) Knowledge on adjusting national development processes to fully incorporate climate change risks and opportunities generated and shared across all levels.

3 Please see http://environment.gov.mu – accessed 10 January 2012.

Government has supported the integration of climate change mitigation and adaptation measures into core development processes. While a Climate Change Action Plan was developed in 1998, follow-up of the proposed action plan was fragmented and uncoordinated due to a lack of technical, human and institutional capacity. Furthermore budgetary, policy, development and implementation gaps also acted as barriers in implementation of the Climate Change Action Plan.ii Furthermore, the MEO 2010 quotes that "other ad hoc mitigation and adaptation projects have been implemented in areas such as: ecosystem restoration and addressing sea level rise. Nevertheless, the scope and magnitude of these projects are limited and isolated. As a result, their outcomes are far from being necessarily sustainable." Since Mauritius is not a LDC, it did not have any obligation to develop a NAPA. These comments need to be qualified since the AAP is currently putting in place a national framework to integrate and mainstream climate change adaptation into the institutional framework and into core development policy, strategies and plans of Mauritius.Similarly, the Energy Strategy 2011-2025 Action Plan (please see Annex 2) provides the future orientations of Mauritius concerning GHG emission reductions from a combination of energy efficiency measures and renewable energy technologies.

In order to demonstrate the country's willingness to mainstream climate change in policies and strategies, Government has institutionalised a Climate Change Division at Ministry of Environment and Sustainable Development since 1 March 2010. The division is responsible for implementing international climate change agreements (i.e. UNFCCC, Kyoto Protocol, Conference of Parties4 decisions, Bali Action Plan5, Copenhagen Accord6 and Cancun Agreements7), preparing, monitoring and implementing the national climate change adaptation plan and mitigation strategy, undertaking GHG inventories, developing economic instruments and exploring potential funding opportunities to facilitate climate practices.

1.5 TNA relevance to national development priorities

The previous sections have revealed the recognition for integrating climate change into national development policies, strategies and actions.Although there is the recognition that technology transfer is important to address climate change mitigation and adaptation, there is currently no methodology in place at the national level to address this issue. At best, technology transfer takes place within the context of a project that has a limited lifespan. Although the TNA is also a project of finite lifespan, its incremental contribution is to provide a methodology and tools for analysing and prioritizing technology options for climate change mitigation and adaptation, as well as providing capacity building to national and institutional stakeholders. In addition, the TNA project will leave a legacy (methodology, tools and human capacity) to address technology transfer options in sectors over and above those discussed below.

4 The Conference of Parties (COP) is a policy-making body that meets periodically to take stock of implementation of legally binding agreements and adopt decisions, resolutions or recommendations for the future implementation of these agreements.

5 The Bali Action Plan was adopted by the 13th Conference of Parties (COP 13) of the UNFCCC in 2007. The purpose of the Bali Action Plan was to enable full, effective and sustained implementation of the Framework Climate Change Convention. It also called for the articulation of a shared vision for long term cooperative action and included a goal for reducing GHG emissions. The Bali Action Plan also set a deadline for concluding climate negotiations during the 2009 COP 15 in Copenhagen.

6 The Copenhagen Accord is the outcome of the 15th Conference of Parties (COP 15) to the United Nations Climate Change Conference, which took place from 7 – 18 December 2009 in Copenhagen Denmark. The Accord is a three-page, non-binding expression of political intent. Some of the elements included in the Copenhagen Accord are: long term goals to limit the increase of global temperatures to below 2°C; support adaptation in developing countries by providing adequate and sustainable financial resources, technology and capacity building; emissions reductions amongst others.

7 The Cancun Agreements are the outcome of the 2010 United Nations Climate Change Conference (COP 16) held in Cancun, Mexico, from 29 November to 10 December 2010. The Cancun Agreements include a comprehensive package agreed by governments to help developing nations deal with climate change, including new institutions, funding channels and a technology transfer mechanism to help the developing world build its own sustainable, low-emissions future, adapt more effectively to climate change and preserve and protect its forests for the good of all nations. The Agreements also call for countries to list under the UNFCCC the emission reduction targets and actions which they announced in 2010.

2. Institutional arrangement for the TNA and the stakeholders involvement

This section discusses the organisational structure of the TNA project, and the MSP that has been put in place to devolve project ownership to key stakeholders.

2.1 Organisational structure of TNA project

The organisational structure of the TNA project for Mauritius is shown in Figure 1. It consists mainly of the National TNA Team and facilitators, with the flow of resources and outputs as indicated by the arrows defined in the legend. The structure of the project can be detailed as follows:

- TNA Coordinator: The TNA project is coordinated by the Director, Department of Environment, MoESD. The alternate TNA Coordinator is the Head, Climate Change Division, MoESD;

- TNA Secretariat: Secretariat facilities are provided by the staff of CCD, MoESD;

- Sectoral Work Groups: The technical work of technology identification, prioritisation and technology action plan development is carried out at the level of multi-stakeholder sectoralworking groups (see section 2.2 for more details). The sectoral working groups have a core constituency as discussed in section 2.2, but are able to co-opt additional members on a needs basis. Based on sector prioritisation (see section 3) the four working groups are Water, Agriculture, Coastal Zone and Energy Industries.
  Each sectoral working group is chaired by the national apex institution, which are WRU, MoA, ICZM Division (MoESD), and CEB, respectively;

- National Consultants: The bulk of the technical work is facilitated by a group of 3 consultants. One is the TNA Consultant who has the responsibility to ensure project completion as well as its quality standards. The TNA consultant also has the responsibility of Adaptation Expert for the Coastal Zone and Mitigation Expert for Energy Industries. The remaining two consultants are Adaptation Experts for the Water and Agriculture Sectors;

- National TNA Committee:The role of the National TNA Committee is to provide leadership to the project in association with the TNA coordinator. The Chairs of the sectoral working groups are by de facto members of this committee; and • National Steering Committee: The main role of the steering committee is to provide guidance in terms of the process leading towards the political and stakeholder acceptance of TNA outcomes.

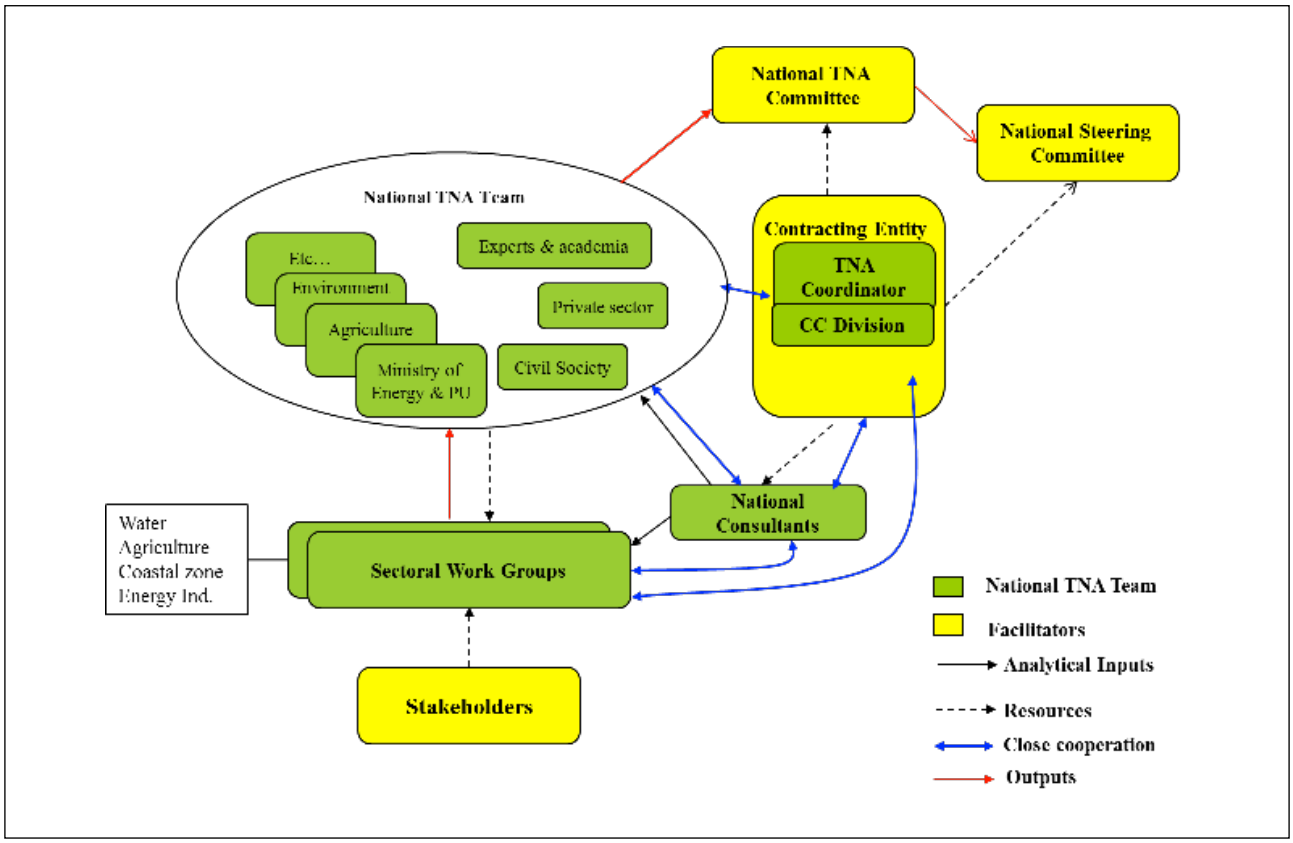

Figure 1. Organisational structure of the TNA project, Mauritius.

2.2 Stakeholder Engagement Process followed in TNA

One of the success factors for the TNA project, especially for the subsequent steps of leveraging financing for technology implementation in priority sectors is to ensure maximum local stakeholder ownership of the project. The best approach is recognized to be the bottom-up approach wherein all the key stakeholders, who know the local context and priority sectors better than anybody else, are given a central role in the project.

The TNA project has employed a MSP. With the bottom-up approach in mind, the TNA coordinator and staff of the Climate Change Division, MoESD, with input from the TNA Consultant, carried out a stakeholder mapping exercise prior to the IW. This process was facilitated following the acceptance of the priority mitigation and adaptation sectors by the National TNA Committee. Hence, the stakeholders were mapped using a sectoral approach. The list of stakeholders mapped is given at Annex 3. At this stage the stakeholder mapping exercise was only a proposal, and it was presented for review and validation at the IW.

Participants reviewed the proposed list of stakeholders, and validated the consolidated list of TNA stakeholders shown at Annex 3. For sake of clarity, the changes made to the proposed list are highlighted in **bold.**

3. Sector prioritization

The prioritization of adaptation sectors followed the inherent climate vulnerabilities of Mauritius as a SIDS. The unique vulnerabilities of island states have been highlighted in FAR of the IPCC.iii Its analysis showed that there was either very high confidence or high confidence of detrimental socio-economic impacts of climate change and extreme events on water resources; coastal systems and resources; agriculture, fisheries and food security; biodiversity; human settlements; infrastructure and transport. This is what motivated FAR to focus predominantly on adaptation to climate change in small island states.As is characteristic of many island states, the impacts of climate change on the coastal communities, infrastructure and ecosystems should be given due consideration in any attempt to address adaptation to climate change using a sectoral approach. Prioritization of the mitigation sectors followed primarily the criterion of relative contributions of sectoral GHG emissions to the national inventory.

It is pointed out that, although it would be highly desirable and relevant to carry out TNA for all socioeconomic and environment sectors, the restrained scope of the current TNA project both in terms of funding and time schedule allows the coverage of a maximum of four priority sectors. The methodology proposed here can be extended to other sectors in the future.

The following sections provide overviews of observed climate change and climate variability in Mauritius, and their impacts on the key priority sectors.

3.1 Trends and projections in climate change and climate variability in Mauritius

Climate research provides compelling evidence that increases in global temperatures are influencing the global hydrological cycle. Average temperature is projected to increase by varying amounts over all major landmasses and during all seasons. Higher temperature increase evaporation, glacial melt and thermal expansion of oceans. It also increases the holding capacity of water vapor in the atmosphere, leading to increased climate variability and a more intense hydrological cycle.iv

Some of the pertinent trends that have been observed for the island of Mauritius are:v

- Long-term time series of rainfall amount over the past century (1905 to 2008) **show a decreasing trend in annual rainfall over Mauritius.** The decreasing rainfall trend is about 8% when compared to the 1950s;

- **The duration of the intermediate dry months, the transition period between winter and summer, is becoming longer.** While in the 60s and 70s summer rains used to start by November, they now occur only in late December. Since the past four summer seasons, the rains started only in January of the following year. Furthermore, and as if to catch up with the delay, when it starts to rain it really pours with recurrent flash floods in February and March. This shift in the onset of summer rain is highly significant as it translates into increasing pressure on the water sector to increase storage capacity to cater for longer periods of dry spells and to meet equally increasing demands of the agricultural, tourism, industrial and domestic sectors;

- The temporal distribution of rain is no longer what it used to be. The number of rainy days has decreased but the frequency of heavy rainfall events has increased. This means that Mauritius has to increase our rain harvesting capacity; and

- **While in the old days (say prior to 2000), most of the summer rains resulted from cyclones, since the past ten years or so years summer rains have been harvested outside cyclones**. Records show that only five storms were observed in the south Indian Ocean and none came to within 100 km of Mauritius. Yet, only five heavy rainfall events, unrelated to storms, replenished the country's reservoirs.

- **Average temperature** on the island of Mauritius **between 1998 and 2008 was higher than that of the decade 1951-60 by between 0.74 and 1.1°C;**

- An **increase in the annual number of hot days and warm nights,** as well as an increase in the minimum temperatures (i.e. winters are getting milder);

- The mean sea level rise during the past decade (1998-2007) was 2.1 mm/yr (measured at Port Louis) An increase in 5 cm in the relative sea level may translate into an increase of one meter during cyclones or tidal surges; and

- **Explosive intensification rate of tropical cyclone.** With the current global warming trend, it is likely that tropical cyclone will continue to intensify at above climatological rate.

The Second National Communication 2010 has also reported on down-scaled climate modeling using MAGICCSCENGEN 5.3 that gives results with a spatial resolution of 2.5degrees x 2.5degrees.vi Using the 1980 to 1999 observed data, the baseline temperature and rainfall were derived. The 1990 to 2008 data were then used to identify a set of nine General Circulation Models (GCM) that best reflects the locally-observed trends, and changes in rainfall and mean temperature were simulated to 2100.vii The results across 9 GCM and 4 emission scenarios are summarized in Table 1.

The projection indicates that the utilizable water resources will decrease by up to 13% by 2050. Despite the fact that the difference in projected values under the two scenarios used in the analyses was only less than 1% for 2020, around 1% for 2030 and 4% for 2050, the changes in pattern of rainfall with more episodes of heavy rainfall and more extreme weather events are expected to allow only a reduced amount of precipitation to go into the storage system. There is an immediate need to increase storage capacity to be able to meet demands in the short term.

Table 1. Range of the projected changes in temperature, rainfall and seal level rise (Source: Second National Communication, 2010).

Time horizon	Temperature (oC)			Rainfall (%)	SLR (cm)
	Mean	Minimum	Maximum		
2020	0.43 – 0.47	0.58 – 0.64	0.37 – 0.41	(5.41 – 6.02)	5.3 – 5.5
2030	0.59 – 0.73	0.81– 0.99	0.51 – 0.63	(6.90 – 8.20)	7.8 – 8.2
2050	0.94 – 1.40	1.28 – 1.91	0.82 – 1.21	(9.19 – 13.96)	13.8 – 16.2
2080	1.48 – 2.64	2.02 – 3.60	1.29 – 2.29	(14.75 – 22.22)	24.5 – 34.6
2100	1.86 – 3.28	2.54 – 4.48	1.61 – 2.85	(17.57 – 26.76)	32.7 – 48.6

Note: Values given in brackets represent negative changes – i.e. decreases relative to the baseline.

3.2 An overview of sectors

Conducting an exhaustive overview of all socio-economic sectors is plainly beyond the scope of this report. The approach carried out here is therefore guided by national sectoral priorities based on vulnerability to climate change and climate variability, and trends in GHG emissions. The overview presented here has been facilitated by exhaustive assessments found in the MEO 2010 and the SNC 2010.viii Broadly speaking, the sectors or areas that are vulnerable to the impacts of climate change have been found in the SNC to be: water, agriculture, fisheries, coastal zones, tourism, infrastructure, health and biodiversity. Since above 95% of tourism infrastructure is found on the coastal zones of Mauritius, they can be grouped together. To date no adequate assessments have been made concerning the linkages between climate change and health hazards in Mauritius, making any such discussions tenuous.The same observation stands concerning linkages between climate change and biodiversity.The overview of coastal zones will also cover coastal ecosystems, tourism, infrastructure and human settlements. The overview of the mitigation sectors is made possible by the availability of quantifiable GHG emissions data by sectoral scope, as well as from the perspective of final energy use.Please note that the sectoral overviews cover the impacts of both climate- and non-climate driver (where applicable).

3.2.1 Water sector

Water is essential for healthy living and is vital for economic development. Water is the primary medium through which climate change will influence the Earth's ecosystem and, thus, human livelihoods and wellbeing. According to the Intergovernmental Panel on Climate Change (IPCC), many experts have concluded that the availability and quality of water will be the main pressure on, and issues for, societies and the environment under climate change.ix

3.2.1.1 Water balance

In Mauritius, the main sources of water supply are reservoir, river and underground water. The island receives an average annual rainfall of about 3,700 Mm3 (million cubic meters). However, owing to its topography, hydro-geological conditions and tropical location, Mauritius experiences high levels of rapid run off. 8 Only 10 % of the precipitation goes as ground water recharge, while evapo-transpiration and surface runoff represent 30% and 60% respectively. Table 2 summarizes the water balance for the island of Mauritius for selected years between 1999 and 2010 that demonstrates the variability in water availability. A severe drought afflicted the island of Mauritius in 1999, whereas 2009 experienced above average precipitation. The years 2006 and 2010 can be taken as the baseline since they give the typical water balance in the absence of variability. The figures in brackets correspond to the (unchanging) percentages relative to total average rainfall. Part of the surface runoff is conveyed to the impounding reservoirs, abstracted from rivers for domestic, agricultural and industrial uses and the remaining flows to the sea. Mauritius has a network of 25 major river basins and 21 minor river basins. There are 5 main aquifers, 11 reservoirs and 350 boreholes.x

Table 2. Water balance (Mm3) for the island of Mauritius, 1999-2010 (Source: Digest of Energy and Water Statistics – 2003 and 2010, Central Statistics Office, Port Louis).

