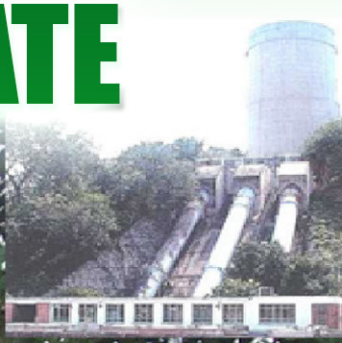
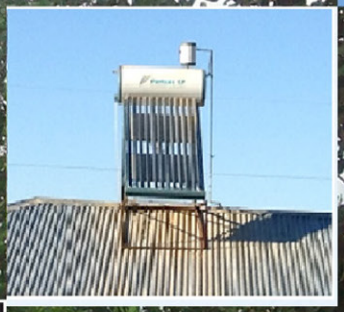
MALAWI GOVERNMENT

NATIONALLY APPROPRIATE MITIGATION ACTIONS FOR MALAWI





Ministry of Natural Resources, Energy and Mining
Environmental Affairs Department

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NATIONALLY APPROPRIATE MITIGATION ACTIONS

Environmental Affairs Department
Private Bag 394
Lilongwe 3
Malawi

Tel: (265) 1 771 111
Fax: (265) 1 773 379
Email: eadinfo@sdnp.org.mw

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FOREWORD

Climate change is one of several unprecedented, large-scale, environmental changes that the world is grappling with in present times. These changes are now affecting the whole planet and disrupting earth's life-supporting mechanisms, but the extent to which this affects human well-being and health varies substantially in different parts of the world, with sub Saharan Africa, including Malawi, being the most vulnerable to climate change and climate variability. Further, there are indications that temperature rises will be progressively higher in Africa with other climate related effects such as the frequency of extreme weather events, placing considerable pressure on livelihoods and economies across the continent.

The Conference of Parties (COP) of the United Nations Framework Convention on Climate Change (UNFCCC) has emphasized the need for deep cuts in global greenhouse gas emissions. These global efforts are encouraged based on the principle that Parties should protect the climate system for the benefit of the present and future generations, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities. It is in this light of reducing global greenhouse gas emissions that the Nationally Appropriate Mitigation Actions (NAMAs) were conceived.

The concept of NAMAs emerged at the thirteenth session of the Conference of the Parties to the UNFCCC in Bali, in December 2007. With regard to developing countries, it was agreed that Parties would consider: *"Nationally appropriate mitigation actions in the context of sustainable development, supported and enabled by technology, financing and capacity-building, in a measurable, reportable and verifiable manner."* The Malawi NAMA covers five key sectors namely: agriculture, forestry, energy, transport and waste management.

The production of the Malawi NAMA has relied heavily on insights from the Initial and Second National Communication Reports that were published in 2002 and 2011 respectively; national development frameworks such as the Malawi 2020 Vision, the Malawi Growth and Development Strategy II (MGDSII); and from stakeholder consultations. This document provides a platform from which the government and other stakeholders could work together to promote low carbon national development through the reduction of greenhouse gas emissions and enhancement of carbon sink capacity. Implementation of the NAMAs will assist in achieving the mitigation goals as outlined in the National Climate Change Management Policy which is *"to promote the reduction of greenhouse gas emissions; and enhance the capacity of carbon sinks while ensuring sustainable development".*

It is my hope therefore, that this NAMA will meet the expectations of bilateral and multilateral development Partners as well as national stakeholders to spur their collaboration and cooperation in providing financial, technological and capacity building support for Malawi to implement her NAMA. I wish to express my sincere gratitude to all those who have contributed in the preparation and production of this NAMA.

Honourable Bright Msaka, SC

Minister of Natural Resources, Energy and Mining.

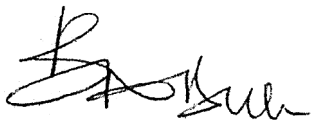
PREFACE

Government of Malawi published its National Adaptation Programme of Action (NAPA) in 2006. The NAPA clearly pointed out that climate change and climate variability have negative impacts that cut across all socio-economic sectors and undermines progress the country has made in these sectors. Thus the Government made a deliberate decision to include climate change amongst its key priority areas in its medium term development agenda, the Malawi Growth and Development Strategy II (2011-2016).

Government is committed to supporting global efforts to reduce greenhouse gas emissions, enhance carbon sinks and related efforts. This commitment has been shown through the signing and ratification of the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol. In addition, the Government has also been an active member of the Conference of the Parties (CoP). The Government, as Party to the Convention, has shown its commitment through reporting on its status of emissions and sinks as well as other climate change related programmes through the Initial and Second National Communication to the UNFCCC, the production of the National Adaptation Programmes of Action, the National Climate Change Management Policy and the National Climate Change Investment Plan.

The development and publication of Malawi's Nationally Appropriate Mitigation Actions (NAMAs) is a major milestone. Through the NAMA, the Government has been able to prioritise areas that will spur national development resulting in the reduction of greenhouse gas (GHG) emissions and enhanced sink capacity. The NAMA also provides direction for national or external support required for the implementation of various proposed integrated project briefs whose implementation will be based on approaches for measurement, reporting and verification (MRV).

The Government will continue to provide policy direction and create a conducive environment where various stakeholders will fully participate in the implementation of the activities as prioritized in this document.



Ben Botolo

Secretary for Natural Resources, Energy and Mining

ACKNOWLEDGEMENT

The compilation and production of the Nationally Appropriate Mitigation Action (NAMA) report was made possible through the assistance rendered by many individuals and organisations. In light of the above, Environmental Affairs Department would like to thank all government ministries and departments, various organizations and individuals who contributed in provision of data, ideas and information that was used as the basis for compiling this important national document. In particular, the Department would like to commend the team that analysed and synthesized the massive data and compiled this report,

Dr. Geoffrey Chavula,

Messrs Kenneth J. Gondwe and

Robert I. Kawiya.

The Department is also thankful to the United Nation Development Programme (UNDP) for the technical and financial support rendered to Government through the National Climate Change Programme that enabled the development of this report. This is an important milestone that will enable Malawi coordinate its efforts in sustainable development and contributes towards the global drive to reduce greenhouse gas emissions and enhance carbon dioxide sink capacity.

Tawonga G. Mbale-Luka
Director of Environmental Affairs

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ACRONYMNS AND ABBREVIATIONS

AFOLU	Agriculture, Forestry and Other Land Use
BAU	Business as Usual
BRT	Bus Rapid Transit
CISONECC	Civil Society Network on Climate Change
COP	Conference of the Parties
CO_2eq	Carbon Dioxide Equivalent
DCCMS	Department of Climate Change and Meteorological Services
DoEA	Department of Energy Affairs
EAD	Environmental Affairs Department
EE	Energy Efficiency
ESCOM	Electricity Supply Corporation of Malawi
GDP	Gross Domestic Product
Gg	Giga gramme
GHG	Greenhouse gas
GoM	Government of Malawi
HEP	Hydro-Electric Power
INC	Initial National Communication
IPCC	Intergovernmental Panel on Climate Change
IPP	Independent Power Producers
IPPU	Industrial Products and other Products Use
KPA	Key Performance Area
KPI	Key Performance Indicator
KII	Key Informant Interviews
MDG	Millennium Development Goal
MESSAGE	Model for Energy Supply System Alternatives and their General Environmental Impacts
MFEDP	Ministry of Economic Planning and Development
MGDS	Malawi Growth and Development Strategy

MRV	Measurement, Reporting and Verification
MSW	Municipal Solid Wastes
MW	Mega Watt
NAMA	Nationally Appropriate Mitigation Actions
NAPA	National Adaptation Programmes of Action
NCE	National Committee on the Environment
NTCCC	National Technical Committee on Climate Change
NSCCC	National Steering Committee on Climate Change
PV	Photo Voltaic
RET	Renewable Energy Technologies
SADC	Southern Africa Development Community
SNC	Second National Communication
TNC	Third National Communication
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
USCSP	United States Country Studies Programme
WTE	Waste to Energy

EXECUTIVE SUMMARY

Background

The climate change debate continues to dominate the global agenda. Its projected negative impacts pose threats to most of the social and economic gains that humanity has attained. The United Nations, at its annual conferences on climate change, has been calling member states to undertake mitigation measures to reduce greenhouse gas emissions. During the Bali Conference of the Parties (CoP), Parties were urged to voluntarily take "nationally appropriate mitigation actions" (NAMAs). Eventually, decisions were made during the CoP 16 in Cancun to implement NAMAs in a way that they could be measured, reported and verified (MRV), using local or international standards.

In April 2012, Malawi made its NAMA submission to the UNFCCC consisting of the following key sectors namely: Energy; Transport; Industrial Products and other Products Use (IPPU); Agriculture, Forestry, and Land Use (AFOLU), and Waste. The final list that was prioritized after stakeholders' consultations included the following:

Energy: solar water heaters, biomass gasification, fuel blend with ethanol, efficient biomass stoves, household biogas digesters, energy efficiency and hydro-electric power generation.

Industrial Processes: Soil-cement stabilized blocks, cement blends (rice or coal ash) and Solvay process for lime making.

AFOLU: Efficient use of fertilizers and manure management, conservation agriculture, improved livestock feeding systems, improved rice cultivation, sustainable land management, afforestation and forest regeneration.

Waste: Municipal solid waste management, composting, waste to energy (biogas/ incineration) and landfills.

Baseline Scenario

Baseline scenario projections involved use of the GHG inventories contained in the Second National Communication (SNC) with a view to coming up with a Business As Usual (BAU) plausible future. Plans and emerging issues in the specific sector were also involved. For instance, the projections in the energy sector considered the fact that coal fired power plants will be part of the energy mix much as Hydro Electric Power (HEP) and renewable energy will continue to grow. The summary of the BAU is shown the table below expressed as gigagrammes of CO_2 equivalents.

Table i: Baseline Scenario Projections by sector (Giga grams) 2015 - 2030

Sector	2015	2020	2025	2030
Energy	795.38	4,782.20	4,961.10	5,140.00
IPPU	72.04	78.17	84.30	90.43
AFOLU: Agric	8,990.58	9,418.44	9,846.30	10,274.16
FOLU	16,935.80	17,741.40	18,547.00	19,352.60
Waste	472.43	531.63	590.83	650.03
TOTAL	**27,266.23**	**32,551.84**	**34,029.53**	**35,507.22**

As shown in the table above, the projections for all the sectors, except for energy, show a steady rise. The energy sector shows a drastic increase in GHG emissions from 2020. This is due to the expected coal power generations plants to be installed at Kammwamba (300 MW) and Chipoka (100 MW). The AFOLU sector will continue to be the significant emitter in the country, contributing about 83% of the total GHG emissions. This is a slight drop from the 95% that was the case without the coal power generation plants.

Mitigation Scenario

The table shown below depicts the scenario with the implementation of mitigation actions for the period 2015 to 2030.

Table ii: Scenario with Implementation of Mitigation Action by Sector (Gg CO_2e) 2015 - 2030

SECTOR	GHG SAVINGS (GG CO2 EQUIV.)
Energy	25,000
Industrial Process	1,800
Agriculture	19,000
Land Use Change and Forestry	9,200,000
Waste	2,793
Totals	9,248,593

The AFOLU offers the greatest potential to reduce GHG emissions and/or sequester carbon dioxide. As a strategy, HEP generation must continue to grow to counter growth in coal power plants.

Since Malawi adopted a generalized NAMA, it was not possible to develop detailed project proposals. Instead, six project concepts have been formulated to capture most of the prioritized sectoral activities. The list of the NAMA concepts is as follows:

i. Sustainable agriculture for improved livelihoods in Malawi

ii. Sustainable Solid Waste Management

iii. Community-based sustainable biomass production and utilization in Malawi

iv. Promoting sustainable production and use of bio-fuels in Malawi

v. Promotion of solar water heaters for domestic and institutional application.

vi. Development of new HEP generation capacity

The publication of the Malawi NAMA document should initiate the elaboration of the NAMA project concepts and the development of full project proposals. The full project proposals will enable the Government to access financial and technical support as well as provide guidelines for local budgeting and implementation.

1.0 INTRODUCTION

1.1 Climate Change and Sustainable Development: Global Context

There is overwhelming scientific evidence that climate has changed remarkably in the last century than in any other before it (IPCC, 2014). Climate change debates have moved from laboratories and conference rooms to political arena because its impacts challenge all the developmental gains that humanity has made in recent years. The year 2015 is a significant milestone; a time when the global community is going to assess itself on the achievement of Millennium Development Goals (MDGs). It is also the year when Parties to the United Nation Framework Convention on Climate Change (UNFCCC) will be expected to adopt a new agreement after the expiry of the Kyoto Protocol. Climate change is a threat to the very systems that support human life and all earth's fauna and flora. It is particularly a major threat to the poor who often have low adaptive capacity. There is need to respond now with measures to reduce greenhouse gas (GHG) emissions as future costs of doing the same will be significantly higher (Stern, 2006).

1.2 Climate Change and Sustainable Development: National Context

In view of the above and in compliance with global efforts, Government of Malawi signed and ratified the UNFCCC in June 1992 and April 1994, respectively. In addition to that, Government ratified the Kyoto Protocol in October 2001, and submitted its Initial National Communication (INC) and Second National Communication (SNC) reports to the Conference of the Parties (CoP) of the UNFCCC in 2002 and 2011, respectively. In 2006, Government developed the National Adaptation Programmes of Action (NAPA) to address short to medium-term impacts of climate change on the country's social and economic sectors. In 2009, Government included Climate Change, Environment and Natural Resources Management as one of the Key Priority Areas (KPA) in the Malawi Growth and Development Strategy, Malawi's medium term development agenda (GoM, 2001; GoM,2006; GoM,2011a).

It is worth noting that Malawi's economy is highly dependent on rain fed agriculture; and hence vulnerable to the vagaries of climate change. Agricultural production and food security are severely compromised under the current climate change scenario. Climate variability is already reducing the length of the growing season for crops as well as force large regions of marginal agriculture out of production. Climate change is already having a negative impact on food security and the country's national development. Climate change is expected to aggravate the water stress that the country is now facing and will impose additional pressures on water availability, water accessibility and water demand. In light of the above, it is imperative that Government should put in place appropriate measures for averting deleterious effects of climate change (GoM, 2011b; GoM, 2013).

Responses to climate change may be classified into two main categories, namely: adaptation and

mitigation. Adaptation entails actions undertaken to reduce adverse consequences of climate change whereas mitigation involves the implementation of measures aimed at reducing the emission of GHGs into the atmosphere, and also efforts aimed at sequestering carbon dioxide (CO_2) that already exists in the atmosphere. Adaptation options for Malawi have been highlighted in the NAPA. The focus of this report is to develop country-driven and voluntary mitigation actions known as Malawi's Nationally Appropriate Mitigation Actions (NAMAs). NAMAs could be developed at various levels and sectors depending on the country's priorities, capacities, resources and other support interventions.

1.3 Rationale for NAMAS

In order to put the issues in context, there is need to reflect on the agreements of the UNFCCC. Developed countries were expected to reduce their levels of emissions to 1990 targets while at the same time taking into account principles of equity and common but differentiated responsibilities of all Parties. The UNFCCC provided a leeway for the developing countries to put priority on development and emission as secondary (UNFCCC, 1992). This provided a moral consideration for developing countries since the developed world had to go through a carbon intensive development path to reach the levels of industrial development that they are experiencing now.

The current global GHG emission trends pose a big challenge to all humanity. If the Business As Usual (BAU) scenario is maintained, the emissions will continue to rise with an average global temperature rise of 2°C by 2050 and likely 4°C by the 2100. Such a rise in temperatures would have catastrophic impacts on the very systems that support life. During the CoP 13 (Bali Action Plan) countries were asked to develop "nationally appropriate mitigation actions" as voluntary actions. CoP 15 (Copenhagen Accord) provided an avenue to establish international financial and technical support for the identification and implementation of NAMAs. While during the CoP 16 (Cancun Agreements) developing countries were urged to make "deep cuts" in GHG emissions (UNFCCC, 2011).

In Cancun, Parties agreed that internationally supported mitigation actions will be measured, reported and verified domestically and be subjected to international standards for measurement, reporting and verification (MRV) in accordance with guidelines to be developed under the Convention. It was also agreed that domestically supported mitigation actions will be measured, reported and verified domestically in accordance with general guidelines to be developed under the Convention. However, it was decided that reporting from Parties not included in Annex I to the Convention (developing countries) will be done in national communications, including inventories (UNFCCC, 2011).

It is against this background, that Malawi Government decided to develop its NAMAs in order for its implementation to contribute to global GHG emission reductions and enhancement of carbon sinks.

2.0 MALAWI NAMA PROCESS

There are different approaches for developing NAMAs depending on the national context. In the case of Malawi, the approach outlined below was adopted:

a. Presentation of potential list of NAMAs based on National Communications and other emerging issues was submitted by Malawi Government to UNFCCC;

b. Elaboration of the NAMA priority issues in Malawi through stakeholder consultations and surveys;

c. Development of reference (baseline) scenarios that would inform the development of national MRV framework;

d. Identification of priority domestically supported NAMAs being implemented or planned;

e. Compilation of sustainability mechanisms for the NAMAs;

f. Facilitation of stakeholder consultative fora constituted for purposes of discussing the elaboration of NAMAs; and

g. Review by National Technical Committee on Climate Change (NTCCC) and approval by National Steering Committee on Climate Change (NSCCC).

2.1 Identification of NAMA Priority Areas

Government of Malawi made its NAMA submission to the UNFCCC on 24th April 2012. The key sectors to be targeted for the development of NAMAs were: agriculture, forestry, and land use (AFOLU), energy (planning and development - i.e. promotion of renewables), waste management (e.g. targeting reductions in methane emissions), industrial production (implementing actions aimed at reducing emissions of CO2 and NO2), and improvement in the efficiency of transport and communication. The selection of a particular NAMA would be guided by its cost-effectiveness, socio-economic and environmental benefits, feasibility of implementation and sustainability.

2.1.1 Agriculture:

The NAMA in agriculture would constitute actions that would contribute to emission reductions while promoting the country's economic development. Since agriculture accounts significantly to GHG emissions, the NAMA would contribute towards emission reduction by taking into account the overriding need to ensure food security and sustainable livelihoods. The following list of activities was submitted for the Agriculture NAMA:

a) Documentation of GHGs in agriculture (CO_2, CH_4, N_2O, CFC, HFC, NOx);

b) Quantification of GHGs emission levels under different farming management practices with

a view to enhancing development of national carbon accounting;

c) Implementing changes in agricultural practices and systems that include integrated pest management, conservation agriculture, post-harvest handling and storage, water harvesting, watershed management, soil and water conservation, and irrigation farming;

d) Enhancing participatory research and technology development in crop, livestock, and fisheries production and management;

e) Land and water management;

f) Implementing agricultural advisory services and information systems by focusing on participatory extension approaches;

g) Strengthening local and farmers institutions and organizations;

h) Promoting microfinance schemes, including ensuring functioning financial markets and institutions;

i) Increasing focus on risk sharing and risk reducing across the entire value chain;

j) Developing/enhancing climate information systems and early warning mechanisms;

k) Reviewing and harmonizing existing policies and regulations that are dealing with climate change related impacts;

l) Mainstreaming win-win adaptation and mitigation strategies and actions through appropriate incentives;

m) Building capacity to develop, implement and monitor agricultural NAMA; and

n) Up-scaling best practices that enhance climate change adaptation and mitigation.

2.1.2 Land Use and Land Use Change and Forestry

The activities identified under land use, land use change and forestry were:

a) Expanding the stand of trees and the pool of carbon in forests; and

b) Maintaining the existing stands of the trees and the proportion of forests.

2.1.3 Energy

The activities identified under energy were:

a) Promoting renewable energy technologies;

b) Construction of biogas digesters;

c) Promoting efficient lighting technologies;

d) Promoting efficient firewood cooking stoves;

e) Increasing efficiency in Electricity Supply Corporation of Malawi's capacity and energy balances;

f) Increasing the ethanol to petrol blending ratio; and

g) Switching from paraffin (kerosene) lamps to photo-voltaic (PV) lamps.

2.1.4 Waste Management

The activities identified under waste management were:

a) Constructing controlled landfills and building capacity for the operation of the landfills;

b) Processing of solid and liquid municipal and agricultural waste into energy and organic fertilizer;

c) Reducing the generation of waste;

d) Promoting composting;

e) Promoting mechanical-biological treatment; and

f) Promoting the disposal of waste in sanitary landfills.

2.1.5 Industrial processes

The activities identified under industrial processes were:

a) Provision of regulation: permits to firms to operate depending on meeting environmental standards so that failure to do so results in financial or criminal penalties;

b) Engaging voluntary programme regulators with firms so as to share and disseminate information and expertise interactively;

c) Using market-based instruments such as the administration of taxes, tariffs and subsidies so as to shift the financial calculations of firms toward environmentally beneficial decisions;

d) Ensuring transparency in the reporting by firms of the pollutant discharged from their firms;

e) Conducting information, education and public awareness campaigns on the dangers of pollutants on human health and the environment;

f) Promoting industries that use carbon capture and storage technologies;

g) Promoting technologies that blend cement with rice husks;

h) Promoting industries that use carbon dioxide (CO_2) as a raw material; and

i) Promoting industries that add value to lime via the Solvay process

2.2 Stakeholder Consultations

Government engaged a team of consultants to undertake a detailed review of various reports, assessments, and projections, computation of emission reductions as well as conduct consultations at institutional and individual levels. The Inception Report and Draft NAMA Report were presented to the NTCCC for review. The draft report was also presented to a National Stakeholders' workshop for validation. The comments from the validation workshop were then incorporated in the final Draft Report which was presented to the NTCCC for review and final comments, and finally submitted to NSCCC for approval in readiness for official publication.