Year	1999	2006	2009	2010
Rainfall (average)	2,184 (100%)	3,571 (100%)	4,470 (100%)	3,368 (100%)
Surface runoff	1,311 (60%)	2,143 (60%)	2,682 (60%)	2,021 (60%)
Evapo-transpiration	655 (30%)	1,071 (30%)	1,341 (30%)	1,010 (30%)
Net ground water recharge	218 (10%)	357 (10%)	447 (10%)	337 (10%)

In 2010, the total water demand was estimated at 975 Mm3. The agricultural sector accounted for most of the water utilized with 454 Mm3 despite the fact that this sector accounts for around only 4% of the country's GDP.xi Water utilization was followed by hydro-electric power generation (295 Mm3), domestic, industrial and tourism uses (212 Mm3), and industrial applications from private boreholes (14 Mm3). Figure 2 shows the percentage breakdown of total water utilization by application.

8 Runoff is defined as that part of precipitation that flows towards the stream on the ground surface or within the soil (International Glossary of Hydrology, World Meteorological Organisation no. 385).

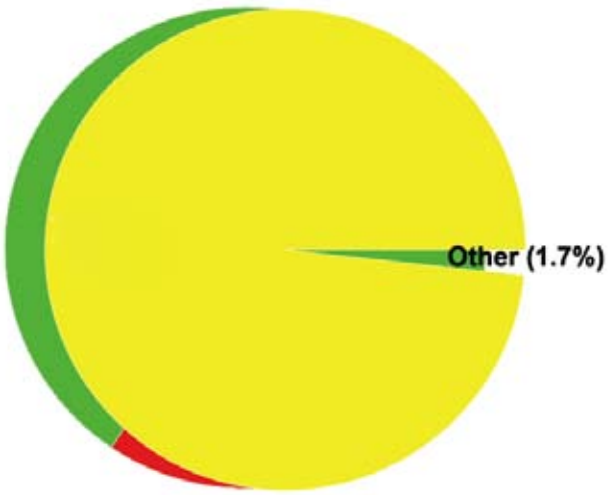

Figure 2. Final water use in 2010 (Source: Energy and Water Statistics – 2010, Central Statistics Office, Port -Louis).

The extraction by source of sectoral water demand in 2010 is summarized in Table 3. Around 56% of freshwater used came from surface water (rivers and streams), 29.8% from reservoirs and the remaining 14.3% came from groundwater aquifers.

Table 3. Extraction by source of sectoral water demand in 2010 (Mm3) (Source: Table 17, Environment Statistics – 2010, Central Statistics Office, Port Louis).

	Surface Water				
	Rivers	**Reservoirs**	**Aquifers**	**Total Mm3**	**%**
Agricultural irrigation	356	80	18	454	47%
Hydropower[9]	148	147	-	295	30%
Domestic, Industrial & Tourism	36	64	112	212	22%
Industrial (Private boreholes)	5	0	9	14	1%
Total Mm^3	545	291	139	975	
Percentage (%)	55.9%	29.8%	14.3%	100%	

3.2.1.2 Trends and projections – nonclimate drivers

Time-series data reveals that water demand has not changed significantly in the Domestic, Industrial & Tourism, and Industrial (private boreholes) sectors over the past decade. Water used for irrigation in agriculture has decreased steadily from over 500 Mm3 in 2002, reflecting mainly the steady reduction in the area under sugarcane cultivation. A cyclical pattern with troughs (2001 & 2006; 210-240Mm3) and peaks (2004 & 2009; 350-370 Mm3) is observed for water used in hydro-power generation.xii

Fresh water availability for human use is affected by both climate and non-climate drivers. The main nonclimate drivers in the water sector arise due to increasing demand from economic development, agriculture, 9It must be noted that part of the water used for hydropower generation is also used for irrigation. industry, tourism and a growing urban population. These in turn result in heavy water extraction and also pollution of water resources. During the first decade of the 21st century, per capita water consumption has increased by 7.1%, and it is expected to increase further into the future with the more affluent lifestyle of the local population. Analysis carried out in the Mauritius Environment Outlook shows that total water demand is projected at 1,200 Mm3 per year by 2040 based solely on changes in population dynamics. This demand, which does not take into account water demand in other growing sectors of the economy like tourism and Integrated Resort Schemes, is in excess of projected supplies and close to the present utilisable renewable potential of 1,233 Mm3 per year.xiii Using this present usable freshwater potential, it is noted that water availability in 2010 was equivalent to 965 m3/person, which is below the threshold for classification as a 'water-scarce' country.10

Groundwater-quality monitoring at 23 Interface Control Piezometers and in boreholes in use for industrial, agricultural and domestic purposes have shown deterioration in groundwater quality in coastal aquifers. xivSources of freshwater pollution include industrial effluents, dumping of liquid and solid waste in rivers and streams, run off from agricultural fields and untreated sewage.xv

3.2.1.3 Climate change and variability impacts in the water sector

Although temperature is projected to continue to increase globally, the effects of this increase on precipitation will vary from one area to another. The effect on precipitation may also vary seasonally; in some areas, precipitation is expected to increase in one season and decrease in another. Although the field of climate modeling has progressed rapidly in recent years, quantitative projections of changes in precipitation, river flows and water levels remain highly uncertain.

Nevertheless, the observed decrease in rainfall, increase in rainfall variability, increase in the occurrence of high-intensity rainfall and the shift in the onset of the summer rains have impacted negatively on the water resources. The Central Plateau with the largest catchments in the common recharge zones has seen a significant decrease in rainfall. This is reflected in changes in ground water and river-flow regimes.These changes will only exacerbate the water scarcity on the island of Mauritius.

3.2.2 Agriculture sector

This section provides an overview of the vulnerability of the Mauritian's agriculture to climate change. Although the sugarcane sector is covered, it is not the main focus of the analysis. Mauritian agriculture occupies around 38 % of the island's land resources in 2010 (around 70,800 hectares), with sugar cane accounting for 85 % (63,780 ha) of agricultural land and involved some 23,051 planters.xviThe Digest of Agricultural Statistics 2010 (i.e. reference xvi) provides the following information: Food crops, tea, tobacco, palm, fruit and ornamentals are produced on the remaining cultivated land area. About 7,570 ha are occupied annually by some 6 000 food crop growers producing annually around some 110,000 tonnes of fresh vegetables and fruits namely pineapple and banana mainly for the domestic market. Food crop production is undertaken on permanent gardens and on rotational and sugar cane interlines and the production system dominated by small scale farming with an average holding of 0.25 ha and a few large farms is mostly rainfed.

Some 30 % (21,543 ha) of the agricultural land is under irrigation, out of which some 18,755 ha (87%) is occupied by large sugar planters including corporate estates. Adverse climatic conditions and water stress over the past 10 years have severely constrained agricultural development with a regression in agricultural activities. The decrease in precipitation coupled with increasing water demand from other sectors, ensuring freshwater supply to the agriculture is a challenge and a threat to our food security. 10Water stress occurs when the demand for water exceeds the available amount during a certain period or when poor water quality restricts its use. Hydrologists typically assess scarcity by looking at the population-water equation. An area is experiencing water stress when annual water supplies drop below 1,700 m3 per person. When annual water supplies drop below 1,000 m3 per person, the population faces water scarcity, and below 500 m3 "absolute scarcity".

The agricultural sector employed about 8.1 % of the labour force in 2010 and contributed 3.6 % to the GDP, of which sugar cane, tea and tobacco accounts to 33 % followed by food crops (28 %) and livestock and poultry (22 %). The country is self-sufficient in poultry and egg but produces only 6 % of the national meat goat, mutton, venison, pork, beef)and 2% of its milk requirement. Despite the importance of agriculture in the Mauritian scene, and the large area of lands under agriculture, Mauritius is a net food importer. Major imported food items include the staples (rice and wheat), pulses, oils and fats, meat and milk products. Agriculture provides around 26% food self-sufficiency. About 25% of the total land area of the Republic of Mauritius11 is under forest cover which is mostly devoted to silviculture along with deer ranching practiced on an extensive basis, over some 10,000 ha while other livestock, a population of some 20,000 animals are reared mainly in closed system. Special efforts have been made to promote conservation and protection with the creation of National Parks and Nature Reserves.

3.2.2.1 Expected climate change impacts

The vulnerability of this sector has been observed and climate change is expected to exacerbate the situation. xvii This is expected to be particularly detrimental for small-scale farming that relies almost exclusively on rain-fed agriculture. The agriculture sector has a strong link with the water sector since the bulk of water extraction is used for irrigation. Consequently, large-scale irrigation projects are also severely affected during periods of water shortages as the supply of irrigation water is halted to favour potable water supply. In 2010, 47% of the total of fresh water on the island of Mauritius was used for irrigation in agriculture.xviiiThe various dimensions of climate-change-related impacts on agriculture are summarized in Table 4.

Table 4. The multiple effects climate change is likely to have on ROM's agriculture sector.

Climate change impacts	Consequences for the agriculture sector
Temperature rise	- Change in soil moisture status; - Shift in agricultural zones from lower to higher altitudes; - Change in cropping pattern and crop cycle; - Heat stress, which will lead to: • Lower crop productivity12 • Reduced feed intake by livestock • Lower livestock productivity • Increased mortality in poultry - Increased incidence of agricultural pests and crop diseases; - Lower pasture productivity and lower carrying capacity of grazing land.
Increasingly variable rainfall	- Increased risk of flooding and crop damage in certain agricultural zones;
Climate extremes (e.g. drought, tropical cyclones, flash flooding)	- Severe soil erosion on sloping land, loss of fertile top soil; - Severe drought affecting crop establishment; - Loss of crop production and livestock production. - Change in frequency and intensity of drought leading to: severe drought affects crop establishment; reduced crop/livestock production; shortage of fodder/low quality feed for livestock - Flooding of food crop production areas. - Increased soil erosion on slopping cultivated land. - Increased leaching of plant nutrients and fertilizer from agricultural land to groundwater. - Damage to crops; farming infrastructure; loss of animals.
SLR	- Salinization of irrigation water in coastal zones; - Coastal flooding; - Loss of agricultural land around the coast.

The following sections provide more detailed impacts on three agriculture sub-sectors.

3.2.2.2 Sugarcane

The sugarcane sector is covered here for the sake of completeness, and also to demonstrate the wider impacts of climate change on agriculture. Sugarcane productivity and sugar extraction rate are reduced by extreme weather events like cyclones and drought. The magnitude of the impact varies according to the timing, severity and duration of the extreme event and may have carry-over effects on the productivity of subsequent years. Assessment made using the Agricultural Productions Systems Simulator (APSIM) biophysical model for a range of climate change scenarios has shown that for a decrease in rainfall of 10% to 20% and an increase in temperature of 2°C, reductions in cane yield is expected to range from 34% and 48% while reductions in sugar yield is expected to range from 47% to 65%. Under the projected increase in temperature and the narrowing of the temperature amplitude between day and night temperatures, it is expected that vegetative growth will be favoured at the expense of sugar accumulation.xix

3.2.2.3 Nonsugarcane

Vegetables and other crops will suffer similarly. With increased temperatures and lower temperature amplitude the vulnerability is expected to worsen. As an example, such a change in temperatures will result in a change in phenology and a decrease in flowering intensity. Expected decrease in rainfall will exacerbate the stress intensity while temperature increase will result in higher demand from evapo-transpiration. Increase in temperature will also have adverse impacts on yield and productivity.

A rising temperature will fasten the reproductive cycle of insect pests and vectors, increase disease transmission rate and lead to expansion of the geographical ranges of agricultural pests and diseases as well as increase the duration that they are prevalent. Intense rainfall events may cause inundation of cultivated areas and the complete loss in vegetable production.

Climate is thus expected to directly impact on profitability and may lead to abandonment of cultivable areas. Such cases would lead to soil erosion and leaching of nutrients.

A recent study has investigated the impacts of climate change on the regional yield of tomatoes on the island of Mauritius using a Ricardian Model.xx The econometric results have shown that increased temperatures and a decrease in precipitation would negatively affect tomato yields over the whole island, where monthly tomato yields in the Eastern region would decrease by 8.2% in the short-run and 13.3% in the long-run with a 1°C temperature increase and 10% precipitation decrease for instance. The results of the sensitivity analysis of the study are summarized in Table 5. It would be desirable to extend this study to production of other food crops in the future.

Table 5. Sensitivity analysis of the impacts of climate change on monthly tomato yields per hectare in the North, East, West and South (Source: Jonsson 2011, pg.53 [xx]).

	Climate change scenarios		Impacts on average monthly yields			
Time period	**T**	**Rain**	**North**	**East**	**West**	**South**
Short run (<5 years)	+1°C	-	-6.0%	-8.0%	-0.8%	-
	+3°C	-	-18.0%	-24.0%	-2.4%	-
	+2°C	-5%	-11.8%	-16.1%	-1.7%	-0.02%
	+2°C	-10%	-11.5%	-16.2%	-1.8%	-0.04%
	+2°C	-20%	-11.1%	-16.4%	-2.0%	-0.08%
	-2°C	+10%?	11.5%	16.2%	1.8%	0.04%
Long run (>10 years	+1°C	-	-13.0%	-13.0%	1.0%	-
	+3°C	-	-39.0%	-39.0%	3.0%	-
	+2°C	-5%	-26.0%	-26.2%	1.8% -	0.05%
	+2°C	-10%	-25.9%	-26.3%	1.6% -	0.1%
	+2°C	-20%	-25.8%	-26.6%	1.2%	-0.2%
	-2°C	+10%?	25.9%	26.3%	-1.6%	0.1%

3.2.2.4 Fisheries

The fishing industry is a primary example for an industry subject to nature's variability, including climate change. Climate change affects fisheries along two main axes, changes in productivity in a given location and changes in fish migrations or the location of their habitats. From an economic point of view, the changes will have impacts on fisheries and coastal communities in different ways. These expected changes require adaptable and flexible fisheries and aquaculture management policies and governance frameworks. However, the forms of future climate change and the extent of its impact remain uncertain. Fisheries policy makers therefore need to develop strategies and decision-making models in order to adapt to climate change under such uncertainty while taking into account social and economic consequences.

In the fisheries sector, significant losses have been noted as a result of fish mortalities around Mauritius due to abnormal SST over the last decade. Any further rise will highly jeopardize the livelihood of many and endanger food security.xxi With anticipated warming, the following effects are expected:xxii

• Migratory shifts in tuna aggregations thereby disrupting fish based industries and may result in conflict over the stock both at an international and national level;

• Changes in fish stock distribution and fluctuations in abundance of conventionally fished and "new" species may disrupt existing allocation arrangements;
• Spatial management schemes such as closed areas to protect spawning or migration areas, or those based on EEZ boundaries may become inappropriate;
• The calcification rate of corals could decrease by about 14% to 30% by 2050 based on the projected rise in Carbon dioxide levels. Thus corals will be threatened due on one hand, to bleaching and on the other, to their restricted growth as a result of ocean acidification. It is estimated that live corals will be reduced by 80% to 100% in the event of 3.28oC rise in temperature by the year 2100; and

Due to the rise in SST, coral bleaching events have been observed since 1998 in Mauritius. This phenomenon is occurring more frequently such as in 2003, 2005 and 2009 with drastic effects on the coral community.13

3.2.3 Coastal Zones

The island of Mauritius has approximately 320 km of coastline that is almost completely surrounded by fringing coral reefs. The coastal zone plays a vital role in protecting settlements, infrastructure, agriculture and important ecological systems from climate-related hazards. For instance, coral reefs protect against persistent wave action and frequent cyclones, and endow the island with sandy beaches and 'turquoise blue' lagoons that are coveted by tourists. Coastal zone impacts, including coastal erosion and flooding, will undermine coastal development, which will hinder the foundation of a proposed increase in tourism, a government intended pillar of the economy. The coastal zone of Mauritius is important not only for providing income through tourism and fisheries but also protecting the island from the natural forces of the ocean. The viability of the major economic activity and protective functions are wholly dependent on the vitality, aesthetics and ecological functioning of the coastal ecosystems.

The coastal land, estuaries and inshore waters that make up the island of Mauritius and its associated islets are rich in natural resources and wildlife.14 They support a large proportion of the population and varied economic activity including recreation, tourism, fisheries, trade and industry. Approximately 20% of the population are resident in the coastal areas.xxiii

Further the socio-economic contribution of the coastal activities cannot be overruled. The Financial Strategies Report of the ICZM Project estimates the revenue directly generated from the coastal zone as just under Rs 74 billion, equivalent to 36% of GDP – out of which 99% is generated by tourism.xxiv The coastal zone is also the focus of many leisure activities by Mauritians and it also provides the prime residential lands. The total economic value of the coast, in present value terms, is of the order of Rs 1 trillion.

The coastal zone is affected by a host of climate and non-climate changes, and although the two types of drivers take place simultaneously, their relative influences depend on the time horizon for their respective actions. The next two sub-sections address the non-climate and climate drivers affecting the coastal zones of the island of Mauritius separately.

3.2.3.1 Impacts of non-climate drivers on coastal zones and ecosystems

Several human-assisted, non-climate changes have affected or continue to affect coastal zones and its ecosystems. Some of the main detrimental impacts of human activities are:xxv

- Inappropriate use and unplanned construction and urbanisation around the Northern and Eastern tourist zones have sustained ongoing degradation of the fringing coral reefs and the marine communities within the lagoons;
- Land-clearing, reclamation and construction activities have caused an increase in sedimentation within the lagoons;
- Coastal construction, marine pollution and over-harvesting threaten the lagoon coastal habitats;
- Inappropriate shoreline construction, such as impervious jetties and groynes, designed to protect property has increased frontal beach erosion;

13 Communication received from the Ministry of Fisheries – 13 June 2012.
14 The richness in natural resources and wildlife is also characteristic to the islands of Rodrigues and Agalega.

- The widening of natural passes in the lagoons or the blasting of new passes on the fringing reef to provide easy access to the outer reef for dive boats and pleasure craft has dramatically changed the wave energy in specific locations, initiating long-term changes in the beach dynamics;15

- Previously sand was extracted from the lagoons for construction work and water purification purposes. This has altered the water circulation and sand replenishment patterns resulting in the erosion of nearby beaches. Sand mining the lagoon is proscribed on the island of Mauritius since October 2001, but still practiced in Rodrigues. Regular monitoring of ex-sand mining sites, namely Grand Gaube, Poudre d'Or, GRSE and Mahebourg, has shown that there is gradual decolonisation of the seabed with sea-grass and other associated marine organism;

- Some lagoons along the Eastern Tourist Zone have suffered from eutrophication through subsurface groundwater discharge.
  Some additional past practices that have affected the integrity and health of coral ecosystems are:xxvi

- Damage to reefs by practices such as walking on the reef, spearing octopus and collecting shellfish;

- Use of dynamite as a fishing practice in lagoons;

- Removal of patch coral from the lagoon by hotels to create more benign swimming and boating areas.

3.2.3.2 Impacts of climate change in coastal zones and ecosystems

The visible and measurable effects of climate change in the coastal zone of ROM have become more apparent over the last ten years, reflecting increases in the rate of negative changes in the coastal zone, due to climate change,xxvii and an increase in the number of vulnerable sites. For example, Mauritius Meteorological Services data indicate that the rate of sea level rise (measured in Port Louis) has averaged 3.8 mm/year over the last five years (albeit a short timeframe sample); this compares to an average of 2.1 mm/year over the last 22 years. The net measured sea level reflects a compounded effect of real sea level rise (absolute water volume increase and more low pressure systems) and a higher frequency and height of waves; i.e., water piled up at that location – both of which have real implications for coastal areas. For example, on May 12, 2007, an extratropical cyclone south of the island of Mauritius created 10 m offshore swells within a period of 18 seconds, traveling 50 km/hr, and hitting the south coast as 5-6 m swells on top of a high tide, resulting in extensive flooding and erosion. The state of coastal vulnerability is therefore not stable; there is no time to spare, as the potential cost of remediation will continue to go up, and not likely in a linear manner.

There is a direct linkage between climate change effects on coastal ecosystem services (especially coral reefs and lagoons) and the integrity of the whole coastal zone of ROM. In particular, there is scientific evidence that increases in sea temperature have led to increased frequency and areal extent of coral bleaching, which may contribute to a failure of the wave attenuation function of reefs. However, the Baird Report of 2003 noted that the back reefs of island of Mauritius were still of good enough quality to serve their function of high energy wave breakers.xxviii This leads to increased beach erosion rates and loss of lagoonal sediments, especially during storm events (for example, intense tropical cyclone Gamede, in February 2007, which resulted in severe beach erosion on the northern and western coasts of the island of Mauritius and at St. Brandon).xxix There is also evidence that coral growth rates, especially in the passes through the barrier reef, are unable to maintain equilibrium with the current rate of sea level rise16, due to the compound effect of recently accelerated SLR, bleaching, accumulated storm damage, increased frequency of freshwater and turbidity events in lagoons (due to storms), and ongoing stresses from local human activities (discharge of wastewater, and anchor damage); Mon Choisy in the north is a good example. Measurements at five key beaches around the island of Mauritius indicate that erosion rates in the last 10-15 years have increased, relative to earlier periods, reflecting this lagging coral growth rate, as well as SLR and storm events.

15 It is pointed out that such practices are no longer used in Mauritius, and that the observed changes in near-shore dynamics are the result of past practices. The widening of natural passes to provide access to fishermen boats and pleasure crafts is carried out through dredging only in exceptional cases (communication from the Ministry of Fisheries – 13 June 2012).

It is, therefore, imperative that the critical ecosystem function of wave attenuation be enhanced in some manner (such as detached, submerged berms in lagoons, adjacent to eroding beaches, to encourage retention of sand in the littoral cell, and eventual beach replenishment). There are few practical alternatives.
Rehabilitation of coral reefs is extremely challenging, since traditional methods, such as coral transplants and artificial reefs, are such small interventions in a coral reef system that is under pervasive pressure. Any new coral patches or rehabilitated areas would still be under the same pressures as the whole reef system, including rising sea level (accelerating), increased storm frequency, and bleaching events. Equally important is the need for a monitoring system that tracks the correlation between key ecosystem functions and weather events, to sharpen the understanding of coastal processes in Mauritius and the extent to which their variability is driven by climate change, which will in turn continue to inform and fine-tune the design of appropriate interventions.

3.2.3.3 Impacts of Climate Change on Tourism

The vulnerability to the effects of climate change, including tidal waves and surges, and deterioration of the coral reef through global warming were issues that had been considered when the Mauritius Sector Strategy Plan on Tourism (2008-2015) was being formulated.xxxApproximately 23% of the beaches on the island of Mauritius are at risk. It can be assumed that over the next 50 years half of these beaches will be lost to the point of not supporting visitors, if there is no intervention (this is realistic, given some observed erosion rates of 1-2 metres per year at beaches which are only 10-15 metres wide, and more during storm events). Thus, 11% of the tourist draws on the island of Mauritius will be lost, progressively over time, as alternative sites for beach tourists do not present themselves. If we take the cumulative 50-year value of beach tourism (US$ 45.5 billion, assuming no increase in tourist numbers from 2010, to be conservative), then the revenue loss per year will range from US$ 2 million in 2011 to US$ 100 million/year in 2060 (in 2010 terms), assuming a constant rate of beach erosion.17 A more likely case is that the erosion rate will continue to accelerate, and the beach losses will occur sooner, rather than later, with the source of the beach sediments (the lagoonal sediments, which are quite shallow, uniquely so on the island of Mauritius) no longer providing a sink and buffer, as these sediments get pumped beyond the reef, and lost from the littoral system during increasingly intense storm events.xxxi

The coastal zone of the island of Mauritius is critically important to the economy of the country, in terms of domestic and international tourism, as well as fisheries. The tourism link is the main concern in the coastal adaptation strategy for the country, since so much revenue and so many jobs are at risk if beaches continue to erode. There are 90 public beaches around the island of Mauritius, with a total length of 26.6 km, making up 8% of the coastline. These attract both domestic and international tourists. As of June 2010, there were 104 registered hotels operational on the island of Mauritius, of which 86 are located immediately adjacent to beaches – these having 21,444 bed places, which represents 92.5% of the hotel guest capacity on the island of Mauritius.xxxii Clearly, most tourists come to enjoy the beaches (34% of tourists are “repeaters”), xxxiii and the market response in the hotel industry (building hotel capacity in proximity to beaches, although often misinformed as to climate change risks, and causing local problems of beach loss) reflects that. The beaches on the island of Mauritius are near capacity, in terms of visitor use. While new beaches cannot be created, existing ones can certainly be lost. One might argue, then, that the percentage of beach loss, due to climate change, could translate into a similar percentage reduction in the number of tourists, and a correlated loss of revenue and jobs in Mauritius.

16Ministry of Environment and Sustainable Development; ICZM Division observations.
17Assuming a constant erosion rate, that leads to a loss of half of the 21 vulnerable beaches by 2060, with the total revenue loss due to the absence of these beaches being US$100 million/year (11% of the US$ 0.91 billion/year that derives from beach tourism revenue), then Year 1 revenue loss due to beach erosion is US$ 2 million, Year 2 loss is US$ 4 million, etc. up to Year 50 at US$ 100 million.

3.2.3.4 Damage to Physical Infrastructure in Coastal Areas

In addition to the risk of physical loss of beaches, infrastructure that is immediately adjacent to the dynamic beach zone is at risk, and there is clear evidence of this risk in some areas, with seawalls collapsing and erosion of roadbeds, especially after storms. In addition, all future design and construction of coastal infrastructure in Mauritius will be informed by the ICZM guidelines that will help reduce or eliminate future infrastructure losses in the coastal zone. For example, assessment of the potential cost of repairs to coastal roads on the island of Mauritius damaged by wave incidence and erosion during a 4-metre wave run-up storm indicates US$ 20 millionxxxiv could be saved during each storm, if present coastal infrastructure were protected and if all future coastal infrastructure were properly designed and located for climate resilience. Assuming one such storm every two years over the next 50 years (based on current MMS data), then US$ 0.5 billion in infrastructure repair costs could be precluded with appropriate climate resilient coastal infrastructure.18 This is a benefit to all Mauritians, who use the coastal infrastructure, and allows re-direction of these funds to investments and services with a higher return.

3.2.3.5 Population Exposed to Storm Surges and Coastal Flooding

The surge risk modeling for Baie du Tombeauxxxv and the surge event in May 2007 in Riviere des Galetsxxxvi were used to determine a typical surge-flooded area for a sustained one-metre surge in areas that are vulnerable (assumed to be, on average, 0.25 km2 at each surge-prone site). When overlain with the population density data, and assuming standard building occupancy patterns, it can be assumed that over 3,400 people in about 1,100 buildings (houses, businesses, public buildings) are currently at risk from storm surges (this number will increase over time, due to natural population growth). These people have suffered (and will possibly again in the future) the consequences of surge flooding, including: loss of goods due to seawater contamination; fear and anxiety during storms; inhibition of investment in local communities; disruption of livelihoods; damage to buildings; and potential risk of loss of life. For these people, the alternatives include relocation, which is both expensive and logistically challenging, or developing the necessary coastal protection structures, which together with the early warning system, would allow these communities to continue to live in proximity to their livelihoods, with a sense of security.

3.2.4 Energy Sector

This section provides an overview of the trends in emissions of greenhouse gases (GHGs) in Mauritius. It provides sector specific analysis of GHG emissions that paves the way for sector prioritization for the TNA project in Mauritius. It is pointed out that the categorization of ‘sectors’ is aligned with the methodology used by the national statistics office. GHG emission data is published on a yearly basis for the ‘sectors’.

3.2.4.1 Introduction

Energy is a meta-technology and is central to all human activities. Typically, there is a positive relationship between the amount of energy used, standard of living and economic output of a society. When countries rely on fossil fuels to meet their energy needs, the positive relationship between energy use and economic activity translates directly in emissions of GHGs. A recent study looking at any correlations between CO2 emissions and economic growth in Mauritius has failed to validate the EKC hypothesis, which, if present, would have implied a decrease in GHG emissions at higher economic output.xxxviiFigure 3 shows the increasing dependence of Mauritius on imported fossil fuels (solid triangles), as well as the general decrease in the energy intensity of the economy except for the marginal increase in 2010 (solid circles). The following discussions will show that absolute emissions have increased despite the relative increase in the energy efficiency of generating a unit of economic output.

18The calculations have assumed 2010 constant repair costs and constant risks over 50-year period.

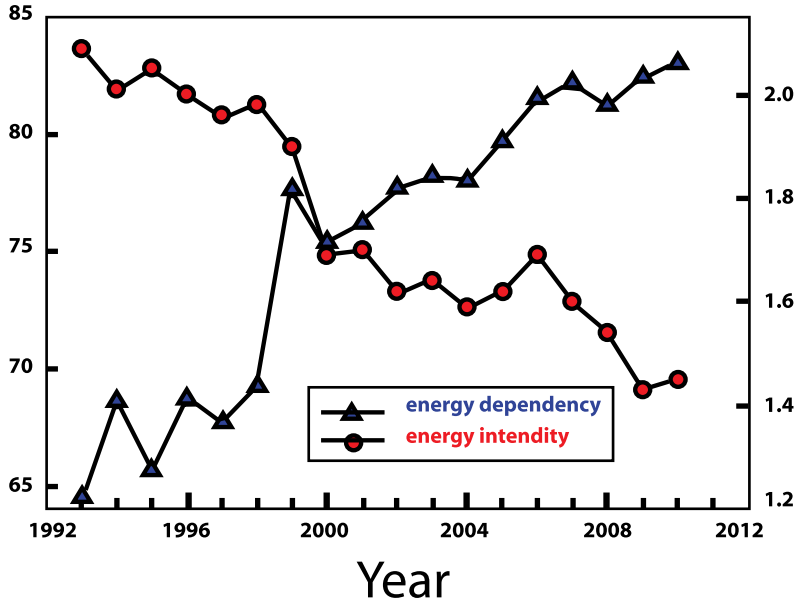

Figure 3. Import dependency and energy intensity of Mauritius, 1994-2010 (Source: CSO, Digest of Energy and Water statistics – 2003 and 2009, Energy and Water Statistics – 2010, [xviii]).

The increasing energy dependency comes at an expense with surging prices and price volatility of imported fossil fuels, and the growing concern for energy security. These concerns provide the motivation for Mauritius to invest more in ESTs, including supply and demand side energy efficiency and renewable energy resources. In addition to enhancing energy security and reducing GHG emissions, investment in mitigation technologies provides prospects for job creation.19

Table 6 shows the breakdown of primary energy consumption by sector. Several observations can be made:

1. The share of energy use has shifted away from Manufacturing towards Transport, Household and Commercial & Distributive Trade. This reflects the gradual shift from a manufacturing towards a service-based economy;
2. The Transport sector accounts for close to 50% of final energy consumption, implying its significant role on energy security and energy bills; and 3. The share of energy consumed by the agriculture sector has been constant, which may reveal its maturity and stagnant investment in the primary sector of the economy.

19 Renewable energy resources should also provide net social benefits arising from generation of employment and health improvements from abatement of air pollution. The prospects for the existing energy sector to generate employment are limited. In fact, the study by Halsnaes, Markandya and Taylor (2002) [Climate Change & Sustainable Development – Prospects for Developing Countries, Eds. Anil Markandya and Kirsten Halsnaes (Earthscan, London, 2002)] has shown that rationalisation of electricity generation from bagasse (i.e. co-generation using bagasse and coal) in Mauritius is expected to result in job losses. Investment in wind energy and photovoltaics can be expected to generate new jobs and also an industry based around infrastructure support; The benefits and constraints, as well as the policies, for using renewable energy to achieve sustainable development in Small Island Developing States has been outlined in Energy as a Tool for Sustainable Development for Africa, Caribbean and Pacific Countries, Ed. Ugo Farinelli (United Nations Publications, 1999).

Table 6. Percentage share of final energy consumption by sector, 1994-2010.

Sector	1994	1998	2002	2004	2008	2010
Manufacturing	41.7	40.6	32.6	30.9	29.4	27.7
No bagasse	16.2	18.9	23.3	21.0	24.9	22.6
bagasse	25.5	21.7	9.3	9.9	4.6	5
Transport	41.9	42.0	47.6	48.8	48.3	49.3
Household	12.2	12.2	13.4	13.2	13.1	13.8
Commercial & Distributive Trade	3.5	4.4	5.5	6.1	8.2	8.3
Agriculture	0.5	0.6	0.6	0.5	0.5	0.5
Other & losses	0.2	0.2	0.3	0.4	0.4	0.4

Source: CSO, Digest of Energy and Water Statistics 2003; Energy and Water Statistics – 2009 & 2010 [xviii].

3.2.4.2 Trends in GHG Emissions in Mauritius

The emission of the three main Kyoto GHGs is shown in Table 7 for 2010.xxxviiiAfter taking the global warming potential (GWP) of the gases into consideration, the total emission was 4718.5 ktCO2e in 2010. Carbon dioxide (CO2) was the main contributor to total emissions at 75.9%, followed by methane (CH4) and nitrous oxide (N2O) with 17.5% and 6.6%, respectively. This high level analysis shows that the most significant leverage for reducing GHG emissions is by addressing the drivers of CO_2 emissions.

Table 7. Total emissions of CO2, CH4 and N2O in 2010.

GHG	Emission (1000 t)	GWP	CO2e (1000 t)	%
CO2	3583.2	1	3583.2	75.9
CH4	39.3	21	825.3	17.5
N2O	1	310	310	6.6
			4718.5	**100.0**

Source: CSO, Environment Statistics – 2010 [xxxviii].

The historical trend in CO2 emission is shown in Figure 4. The bar charts shown in red depict the projected CO2 emissions under the 'business-as-usual' scenario until 2020, and the data are taken from the Initial National Communication under the UNFCCC.xxxix The solid line serves only to guide the eyes to follow the projected trend in emissions. The black bar charts show the measured quantities of CO2 emitted. Although the projections were made more than a decade ago, the measured data agree very well with the projected values of CO2 emissions. The bar charts in white demonstrate the relatively unchanging CO2 sequestration by sinks. The lower-than-expected emission in 2009 corroborates very well with a global dip in CO2 emissions due to the global financial crisis. The increase in 2010 shows a recovery in economic activity but is still less than the projected emission.

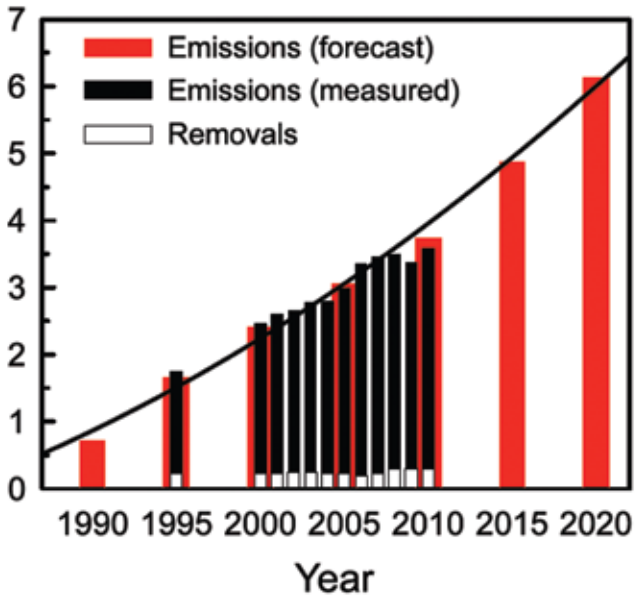

Figure 4. Projected (red) and measured (black) emissions of carbon dioxide (Sources: CSO, Energy and Water Statistics (annual indicators); Initial National Communication under the UNFCC, 1999).

3.2.4.3 ;\]Sectoral breakdown of CO2 emissions

In order to identify mitigation priority sectors for the TNA process, it is important to first investigate the sectoral emissions of the main GHG, namely CO2, in Mauritius. Table 8 summarises CO2 emissions in five sectors for the past 3 years both in absolute terms and as percentages. The largest source of CO2 emissions is from the burning of fossil fuels to produce electricity – i.e. Energy Industries. This sector accounts for around 60% of national CO2 emissions. The Transport sector is the second largest emitter and accounts for around 25% of CO2 emissions. It is worth noting here that the total emission from the Transport sector is not the largest despite it representing the largest sector in terms of final energy consumption (see Table 1). Stationary combustion of fossil fuels (mainly LPG) for thermal energy needs places the Manufacturing sector as the third largest emitter with around 10% of total CO2 emissions. The Residential sector accounts for roughly 4% of total CO2 emissions, which arises from the combustion of mainly liquefied petroleum gas (LPG) and fuel wood for thermal needs, such as cooking and heating water.

Table 8. Sectoral CO2 emissions from fuel combustion activities, Republic of Mauritius, 2008-2010.

Sector	2008 Quantity (1000 t)	%	2009 Quantity (1000 t)	%	20101 Quantity (1000 t)	%
Energy industries (electricity)	2,032.0	58.3	1,997.0	59.3	2,158.3	60.3
Manufacturing industries	456.0	13.1	351.6	10.4	360.4	10.1
Transport	813.0	23.3	844.8	25.1	887.0	24.8
Residential	131.0	3.8	122.8	3.6	135.6	3.8
Other (incl. Agriculture and Trade)	53.8	1.5	49.1	1.5	39.7	1.1
Total	**3485.8**	**100.0**	**3,365.3**	**100.0**	**3,581.0**	**100.0**

Source: CSO, Environment Statistics – 2010 (with corrections made to sectoral % emissions for 2008 and 2009 by the author).

1 Provisional.

3.2.4.4 Energy industries (power sector)

The generation of electricity has grown by 4-5% annually over the past decade in order to match demand (see Figure 5), reaching 2,687.7 GWh in 2010. Thermal energy currently generates 96.2% of this electricity and primary sources like hydro and wind the remaining 3.8%.