2.3 Prioritization of NAMAS for Malawi

The prioritised list of NAMA activities was agreed during the stakeholders' national workshop. It considered both the government submission to the UNFCCC and inputs from the stakeholders.

The basis for prioritization of the potential NAMAs were their potential to reduce emissions, synergy with government policies and plans, and their potential to secure funding and co-benefits (impact to the environment, economic opportunities, social well being).

The prioritised NAMAs were within the four GHG emissions source categories, namely:

- Agriculture forestry and other land use (AFOLU);
- Energy (including transport sub-sector);
- Wastes;
- Industrial process and other product use (IPPU);

2.3.1 Agriculture Forestry and Other Land Use NAMAS

a. Promotion of Efficient Use of Fertilizers and Manure Management

b. Popularization of Conservation Agriculture

c. Improved Livestock feeding systems

d. Improved Rice Management Systems

e. Sustainable Land Management

f. Afforestation and forest regeneration

2.3.2 Energy and Transport NAMAS

a. Increase hydro-electric power generation capacity

b. Solar water heaters

c. Biomass gasification technologies

d. Fuel blend with ethanol

e. Efficient biomass cookstoves

f. Biogas digesters for household use (see WTE)

g. Bus rapid transit (BRT)

h. Rail transit (Blantyre and Lilongwe)

i. Ethanol vehicles

j. Sena rail line

k. Carbon tax

2.3.3 Waste NAMA

a. Municipal Solid Waste (MSW) Reduction

b. Organic wastes for Composting

c. Waste to Energy (WTE) by incineration for power generation

d. WTE by anaerobic digestion for power generation/ fuel and Compost

e. Landfill gas recovery for power generation

f. Sanitary landfills

2.3.4 Industrial Processes NAMAS

a. Cement blend (rice or coal ash)

b. Lime production by solvay process

c. Cement blend for stabilized blocks

3.0 BASELINE GREENHOUSE GASES EMISSIONS

3.1 Background

Government of Malawi has so far undertaken three main GHG emission inventory studies. The first one was part of the US Country Studies. The other two were part of the preparation of the Initial National Communication (INC) and the Second National Communication (SNC) to the UNFCCC for base year 1994 and time series 1995 to 2000. The results from these national greenhouse gas inventories form the basis for the preparation of any mitigation activities.

Since the preparation of GHG inventories for the Third National Communication (TNC) is still in the pipeline, data for emission inventory for the SNC has been used in generation of baseline data. In cases where updated sectoral data was available, these were used to develop projection equations for future scenario.

There have been a number of developments in the regulatory frameworks and policies that relate to climate change. Malawi published its National Environment and Climate Change Communication Strategy in 2012, Climate Change Learning Strategy in 2013, Climate Change Investment Plan in 2013 and National Disaster Risk Management Policy in 2015. Furthermore, the National Climate Change Management Policy and Meteorology Policy have been drafted, and going through the final approval processes while the Forestry Policy is currently undergoing review.

Table 1 below is based on the GHG emission inventory that was used in the compilation of the SNC.

Table 1: GHG Emissions for period 1995 to 2000 (Gg of CO_2 eq./year)

	1995	1996	1997	1998	1999	2000
Energy	743.5	753	808.7	844.2	782.4	726.8
IPPU	59.6	46.8	38.7	48.4	57.7	59.7
AFOLU	21007	21226.3	21555.7	21623.4	21869.6	22334.3
Waste	248.6	259.4	270.5	281.6	293.5	308.8

Source: Government of Malawi, *Second National Communication for Malawi (2011)*

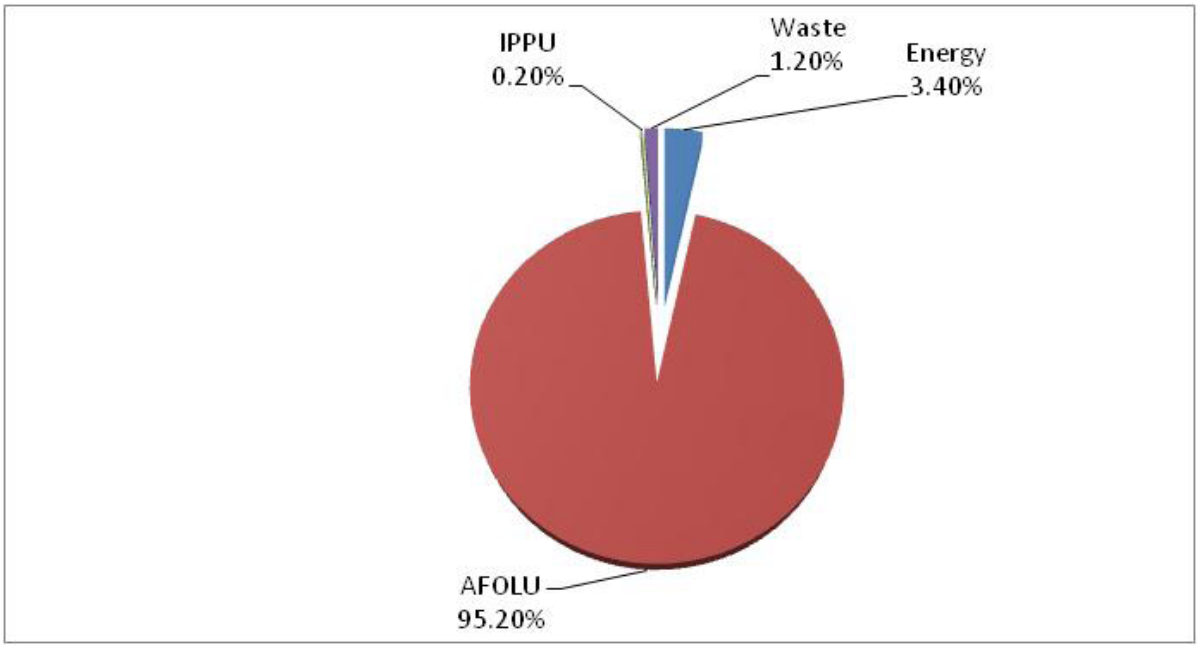

Figure 1: GHG emissions contributions by sector for year 2000, GoM (2011)

GHG data in Table 1 were used in projecting emission trend lines using statistical models to 2030. The results of the projections are shown in Table 2 and Figure 2a. This represents the BAU scenario without the investment in coal fired power generation.

Table 2: GHG emission projections based on SNC trends (Gg of CO_2 eq./year)

	2000	2005	2010	2015	2020	2025	2030
Energy	726.80	783.90	789.64	795.38	801.13	806.87	812.61
IPPU	59.70	59.78	65.91	72.04	78.17	84.30	90.43
AFOLU	22,334.30	23,205.90	24,439.35	25,672.80	26,906.25	28,139.70	29,373.15
Waste	308.80	354.03	413.23	472.43	531.63	590.83	650.03

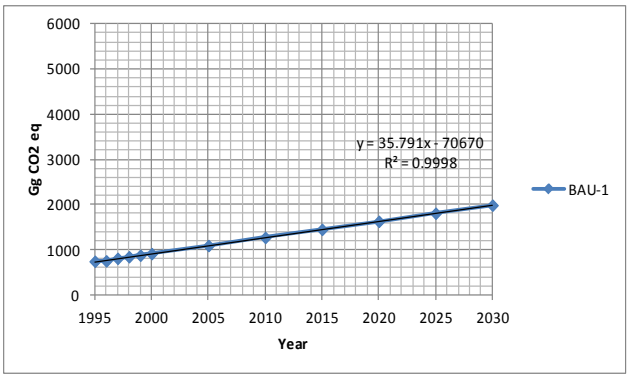

Figure 2a: GHG Emission projections BAU-1

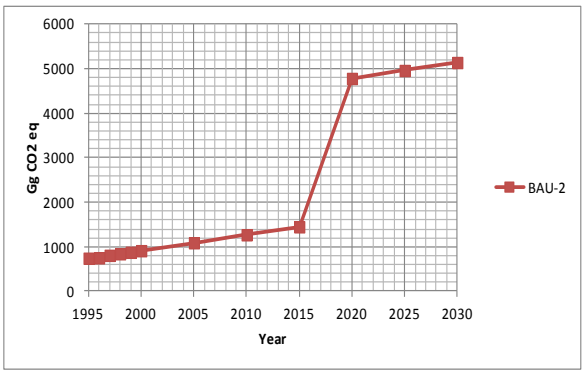

Figure 2b: GHG Emission projections BAU-2

However, the reality on the ground is that independent power producers (IPPs) have shown interest to develop two coal fired power plants between 2020 and 2030 under public private partnership (PPP) arrangement at Zalewa (300MW) and Chipoka (100MW) (GoM, 2011c). This would have a major impact on GHG emissions from the energy sector for the period 2020 to 2030. Thus, figure 2b and Table 3 represents the final BAU scenario-2 which has been used in this NAMA report.

Table 3: GHG emission projections adjusted for the current sectoral plans (Gg of CO_2 eq./year)

Sector	2000	2005	2010	2015	2020	2025	2030
Energy	726.80	783.90	789.64	795.38	4,782.20	4,961.10	5,140.00
IPPU	59.70	59.78	65.91	72.04	78.17	84.30	90.43
AFOLU: Agric	7,747.38	8,134.86	8,562.72	8,990.58	9,418.44	9,846.30	10,274.16
FOLU	14,586.92	15,324.60	16,130.20	16,935.80	17,741.40	18,547.00	19,352.60
Waste	308.80	354.03	413.23	472.43	531.63	590.83	650.03
TOTAL	**23,429.60**	**24,657.17**	**25,961.70**	**27,266.23**	**32,551.84**	**34,029.53**	**35,507.22**

3.2 Sectoral Baseline Emissions

A number of developments have taken place in the sectors that are responsible for GHG emissions. Some of the notable ones are:

3.2.1 The Energy Sector

The Energy Sector has opened up to IPPs, ending a 50 year monopoly of the government supported Electricity Supply Corporation of Malawi (ESCOM) as the sole grid electricity generating company. Malawi is still working towards electricity interconnection in the Southern Africa Development Community (SADC) Power Pool.

In terms of the emissions in the energy sector, biomass energy is accounted for in the forestry sub-sector. The main sources that have been considered are liquid and solid fossil fuels. Liquid fossil fuels have been covered under transport subsector, leaving coal as the major source of emissions. Coal is mostly used in the production of steam for process heating purposes.

The Department of Energy Affairs (DoEA) with support from the International Atomic Energy Agency (IAEA) developed a long term energy supply plans/ projections using a model called *Model for Energy Supply Strategy Alternatives and their General Environmental Impacts* (MESSAGE). The output from MESSAGE has shown how the energy mix is expected to change overtime and would enable Government make plans and allocate resources (e.g. capital, labour, technology, services) to meet demand for modern energy (GoM, 2011b).

3.2.2 Industrial Processes and Other Products Units (IPPU) Sector

Malawi has seen an increasing level of industrial activities and investor interests in the recent past. Since the last GHG inventories, there have been a new entrant in the cement manufacturing industry in Mangochi that is using locally mined limestone, as well as an increase in the overall cement production volumes at the Kasungu factory. Cement manufacturing is the largest source of industrial emissions in Malawi.

The key development policy documents, namely, the Malawi Growth and Development Strategy (MGDS) I and II and the Vision 2020, highlight the need for the country to enhance its capacity to add value to primary products through manufacturing (GoM, 2000; GoM, 2013). Thus, the projected growth in the manufacturing sector is in line with the country's medium and long term growth strategies. Furthermore, Government has a number of programmes to improve its infrastructure such as roads and bridges as well as construction of social service facilities such as hospitals and schools. Government has also embarked on improvement of rural housing for its population. There will be need to build 21,000 new homes annually, in order to meet the increasing demand for the urban population (GoM, 2010). All these efforts seem to indicate a steady market for the cement and lime industries.

3.2.3 Agriculture Forestry and Other Land Use (AFOLU) Sectors

3.2.3.1 Agriculture

Agriculture is the mainstay of Malawi's economy. It accounts for 30 to 40% of Malawi's Gross Domestic Product (GDP), employs about 85% of the country's workforce, contributes over 80% of foreign exchange earnings and supplies 60-70% of the raw materials to the manufacturing sector (GoM, 2010). Furthermore, the Agriculture sector contributes significantly to national and household food security. Malawi's agriculture is dependent on rainfall which is currently not reliable because of climate change and climate variability.

Despite the well developed agricultural research facilities and extension work in the 80s and 90s, the emphasis was on mono cropping with majority of Malawians growing maize for food and tobacco as cash crop. Use of chemical fertilizer was highly promoted. Majority of smallholder farmers were opening up new lands to increase production instead of emphasizing on productivity. Between 1975 and 1990, the area under cultivation expanded by 31%, giving an average expansion rate of 1.4% per year. Since this calculation includes fallow land, it can be concluded that the expansion must have come from clearing indigenous forests and woodlands. Such practices perpetuated unsustainable use of forestry resources, land degradation and increased emissions arising from chemical fertilisers. In the recent past, the country has witnessed promotion of conservation agriculture and other sustainable land use practices.

3.2.3.2 Forestry

The Forestry Department has the responsibility of managing public forestry resources in the country. There are 71 gazetted forests managed by the Forestry Department covering an estimated 0.87 million hectares representing 22% of forest cover in Malawi. The Department of National Parks and Wildlife manages national parks and wildlife reserves, comprising an estimated 0.98 million hectares which represents about 25% of total land area. Forests on customary land are owned by chiefs and cover 3.1 million ha, which is about 50.4% of the forested area in Malawi. The forests resources are inversely distributed with the population. The Northern region which has 10% of the population has 50% of the forests resources (GoM, 2010).

Due to various challenges, it has not been possible to regularly map and classify these resources. As a result, it is difficult to assess what is available for various competing uses. Forest cover has declined at an average rate of 179 square kilometres per year, between 2000 and 2010. Land clearing for agriculture coupled with high wood demands has led to increased deforestation and forest degradation. It is worth noting that forests also provide 93% of energy supply in the country in form of firewood and charcoal. Dzalanyama and Zalewa, which are major sources of firewood and charcoal for the major cities of Lilongwe and Blantyre respectively, are currently experiencing unprecedented deforestation levels that if left unchecked will have significant and irreparable damage to ecosystems. Government driven tree planting season campaigns and support is good strategy and should continue, but it should also result in more participation by communities and other stakeholders to ensure improved survival rate of the planted tree seedlings.

3.2.4 Waste Sector

Malawian municipalities have the overall responsibility for solid waste management (SWM) in their areas of jurisdiction. However, most of them are currently unable to fulfil their duty to ensure environmentally sound and sustainable ways of dealing with waste generation, collection, transport, treatment, and disposal. The failure of municipal solid waste management (MSWM) can result in serious health problems and environmental degradation. Because of deficient collection services, uncollected waste is dumped indiscriminately in the streets and in drains, thereby contributing to flooding, breeding of insect and rodent vectors, and spreading of diseases. Furthermore, even the collected waste is disposed of in uncontrolled dumpsites or burned openly, thus contributing to severe environmental impacts including pollution of water resources, land and air.

Human activities create waste, and the ways that waste is handled, stored, collected, and disposed of can pose risks to the environment and to public health. SWM includes all activities that seek to minimize health, environmental, and aesthetic impacts of solid waste. In urban areas, especially in the rapidly urbanizing cities of the developing world, problems and issues of MSWM are of immediate importance. This is putting undue strain in the service infrastructure. The city councils are struggling to provide good quality services to its citizens. Solid waste collection and disposal is currently operating well below people's expectations. However, data on waste management are

not regularly collected and used in decision making.

Waste treatment and disposal produce GHGs which are emitted into the atmosphere and contribute to global warming. The mitigation of GHGs aims at abating the effects of climate change. This can be achieved by reduction in generation of waste, recovery of GHGs such as methane, and adopting waste management practices that minimize the overall effects of GHGs. The key GHGs emitted in the Waste Management Sector (WMS) are carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). Due to lack of local activity data and emission factors, the GHG inventory in the SNC was computed by using estimated per capita solid waste generated values and default emission factors (GoM, 2011b).

4.0 PRIORITISED NAMAS AND POTENTIAL GHG EMISSION REDUCTIONS

4.1 Energy NAMA

The general principle that drive the mitigation interventions in the energy sector revolve around two areas, namely, substitution of fossil based fuels with renewable energy sources and reducing or eliminating avoidable energy losses during generation, transmission, distribution and end use equipment level.

Table 4 below shows the prioritised areas of energy NAMA from the list submitted to the UNFCCC by GoM and those that emerged from the consultative process.

Table 4: Prioritised areas of Energy NAMA

MITIGATION OPTIONS	
NAMA Submitted By Government of Malawi	**NAMAS Emerging From Consultations**
Renewable energy technologies (RETS)	Solar water heaters
Biogas technology	Biomass gasifier stove for domestic and institutional use
Energy efficient lighting	Energy efficiency practices-domestic and industrial
Improved cookstoves	
Improved transmission	
Ethanol blends in petrol	
Fuel switch for lighting in homes	

The above list was clustered into thematic areas based on energy sub-sectors. These were

a) **Large scale HEP:** Malawi Government will continue developing the HEP generation capacity (see Figure 3). It has over 1000MW potential of untapped generation from hydro-electric power on the Shire River systems and other parts of Malawi (Figure 5). The increase in HEP generation has to continue growing despite the private sector interests in the development of coal fired power plants;

b) **Other renewable energy technologies (RETs)/sources:** Solar PV for electric power and solar thermal for water heating will increase considerably over time (Table 5);

c) **Energy efficiency**: EE will be applied at generation, transmission, distribution and end-user levels to ensure losses are avoided in the energy supply chain. Additional benefits will be from household and institutional efficient energy end-use devices such as biomass stoves and kilns (Table 6);

d) **Efficient transport system-** In the 1970s and 1980s, Malawi used to have effective and efficient urban mass transit transport system. The aim is to re-launch mass transit system with improved facilities, schedules and coverage as well as promote the use of biodiesel; and improvement in road infrastructure necessary to reduce congestions in the cities of Blantyre and Lilongwe; and

e) **Biomass energy**: The government objective is to reduce percentage contribution of biomass in the energy mix over time as well as promote the use of improved biomass stoves. There is also great potential to produce biomass briquettes using sawdust and agricultural wastes. Note that the GHG emissions from combustion of biomass are accounted for in the AFOLU.

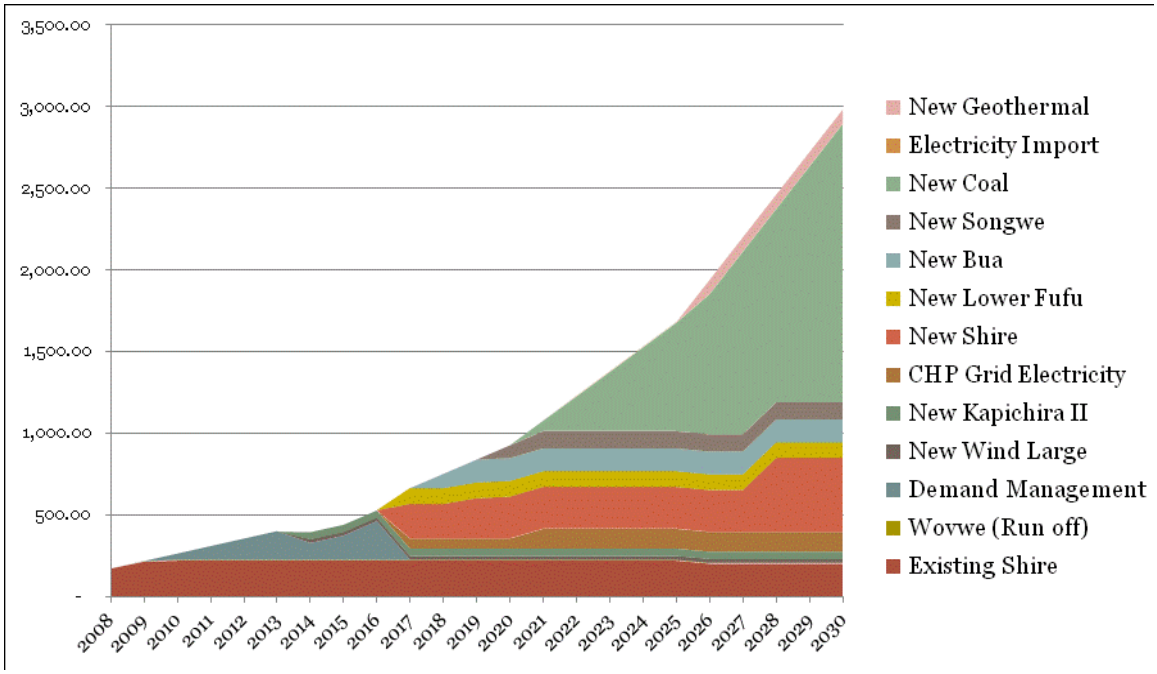

Figure 3: How Centralised Electricity is Supplied (MWyr)

Source: Energy Affairs Department, 2011.