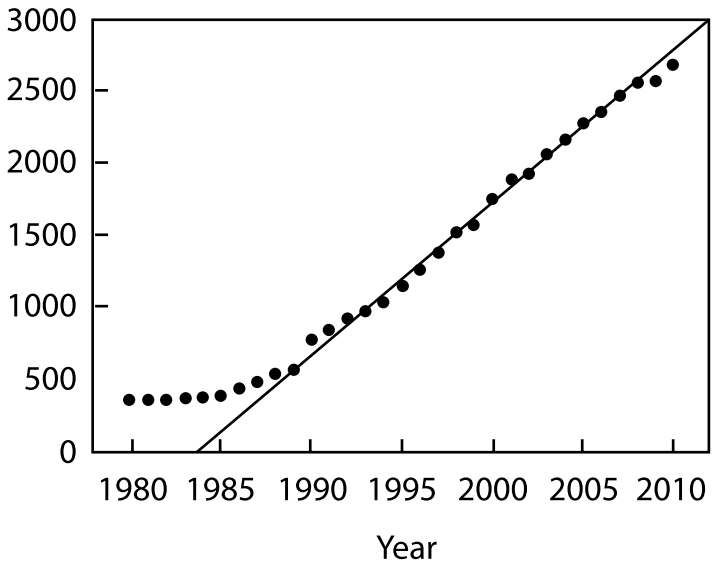

Figure 5. Electricity generation in Mauritius, 1980-2010 (Source: CSO – Digest of Energy and Water Statistics – various, Energy and Water Statistics – 2009 and 2010).

In 2010, bagasse, a renewable source of biomass obtained after sugar cane is crushed to extract its juice, accounted for 20.5% of total electricity generation (and 21.3% of all thermal generation). Fossil fuels, such as coal (38.7%), and diesel & heavy fuel oil (36.3%), accounted for 75% of electricity generation. The combination of hydro and bagasse meant that the share of renewable energy in the electricity mix of Mauritius (island) was 24.3% in 2010. The renewable component of the electricity mix is vulnerable to the impacts of climate variability, especially during periods of drought when reduced precipitation has adverse impacts on hydroelectric generation, as well as reducing the yield of sugar cane, and hence, bagasse. In such circumstances, demand for electricity is met by adding more fossil fuels in the electricity mix.

Public and private generation of electricity

Electricity is produced both by CEB and IPPs. In 2010, the CEB and IPPs generated 44.9% and 55.1%, respectively, of all electricity on the island of Mauritius. In fact, IPPs have generated more than 50% of total electricity needs of the country since 2007. This breakdown shows the prominent role of both the public utility and private producers in addressing emission reductions in the power sector.

Final electricity consumption

Since the generation of electricity is the main source of CO2 emissions, a better understanding of the end uses of electricity can assist in identifying mitigation technologies for demand-side management. Figure 6 shows the breakdown in final electricity use in 2010. Three activities – domestic, commercial and industrial – account for over 98% of electricity use, and each activity uses approximately one third of total electricity. In terms of identifying mitigation technologies in the power sector, it would then be worthwhile investigating the potential of demand-side management in these three sectors.

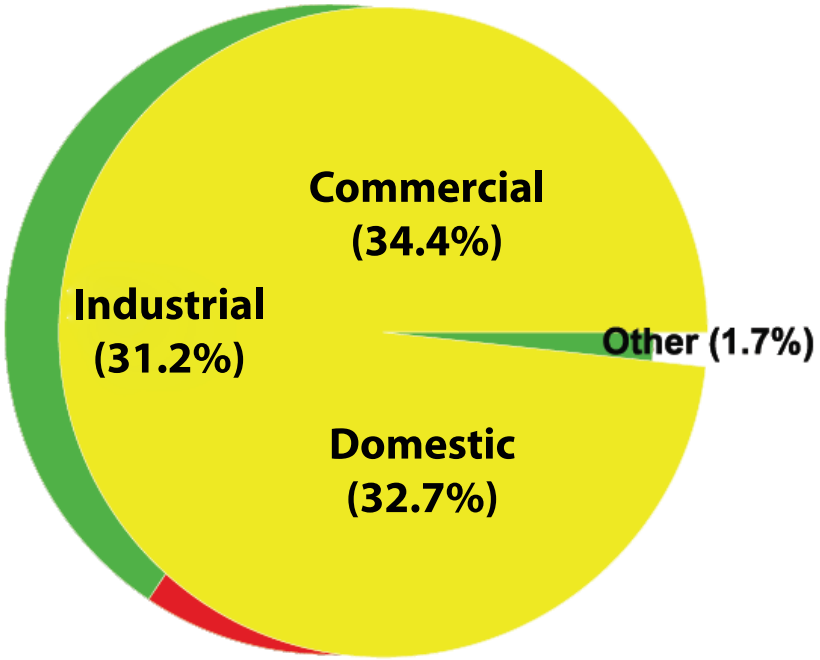

Figure 6. Breakdown of final electricity use, 2010 (Source: CSO, Energy and Water Statistics – 2010).

3.2.4.5 Transport

As shown in Table 8, the Transport sector is the second largest emitter of CO2 at around 25% of total emissions. This sector is virtually completely dominated by the use of imported fossil fuels, and it accounts for close to 50% of final energy consumption. Land transportation and civil aviation are the two major end uses of transport. In 2010, some 418 ktoe of energy were used for transportation, representing an increase of 6.9% over the previous year's figure of 391 ktoe. Comparing year-on-year changes (i.e. from 2009 to 2010), it is noted that the consumption of gasolene increased from 121 ktoe to 128 ktoe (+5.8%) and that of diesel oil from 155 ktoe to 162 ktoe (+4.5%). Consumption of aviation fuel increased from 111 ktoe in 2009 to 123 ktoe in 2010 (+10.8%), while the use of LPG in the transport sector remained stagnant at 5 ktoe.

Mitigation initiatives in the transport sector

While noting that Mauritius does not have a large leverage in implementing emission reduction projects of significance in the civil aviation sector,20this section will focus on land transportation. There are several ongoing measures and investment of resources in the land transport sector, and the main ones are listed The below based on the typology of mitigation technologies provided in the TNA Guidebook on the Transport Sector:xl,21

- Measures to encourage public transport: Mass rapid transit (and land use planning to support such an initiative); free travel to students/senior citizens in public transport; introduction of end-to-end services to avoid interchanges; and public transport services accessing the city centre to provide a door-to-door service;

- Renewable fuel technologies: Several studies have been carried out to investigate the feasibility of both biodiesel and bioethanol as a substitute for fossil fuels. There are also tested and proven uses of waste vegetable oil and coconut oil as direct substitutes for diesel oil in land transportation;

- Private vehicle demand management: Some examples include behavioural change awareness programmes (e.g. benefits of car-pooling, and use of public transport), control on public and private parking, government proposal to introduce toll or road pricing charges, and vehicle registration charges that favour smaller and alternative cars (e.g. road taxation);

- Reducing the need for travel: Land use planning allows mixed development zones, one benefit of which is expected to be to reduce the need for travel;

- Improving private vehicle operating standards: There are various policy areas that directly or indirectly aim to reduce GHG emissions from private vehicles: (i) carbon emission tax to favour most fuel efficient vehicles; (ii) standards for vehicle emissions; (iii) standards on fuel quality; (iv) driver or owner education; and (v) government proposal to privatize vehicle examination for enhancing vehicle emission control and roadworthiness;

- Traffic management: For instance, traffic 'calming' measures such as mixed use of speed limits, pedestrian crossings, traffic control at intersections, and speed breakers

20 The International Civil Aviation Organisation (ICAO) and the International Maritime Organisation (IMO) have taken a resolution to transform the civil aviation and sea transportation carbon-free by 2050. It is pointed out that air transportation has already binding emission reduction targets in the EU, and that this sector was recently included in Phase 2 of the EU Emission Trading Scheme (EU ETS). This will have an impact on our local carrier, which already practices an initiative of planting one endemic, in collaboration with the Mauritian Wildlife Foundation, for each take-off. Several commercial airlines already offer carbon-offset schemes to passengers on a voluntary basis, but all these initiatives remain marginal.

3.3 Process and criteria of prioritization

The process of sector prioritization followed the MSP discussed in section 2.2. Although a consensual approach was used, by first having formal approval of the National TNA Committee and then broader validation at the national TNA Inception Workshop, the sector prioritization process was carried out by taking into consideration constraints and the national context that are illustrated by the following criteria:

- Because of funding and time constraints, the TNA project would cover 4 sectors (adaptation and mitigation) in total;

- The beneficiary country has the flexibilityto choose the number of mitigation and adaptation sectors – i.e. need not be 50%/50%, and the final choice should be on analysis of inherent vulnerabilities and resilience to climate impacts and relative share in terms of GHG emissions;

- While noting that addressing climate change is permeated by a nationally-determined political process, it would be best to choose sectors that have political support;

- A sector should necessarily not be one that is already receiving much attention as far as climate change is concerned;

The remaining two constraints are necessary but not sufficient conditions for the identification of priority sectors and are further discussed below.

- Sectors for adaptation should be those that are most vulnerable to the impacts of climate change; and

- Sectors for mitigation should be those that account for most of the national GHG emissions.

21 Some of the examples were provided by the Road Transport Commissioner, National Transport Authority – 14 June
2012.

3.3.1 Selection of priority sectors

Based on the abovesectoral analysis, and the criteria for prioritization, four priority sectors had been retained for adaptation, and one sector retained for mitigation. These sectors are revealed by the sectoral MSP described in section 2.2. Since an adaptation expert could not be found to work on the fisheries sector, and in order to avoid further delays in TNA project implementation, this sector was dropped. Consequently, the priority adaptation and mitigation sectors retained for Mauritius are:

1. Priority adaptation sectors: Water; Agriculture; and Coastal Zone.

2. Priority mitigation sector:EnergyIndustries.

For both adaptation and mitigation sectors, the sectoral political support has been one of the key deciding factor, as well as the last two criteria given in section 3.2. For adaptation, the three priority sectors are also the same ones that had been identified by the Africa Adaptation Programme as key to enhancing the resilience of Mauritius in line with the sectoral overviews discussed in section 3.1. A recent qualitative assessment of the vulnerability to climate change in Mauritius also identified the same key sectors.xli

Since the inception of the Maurice Ile Durable (MID) project, transforming the power sector towards renewable energies and energy efficiency has featured prominently in national debates and has been high on the political agenda. This has been further revealed at the recent broad multi-stakeholder meetings that have revolved around the Energy Sector in order to formulate a coherent MID policy and strategy.

Consequently, it is investment in these sectors where the TNA project can play the biggest catalyst role, and in which the best return on investment can be expected in a relatively short time (say within the next 5 years).

3.4 Current status of technologies in the selected sectors

This section looks at the current status of technologies in the four priority sectors.

3.4.1 Water sector

Examples of adaptation strategies in the water sector are provided in the IPCC Summary for Policy Makers: expanded rainwater harvesting; water storage and conservation techniques; water re-use; desalination; efficiency in water-use; and efficiency in irrigation (see [iv]).Desalination and re-use of secondary treated water are already adopted in Mauritius in the hotel and agriculture sectors, respectively.22

In order to adapt to the impacts of climate change, the following strategies are ongoing and or planned:xlii

1) Increase in surface water storage capacity through the construction of two new dams and increase in the storage capacity of existing ones;

2) Incorporation of climate variability into water management;

3) Quantitative projections of changes in rainfall, river flows and groundwater levels and systematic monitoring of water resources systems and coastal aquifers;

4) Protection of common recharge zones of aquifers and rivers as a priority through appropriate land use management strategies including legal aspect;

5) Water recycling rationalization of grey water;

6) Recharge of artificial groundwater;

7) Control of sea water intrusion through groundwater licensing; and

8) Desalination especially for Rodrigues which is water-scarce, despite the relatively high investment cost.

A WaterMaster Plan Study for the development of water resources is being drawn up. This will take into consideration impact studies of climate change on the sector.

3.4.2 Agriculture sector

TheBlueprint for a Sustainable Diversified Agri-food Strategy for Mauritius, 2008-2015xliiiaddresses the food security through improving self-sufficiency status of a number of strategic crops in the short to medium term. It aims at reducing the gap between local food production and consumption and the dependency on imported food through investment in the following priority areas such as modern production techniques, sustainable land management and water conservation, quality improvement, integrated pest management, irrigation facilities and meat and milk production.

A **Food Security Fund**[23](policy instrument)has been set up to increase the resilience of Mauritius towards food self-sufficiency and to face subsequent global food and feed crisis by increasing production of foodstuff locally and at the regional level by partnering with neighboring countries. The strategy and policy instrument were not designed to address the climate change-Agriculture nexus directly. Nevertheless, they cover several'no regrets'24 measures such as regional diversification of food production that will reduce vulnerability to the adverse effects of climate change, and hence increase climate resilience of this sector. Further, the Fund also provides for promoting local seed production to improve seed security, fodder production, livestock genetic improvement , research and development to develop improved crop varieties, training in agro-processing value addition, meat and milk production and other adaptation measures such as the Food Crop Insurance Scheme, Post harvest treatment and storage facilities and Sheltered Farming.The Fund also makes provision to modernize irrigation schemes for small planters.

Being aware of the impact of climate change, variability and climate extremes, a number of adaptation technologies have already been identified and proposed to assist farmers to cope with the challenge of climate change (and climate variability) and increase the resilience of the sector. These are summarized in Table 9. The options have been implemented to varying degrees and levels of success, but their systematic application has been lacking.

Table 9. Adaptation measures proposed for agriculture in national documents.

National documents	Proposed adaptation options
First Technology Need Assessment Report	- Increasing water use efficiency through more performing irrigation systems;
(2004)xliv	- Trash blanketing / green cane harvesting (sugar cane) - Changing harvest period; - Land use change (shifting areas); - Crop change - Adopting drought tolerant cultivars - Introduction of more performing cultivars - Integrated Pest management - Rational use of fertilizers and herbicides
Second National Communication (2010)[xlv]	- Introduction of new varieties or cultivars; - Shifting crop production zone. - Increasing irrigation water requirement - Sustainable land/ soil management of land/soil - Promoting conservation and sustainable agricultural practices; - Combating land degradation; - Biotechnologies to improve water-use efficiency of crops or plant more resistant crop varieties; - Provide farmers with Insurance and security for their investments; - Application of new and sustainable technologies, e.g. protected cultivation; and - Establishment of an early warning system for pest and disease management.

23 Please see http://www.gov.mu/portal/goc/moa/file/straplan.pdf - accessed 18 May 2005.
24 Defined as adaptation options (or measures) that would be justified under all plausible future scenarios, including the absence of manmade climate change.

3.4.3 Coastal zones

A study for the Development of an **Integrated Coastal Zone Management** (ICZM) Framework has been completed with the objectives of: xlvi

1. Developing an ICZM Strategy for Mauritius;
2. Reviewing and Preparing a National Policy and Comprehensive Legislative Framework; and
3. Preparing ICZM Area Plans for Pressure Zones in Mauritius.

The implementation of the ICZM Strategy is currently under way, and it is pointed out that the adoption of climate change adaptation technologies for addressing coastal erosion and flooding should be done within the ICZM context in order to maximize the likelihood of their success.

Several technologies have been implemented in Mauritius with varying successes to deal with the issue of coastal erosion. They include the use of break waters, groynes, increasing the setback, removal of hard structures below the high water mark, enhancing coastal vegetation, and the creation of artificial beaches. The systematic study of the status of these technologies has not been undertaken. Nevertheless, several of these technologies have been retained for MCA analysis. A more detailed discussion of coastal adaptation options is given in section 6.1. Further, Annex 7 and TFS summarize the status of many technologies in Mauritius.

3.4.4 Energy industries (power sector)

Two parallel tracks were used to gauge the current status of technologies in the power sector. The first track consisted of a survey carried out with CEB and an IPP before the IW, and the results are summarised in **Table 10.**

Table 10. Current status of mitigation technologies and enabling conditions.

Index	Technologies in the Pipeline (including	Status of technology implementation	Supporting technologies/enabling frameworks would be required to facilitate being implemented) the pipeline technology identified
1	Wind farms • 10-30 MW at Plaine Sophie • 22 MW Britannia (Omnicane)	• Proposal made one bidde. • Britannia- Wind Measurement in progress, and request submitted to CEB for consideration	• Utility regulatory Authority • Differential feed-in-tariff (part financing from MID/Govt) • Standardised Energy Purchasing Agreement • Extending the geographical spread of wind energy resource measurements over the territory to gauge the further potential of wind energy in Mauritius (may be offshore wind measurement) • Mapping the stability of the national grid to know the maximum input of wind energy • Mitigation measures for wind turbines interference with communication bodies
2	SSDG (3MW total – wind; PV; hydro)	• Permits have been granted for 1.8 MW by CEB • Implementation, monitoring and evaluation of pilot phase before deploying a second phase in second half of next year	The result of the grid assessment from the first phase shall govern the SSDG capacity addition for the second phase.
3	PV Farm (1-10 MW)	• Closing date for bids is 29 August 2012	Power system study to determine maximum amount PV grid connected systems that can be added to CEB's network. • Differential feed-in-tariff (part financing from MID/Govt) • Standardised Purchasing Power Agreement • Establish a solar map of Mauritius

4	Carbon burn-out unit able to reduce the carbon content of the fly ash and bottom ash of spreader stoker boiler to less than 5%	• Feasibility study being completed • Ready to order the boiler to Indian supplier	• Homologation by the Mauritian standard office of the fly ash and bed ash as an additive of cement and sand material in order to use them in the construction in Mauritius
5	New and habilitation of the existing Minihydro • Midlands Dam (350 kW) • Britannia (50 kW) • Riche en Eau (150KW) • Bois Cheri (100 KW) • Saint Felix (50 kW)	• Implementation of the Midlands Dam hydro project will be completed in September 2012 • Britannia in operation to supply the garage	• Possibility to sell the excess to the CEB as SSDG to get the return on investment
6	Mare Chicose Landfill Gas to Energy (3 MW)	• Implementation of the Midlands Dam hydro project will be completed in September 2012 • Britannia in operation to supply the garage	• Possibility to sell the excess to the CEB as SSDG to get the return on investment
7	Combustion trial of bio-pellets in OTEO Saint Aubin	Combustion trial of bio-pellets in OTEO Saint Aubin	• Production of 2000 t of pellets with cardboard, food, used oil, and other biomass
8	Liquefied Natural Gas (LNG) for electricity generation	Liquefied Natural Gas (LNG) for electricity generation	

During the IW, a detailed analysis of baseline technologies was carried out. The starting point was the mitigation technologies listed in Annex 7 of the TNA Handbook.xlviiSixty (60) technologies were reviewed. This list is shown at Annex 9, including a brief description of the status and applicability of the technology in Mauritius.

4. Technology prioritization for water sector

4.1 Possible adaptation technology options in watersectorand their benefits

The potential adaptation technology options in the water sector were identified during a brainstorming session at the IW. The list emanating from the IW is given at Annex 4(a). Following feedback during subsequent working group meetings a short-list of potential technologies (see Table 11) that could be considered in the process of adaptation to climate change was prepared. The first column categorizes the type of technology according to the typology used in the TNA Guidebook for the water sectorxlviii, while the second column gives the current technology requirements for Mauritius following consultations with stakeholders. The third column makes a comparison of the current propositions with the technology options proposed in the first TNA report of 2004. The short-listed technologies are given in the last column.

Table 11. Short-list of adaptation technologies retained for the water sector.