Table 5: Projected Growth of various energy subsectors

Category	2015	2020	2025	2030
Number of solar water heaters	2,000	5,000	15,000	20,000
Number of solar small PV systems	20,000	30,000	40,000	50,000
Number of HH adopting improved stoves	10	750,000	1,000,000	1,500,000
Volume of bio-diesel (million litres)	2	10	15	20
Volume of ethanol (million litres)	18	25	30	40
% passenger using mass transit urban buses	<1	10	20	30
Additional HEP generation	-	25	100	200

Table 6 below shows alternative energy options that have potential to significantly reduce carbon dioxide emissions in the energy sector.

Table 6: Emission reduction potential from energy subsectors (Gg $CO_{2\ eq}$)

Category	2015	2020	2025	2030
GHG savings from other RETs- SWH	-	13	39	46
Tonne CO_2 eq SPV	-	6	8	10
GHG savings from improved stoves	-	1,500	2,000	3,000
Efficient transport system	-			
Use of biodiesel		60	90	120
Ethanol fuel blend (20%)		65	78	105
New HEP installations (coal power avoided)	-	197	788	1577
Total potential savings	**-**	**1841**	**3003**	**4858**

GHG mitigation potential is expected to grow from 1841Gg CO_2 equivalent by 2020 to 4858 Gg of CO_2 eq. by 2030. This will be an important contribution since the grid emission factor is bound to increase from almost zero to some significant value due to coal fired power plant. The biggest contributor to the reduction in GHG emissions is power generation from HEP which would potentially avoid investment in the coal fired power generation. The alternative pathway (MIT SCEN) is shown in figure 4 below. The cumulative GHG avoided between 2015 and 2030 is 25,200 Gg CO_2 eq.

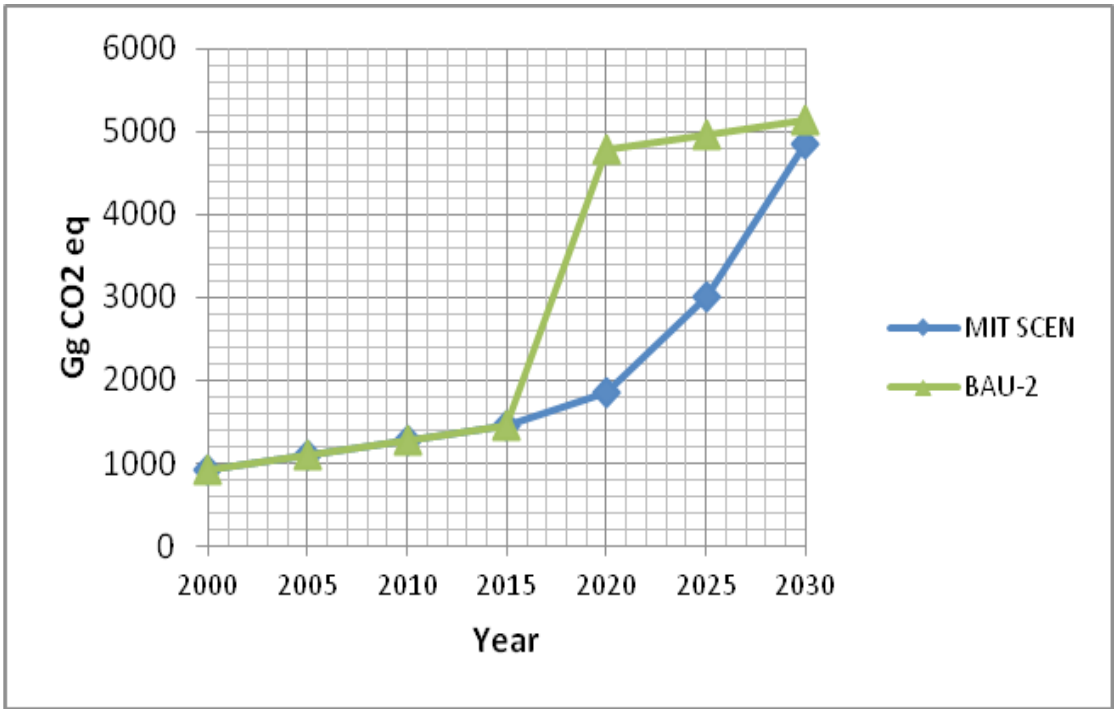

Figure 4: Mitigation scenario for the energy sector.

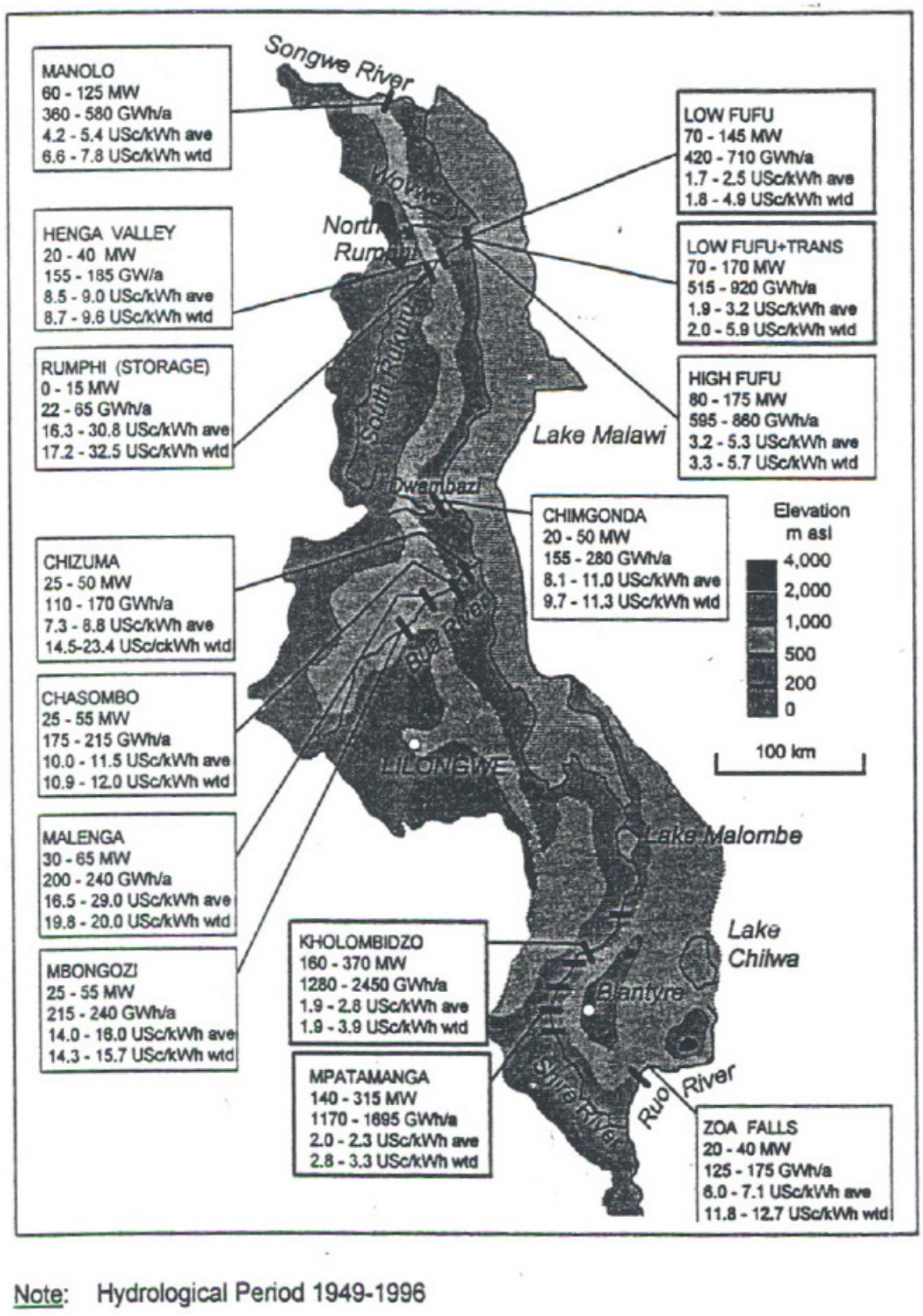

Figure 5: Malawi's large hydro-electric power potential sites.

Source: Energy Affairs Department.

4.2 Industrial Processes and Other Product Use (IPPU) NAMAs

The two main sources of GHG emissions for Malawi are from the calcination process in cement and lime manufacture. Since cement and lime manufacture are unlikely to decline overtime, the mitigation efforts are directed towards demand side management. The two main areas of mitigation in the Industrial Processes and Other Product Use (IPPU) are the reduction in cement consumption through cement blend (using rice husks ash or coal ash) and use of stabilized cement-clay blocks in place of cement blocks.

Table 7 shows GHG emission reduction for two activities that would contribute to net GHG emission reduction in the IPPU sector.

Table 7: GHG Reduction potential from the IPPU

Category	2015	2020	2025	2030
Stabilized soil-cement blocks	100	150	200	250
Cement blocks	40	50	60	70
Total potential savings	**140**	**200**	**260**	**320**

Related to the building industry is the sustainable production of burnt clay bricks. Currently, Malawi needs to build approximately 21,000 houses per annum to meet the needs of growing population in the urban areas. This would require around 1.7 billion bricks and cement. Alternatively, stabilized soil-cement (10%) interlocking blocks would be an ideal substitute or cement blocks to replace burnt clay bricks. From Table 7, the total GHG reduction between 2015 and 2030 will be 1,800 Gg CO_2 eq.

4.3 Agriculture Forestry and Other Land Use (AFOLU) NAMAS

4.3.1 Agriculture

GHG emission inventories of 1994 for Malawi showed that the greatest contributor to CO_2 equivalent emissions were N_2O emissions from the usage of fertilizer in agricultural soils. The second contributor was enteric fermentation and this accounted for about 20% of the agricultural GHG emissions.

The Initial National Communication presented a number of proposals aimed at reducing the volume of GHG emission from the agriculture sector, including: proper utilization of crop residues (rather than open burning) to increase soil fertility; effective and efficient use of fertilizers to reduce volatilization and leaching; enhanced reductions in savanna burning during the dry season.

The baseline scenario was defined as the BAU scenario, a situation that assumed that no attempts were made to curb the emission of GHGs. It was further assumed that in the BAU scenario, GHG emission would increase annually at a rate of 5%. Some of the mitigation options considered

included: improved animal husbandry where manure management to reduce or replace inorganic fertilizer and collection of dung for bio-gas production in anaerobic digesters are necessary to reduce emissions; improved fertilizer application whereby minimizing the use of fertilizer and encouraging application of organic manure has potential to reduce N_2O emissions; the planting of nitrogen fixing plants to reduce fertilizer usage; carbon sequestration where trees and tree crops are regarded as carbon sinks and purifiers, hence promoting the growing of tea, rubber, and fruit trees to increase the volume of sequestered carbon; the use of timber, poles and other wood products in building and carpentry thereby fixing the captured carbon permanently; and zero tillage. Potentially 19,000 Gg CO_2 eq. could be saved between the period 2015 and 2030.