	IPCC(2007) [iv]/ UNEP/RISOE(2011)	Technology Needs Gap Analysis Working Group on Water IW Sep 2011	TNA (2004) – Mauritius [xliii]	Technology Retained under the TNA study
1	**Efficiency in Water- Use**	• Sustained sensitization campaigns on water saving at all level whole year round (software)		**Sensitisation Campaigns At National Level**
		• Promote use of water efficient fixtures,		**Water Efficient Fixtures**
		devices/appliances		
2	**Desalination by Reverse Osmosis in Coastal Hotels**	• Rain water harvesting at household level/ industrial level		**Rainwater Harvesting – Rooftop**
		• Desalination of sea water at level of hotels (e.g. reverse osmosis) • Desalination plant – much larger scaled for several hotels		**Desalination by Reverse Osmosis in Coastal Hotels**
3	**Water Reuse**	• Tertiary wastewater treatment for industrial purpose		**Post tertiary treated – reuse of treated wastewater for food crops**
4	**Water storage and conservation techniques**	• Create artificial ground water recharge (e.g. grass-crete)		**Stormwater – Grass Crete**
		• Close monitoring of water systems and aquifers		**Telemetry System**
		• Integrated surfacegroundwater models		**Hydrological Models**
		• Reduction of losses at Reservoir level		**Rehabilitation of Feeder Canals**

4.2 Criteria and process of technology prioritization

A pre-screening step was not judged necessary since 9 potential adaptation technologies were identified by the stakeholders in section 4.1 for subsequent prioritisation using MCA.

Technology Fact Sheets

TFS were prepared for each short-listed technology (**Table 11).** TFS were used to assist members of the technical working group to score the technologies against indicators during MCA. Theyhighlight the technical aspects of the technology, the capital, the operational and the maintenance cost associated with the implementation of the technology, the benefits that can be obtain should the technology be implemented, and the barriers that are likely to influence the successful implementation of the technology. Bilateral meetings were held with key stakeholders, both from the public and the private sector in order to discuss the status of the technology, its market potential and any Government policy likely to influence the success of the particular technology. Bilateral meetings contributed significantly to getting local information on cost implications associated with the technology. Technical working group meetings were held to finalise and validate the TFS prior to MCA.The TFS for the 3 prioritized adaption technologies in the water sector are included in **Annex 4(b).**

MCA criteria and indicators

In order to prioritize the adaptation technologies, a set of locally-validated criteria and indicators was selected based on the generic framework proposed by the MCA4Climate projectxlix and expert views on the ease of assessment of each of the criteria and availability of measurable indicators. The criteria and indicators used for MCA for adaptation options in the water sector and the scoring scale for quantifying each indicator are summarized in **Table 12**. Only criteria which are independent of each other (or mutually exclusive) were retained for compatibility with the linear additive MCA technique used in this project. However, two of the technologies listed in **Table 11**,namely the Hydrological Models and the Telemetry were analyzed separately becauseseveral locally-validated criteria and indicators could not be applied to thetwo technologies. This was particularly the case forthe indicators‘volume of water saved’ and ‘total average revenue from water saved’. Hence, as will be shown below, the two technologies were treated separately and did not undergo MCA.

Criteria	Indicators	Scoring Scale	Weight	Sensitivity Analysis
Public financing needs	Direct cost.	Cost/m3 produced OR Cost/m3 saved over the life span of the technology	0.15	0.05
Implementation barriers	Ease of implementation.	Likert scale: 1 (lowest) to 10 (highest)	0.2	0.1
Climate-related	Enhance resilience to climate change	m3 of water used/produced	0.25	0.25
Economic	Improvement in economic performance.	Total Average revenue from water saved or soldover the life span of the technology.	0.1	0.05
Environmental	Protect environmental resources	0: Yes 10: No	0.1	0.15
Social	Improve health	Likert scale: 1 (lowest) to 10 (highest)	0.1	0.15
Political and institutional	Improve governance	Likert scale: 1 (lowest) to 10 (highest)	0.1	0.25

Scoring Scale: The indicators *ease of implementation, social acceptance and improve governance, were analysed* on a Likert scale: 1 (lowest) to 10 (highest). The indicator *environmental protection* was analyzed on the scale: 0 (Harm to the environment) and 10 (Protect environment). The indicator *Direct Cost* was then rated on a scale of 1 to 10, with the lowest cost being given the highest number. For the indicators, *enhance resilience to climate change and improvement in economic performance*, the technology providing highest resistance to climate change was assigned a value of 10 and the technology providing highest economic performance was assigned a value of 10. The technology which was most easy to implement was assigned a higher value, the technology offering least social acceptance was assigned a higher value and that which improve governance was assigned a higher value. For the indicator environment protection, only two possibilities were concerned, either this technology would cause harm to the environment, in which case it was assigned value of 0, or it would help to protect the environment, in which case it was assigned a value of 10

Weightage: The next step in the analysis was to define a weightage for each of the 7 analysis criteria (see Table 13). Members of the working group considered that costs, ease of implementation and improve resilience to climate change were three very important factors, and the 7 criteria were assigned weightsbased on this reasoning. MCA was carried out and the weightage was subjected to sensitivity analysis in order to highlight the importance of the weighing factor on the prioritization of the technology. The set of weights used for sensitivity analysis reflects the choice of the working group to balance the social and environment criteria in the analysis.

Combining weights and scores: After the criteria were scaled from 1 to 10, a linear additive model was used to work out the total weighted score of each technology. The score for a given criterion was multiplied by the weightage associated with that particular criterion, to obtain a weighted value. This was repeated for all the nine technologies and the ranking was carried out as per the weighted scale, with the topmost being the technology having the highest score.

4.3 Results of technology prioritization

A MCA calculator was customized to prioritize technologies in the Water sector (please see Annex 4(c)). Having ranked the technologies based on the weighted score, the first three technologies prioritized in this exercise are highlightedin Table 13. Members of the working group debated in depth on the outcomes of this exercise. The MCA grouped both tangible issues (costs, revenue) and intangible issues (social acceptance, environmental protection, improve governance), and this exercise had provided further insight into the proposed adaptation technologies. Members of the working group agreed that some of the proposed technologies could not be considered within the TNA framework. The proposal for 'sensitisation programme' was based on the creation of a dedicated unit with 3 staff which would focus on a regular sensitisation programme. It was debated and concluded that the TNA project would not sustain the cost associated with this technology on a long term basis. Also, it was argued that it may be better to have sensitization programmes targeted to individual/ specific technologies.For'rehabilitation of feeder canals', it was noted that necessary actions had already been taken for large projects (as a response to a severe drought of 2010-2011), and that the concerned authority was already looking into the need to implement small feeder canals. In the case of the 'telemetry project', the concerned authority reported that there was a need for a full network and presently the existing similar facilities were not in working conditions and the causes had first to be addressed before investing further. Finally, the proposal for the 'reuse of treated wastewater' was discussed, and it was noted that social acceptance for this technology was very low, and given that there was the government policy for improving water storage facilities, the need to treat wastewater forpotable purposeswas not justified.

	PROPOSED ADAPTATION TECHNOLOGY	RANK
1	Sensitisation Programme	1
2	Reuse Treated wastewater	2
3	Rehabilitation Feeder Canals	3
4	Desalination	4
5	Stormwater Harvesting	5
6	Rainwater Harvesting	6
7	Water Fixtures & Fittings	7
8	Hydrological Models*	1
9	Telemetry Systems*	2
*Technologies analyzed separately from the rest (Refer to section 4.2)		

Final prioritization exercise

The following four technology options: (1) Sensitisation Programme; (2) Rehabilitation of Feeder Canals, (3) Telemetry Systems, and Reuse of Treated Wastewater were notretained after the first MCA exercise. The MCA proceeded with fivetechnologies; Rainwater harvesting, Stormwater Harvesting, Desalination, Water fixtures and fittings, and Hydrological Models.After the ranking of these five technologies, debates followed on 'stormwater harvesting' and 'water fixtures and fittings'. Members of the working group agreed that the latter was indeed a good proposal and given its benefits, including low cost, that it could be considered under a local programme rather than the TNA. As for 'stormwater harvesting', members of the working group noted that this technology is important in the local context given some 60% of annual rainfall goes off as surface runoff. The implementation of this technology by large commercial project would be challenging, hence it was not considered a priority under the TNA project. The results shown in **Annex 4(c**) reveal that the 'efficient water fixtures and fittings' and 'stormwater harvesting' ranked 3rd and 4th, respectively, behind 'desalination' and 'rainwater harvesting (rooftop)'.

Results of sensitivity analysis

The ranking of technologies was carried out based on their weighted scores. A sensitivity analysis was carried out using the weights shown in the last column in **Table 12**.This set of weightsreflects the thinking of the working group that cost and revenue were not priorities for the Water sector. Rather the social acceptance, environment protection and improved governance could be more important factors.Sensitivity analysis did not change the relative rankings of'desalination' and 'rainwater harvesting' as the first two technologies. The 'hydrological model' was considered a priority for the country, and it was therefore retained. Finally the prioritized proposed adaptation technologies were agreed by all members of the working group and the results are summarized in **Table 14**.

	PRIORITISED Proposed Adaptation Technology	**Comments**
1	Desalination	This proposed adaptation technology is about promoting the use of Desalination plants by hotels located close to the coast. Falls within the Government Policy
2	Rainwater Harvesting	This proposed adaptation technology is based on encouraging each household to have a rain water harvestor for secondary uses. Falls within the recommendations of the Build ing Codes currently being reviewed
3	Hydrological Model	This proposed adaptation technology is based on the need for improved decision making at the level of water resource management in the country.

5. Technology prioritization in agriculture sector

5.1 Possible adaptation technology options in agriculture and their adaptation benefits

Based on the current challenges faced by the agricultural sector with climate events over the past decade and the vulnerability of the sector to predicted climate change, a list of 25possible adaptations technologies were identified to improve the resilience of the agro-ecosystems and the livelihood of farmers through expert views and brainstorming with relevant stakeholders during the sectoral working group session at the IW. Technologies of benefits to small-scale vulnerable foodcrop growers, livestock breeders and to local biodiversity and forest resources were integrated. The technology identification exercise drew from multiple sources and the socio-cultural context, including (1) adaptation technologies proposed in previous national documents;(2) technologies currently in practiceand supported by national agricultural policy; (3) initiativesin the pipeline (e.g. sheltered farming and rainwater harvesting);(4) appropriateness of technologiesin the local context (e.g. fog harvesting, grain storage); and (5)social acceptability (e.g. use of genetically modified organisms), among others.

As per the TNA Guidebook,l the adaptation technologies identified were then regrouped under different categories (or typologies):sustainable water use and management, planning for climate change variability, soil management, sustainable crop management, sustainable livestock management, sustainable farming system, land use management, and capacity building and stakeholders. The classification of adaptation technologies and their status are summarized in Annex 5(a).

5.2 Criteria and process of technology prioritization

Two steps were used to arrive at a shortlist of technology options for adaptation in the agriculture sector. The first step consisted of pre-screening most likely implementable adaptation technologies from the long-list of identified technologies.The second step consisted of developing technology factsheet (TFS) for each of the short-listed technologies, and establishing the criteria and indicators for technology prioritization usingMCA.

5.2.1 Prescreening of technologies in agriculture sector

The pre-screening of the technologies involved assessing the technical feasibility and adaptation benefits of each of the 25identified potential adaptation technologies based on the likely future scenarios of climate impacts on Mauritian agriculture, expert knowledge and pre-screening criteria as prescribed in TNA Handbook (see reference l) namely:(i)technical potential of the technology; (ii)contribution to improve adaptation resilience; (iii) costof the technology and (iv)contribution of the technology with national development strategy and policies. The pre-screening was conducted through discussion with a wide group of stakeholders in technical working group meetings, and a short-list of nine most appropriate technologies were retained based on national priorities and knowledge on ease of adoption of technologies in the local context.

5.2.2 Technology Fact Sheets and criteria for MCA

Technology fact sheets (TFS) were produced for each short-listed technology. The TFS contain relevant information on the technical aspects of the technology implementation, including its installation, operation and maintenance, efficiency, cost, and the benefits / opportunities, as well as the barriers for each short-listed adaptation technology. Bilateral meetings werealso held with key stakeholders to discuss themarket potential and status of thetechnologies in Mauritius,and to acquire technical information to estimatethe incremental cost of the adaptation technologies. The TFS for the three prioritized adaptation technologies in agriculture that have been retained for TAP are given at **Annex 5(b**). TFS for remaining technology options had the same format and similar contents.

In order to prioritize the adaptation technologies, a set of locally-validated criteria and indicators was selected based on the generic framework proposed by the MCA4Climate project [xlviii] and expert views on the ease of assessment of each of the criteria and availability of measurable indicators. The criteria and indicators used for MCA for adaptation options in the agriculture sector and the scoring scale for quantifying each indicator are summarized in **Table 15**. Only criteria which areindependent of each other (or mutually exclusive)were retained for compatibility with the linear additive MCA technique used in this project.Climate-related criterion such as GHG reduction was found to be irrelevant, and economic criterion such as job creation was found to be difficult to calculate.

Table 15. Criteria and indicators for MCA for prioritization of adaptation technologies in agriculture sector.

Criteria		Indicators	Scoring Scale
Institutional/ implementation barrier	1	Ease of implementation	1 - Very difficult 2 - Difficult 3 - Moderately difficult 4 - Easy 5 - Very easy
	2	Use and maintenance /replicability	1 - Very difficult 2 - Difficult 3 - Moderately difficult 4 - Easy 5 - Very easy
Public financing needs Economic	3	Cost to set up and operate the technology (resources, skills, infrastructure..)	Additional cost of per beneficiary /yea (Rs)
	4	Catalyzing private investment	1 - Very low 2 - Low 3 - Medium 4 - High 5 - Very high
	5	Improving farmer income and ability to reinvest	1 - Very low 2 - Low 3 - Medium 4 - High 5 - Very high
Environmental	6	Contribution of the technology to protect and sustain ecosystem services	1 - Very low 2 - Low 3 - Medium 4 - High 5 - Very high
Climate-related	7	Enhancing resilience against climate change (i.e. to what extent the technology will contribute to reduce vulnerability to climate change impacts)	1 - Very difficult 2 - Difficult 3 - Moderately difficult 4 - Easy 5 - Very easy
Social	8	Contribution to social and sustainable development (benefit to society)	1 - Very low 2 - Low 3 - Medium 4 - High 5 - Very high
Political	9	Coherence with national development policies and priority	1 - Very low 2 - Low 3 - Medium 4 - High 5 - Very high

5.3 Results of technology prioritization

The TFS were circulated to allmembers of the technical working group for familiarization with the technology options prior to the MCA prioritization exercise,which involved scoring, weighting, and sensitivity analysis. The MCA calculator used for technology prioritization in agriculture is shown at Annex 5(c). The calculator also contains the methodologies and calculations used to estimate the incremental cost of adaptation technologies.

Scoring: A performance score card in which each row describes a technology option and each column describes the performance score of the options against each criteria was developed and filled following thoroughly discussion with technical working team during 2 MCA working sessions. The assumptions made and methodology used to work out the public financing needs (cost to set up and operate the technology) was discussed and agreed was cost per beneficiary per year. The cost was then standardized between 1 (most costly) and 5 (least costly). For the other criteria, technology options were scored on a Likert scale anchored at 1 (lowest score) and 5 (highest score) based on the expected merits of the technology.

Weighting: Expert judgements were sought from members of the agriculture technical working group to assign a numerical weight (between 0 and 1) to each indicator to reflect their relative importance in the decision-making process. The cumulative sum of weights across all indicators was equal to 1. In order to minimize bias, weights were assigned to indicators prior to scoring the technologies.

Combining weights and scores: The linear additive model was used to derive the total weighted score of each technology option. This was done for a technology by multiplying its score for each criterion by the corresponding weight of that criterion,and then adding the weighted scores to give the total weighted score for this technology. The9 adaptation technologies were then ranked according tooverall preference. The option scoring the highest total weighted score was rank as the most preferred options, whereas the one with the lowest score was ranked as the least preferred option.

Sensitivity Analysis:The results of the MCA exercise were carefully examined by members of the technical working group to see if the ranks were logical. Firstly, it was ensured that the scores given to different criteria were consistent and reflective of the technological merits. The scope of the technology options was rediscussed and fruit bat control was then included as one of the proven IPM technology to be up-scaled due to the extensive damage they cause.

In order to investigate the sensitivity of technology ranking on allocated weights, the weight assigned to each criterion was reassessedby taking into consideration any uncertainty and conflicting objectives of multiple stakeholders. Hence, the ranking of adaptation technologies was carried out for different sets (or cohorts) of weights as shown in the MCA calculator for agriculture (see Annex 5(c)).The overall ranking of the adaptation options was finally agreed by all stakeholders and technical expert based on the sensitivity analysis. The results are summarized in Table 16.

Ranking order of priority	Adaptation technologies for the agriculture sector
1	Reforestation of the water catchment area of the main Reservoirs of Mauritius
2	Up-scaling of locally proven IPM technologies for control of pest of economic importance
3	Micro irrigation (gravity fed drip & mini and micro sprinkler irrigation)
4	Decentralised rapid pest and disease diagnosis service (plant clinic)
5	Reinforce breeding and conservation programme for crop adapted to change in climate
6	Education and awareness raising among farming community to promote adaptation to climate change
7	Low cost postharvest technology (crates and evaporative cooling chambers)
8	Improving Agro-meteorology Information network for forecasting and Early Warning System
9	Index based weather disaster subsidized agricultural insurance scheme for food crop

Though reforestation of the water catchment area of the main reservoirs of Mauritius was identified as the highest priority, it was not considered among the first three prioritised technology options retained for the preparation of TAP. This was decided following discussions with relevant stakeholders, and on the basis that funding has already been earmarked for watershed management, including reforestation of water catchment areas,25 at the national level. Consequently, the 3 prioritised adaptation technologies that are retainedfor TAP are:

1. **Up-scaling of locally proven IPM technologies for control of pest of economic importance**: to minimise on use of chemical pesticides and reduce risk of damage by pest and diseases;

2. **Micro irrigation (gravity fed drip & mini and micro sprinkler irrigation)**: to optimise use of irrigation water, improve on crop productivity and reduce risk of crop damage by drought among small scale farmers; and

3. **Decentralised rapid pest and disease diagnosis service (plant clinic)**: to provide a rapid and reliable pest and diagnosis service to enhance farmers' ability for damage due to pest and disease and thus improve productivity and quality.

Please note that the TFS for these technologies can be found at **Annex 5(b)**.

6. Technology prioritization for coastal zones

6.1 Possible adaptation technology options in coastal zones and their adaptation benefits

Several coastal management approaches have been proposed for the island of Mauritius by the **Baird Report of 2003**.liThe main benefit accruing from the technology options is to curb beach erosion, as revealed by the following objectives:

1. Determine and assess the extent of coastal erosion at critical sites around the island of Mauritius;
2. Analyse the various causes of coastal erosion;
3. Assess the performance of existing protection works along the beach and suggest remedial measures if any;
4. Propose abatement measures to arrest the erosion problem; and
5. Prepare tender documents for the recommended remedial works.

[25] Information that funding had been allocated for watershed management, including reforestation of water catchment areas, became available after the technology pre-screening step has been carried out. This is an example of the dynamic nature of the technology prioritisation process.

The study found that there were signs and hard evidence for irreversible erosion of the sandy beaches on the island of Mauritius, and which would become widespread if no immediate actions were taken to restore the health and integrity of the reef-lagoon-beach-dune system. It also showed that the impacts of climate change on the reef ecosystems were uncertain, and that negative anthropogenic impacts on the health of lagoons, beaches and dunes were more serious problems to be addressed in the short-term. Although the study did not focus on the climate change impacts on coastal zones, the proposed alternative coastal management approaches (or technologies) are still applicable as adaptation to climate change. These approaches or technologies were classified under three broad categories as follows:

<u>Prevention</u>

- Setbacks (including minimum elevation requirements)
- Relocation

<u>Non-structural</u>

- Shore and beach management (e.g. controlled access, onshore grading, vegetation enhancement, dune enhancement etc ..)

- Beach nourishment

<u>Structural intervention</u>

- Groynes
- Artificial headlands
- Detached breakwaters
- Shoreline armouring (e.g. revetments and sea walls)

It should be noted that physical works to date have not been very effective at reducing beach erosion rates due to inappropriate technical designs. A lessons learned exercise and stock taking has been undertaken in the Baird Report of 2003.

More recently, the Second National Communication (2010) has proposed several adaptation options for the coastal zone, including:[lii]

a. Management of ESAs and implementation of Integrated Coastal Zone Management Plan

b. Coastal protection and rehabilitation works – consolidation of existing reefs and or building of artificial ones. An example is the placement of break water structures at Rivière des Galets for the protection of the residential zone in the village. Beach protection works at affected beaches, such as at Mon Choisy, Grand Baie, Mon Choisy, Pointe aux Sables, Flic en Flac, Rivière des Galets, Bain Boeuf, Cap Malheureux and Poudre d'Or. The costs of coastal protection works and beach maintenance would undoubtedly become very high. The present estimated cost of construction of 100 m of wavebreaker is of the order of Rs 100 million. For a 3.28°C rise in temperature by the year 2100 under the worst case scenario, the cost for 200 km of coastal protection (wave breaker) would be of the order of Rs 20 billion on top of rising infrastructural maintenance costs;

c. Preparation of detailed inundation maps and monitoring of flood prone areas;

d. Policy review in the Environment sector;

e. Adaptation of public infrastructure on the coastal zone and the Ports Area; and

f. Strengthening of capacities for disaster risk reduction and disaster management.

The applicability of several technologies for adaptation in the coastal zone was investigated at the IW and subsequent meetings of the corresponding sectoral working group. The outcome of the MSP is shown at Annex 6(a). Based on the review process, seven technologies were retained by stakeholders for adaptation in the coastal sector. The short-listed technologies are: (1) beach nourishment; (2) break waters; (3) coastal development setbacks; (4) wetland protection and restoration; (5) dune restorations; (6) restoration of coastal vegetation; and (7) rock revetment.

6.2 Criteria and process of technology prioritization

A pre-screening step was not needed since only 7 adaptation technologies were identified by the stakeholders in section 6.1 for subsequent prioritisation using MCA.

At the IW, the working group on coastal zone had the task of identifying the criteria they considered that would be important to carry out technology prioritisation using MCA. The MCA4Climate methodology (see [xlix]) was retained for defining the criteria for MCA, while corresponding indicators were defined by the technical working group. **Table 17** lists the criteria, as well as their corresponding indicators. This set of indicators was finalized during post-IW technical working sessions.

Creating a common understanding of the meaning of criteria and indicators

One of the crucial tasks during the finalisation of the MCA criteria and indicators was to ensure that all members had the same understanding of the meanings of the criteria and indicators. This was an important step to be accomplished before scoring the retained technologies against the MCA indicators.

Table 17. Summary of criteria and indicators for prioritizing coastal adaptation technologies.

Criteria	Indicators	Measurement scale	Weight	Sensitivity Analysis	
Public Financing needs	Direct incremental costs	Rs/linear m	0.15	0.2	0.25
Implementation of barriers	Ease of implementation (e.g. all non-financial barriers)	Likert scale: 0 (highest barrier) – 100 (lowest barrier)	0.1	0.1	0.1
Climate - related	Enhance resilience to climate change	Likert scale: 0 (lowest resilience) – 100 (highest resilience)	0.2	0.2	0.25
Economic	Job creation / maintenance	Likert scale: 0 (lowest creation) – 100 (highest creation)	0.1	0.05	0.1
Environment	Biodiversity conservation	Likert scale: 0 (lowest conservation) – 100 (highest conservation)	0.15	0.1	0.1
Social	Social sustainability, SS (e.g. social acceptance, job maintenance, community involvement etc...)	Likert scale: 0 (lowest SS) – 100 (highest SS)	0.1	0.15	0.1
Political & institutional	- In line with government policy - Improve institutional capacity	- Binary scale: 0 (yes) or 100 (no) - Likert scale: 0 (lowest improvement) – 100 (highest improvement)	0.1 0.1	0.1 0.1	0 0.1

Table 17 also gives the unit (for direct incremental cost) and scales for scoring technologies relative to each other for qualitative indicators. The incremental cost of adaptation technologies was calculated from inputs obtained from key stakeholders and from the literature. For qualitative indicators either a Likert (0-100) or binary (0 or 100) scale was used. The methodology and data used to estimate the incremental cost of technologies was reviewed by members of the technical working group. The scoring of technologies on Likert scales was carried out using the expert knowledge of team members.

Allocation of weights and sensitivity analysis

Members of the working group also allocated weights to the different indicators that reflected the group understanding of how the different indicators (and criteria) helped to achieve the objectives of the TNA project. Further, members of the working group also allocated two additional sets of weights that were used in sensitivity analysis. The sensitivity analysis therefore consisted of investigating the relative changes in technology ranking based on relative changes in a combination of: (1) public financing since this criterion could be a significant barrier to technology adoption; (2) social sustainability since members felt that successful technology adoption was highly dependent on community participation; (3) biodiversity conservation that was deemed not to be a direct objective of the TNA project and could be taken to be partially covered by the indicator on enhancing resilience (especially for ecosystem-based adaptation options); (4) job creation which members felt could be less important than community participation. It is pointed out that the assignment of weights was carried out prior to scoring of technologies in order to minimize bias in their allocation; and (5) increasing the contributions public financing and climate-related criteria at the expense of 'in line with government policy'. The relevance of (5) is that all short-listed technologies were supported by government policy.

Sensitivity analysis was also carried out for the incremental cost of rock revetment since data provided by two key institutions differed (Rs40,000/m versus Rs100,000/m)

Technology fact sheets

TFS was developed for each adaptation technology, and information was provided on all aspects of the criteria and indicators given in Table 17. In addition to using their expert knowledge in the field, working group members could also use the TFS when needed. The TFS were validated after members of the working group had been given ample opportunities to provide their comments and suggestions. Bilateral meetings were also held with key institutions before finalizing the TFS. The TFS for the technologies retained for TAP are found at **Annex 6(b)**.

Scoring of technologies against indicators

The members of the technical working group were provided with all the TFS and a MCA calculator customized for the Coastal Zone. The MCA calculator for the Coastal Zone is found at Annex 6(c). The MCA calculator for the Coastal Zone was customized so that only the fields in the Performance Matrix (PM)sheet and weights needed to be changed. During the technology scoring session, only the PM sheet (see MCA calculator for Coastal Zone) was provided to the participants. Hence, they were able to score the technologies without seeing the evolution of the cumulative scores. This was one way to avoid bias in scoring to favour any particular technology. As part of the sensitivity analysis, participants were allowed to review their scores once the final results were known. The scoring was carried out through consensus based on shared expert knowledge.

6.3 Results of technology prioritization

The results of the MCA for Coastal Zone are summarized in Table 18 for the first four ranked technologies. The ranking (similar to results shown in the MCA calculator at Annex 6(c)) is for the incremental cost of rock revetment set at Rs100,000/m, which is the higher of the two cost data for this technology. The ranking of the first four technologies is maintained for all the three sets of weights given in Table 17. The rankings of the remaining three short-listed technologies are not shown because they showed variations during sensitivity analysis of weights. Further, they are not significant for TAP.

Table 18. Ranking of coastal adaptation technologies using MCA.

Rank	Technology
1	Restoration of coastal vegetation
2	Wetland protection
3	Dune restoration
4	Rock revetment

When the incremental cost of rock revetment is set at Rs40,000/m, the same list constitutes the top four ranked technologies. Further, the ranks are conserved except for the swap between dune restoration and rock revetment when the last set of weights (right-hand column) shown in Table 17 is used. In this case, the difference between rock revetment and dune restoration is marginal – i.e. only 1.1 absolute points.

The results show that the MCA analysis is quite robust.

7. Technology prioritization for energy industries

7.1 Possible mitigation technology options in energy industries and their mitigation benefits

As mentioned in section 3.3.4, a detailed review of possible mitigation technologies has been performed by the project stakeholders. The cross-cutting benefits of all these technologies are: (1) GHG emission reduction; and (2) lower dependence on imported fossil fuels. The latter enhances energy security and also has positive financial and economic returns through decreases in the energy import bill.

The first step was to identify all technologies ranging from low applicability/technically feasible to high applicability based on expert knowledge of the local context in terms of factors such as: (1) technologies must be related to Demand and Supply Sides management in the Energy Industries; (2) applicability of technologies for a sub-tropical country; (3) necessity for large capacities (e.g. scale of economies) for a small island like Mauritius; (4) baseline situation of technology (i.e. technology is current practice; technology is supported by ongoing initiatives or initiatives in the pipeline); and (5) time horizon for technology implementation. Sixty (60) technologies were reviewed. This list is shown atAnnex 7(a), including a brief description of the status and applicability of the technology in Mauritius.

It is pointed out that several mitigation technologies are not applicable in Mauritius because of a combination of context (e.g. climatic conditions implying no need for heating; topography that limits hydro-electricity; feed-in-tariffs to promote micro-generation of renewable energy technologies in place); technology already adopted (e.g. CFL and solar water heating for household and industrial applications); low socio-cultural acceptability (e.g. solar cook stoves); and/or the stage of development of Mauritius (e.g. use of modern fuels like LPG for cooking automatically excludes biomass/coal/kerosene cook stoves).

7.2 Criteria and process of technology prioritization

7.2.1 Prescreening of longlisted mitigation technologies

The second step consisted of a pre-screening of the retained technologies based on expert knowledge of the local political context and technology requirements for mitigation. Here, the factors that were used to retain technologies were: (i) contribution of technology to development priorities and existing policy orientations, (ii) GHG abatement potential, and (iii) cost estimates. These indicators are prescribed for technology prescreening in **Annex 7(a)** of the TNA Handbook ([l]). The list of 15 hardware technologies is shown in Table 19.

Table 19. Pre-screened mitigation technologies for the energy industries.

Index	Technology	Index	Technology
1	Solar PV (above 1 MW)	9	Biogas production from waste for domestic and industrial use
2	Wind turbines (utility-scale)	10	Micro-cogeneration/Biomass Heat and Power
3	Small-scale hydro (>50 kW)	11	Geothermal electricity
4	High Efficiency HVAC (industrial application)	12	Electricity Storage for intermittent RE
5	Efficient building design (façade /exterior wall insulation)	13	Ocean wave (hydro-kinetic) electricity generation
6	Building automation and management systems	14	Conventional Natural Gas combined Cycle
7	High efficiency compressors (industrial)	15	Humidity control systems
8	High efficiency boilers / heat recovery (industrial)		

Sectoral priorities of Mauritius are drawn up in updated Energy Strategy 2011 – 2025 Action Plan (see **Annex 2**).26In order to be in line with government policy, the first 8 technologies given in Table 19 have been retained for prioritization using MCA.

7.2.2 Technology prioritization using MCA

Defining MCA criteria and indicators

The first step was to define the MCA criteria and indicator for the energy industries (power sector). The MCA4Climate methodology (see [xlix]) was adopted at the IW and MCA indicators were identified for the criteria in subsequent technical working group meetings.**Table 20** lists the criteria, their corresponding indicators, as well as their units of measure (for quantitative indicators) or measurement scales (for qualitative indicators). The process of identifying indicators also allowed member of the working group to develop a common understanding of the meanings attached to each indicator.

Table 20. Sustainability criteria and indicators for prioritization of mitigation technologies.

Criteria	Indicators	Measurement scale	Weight	Sensitivity analysis	
Public Financing needs	Direct incremental cost, e.g. direct government budgeting	Rs/tCO2	0.15	0.2	0.15
Implementation Barriers	Ease of Implementation e.g. non-financial barriers	Likert scale: 0 (highest barrier) – 100 (lowest barrier)	0.15	0.1	0.1
Climate-related	GHG reduction	tCO2 (to 2025)	0.2	0.25	0.2
Economic	- Catalysing private investments	Likert scale: 0 (lowest) – 100 (highest)	0.15	0.1	0.05
	- Reduction in energy import bill	MRs (million Rs) (to 2025)	0.1	0.1	0.1
	- Replicability	Likert scale: 0 (lowest) – 100 (highest)	0.05	0.05	0.05
Social	- Impact on health	Likert scale: 0 (lowest) – 100 (highest)	0.05	0.05	0.05
	- Job creation	Quantity (to 2025)	0.10	0.15	0.15
Political and Institutional	Contribute to political stability	Likert scale: 0 (lowest) – 100 (highest)	0.05	0.05	0.15

[26] The Energy Strategy 2011 – 2025 Action Plan can be downloaded at http://www.gov.mu/portal/site/mpusite - accessed 5 February 2012.

Four of the indicators were quantified. Cumulative GHG emissions were calculated up to 2025, which is also the timeline for the Long-Term Energy Strategy Action Plan (see footnote 24). For GHG emissions related o electricity use, emission reductions were calculated using the 2011 Operating Margin (OM) for the national grid.27Where energy efficiency reduced the use of fossil fuels, the emission factors of fossil fuels were used to calculate emission reductions. The penetration of renewable energy and economy-wide efficiency gains in the power sector were derived from the Long-Term Energy Strategy, while the efficiency of technologies was obtained from the literature or from case studies conducted locally. References of all sources are given in TFS. The incremental costs of technologies were calculated using either the feed-in-tariffs (for renewable energy technologies) or from the difference between the energy efficient technology and the replacement cost of the baseline technology. Reduction of energy bill was calculated based on the reduction imported fossil fuels due to production of electricity using renewable energy technologies or through energy efficiency gains. Jobs were calculated using the methodology employed in the UNEP Green Economy Report.liii

Qualitative indicators were measured on a Likert anchored at 0 and 100. The scoring of technologies on Likert scales was carried out using the expert knowledge of team members.

Allocation of weights and sensitivity analysis

The procedure for the allocation of weights for MCA and sensitivity analysis is described in section 6.2. The sensitivity analysis therefore consisted of investigating the relative changes in technology ranking based on relative changes in a combination of: (1) public financing since this criterion could be an important barrier to technology adoption; and (2) balancing the social criterion by reallocating the weight of 'catalysing private investment' to 'job creation' (and GHG emission reduction). The weight allocated to improvement of health was kept low at 0.05 reflecting the observation of working group members that the direct benefits of technology adoption and diffusion on health was weak in Mauritius.

Technology fact sheets

TFS were developed for each adaptation technology, and information was provided on all aspects of the criteria and indicators given in **Table 20**. In addition to using their expert knowledge in the field, working group members could also use the TFS when needed. The TFS were validated after members of the working group had been given ample opportunities to provide their comments and suggestions. Bilateral meetings were also held with key institutions before finalizing the TFS. The TFS for the technologies retained for TAP are found at **Annex 7(b)**.

Scoring of technologies against indicators

The procedure described in section 6.2 was used. The MCA calculator that was customizedfor the Energy Industries is found at **Annex7(c)**.

7.3 Results of technology prioritization

The results of the MCA for Energy Industries are summarized in Table 21. The ranking shown did not change with sensitivity analysis showing that the MCA was quite robust.

Table 21. Ranking of "Energy Industries" technologies using MCA.

Rank	Technology
1	Wind (utility scale)
2	PV (>1 MW)
3	EE Boilers (heat recovery)
4	HE compressors (industrial)
5	Small-scale hydro (>50 kW)
6	Energy Efficient Building Design (Façade insulation)
7	EE HVAC (industrial)

During MCA, 'building automation and management system' was dropped after discussions with working group members. Research carried out while developing the TFS showed that this technology was always implemented concurrently with numerous energy efficiency and renewable energy technologies, making the calculation of technology-related emission reductions difficult to be carried out. Further, the investment cost seemed related to the size of the building and examples were scarce in Mauritius. The IPCC (2007) concludes on the building automation and management system that it is as yet unclear how much the technology can reduce energy usage and at what costs. Estimates provided on the technology energy savings differ considerably and therefore the technology requires more research and development to determine the financial requirements and costs. In this context, it was felt that inclusion of this technology in the TNA was premature.[liv]
The first three technologies have been retained for TAP.

8. Summary

The TNA report has reviewed the multi-stakeholder process that has been put in place in Mauritius to prioritize adaptation and mitigation sectors, as well as identifying climate change technologies for the priority sectors. The sectors that have been retained for the TNA project are: water, agriculture and coastal zones for adaptation, and energy industries for mitigation.

MCA, including sensitivity analysis of scores and weights, was used to prioritize and rank technologies. The resultsare summarized as follows:

SECTOR	TECHNOLOGIES RETAINED FOR TAP
WATER	• Desalination • Rainwater harvesting • Hydrological model
AGRICULTURE	• Up-scaling of locally proven Integrated Pest Management technologies • Micro irrigation (gravity fed drip & mini and micro sprinkler irrigation) • Decentralised rapid pest and disease diagnosis service (plant clinic)
COASTAL ZONE	• Restoring coastal vegetation • Wetland protection • Dune restoration • Rock revetment
ENERGY INDUSTRIES	• Wind (utility scale) • PV (>1 MW) • EE Boilers (heat recovery)

Annex 1 Status and progress of key national policies, strategies and actions plans that support sustainable development in Mauritius.