Table 8: Emission reduction potential from agriculture sector (Gg CO_2 eq/year)

	2015	2020	2025	2030
Baseline	7500	9000	10000	11000
Improved fertilizer application	7500	8500	9200	10000
Conservation agriculture	7500	8300	8800	9500
Agroforestry	7500	8000	8300	8800
Savings		**1000**	**1700**	**2200**

4.3.2 Forestry and Other Land Use

Forests and trees meet Malawi's requirements for fuel-wood and poles for most of the timber demanded for construction, joinery and board manufacture. Rural dwellers, who make up the majority of the population in the country, rely to a large extent on forests for their needs in form of fuel-wood, bush-meat and other foods, construction materials, agricultural tools and medicinal plants.

However, the extent of deforestation is continually increasing with agricultural expansion, overgrazing, wood-fuel gathering, commercial logging and large-scale industrial wood-fuel use for tobacco curing, lime burning, brick making, bushfires, etc. Between 1972 and 1990, forest cover declined by 41% representing an average 2.4% per year. The current average national deforestation rate is 2.8% (GoM, 2010). Presently, only 23 and 26% of the total land area is estimated to be under some form of forest cover.

Two main mitigation options were suggested for the forestry sector by stakeholders, and these are: maintaining existing stands of the trees through reduced deforestation, or forest protection (i.e., forest regeneration); and expanding the stand of trees and the pool of carbon in wood products through reforestation programmes. These two options were then analyzed for their associated benefits. The reforestation option took into account the Tree Planting for Carbon Sequestration

that the country implemented and other Ecosystem Services Programme initiated by the Malawi Government. From Table 9, it can be estimated that the total potential GHG sequestration is 9.2 million Gg of CO_2 between 2015 and 2030.

Table 9: Emission reduction potential from Forestry sector (Gg CO_2 eq/ year)

	2010	2015	2020	2025	2030
Reforestation	8,800.00	11,000.00	11,000.00	11,000.00	11,000.00
Regeneration	220,000.00	458,333.33	660,000.00	953,333.33	1,210,000.00
TOTAL	**228,800.00**	**469,333.33**	**671,000.00**	**964,333.33**	**1,221,000.00**

4.4 Waste NAMAs

Human activities create waste, and the ways that waste is handled, stored, collected, and disposed of can pose risks to the environment and to public health. Government of Malawi has acknowledged the importance of MSWM. However, rapid population growth overwhelms the capacity of most municipal authorities to provide even the most basic services. Typically one- to two-thirds of the solid waste that is generated is not collected.

Figure 5: A typical sight in many high density/ unplanned residential areas

Malawian municipalities have overall responsibility for solid waste management (SWM) in their areas. However, most of them are currently unable to fulfil their duty to ensure environmentally sound and sustainable ways of dealing with waste generation, collection, transport, treatment, and disposal. The failure of MSWM can result in serious health problems and environmental degradation. Because of deficient collection services, uncollected waste is dumped indiscriminately in the streets and in drains, thereby contributing to flooding, breeding of insect and rodent vectors, and spreading of diseases. Furthermore, even the collected waste is disposed of in uncontrolled dumpsites or burnt openly, thus contributing to severe environmental impacts including pollution of water resources and the air. The problem of SWM in Malawi, when combined with rapid urbanization and unplanned development, is expected to be of such magnitude that significant reasons exist to initiate immediate action for improvement of this appalling situation.

There is no comprehensive data on waste generation rates, collection coverage, storage, transport, and disposal volumes and practices. The estimated per capita waste generation in cities and towns lies in the range of 0.37 to 0.9 kilograms per day. For Blantyre, the per capita waste generation is estimated to be 0.9 kilograms per day comprising 81% organic component. Lilongwe and Mzuzu cities estimate that per capita waste generation is 0.5 kilograms per day. On waste composition, it was characterized that solid waste in the City of Mzuzu, on average, constitutes: (i) organic matter (90%), (ii) plastic and rubber (4%), (iii) paper (4%), (iv) metal (1.0 %), (v) textile (0.5%), and (vi) glass (0.5%) (Chinyama & Madhlopa, 1999). Government recommended reduction of waste generation, use of landfill biogas, controlled incineration and composting for organic manure as technological approaches to mitigate GHGs in waste sector (GoM, 2011a).

From Table 10, it is estimated that the total reduction in GHG from municipal waste reduction, composting and conversion of wastes to energy to be 2,792.5 Gg of CO_2 eq. between 2015 and 2030.

Table 10: Emission reduction potential from wastes (2015 – 2030)

Option	2015	2020	2025	2030
Baseline	472.43	531.63	590.83	650.03
Municipal solid wastes	472.43	425.304	443.1225	455.021
Waste to energy + composting	472.43	372.141	354.498	325.015

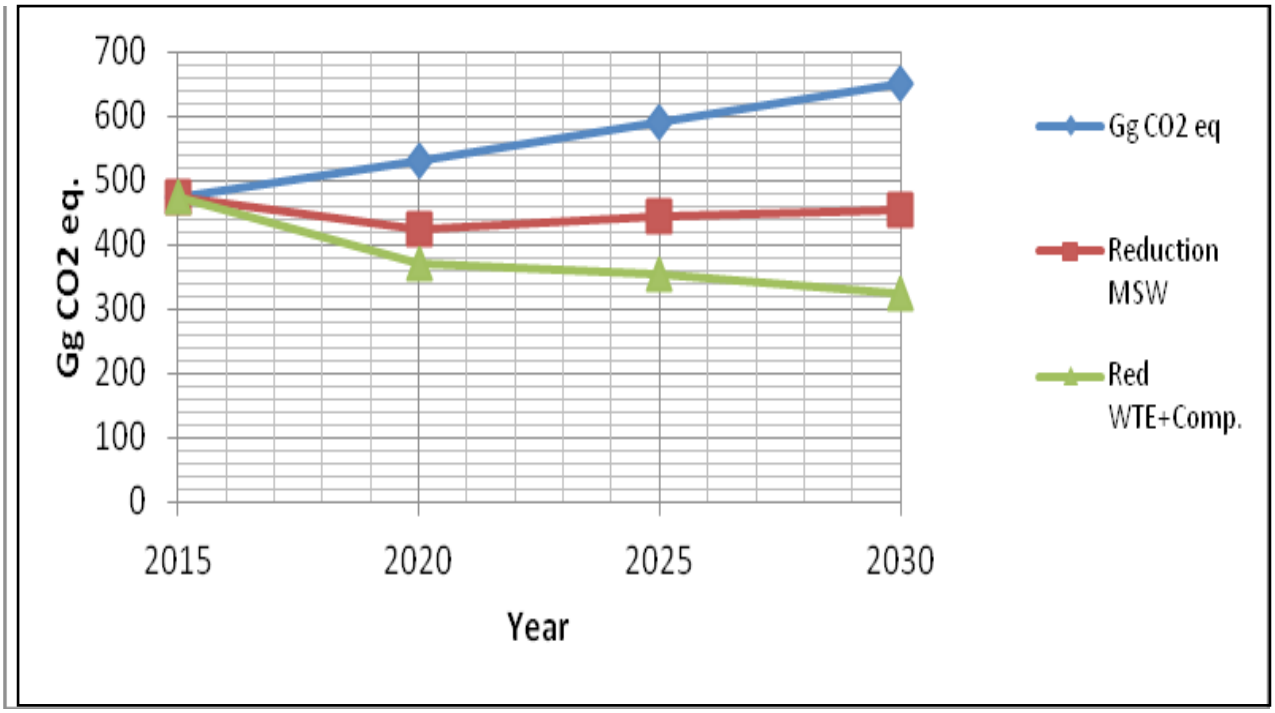

Figure 6: Mitigation scenario for the waste sector

5.0 IMPLEMENTATION ARRANGEMENTS

Environmental Affairs Department in the Ministry of Natural Resources Energy and Mining has the overall mandate to provide policy direction in environment and climate change programmes, projects and activities. In terms of implementation, relevant government departments and ministries, as well as other relevant non-state actors will lead in the implementation of sector specific interventions (Table 11).

There are also a number of programmes that are being implemented by non-governmental organizations (NGOs) and private sector.

Table 11: Lead Government Institutions

Thematic area	Lead Institutions
Energy	Department of Energy Affairs Malawi Energy Regulatory Authority Ministry of Transport and Public Works
Industrial Processes	Ministry of Trade and Industry
Agriculture	Ministry of Agriculture, Irrigation and Water Development
Forestry and Land Use	Department of Forestry Department of Land Resources
Waste	Ministry of Local Government and Rural Development City Municipal Councils and Town Councils

Main constraints or barriers to the implementation of the proposed NAMAs are inadequate financial resources, technology development and transfer, and lack of capacity. Since most of the proposed NAMAs are expected to be supported financially by donors and other financing institutions, the absence of such support will derail the implementation of the mitigation actions proposed by the Government of Malawi. Additionally, there is need for support in terms of technology development and transfer, and capacity building.

Proposed NAMA Concepts

Different types of NAMA have been submitted to UNFCCC. Most of the submitted NAMA are very specific and project oriented. However, Malawi adopted a generalized NAMA. Therefore, it was not possible to develop detailed project proposals for the long list that was submitted to the UNFCCC (See Section 2). Instead, six project concepts (see Annex) have been formulated to capture most of the prioritized sectoral activities. The list of the NAMA concepts is as follows:

i. Sustainable agriculture for improved livelihoods in Malawi

ii. Sustainable Solid Waste Management

iii. Community-based sustainable biomass production and utilization in Malawi

iv. Promoting sustainable production and use of bio-fuels in Malawi

v. Promotion of solar water heaters for domestic and institutional application.

vi. Development of new HEP generation capacity

The publication of the Malawi NAMA document should initiate the elaboration of NAMA project concepts and the development of full project proposals. The full project proposals will enable the Government to access financial and technical support as well as provide guidelines to enable government ministries and departments prepare and submit their NAMA budgets for funding. The respective project proposals will also provide details for planning and implementation.

6.0 MRV AND PERFORMANCE INDICATORS

6.1 Measurement, Reporting and Verification

In order to be able to track the impact of the various NAMA activities, the Government will enhance the existing measurement, reporting and verification structures. Currently, the mandate of monitoring and evaluating government programmes and projects is vested in the Ministry of Finance and Economic Planning and Development (MFEPD). Each government ministry and department publishes an annual report from which the MFEPD produces a concise report, *Annual Economic Review Report*, which reviews the performance of key government agencies.

The MRV approach will benefit from the aforementioned structures. The figure below shows how the information is expected to flow.

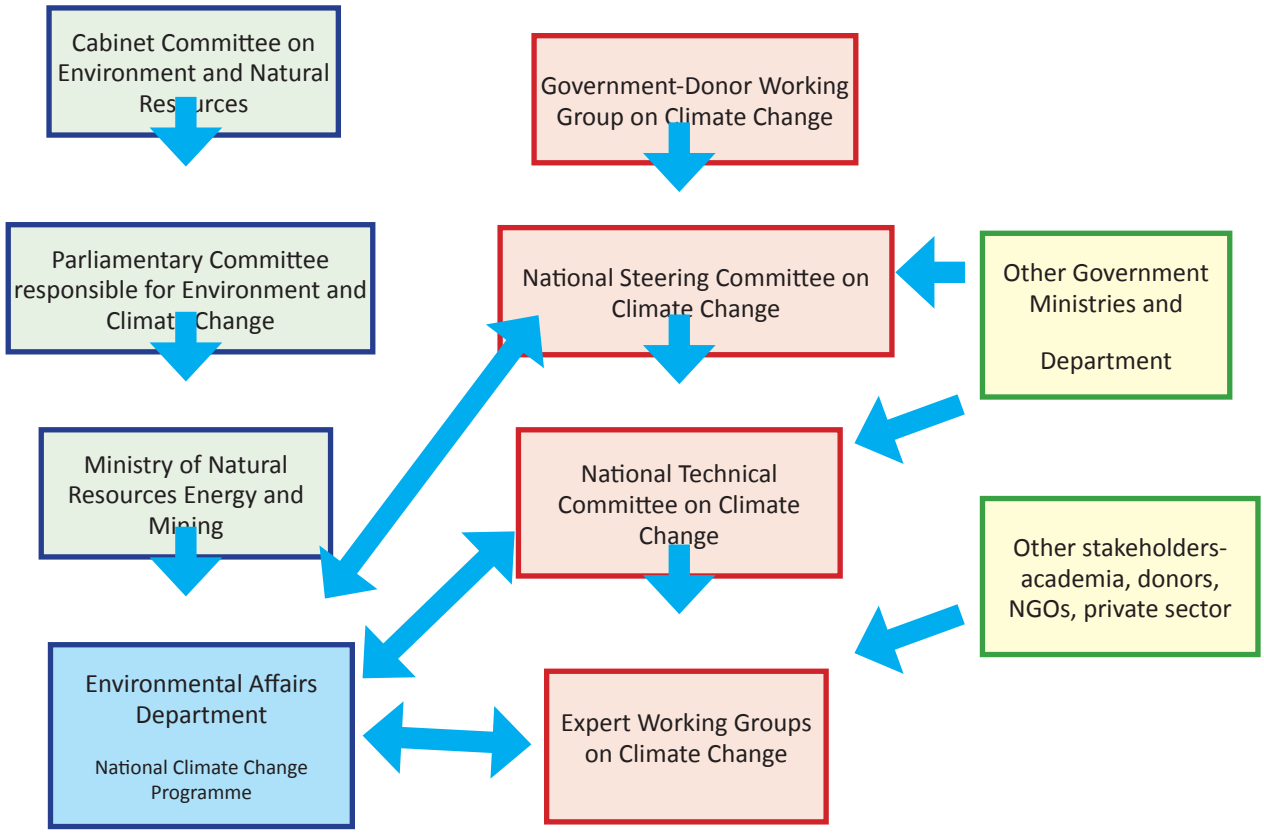

Figure 7: *Climate Change Institutional Coordination in Malawi Source: (GoM -NCCIP, 2013)*

Specific to climate change programmes and projects, Government has National Steering Committee on Climate Change[1] (NSCCC) which reviews policy related issues and National Technical Committee on Climate Change[2] (NTCCC), which monitors Government and other climate change programmes and projects in the country. Climate change programmes implemented by Government institutions in Malawi are coordinated by the National Climate Change Programme (NCCP) housed in

1 NSCCC is made up of Principal Secretaries of relevant ministries and sectors

2 NTCCC is made up directors from government agencies, and stakeholders from donors, NGOs/CSOs, academia, private sector who are active in climate change activities.

Environmental Affairs Department (EAD). Donors, NGOs and academic institutions also host and implement climate change programmes and projects.

6.2 Performance Indicators

Ideally, performance indicators must be aligned to the country's national sustainable development goals. The indicators may show two levels of performance. The first level of indicators is used to measure progress in terms of project implementation targets. The second level of indicators is used to measure the project impact in terms of the triple bottom line- economic, social and environmental benefits.

It is expected that the line ministries, departments and government agencies will be collecting data as part of the reporting requirement to the Government through the MFEPD. It will be necessary to develop appropriate data collection sheets to ensure that all the relevant data is regularly collected stored and archived. The proposed performance indicators for the NAMA are shown in Table 12.

Table 12: Potential Performance Indicators for NAMAs.

Indicator	Unit	Sectors				
		Energy	Transport	Industrial	AFOLU	Wastes
Number and ratings of solar water heater (SWH)	Numbers and kilo-wattage (kW/ unit)	X				
Number and type of improved stoves installed/ disseminated	Numbers and type (units/ type)	X				
Household expenditure on energy	Kwacha/ capita	X				
New HEP electricity generation	MW	X				
Energy costs saved (from energy efficiency)	Kwacha or US Dollar equivalent	X				
Number and capacity of biogas digesters	Volume of gas/ unit (m3/digester unit)	X			X	X
Biodiesel sold	Litres	X	X		X	
Ethanol sold or blended for fuel	Litres	X	X	X	X	X
Number of vehicles using biofuels	Number of vehicles	X	X	X	X	X
Energy security	Share of imported fossil liquid fuel substituted	X	X			
Jobs created	Number of new jobs created	X	X	X	X	X
Technology transfer	Number training programmes	X	X	X	X	X
Value of waste related products	Mk or USD equivalent				X	X
Access to waste management services						X
Number of trees planted	Number of Trees/Hectare	X			X	
Increase in area under forest cover	Hectares				X	
Chemical fertilizer imported	Tonnes per type				X	
Amount of chemical fertilizer consumption rate	Kilogrammes/ hectare				X	
Area under conservation agriculture	Hectares				X	
Public expenditure	Avoided infrastructure (K or US Dollar equivalent)	X				X
GHG reduction	Gg of CO_2 equivalent	X	X	X	X	X

7.0 COSTS AND FINANCING OPTIONS FOR NAMAS IN MALAWI

Climate finance covers resources that support a wide range of activities, projects and programmes. These are low-carbon and climate resilient development, policy and capacity for adaptation and mitigation, research, development and dissemination of new technologies.

Developers of supported NAMA should tailor their proposals in order to access international climate financing. Although the majority of the proposed NAMA activities will be supported NAMAs (Figure 8), the Government of Malawi has continued to show its commitment by supporting a number of activities through the central budget. Some of these are national tree planting season, policy enforcement, support climate change research activities and capacity building.

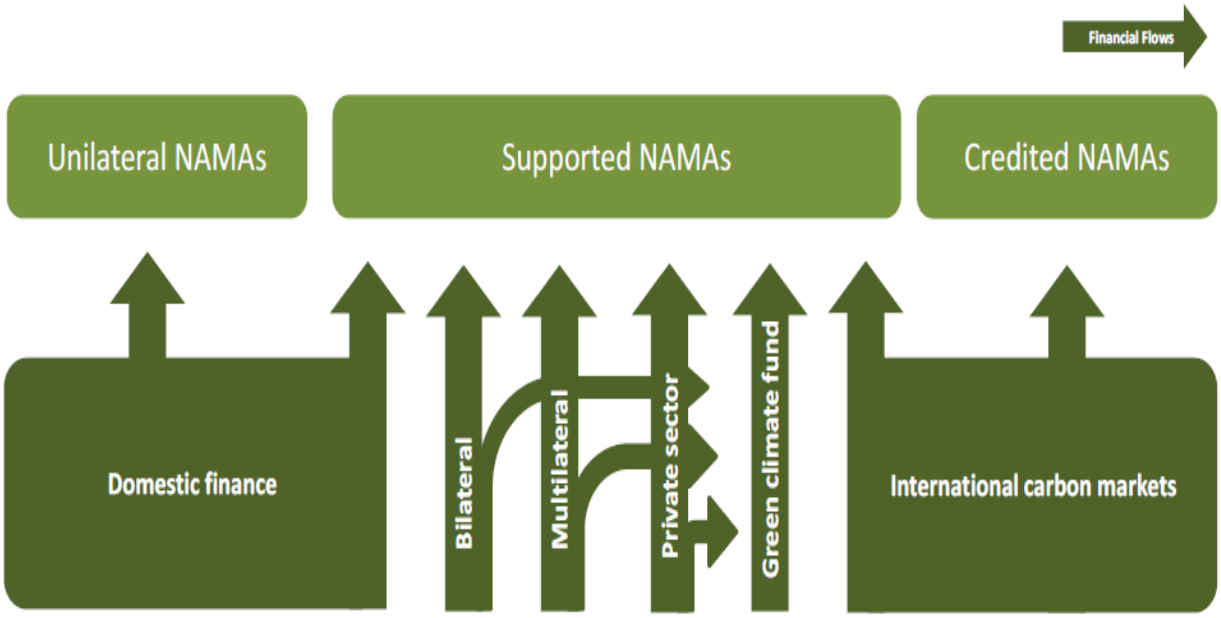

Figure 8: NAMA Types by Funding Source Source: IISD, 2014.

There are five main sources of funding for NAMAs, namely: Domestic Public Funding, Domestic Private Sector, International Public Funds, International Public Private Finance, and Hybrid Sources.

Under Domestic Public Funding arrangement, the host country sets aside in its national budget some money for climate change mitigation activities highlighted in the NAMA. Most activities or public sector services with emission reduction potentials enjoy public sector budgetary allocations e.g. the Government supported annual national tree planting season.

Table 13: Financing Malawi NAMA

Source of Finance	Type of NAMA	Coverage
National Budget	Unilateral	National budget can finance Public works program and public roads grass cutting using labour intensive approaches. There are attendant GHG savings using manual labour as opposed to using machinery to undertake the same works.
National Budget	Supported	Supported NAMA can be supported by government by issuing Government Bonds to raise finance. This is done to show government commitment to the cause to attract private sector investments. Other ways of raising finance is by regulations and incentives. The private sector will benefit from non-market based mechanisms which should be predictable, non-discriminating and do not erode business competitiveness. Public sector intervention modes to encourage private investment includes instruments like grants, purchase of assets, fixed payments for services, additional payments, subsidies (eg feed-in-tariffs), removing subsidies, tax, tax credits/ reductions/ exemptions, variable or accelerated depreciation, guarantee schemes, loan schemes, Technology standard (forcing investments). Examples may include • Fuel tax or reduction in fuel subsidy can generate revenues for NAMA if ring fenced. • Tax to replace electricity geysers for solar geysers – a level that ensures revenue. Bonds or green bonds are loan instruments available to corporations and governments. Bonds have longer maturity periods and low interest rates.

Under Domestic Private Sector Funding arrangement, private business, households, and private financial sector are three key potential sources of funding for climate change mitigation activities. Banks are seen as the financing partner for the private sector. Private sector is in turn prompted by economic benefits of the associated climate change mitigation activities.