NSDS or Equivalent & Other Key Sector Strategies and Plans	Comments/Status
'Vision 2020' policy document.	Developed in 1997
2nd National Environmental Strategy and Action Plan (2000-2010).	Developed in 1999; Reviewed in 2008 and recommendations made for its further implementation;
National Environment Policy	Consolidation of scattered policy statements into a common approach for cohesive sectoral and cross-sectoral environmental management; Updated in 2007; Objectives: (1) conservation of environmental resources; (2) inter- and intra-generational equity; (3) include environmental concerns in socio-economic development; (4) achieve sustainable consumption and production patterns; (5) achieve "garden island" concept; (6) enhance partnerships across society; (7) development of environmental ethics in citizens; (8) promote policy dialogue;
National Solid Waste Management Strategy.	Based on three pillars: (1) minimisation of solid waste; (2) maximisation of value derived from waste; and (3) environmental waste treatment and management; Priority measures according to action plan are: (i) construction of additional transfer stations and upgrading of existing ones; (ii) construction of additional waste disposal facilities; and (ii) setting up of a compost plant;
Blueprint for a Sustainable Diversified Agri-food Strategy for Mauritius, 2008-2015;	addresses the food security through improving self-sufficiency status of a number of strategic crops in the short to medium term;
Food Security Fund	set up to increase the resilience of Mauritius towards food selfsufficiency and to face subsequent global food and feed crunches by increasing production of foodstuff locally and at the regional level by partnering with neighbouring countries; provides funds for adaptation such as the Food Crop Insurance Scheme and Sheltered Farming;

NSDS or Equivalent & Other Key Sector Strategies and Plans	Comments/Status
Climate Change Action Plan.	Formulated in 1998; Although most actions have not been implemented, many recommendations are still relevant;
National Physical Development Plan (NPDP) - Development Strategy and Policies	National-level strategy and policy framework to guide the efficient implementation of public and private sector infrastructure and development projects within a sustainable environment; Reviewed 2003;
National Development Strategy	The NDS, the main planning instrument providing the spatial framework, was approved in 2003. Subsequent proclamation of part of the Planning and Development Act in 2005 gave legal force to the NDS. In 2006, the policies and proposals were successfully translated at the local level through the preparation and approval of local development plans. In line with the principles of sustainability advocated in the NDS, a thorough review of the local plans for the main urban areas which have coalesced into a linear conurbation is planned so that an up to date framework for development is available for the next 10 years. The NDS is supported by sectoral or subject plans for issues like irrigation, land transport or for agricultural diversification, including the reform of the sugar and non-sugar sectors.
National Biodiversity Strategy and Action Plan.	Finalized 2006; A ten-year strategy to ensure the conservation of biodiversity, its sustainable use and the fair and equitable sharing of its benefits;
National Tourism Policy Tourism Sector Strategy Plan (2009-2015) Hotel Development Strategy.	Government vision to attract 2 million tourists by 2015; Emphasizes low impact, high spending tourism. Selective, upmarket, quality tourism is favoured, and although such tourism is not the only type, it constitutes the major segment of our tourists who stay in high class hotels; Recommends ways and means of achieving an environmentally sound, socially acceptable and economically viable tourism development. October 2009;

NSDS or Equivalent & Other Key Sector Strategies and Plans	Comments/Status
	In conformity with Planning Policy Guidance for Hotels and Resorts.
Development of an Integrated Coastal Zone Management Framework (ICZM)	Proposed 2009; To secure clean, healthy, safe, productive and biologically diverse marine and coastal environments; ensuring that natural resources, including those of the Exclusive Economic Zone, are managed to meet the long term needs of nature and people, through their sustainable use and development; and, at the same time, acknowledging the multiple uses and objectives of different sectors and stakeholders (e.g. tourism, fisheries, conservation). Under implementation;
National Programme and Action Plan on Sustainable Consumption and Production (SCP)	Covers period 2008-2013; 44 projects estimated to cost around Rs25.6million have been identified for implementation; Strategic priorities include: Resources Use Efficiency with a Focus on Energy and Water and Sustainable Buildings; Education and Communication for Sustainable Lifestyles; Integrated Waste management and Recycling; Sustainable Public Service Practices; and Improve the Market Supply of Sustainable Products and Services;
White Paper on Health Development & Reform.	Action Plan for Health sector; The principal actions proposed include a 24 hour family doctor service, major expansion of high tech, diagnostic and treatment services, new and improved hospitals and health centres and a greater emphasis on health promotion and preventive medicine;
Education and Human resources Strategy Plan 2008-2020	Formulated in October 2009; formulated in line with the vision of providing a quality education for all and developing a Human Resource base to transform Mauritius into an intelligent nation state in the vanguard of global progress and innovation through the development of a culture of achievement and excellence;
Water Sector Master Plan	Under study
Long-Term Energy Strategy 2009-2025	Finalised October 2009 Long-term energy action plan currently being reviewed;

NSDS or Equivalent & Other Key Sector Strategies and Plans	Comments/Status
	Renewable Energy Master Plan being articulated with support of the World Bank;
Maurice Ile Durable (MID) Policy & Strategy	MID Fund of US $40 M set up in June 2008 with resources mobilized through various taxes to finance a scheme for the preservation of natural resources and adapting to climate change; Initially focused on achieving energy independence, but has evolved to include social and economic considerations; MID 'Green paper' has been finalized; 10-year MID Policy & Strategy, with multi-annual (3 years) action plan are in the process of formulation

Annex 2 – Energy Strategy 20112025 Action plan

REGULATORY			
ACTION	**DESCRIPTION**	**TARGET**	**NOTES**
Energy Efficiency Act 2011	Proclamation of Energy Efficiency Act Part III Setting up of Energy Efficiency Committee	2011/2012 September 2011	The Act was enacted in March 2011 but will come into force on proclamation. Proclamation will be made by Sections
	Part II – Setting up of Energy Efficiency Management Office	December 2011	
	Part IV and V – Energy Audits and Miscellaneous sections	2012/2013	
Electricity Act 2005	Proclamation of Act	2011/2012	The Act will be proclaimed after the setting up of the Utility Regulatory Authority
Energy on Efficiency Regulations	Regulations to prescribe standards for products and standards for auditing	2012	Consultant is working the standards

INSTITUTIONAL			
ACTION	**DESCRIPTION**	**TARGET**	**NOTES**
Utility Regulatory Authority	Set up an independent utility regulatory body	2011/2012	
Energy Efficiency Management Office	Set up the Energy Efficiency Management Office	December 2011	Parts I, II and III of the Energy Efficiency Act to be proclaimed.
	Filling of posts	2011/2012	Posts to be advertised once Schemes of Service are approved by the PSC.
Observatoire de l'Energie	Set up a data base on energy efficiency	2011-2012	Assistance of ADEME,Reunion obtained to establish the data base
Mauritius Land Transport Authority (MLTA)	Set up and operationalize the Mauritius Land Transport Authority to implement reforms in the transport sector	2012	Relevant sections of the MLTA Act has been proclaimed to allow the setting up of the MLTA. The Consultants have submitted the draft final report.
Institutional mechanism for implementation of Action Plan	Reinforcement of technical capacity within the implementing agencies	2011- 2014	Training to be organized with the assistance of Indian Ministry of New and Renewable Energy and ADEME Reunion
Capacity Building	Develop training and capacity building programmes with the collaboration of tertiary institutions	2011- 2015	

ENERGY EFFICIENCY			
ACTION	**DESCRIPTION**	**TARGET**	**NOTES**
Sustainable energy budget	Establish appropriate budget for the setting up of Energy Efficiency Management Office	2011- 2025	Funds provided in the 2011 PBB and forecasted budget for 2012/2013 appear in PBB.
Minimum energy performance standards and energy efficiency labeling	performance prepared and enforced for the following appliances		Regulations to prescribe standards under preparation.
	Refrigerators and air conditioners	2012	
	Electric lamps and washing machines	2013	
	Electric ovens and dishwashers	2014	
	Electric water heaters and storage types	2015	
	Clothes dryer	2015	
Certify energy auditors	Develop a certification system for energy auditors and energy managers	2012-2013	
Energy Management Education	Develop professional courses in energy auditing, energy management, monitoring and targeting of sustainable building design	2012-2013	
Targeted incentives	Develop incentives to encourage purchase of energy efficient appliances	2012-2016	
Incentives for suppliers	Develop and introduce incentives to encourage suppliers to supply energy efficient appliances	2012-2013	No customs duty applicable on equipment for renewable energy
Energy Service Companies	Provide incentives to promote energy service companies	2012	

ACTION	DESCRIPTION	TARGET	NOTES
Clean development mechanism (CDM)	Secure financing for projects to release 1.8 million tons of CO2 emissions savings per year from:	2010-2015	The CDM designated national authority is under the Ministry of Environment and Sustainable Development. Letters of no objection have already been issued for four projects including the Lanfill gas-to-energy project, the Plaines des Roches and Bigara wind farm projects. Project proponents in Mauritius face several constraints in developing CDM projects, namely, high transaction costs, complex and timeconsuming procedures for obtaining CDM approvals and problem of economies of scale where individual projects cannot generate significant volumes of CERs to make the projects cost effective.
	Landfill gas	2011	
	Solar water heaters	2012-2013	
	Solar photovoltaic	2013-2015	
	Wind energy	2013-2014	
	Energy efficient lighting	2012	
	Transport projects	2014	
Sustainable building design	(i) Introduce Building Control Bill for mandatory sustainable energy design standards for new buildings, including housing, hotels and offices offices, including natural ventilation; day lighting; appropriate orientation; solar hot water systems; time-of day and smart metering; intelligent lighting systems that are suitable for low-energy lamps; and building energy management systems for buildings more than 500m2	2012	Ministry of Environment and Sustainable Development is embarking on the development of a national policy, guidelines and rating system for sustainable buildings under European Union funding.
	(ii) Guidelines for Passive Solar Design for buildings <500 m2	2012	
	(iii) Guidelines for Green Buildings (Min of Environment and sustainable Development)		

ACTION	DESCRIPTION	TARGET	NOTES
Low-energy consumption	Incentive schemes developed so that existing hotels and rented spaces make use of solar water heating systems, low-energy lighting and appliances. Rented houses/apartments to gradually use low-energy lamps as well as appliances with the highest energy efficiency label.	2011-2015	One million CFL lamps sold at subsidized prices to households. Budgetary provision made for two millions lamps in 2011-2012. All traffic lights replaced by LED.
Sustainable energy education	Introduce sustainable energy topics into the curriculum and provided appropriate teaching materials for schools.	2012	
Public awareness	Run programmes as a permanent activity to create awareness of the benefits of energy efficiency, renewable energy and sustainable living, including information on incentives/deterrents and rights/obligations for consumers.	2011-2025	Enhancement of Demand Side Management with special focus on contracts with big industrial/ commercial consumers to achieve peak shaving targets.
Energy efficient public	Implementation of a programme to	2011-2025	50,000 street lights being
lighting	eliminate energy-inefficient lamps, reconfigure lighting patterns as appropriate, and address issues such as over-lighting.		replaced by low energy bulbs in urban and rural areas. Consultant to be recruited to review lighting systems of major roads and motorways
Energy Audit Management Scheme (Non-residential Buildings)	(i) Adoption of Energy Audit Management Scheme (ii) Mandatory energy audits for designated consumers	2011 2012	
Training &Certification of Energy Auditors (Auditing and Energy Code compliance)	(i) Training in building auditing	2011- 2012	
	(ii) Training in compliance with Energy code in Building Control Bill	2012	
	(iii) Interim Certification of Auditors (Auditing & compliance)	2012	

ACTION	DESCRIPTION	TARGET	NOTES
	(iv) Training of MITD Trainers in building energy auditing	2011	
	(v) Capacity building of Mauritius Standard Bureau to be a	2012	
	Certification Body		
	(vi) Capacity building of MAURITAS as Accreditation body	2012	
Energy Management (Industrial Processes)	(i) Development of Guidelines for energy management in industries	2012	
	(ii) Mandatory energy audits in industries	2013	

RENEWABLE ENERGY			
ACTION	DESCRIPTION	TARGET	NOTES
Renewable Energy Development Plan	Finalize the Renewable Energy Development Plan	End 2011	Draft plan being finalized with assistance from Indian Ministry of New and Renewable Energy
Feed-in tariff	Development of feed-in-tariffs for renewable energy power plants:		
	(i) 50-400 kW	2012	
	(ii) above 400 kW	2012	
Wind Energy Projects	(i) Comprehensive wind assessment study and identification of potential onshore and offshore sites, as feasible, for development of wind farms	2012-2013	
	(ii) Construction of a 4x275 kW wind farm at Bigara	2012	
	(iii) Construction of a 20-30 MW wind farm at Curepipe Point	2013	
	(iv) Construction of an 18 MW wind farm at Plaines des Roches	2013-2014	10MW in 2013. 8 MW in 2014.
	(v) Construction of 20MW wind farms every three years, as from 2017	2017, 2020, 2023	

Bagasse Based Power Plant	(i) Increase bagasse-based energy from 350 to 520 Gwh	2015	Subject to the outcome of high level negotiations following the independent study on IPP's carried out in 2009
	(ii) Commissioning a study on the potential of cane residues for electricity generation	2012	
	(iii) Setting up of a pilot plant for handling and feeding cane residues	2013-2014	Subject to outcome of study
	(iv) Using cane residues for electricity generation by existing IPPs	2015-2020	Subject to outcome of study and successful pilot plant

ACTION	DESCRIPTION	TARGET	NOTES
Waste Management	(i) Production of electricity from 3 MW gas-to-energy plant at Mare Chicose	2011-2016	Plant to be commissioned in August 2011. Energy potential 20Gwh/year
	(ii) Management of municipal waste and composting	2014	
Hydro Power	(i) Construction of a micro hydro power plant at Midlands dam	2012	To be commissioned in 2012.
	(ii) Study on increasing hydro storage capacity at existing sites	2012-2013	
	(iii) Construction of two micro hydro power plants, one at Bagatelle Dam and the other upstream of the water treatment plant.	2015-2016	
Geothermal energy	(i) Preliminary study on the geothermal potential of Mauritius	2011	
	(ii) Feasibility study, including geophysical survey and borehole drillings, for the development of geothermal energy in Mauritius	2012	Subject to outcome of preliminary study
	(iii) Construction of a geothermal energy pilot power plant	2015	Subject to outcome of feasibility study.
Solar photovoltaic PV projects	(i) Installation of 5 kW photovoltaic systems in 10 Government schools	2011-2012	Energy potential, 70MWh/year
	(ii) Installation every two years of a capacity of 50 kW photovoltaic panels in Government buildings, as from 2013	2013-2025	
	(iii) Setting up of a gridconnected photovoltaic plant of up to 10MW	2013	
	(iv) Setting up of a gridconnected photovoltaic plant of 10MW, every 3 years after 2013	2016, 2019, 2022, 2025	

ACTION	DESCRIPTION	TARGET	NOTES
Small scale distributed generation	2MW of solar/wind/micro hydro small scale generation plants connected to the grid, on a net metering basis	2011	
	Review of grid code and feed-in-tariff	2012	
	2MW of solar/wind/micro hydro small scale generation plants connected to the grid, on a net metering basis	2013	
Solar water heaters	(i) Subsidy for the purchase of solar water heaters Phase II	2011-2013	Provision made in PBB for Rs 100M in 2012 and Rs 50M in 2013.
	(ii) Introduce a range of complementary policies, incentives to promote solar water heating systems to achieve in a short-tomedium term the target of 50% households and businesses, and in the longer term neareliminating the use of LPG and electricity for water heating purposes.	2012	
	(iii) Provision of solar water heater systems in 4 hospitals	2011-2012	
	(iv) Provision of solar water heater systems in 7 hospitals	2013-2015	
	(v) 50% of the hot water requirements of all new large buildings to be met from solar water heaters, in accordance with the Energy Efficiency Building Code.	As from 2013	
Grid Study	Study on smart grid	2012	
Studies on: Biomass, biogas, Trigeneration and Ocean energy	Studies to assess the technologies for long-term options for energy generation and interaction with other sectors.	2013-2015	
Policy for financing of renewable energy	Define a clear framework for financing of renewable energy technologies	2011-2012	
Research and Development	Develop research and innovation strategy along with MID framework	End 2011	
Regional cooperation	Develop regional cooperation in field of renewable energy and energy management	2011-2012	

TRANSPORT			
ACTION	DESCRIPTION	TARGET	NOTES
Lower average age of vehicles	Regularly review and implement measures to lower the age and improve the composition of vehicle fleets.	ongoing	
Control of high emission vehicles	Regulate imports of high emission vehicles and tax vehicles based on CO2 emissions Privatization of vehicle examination centre in order to introduce modern vehicle testing systems	2012-2015 2014	Control of emission of vehicles regulations made in 2002. Additional Smoke meters being procured for enforcement Excise duty halved on electric cars
Public transport incentives	Introduce economic incentives to choose public transport over private transport.	2012	
Bus ModernisationProgramme	Create high safety, comfort and cleanliness standards for new buses, which should all be low floor, multiple-entrance, air conditioned models, with minimum fuel efficiency standards and maintenance, inspection and emissions standards.	2011-2016	
Public transport information	Enhance bus and taxi service information.	2012	
Taxi regulations	Introduce a transparent, published, regulated tariff for taxis, to make them more attractive	2014	
Optimise traffic flow	Monitor traffic and travel demand patterns to improve traffic flow, which also lowers energy use.	2015	
Congestion charge	Introduce congestion charges in Port Louis, to encourage the use of public transport, discourage the use of private cars and reduce congestion.	2013-2015	Goods vehicles above 3.5 tons already restricted on motorway and A1 roads between 07.00 a.m and 09.30 a.m.
Introduction of mass transit system	Implementation of modern mass transit system	2017	

ACTION	DESCRIPTION	TARGET	NOTES
Ethanol - E10	Introduce E10	2012	Steering Committee set up at PMO to look into the introduction of ethanol.
Ethanol - E20	Carry out studies to determine whether and when E20 should become mandatory, taking into account the experience of the introduction of E10.	2014	

POWER SECTOR			
ACTION	**DESCRIPTION**	**TARGET**	**NOTES**
Electricity pricing	Set cost-reflective electricity prices. Costs may also include support schemes for energy savings, for Demand Side Management and for renewables.	2012-2013	
Feed-in tariffs	Introduce preferential feed-in tariffs for electricity generation from renewable energy sources for plants above 50kW.	2012	
Time-of-day metering	Introduce sophisticated meters for larger customers to provide better information about electricity use and costs.	2012	
	Introduce time-of-day metering and tariffs that provide an economic incentive for customers to move daytime electricity loads to night time, hence increasing the overall efficiency of the power system	2012/2013	
	Create consumer awareness of day/night tariffs, for example, washing clothes at night represents a cheaper and more sustainable lifestyle option.	2012/2013	
Capacity expansion	Commissioning of new power plants:		
	(i) 50MW coal unit	2014	
	(ii) 50MW coal unit or LNG plant	2015	
	(iii) 50MW coal or LNG plant	2019	
	(iv) 50MW coal or LNG plant	2023	
	Review of capacity expansion plan and future site selection for power plants	2015	

CONVENTIONAL FUELS			
ACTION	**DESCRIPTION**	**TARGET**	**NOTES**
Minimum stocks of petroleum products and coal	Construction of strategic and operational storage tanks:		
	(i) Mogas: 15000 MT (2x7500 MT)	2013	
	(ii) Gasoil: 10000 MT	2013	
Low-sulphur diesel fuel	Shifting from 500 ppm sulphur diesel oil to 50 ppm for land transport and industrial use, making a substantial, and noticeable improvement to air quality.	2012	As from August 2010, sulphur content in gasoil has been reduced from 2500 ppm to 500ppm Importation of 2500 ppm sulphur gasoil will continue for marine bunkering

INDUSTRY AND TOURISM			
ACTION Encourage sustainable programme for Industry and Tourism Sectors	DESCRIPTION Create energy efficiency programmes such as voluntary agreements with industries; sub-sector technology and know-how transfer projects; training in specialist sustainable energy topics; awareness building, promotion and transfer of know-how; proposals for new financial and fiscal tools. Resource Efficient and Cleaner Development Centre to be set up	TARGET 2011-2014 2014	NOTES Resource efficient and cleaner production programme being Industry with UNIDO funding. Further funding is sought to support enterprises during the implementation of the programme
Energy audits	Carry out Energy Audits by licensed Energy Auditors for the largest companies and develop energy management plans.	2012-2015	Energy audit reports drawn up by Enterprise Mauritius for 71 enterprises.
Sustainable tourism	Develop close working relationships between the Tourism Industry, the Land Transport Authority and the Energy Efficiency Management Office, in the context that fuel security, environmental sensitivity and tourism goals are mutually reinforcing.	2011-2012	
Fisheries sector	Economic incentives to be provided to use sails to complement outboard motors Use of wind and solar energy for operating water pumps and aeration equipment	2012-2015	

PUBLIC SECTOR			
ACTION	DESCRIPTION	TARGET	NOTES
The Public Sector Leads the Way	Introduce sustainable energy projects for public sector adhering to the principle 'The Public Sector Leads the Way'.	2011-2025	
	Provision of 5 KW solar PV systems in 10 schools	2012	
	Provision of solar water heaters in 4 hospitals	2012-2013	
	Provision of solar PV systems in all Government buildings	2012-2025	
	Energy audits in 100 government buildings	2011 - 2025	
	Capacity building for sustainable energy projects in Government buildings	2012-2025	
Sustainable procurement	Introduce sustainable procurement as a mandatory practice for all public services, for example-lamps, computers, airconditioning and fans, freezers, vehicles etc are energy efficient and have energy saving/stand-by modes and that all photocopiers and printers are equipped with a duplex mode to use both sides of the paper. The Energy Efficiency Management Office should develop expertise in these areas and advise all public sector institutions.	2012-2016	Procurement Policy Office has embarked on a project for sustainable procurement with collaboration of UNEP

GENDER			
ACTION	DESCRIPTION	TARGET	NOTES
Gender and Energy Use	Study on needs/assessment/capacity building for women, especially for the vulnerable groups. Information, Education and Communication programmes for women so that women are fully familiar with the efficient usage of energy.	2012 2011-2012	

Annex 3 – Validated Composition of Sectoral Working Groups

	Group 1: Energy	Group 2: Agriculture	Group 3: Water	Group 428.:	Group 5: Coastal Zone & Tourism
Proposed Chair	CEB	Agricultural Services/AREU	WRU	Ministry of Fisheries	ICZM Division, MoESD
	Ministry of Energy and Public Utilities,	Mauritius Chamber of Agriculture	Central Water Authority	Mauritius Oceanography Institute	Ministry of Tourism and Leisure
	Enterprise Mauritius	Ministry of Agro-Industry and Food Security	Wastewater Management Authority	Indian Ocean Commission	Beach Authority
	Ministry of Industry, Commerce and Consumer Protection	University of Mauritius	Statistics Mauritius	Statistics Mauritius	Mauritius Oceanography Institute
	Ministry of Local Government and Outer Islands	Mauritius Sugar Industry Research Institute	Mauritius Meteorological Services	Association pour le Developpement Durable	AHRIM
	Mauritius Chamber of Commerce and Industry	Agricultural Research Extension Unit	Mauritius Research Council	Policy Planning, MoESD	United Nations Development Programme
	Energy Consulting IPA London	Food and Agricultural Research Council	Pesticide Action Network of Mauritius	CPI, MoESD	CCD, MoESD
	OMNICANE Management and Consultancy Ltd	Forestry Service	Pollution Prevention and Control Division, MoESD	ICZM Div, MoESD	AFRC – Fisheries Division
	CCD, MoESD	National Parks and Conservation Service (NPCS)	Environmental Law Division, MoESD	Private Sector	Indian Ocean Commission
	CEB	CCD, MoESD	CCD, MoESD	NGO – MMCS,	
	Statistics Mauritius	NGO – Mouvement Auto-Suffisance Alimentaire	Sustainable Development Division, MoESD	Sustainable Development Division, MoESD	
	ECO-BIO-Tech (private sector)	Mauritius Sugar Planters Association	Mauritius Sugar Planters Association	Fishermen Investment Trust	
	We love Mauritius (NGO)	Farmers Service Corporation (FSC)	National Development Unit	Rodrigues Regional Assembly	
	University of Mauritius	Irrigation Authority Small Planters Welfare Fund (SPWF)	Irrigation Authority		
		Mauritius Agricultural Marketing Cooperative Federation Ltd			

Annex 4(a) – Adaptation options in the water sector.

Index	Technologies in the Pipeline (including being implemented)	H = hardware; S = software	Status of technology implementation	Benefits of technology
1	Building of new dams	H	In the pipeline	Increase of rain water capture and storage
2	Reduction of losses and leakage in distribution network	H	Ongoing	Reduce loss of treated water
3	Rain water harvesting at household level industrial level	H	Low level of implementation	Reduce dependence and consumption of treated potable water
4	Tertiary wastewater treatment for industrial purpose	H	Not yet implemented	Reduce dependence and consumption of treated potable water
5	Water demand management	S		Optimization of water utilization
6	Desalination of sea water at level of hotels (e.g. reverse osmosis)	H	In some hotels	Reduce dependence and consumption of treated potable water New technologies using renewable energy to be investigated
7	Create artificial ground water recharge (e.g. grass-crete)	H	Not yet implemented	Increase ground water availability and to protect coastal aquifers
8	Rationalization of water rights (legal perspective)	S	Census of water rights ongoing	Optimize water availability and utilization
9	National water policy	S		Monitor and regulate overall water utilization
10	Aggressive sensitization campaigns on water saving at all level whole year round	S	Ad hoc basis	Sensitise all water consumers on importance to use water judiciously
11	Close monitoring of water systems and aquifers	H	Ongoing	To make periodical assessment of water availability and to take appropriate actions as and when required
12	Review water tariff (e.g. differential tariff)	S	Recently done	Enhance judicious use of water and encourage use of treated wastewater and rain water harvesting
13	Protection of common recharge zones, aquifers and rivers (e.g. policy)	H / S	Already taken care in appropriate legislation	For protection of water quality

14	Promote use of water efficient fixtures, devices/ appliances	H	Low level of implementation	Enhance judicious use of water
15	Integrated surface-groundwater models	S	Not yet implemented	Forecasting/ planning and optimize use of water resources
16	Integrated Water Resource Management	S	Low level of implementation	This is a framework and not a technology

Annex 4(b) – Technology fact sheets for short-listed technologies in the water sector.

Annex 4(c) - MCA calculator for technology prioritization in the Water Sector

Annex 5(a)– Adaptation options for the agricultural sector.

Category	SN	Adaptation technologies	Status of the technology in Mauritius
Water Use and management	1	Improve water conveyance system	Implemented by the Irrigation Authority
	2	Micro irrigation (drip and sprinkler)	Its adoption by small scale farmers is low due to high initial investment.
	3	Rainwater harvesting and improved field ponds for water storage	A scheme has recently been launched to assist farmers in investing in rain water harvesting infrastructures.
	4	Use of treated wastewater for irrigation	Presently it can be used for irrigation of sugar cane but regulation need to be put in place. Sensitization campaign on the use of treated water for irrigation should be enhanced at the level of planters.
Planning for climate change variability	5	Improveagro-meteorological information network for forecasting and Early warning - data collection, processing and dissemination	Presently not being implemented.
	6	Reinforcing pest and disease monitoring and early warning system	It is limited to diseases of major crops but available to a small group of farmers through SMS
Soil management	7	Integrated nutrient management (organic, inorganic, bio-fertiliser, compost)	Technology implementation is very low and need to be reinforced.
	8	Composting of agricultural waste at household and farm level	Need to be encouraged at all levels and the use of compost should be further promoted.
Sustainable crop management,	9	Reinforce conservation of locally adapted varieties and seed production of locally adapted crop varieties	Need to be reinforced
	10	Enhance R&D in breeding,of varieties/breeds better adapted to drought, heat, disease (crop with better shelf life and nutritional value)	Limited to only a few crops due to limited resources
	11	Low-water consuming crop species and varieties	Not yet implemented
	12	Integrated Pest and Disease Management (use of physicacontrol measure and bio-control agents/ bio-pesticide and crop management	Presently being implemented in few location but need to be further reinforced.
	13	Protected cultivation (integrating rainwater harvesting and reuse of leachate)	Protected cultivation is being implemented but not integrated with rainwater harvesting and reuse of leachate
	14	Reduce postharvest losses- training and postharvest facilities	New technology need to be promoted to reduce food losses
	15	Increase foodcrop and feed production – promote soilless culture and rooftop gardening	Actually being implemented and being supported by Food security Fund.

Sustainable livestock management	16	Livestock disease management / training	Presently being implemented
	17	Livestock insurance scheme	Not yet implemented
	18	Biotechnologies – conservation of local adapted livestock breed for use in breeding via controlled mating	Need for reinforcing conservation of local breeds
Sustainable farming system	19	Mixed farming	Practised on a limited scale
	20	Tree planting and tree management / pruning	New technology need to reinforced
Land use management	21	Watershed management and agroforestry	New technology, not yet implemented
	22	Wetland restoration and afforestation	Need to be further reinforced.
	23	Monitor land use change / land bank – incentive for sustainable land management	Not yet implemented
	24	Mapping of Vulnerable areas (drought , floods)	Mapping of flood prone areas in the pipeline.
Capacity building and stakeholders organisation	25	Capacity building of research and extension to identify and adapt green and environment friendly technologies / indigenous technologies for dissemination to farmers/ schools	Implemented but need to be reinforced.

Annex 5(b) -Technology facts sheets for short-listed technologies in thewater sector

Annex 5(c) - MCA calculator for technology prioritization in agriculture.

Annex 6(a) – Adaptation options for the coastal zone.

Coastal Zone &Tourism				
Hardware	**Status**	**Software**	**Status**	**Organisational - ware**
Beach nourishment	Presently being implemented	Mapping , surveying and modelling	Not yet applied in Mauritius	
Rock revetment	Practiced			
Break waters	Practiced at certain location	Satellite remote sensing (AMESD Project by MOI) (Technology is evolving rapidly –COI)	In practice	
DuneRestoration	Presently being implemented			
Coastal Wetland Protection and Restoration	Implemented	Airborne / terrestrial laser scanning		Integrated Coastal Zone Management
Living shorelines		Videography	Done only for specific projects from the private sector	CZM Policies & Guidelines PPG OutlineSchemes EnvironmentalLaws
Restoration of coastal vegetation (Agro Industry)	Presently being implemented			
Removal of hard structures within the dynamic beach zone (site specific)	Presently being Implemented	Bathymetry survey (done by MOI)	In practice	
Scour Protection	Being implemented at mouth of drains	Identification and protection of sensitive areas in beach and lagoon	Need to be reinforced	
Coral reef system protection/ management	Being implemented Need to be reinforced	Environmental Education and		
Ecosystem Management	Presently being implemented	Development of maps to identify vulnerable areas		
Coral Transplant (cluster with coral growth enhancement)	Need to be reinforced Presently beingi mplemented	Mapping and surveying		
Coral Growth Enhancement	New technology ; still under R&D stage			
Flood Hazard Mapping	Implemented under AAP			
Salt water intrusion barriers	Future implementation			Integrated Water Resources Management
Surface Water runoff				

Annex 6(b) – Technology fact sheets for four prioritized coastal zone technologies.

Annex 6(c) – MCA calculator customized for the coastal zone.

Annex 7(a) – Mitigation options in the energy industries sector.

Index	Technology and description	Status in Mauritius
1	Renewable Energy (PV, wind and hydro) Micro-generation system (< 50kW)	Currently being implemented by CEB. Initial installed capacity of 2MW has been increased to 3MW. Uptake of Small Scale Distributed Generation of RE is very high because of favourable Feed-in Tariffs. A Grid Code for the interconnection of decentralized systems is also in place, guaranteeing technical quality standards. Standardized contracts for selling electricity to the utility are also in place, ensuring cash flows projections over 15 years. No such softwares are in place yet for larger, centralized generation systems.
2	Ocean, Wave, tidal energy	There is potential for hydro-kinetic energy generation, but not for tidal since tide differences in Mauritius are not significant. Where there are potential, there are no feasibility studies to justify them.
3	Energy Towers (solar towers)	More applicable in desert conditions; not very applicable to Mauritius.
4	Wind Turbines (on-shore; utility-scale)	Applicable and government already promoting market deployment through Public-Private Partnership through competitive bidding andIndian expertise has been solicited to prepare a wind energy resources atlas.
5	Geothermal (study underway and the report will be available by the end of 2012)	Preliminary or prospective study shows that there is some potential. The Ministry of Energy and Public Utilities (MEPU) is currently undertaking the drilling of a gradient well to confirm or otherwise the availability of this resource.
6	Biomass / Biomass combined heat and power	Already in application. Mauritius is a world leader in bagasse co-generation.
7	Digesters	Technology has been tested in Mauritius and used by a few small-scale farmers who also carry out animal husbandry. Bio-digestion of highly productive pig effluents is not culturally accepted.
8	Solar thermal (low temperature for heating water)	Applicable for both household and industrial uses. Technology has good and increasing penetration in Mauritius after government rebates.
9	Solar thermal (high temperature)	Concentrated Solar Power not very applicable since it requires vast areas.
10	Solar PV (centralized)[a 10MW PV farm is a the bidding stage]	Applicable. One 74kW centralized system operates on the New Government Centre. Government in the process of launching a Request for Proposal for a large centralized PV plant. Lack of technologies like: (1) feed-in-tariff; (2) standardized Energy Purchase Agreement; and (3) wind energy resources atlas prevents its quick and transparent deployment.

11	Hydro dams (large scale)	Already been done at maximum capacity. No room for expansion. Large variability in precipitation has negative impacts on hydro schemes.
12	Small-scale hydro	Applicable. Already being exploited by CEB. Expansion is known to be limited due to topography but need feasibility studies on site identification to know practicable potential.
13	Renewable for Pump Storage	Not very applicable; need big facilities; topography limits pumped storage.
14	Renewable & Batteries	Already been done, storage systems, low priority.
15	Hydrogen	No technical feasibility; lack of commercial application means it is not very applicable.
16	Solar pond	Not very applicable. Studies/dissertations carried out at the University of Mauritius have shown in limited application/potential.
17	Biogas from anaerobic digestion (similar to green gas) [several propositions have been submitted at the level of BOI and are being examined]	See comments on 'bio-digester' above
18	Biomass gasification	There is interest in gasification of bagasse, but technology is not proven.
19	Fossil Conventional Gas Cycle	Operated by CEB
20	Microgeneration	Very small scale generation (heat and electricity at same time) at level of energy industries has not been properly investigated in Mauritius. Economies of scale are not known.
21	Conventional Natural Gas Combine cycle	Applicable. Logistics for Natural Gas do not exist in Mauritius. Currently, Mauritius only uses LPG for cooking applications.
22	Conventional oil combined cycle	Not envisaged in Mauritius; possible to use fuel oil in combined cycle oil generators. Gas turbine for Mauritius is for peaking demands.
23	Advanced oil combined cycle	Not natural, synthetic oil. For time being, not applicable.
24	Conventional oil combustion turbine	Technically possible; not very applicable.
25	Integrated coal gasification	At development stage. Some big units in Europe. Cost is very high; not very applicable for Mauritius.
26	Supercritical coal	Not applicable; need very high capacities.
27	Coal Mine (+ Combined Heat and Power)	Not applicable. No coal mining in Mauritius.
28	Fuel Cells	Molten carbonate fuel, etc. Small scale. Not applicable for Mauritius.
Heating for household and industrial applications (in Mauritius heating requirements are exclusively for industrial purposes)		

29	High efficiency furnaces and boilers.	Applicable.
30	Heat pumps	Applicable in big residential complexes, could be applicable. Lack of interconnection between buildings prevents its application in Mauritius.
31	Green gas from biomass	Not applicable.
32	Heat recovery from tarmac on roads	Technically possible but not financially realistic in Mauritius. Unless a new city being constructed.
33	Wall insulation	Applicable.
34	High efficiency HVAC	Applicable. Need to convert old chiller systems.
35	Building orientation	Taken care of by Energy Efficiency Building Codes.
36	Heat storage (for re-use)	Air sealing could be efficient in a cold country. In Mauritius we need ventilation. Design principles are taken care of in EE Building Codes.
37	Advanced glazing	Mainly used to reduce heat loss in buildings. Not applicable in sub-tropical climates.
Cooling – Climate Control		
38	Solar air conditioners	Available now in Mauritius. Case study being implemented in Rodrigues.
39	Façade technology	Applicable.
40	Ventilation	Applicable in terms of air conditioning.
41	High efficiency HVAC	Applicable.
42	Window air conditioners	Will be promoted in Energy Efficiency Act.
43	Hot water in buildings	
44	Condensing boilers	Not applicable since space heating not required in Mauritius.
45	Solar thermal	Applicable. Already practiced. See comments above ‘solar thermal (low temperature)’
Lighting		
46	CFL	High uptake because of Government rebates.
47	Solar lanterns	Technology available on local market and financially attractive.
48	Light tubes	Already implemented in Mauritius.
49	Smart controls	Important and applicable. Is taken into account in EE Building Codes. Some hotels are already using this technology.
50	Daylight and building design	Important and applicable. Already being promoted through the EE Building Codes. Building design already adopted in commercial & industrial applications (e.g. RT Knits, MCB HQ, …).
Demand side management		

51	Smart appliances and home automation[new Mauritian Standards are under preparation for several domestic appliances, favouring energy efficiency]	Interesting but applicability in the current context of EE Act and EE Building Codes is questionable. Selective application in place e.g. MCB HQ and Longbeach Hotel.
52	Electronic power supplies	Already included in existing appliances?
53	CFLs and LEDs	CFL already promoted by Government through subsidized scheme.
54	High efficiency PC monitors and television	LCD Displays already on the market and fairly widely adopted. CRO being replaced now.
55	Variable speed drives	Already on the market.
Cooking (99% penetration of LPG for cooking in household and commercial applications makes several technologies in Annex 7 not applicable in Mauritius).		
56	Solar cookers	Technologically possible. No socio-cultural acceptability.
57	LPG and LNG	NG not imported in Mauritius. 99% cooking carried out using LPG that is highly subsidized by Government.
Industrial (energy saving) – Please note that Cement and Iron and Steel industries do not exist in Mauritius.		
59	Agro-food industry	Could be applicable in cattle farming – e.g. production of biogas. However, cattle farming are not practiced on a large scale in Mauritius. Thon des Mascareignes has adopted waste heat recovery.
60	Chemical (including textiles) industry	UNIDO is carrying out a EE project in textiles. Lot a scope for reducing steam use in textiles.

Annex 7(b) – Technology fact sheets for selected prioritized mitigation technologies in the energy industries sector.

Annex 7(c) – MCA calculator for the energy industries sector.

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