As regards International Public Funding arrangement, the public international financing is provided by a diverse group of institutions such as the World Bank, Regional development banks, UN and Supra- National Bilateral Funding Agencies i.e. GEF, EU, etc. Such traditional development assistance mainly provide grants. Grant programmes are usually less relevant for financial engineering of NAMAs i.e. they are generally short-term financing options, not designed to effect permanent transformational changes in the respective countries.

Under International Public Private Finance (FDI) arrangement, foreign investors may deploy investment capital in a country of their choosing anywhere in the world. There must be good reasons to invest in country like Malawi and not in neighboring country seeking the same funds. Investors look at investment climate, host country's attitude and track record, risk rating (if it exists). Attracting FDI is a question of offering attractive investment options with appealing risk/ return ratios.

Hybrid Sources of Financing may fall into three main groups, namely: privately operated investment funds, export credit agencies, and private philanthropic foundations e.g. Rockefeller or Ford Foundations. However, even though the foundations are philanthropic they are increasingly tending to finance profitable businesses.

Privately operated investment funds with public capital (core capital is devoted to business development objectives in developing countries e.g. the IFC within the World Bank group). Export credit agencies (ECAs) providing insurance for FDI backed by their governments. Provision of risk guarantees is an indispensable instrument to bring foreign investors into sectors that are dependent on public sector regulation. This is the case for significant proportion of NAMAs.

NAMA Facility supported by United Kingdom and the Germany Government is one of the potential sources of funding for Malawi NAMA. This facility aims to be broadly accessible and aims to fund the most ambitious NAMA Support Projects available to the tune of € 5-15 million as ODA to the developing country. Table 13 shows a summary of potential financiers for Malawi's NAMA. The NAMA Facility asks for the submission of outlines of NAMA Support Projects through competitive calls for proposals. In general, outlines for NAMA support projects may be submitted by national governments or by qualified delivery organizations.

National governments submitting outlines for NAMA support projects to the NAMA Facility need to name qualified delivery organization(s) which will support the implementation of the NAMA support project. Outlines for NAMA support projects, which have been pre-approved by the Board, will be sent to the respective Delivery Organization. The Delivery Organization will be responsible for conducting an in-depth appraisal and due diligence of the NAMA Support Project to ensure its feasibility and to produce a robust implementation plan. The in-depth appraisal will be guided by a template for proposals for NAMA Support Projects, which will address the main aspects to be appraised.

Appraisal funding will be granted to Delivery Organizations based on the estimated appraisal costs, which have been indicated in the project outline. For administrative reasons, Delivery Organizations other than GIZ and KfW will be subcontracted by GIZ and KfW.

NAMAs are an emerging climate mitigation mechanism that may include projects, strategies and policies that contribute to GHG emission reductions in developing countries and facilitate low-carbon development in those countries. NAMAs are important for low-carbon development strategies because they help link climate mitigation efforts with social and economic development priorities (Sawyer et al., 2013, p. 5).

Table 14: Potential NAMA Financing for Malawi

Thematic area	Subsectors	Type of NAMA	Potential Funding Partners
Energy	HEP	Supported	Japanese Government
	Solar PV	Supported	DFID
	Improved Biomass Stove	Supported	DFID/ EU
Industrial	Stabilized Soil-Cement Block	Supported	Private sector- Lafarge
Agriculture	Conservation Agriculture	Supported	FAO, World bank, IFAD
Forestry	Regeneration (Conservation)	Supported	REDD+ /GEF
	Afforestation	Domestic/Supported	National Budget/ Private Sector
Waste	Waste to Energy	Supported	GEF, World Bank, UNDP

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9.0 ANNEX: PROJECT CONCEPTS

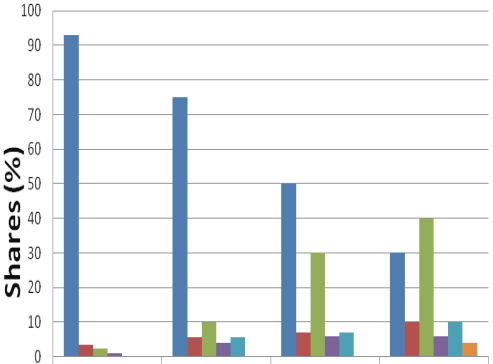
Project Title: Development of new hydro power generation capacity in Malawi

Background and justification:

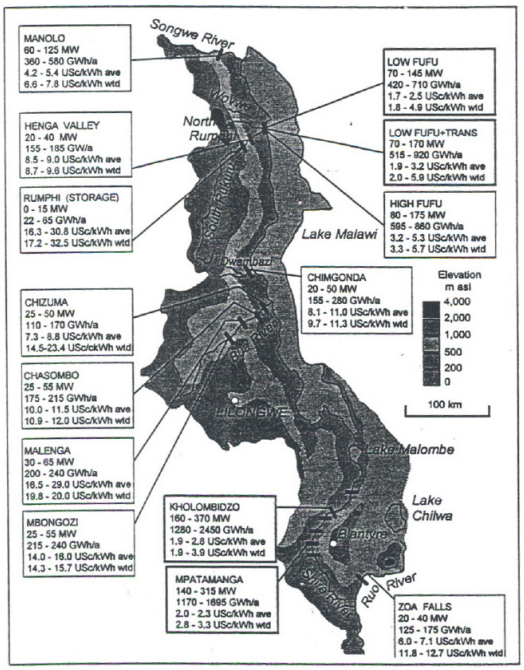
Energy is the prime mover of development. Unfortunately for Malawi, the demand for electricity by far exceeds the available generation capacity. Only 10% of Malawians can access grid electricity. The energy mix is highly skewed towards biomass which accounts for 93% of energy supply. Government has shown good intentions to grow the sector and shift the energy mix overtime (Figure 1). However, the picture has not changed much even after 12 years of implementing the policy. The inadequate capacity has also constrained the development of new economic activities such as mining.

Malawi has huge potential for hydro electric power generation (See map figure 2). Thus amongst other options, the Government has been exploring and implementing detailed feasibility studies on hydro power potential sites throughout Malawi in order to generate information necessary to come up with bankable projects that could attract investments in hydro power generation. Some of the potential sites are on the Shire, Songwe, Bua, Dwambazi, South Rukuru and Ruo rivers.

HEP provides the opportunity for Malawi to generate clean energy.



	2000	2010	2020	2050
Biomass	93	75	50	30
Liquid Fuels	3.5	5.5	7	10
Electricity	2.3	10	30	40
Coal	1	4	6	6
Renewable Energy Technologies	0.2	5.5	7	10
Nuclear	0	0	0	4



Note: Hydrological Period 1949-1996

Main and Specific Objectives:

Main Objective: To increase the generation hydro electric power in order to meet domestic, commercial and industrial energy needs in Malawi

Specific Objectives:

i. Undertake detailed feasibility studies in all the potential hydro sites in Malawi

ii. Develop bankable project support documents for the prioritised sites;

iii. Identify investors to implement the projects as a sustainable business ;

iv. Implement the projects

Target Group:

Domestic, institutional, commercial and industrial electric energy users

Lead Organization: Department of Energy Affairs, Ministry of Agriculture Irrigation and Water Development
Key Stakeholders/Partners: EAD, Land Resources and Conservation Department, Lands Department, Ministry of Industry and Trade, Malawi Investment and Trade Centre
Main Activities: i. Prioritise the sites for feasibility studies ; ii. Identify resources for the studies iii. Recruit consultants to undertake the studies; iv. Develop bankable project proposals; v. Identify investors; vi. Launch the project; vii. Implement the project; viii. Commission the project ix. Interconnect to the national grid through power purchase agreements
Time Frame: 2016 to 2030
Type of Support: i. Financial ii. Technical
Co-Benefits:
➢ Increase access to grid electricity from 10%- one the lowest in the world ➢ Avoided GHG emissions- compared to coal power generation ➢ Job creation and IGA opportunities ➢ Opportunity to attract foreign investments in priority sectors e.g. mining ➢ Saving forex: High quality and ample HEP will avoid diesel (standby gene sets) and paraffin for lighting ➢ Healthier lives- no indoor air pollution ➢ Energy security
MRV framework: national indicators will used during project implementation progress and final impacts

Project Title: Promotion of solar water heaters for domestic and institutional applications.

Background and justification:

The whole continent of Africa may generally be considered as a high potential area for solar. According to reports many countries receive an average of 325 days of per year of bright sun- light (Yansane, 2007). Despite the high potential, Africa has not made meaningful effort to exploit the massive resource due to various constraints. Most of the applications have been small stand alone home systems. The only facility that has been linked to the grid is the Kigali-based 0.25MW power in Rwanda that was supported by the German Government through GTZ. Large scale applications are under development in South Africa and Algeria.

Being within the tropics, Malawi has high solar power potential with an average of 3000 hours of sunshine per year falling at a rate of 2200 kilowatt hours (kWh) per square metre. Traditionally, direct solar power has been used as a source of energy for drying clothes and crops for a long time, a practice that is common to this very day. In the 80's, the Government promoted the use of solar thermal systems for water heating in public facilities such as hospitals. This initiative was discontinues in the early 90's. In terms solar photovoltaic (PV), large scale promotion and comprehensive boost came in late 1990's with the Global Environmental Facility (GEF)/ DANIDA funded programme of Barrier Removal to Renewable Energy in Malawi Project (BARREM) within the National Sustainable and Renewable Energy Programme (NSREP). Under BARREM, assessments were undertaken, human and institutional capacity built, policy incentive put in place (duty waiver on all RETs) and a number of demonstration facilities were developed to popularize the solar PV technologies. Currently, solar PV technology is considered as the technology of choice to supply electricity to rural public facilities that are sited far from the national grid. However the uptake for the solar thermal systems (which include solar water heaters) has remained low yet it offers the biggest potential to reduce demand for wood required for water heating. Solar water heaters can also be used to heat water in swimming pools as well as preheat process water in industries thereby reducing energy demand.

Main and Specific Objectives:

Main Objective: To promote solar water heaters for domestic, institutional and industrial applications.

Specific Objectives:

i. Develop a sustainable financing mechanism for solar water heaters;

ii. Develop local capacity to design and manufacture efficient solar water heaters

iii. Replace existing electric geysers with dual solar-electric water heaters at subsidized rates

iv. Install solar water heaters in all new government housing schemes and institutions

v. Promote the use of solar water heaters in medium and high density residential areas.

Target Group: Domestic, institutional, commercial and industrial hot water users

Lead Organization:

Department of Energy Affairs, Department of Climate Change and Meteorological Services, Department of Housing and Physical Planning, Malawi Housing Corporation

Key Stakeholders/Partners:

Malawi Polytechnic, Mzuzu University, Malawi University of Science and Technology, MIRTDC, Private sector,

Main Activities:

x. Draw TORs for SWH financing model/scheme ;

xi. Undertake the assignment;

xii. Identify fund managers;

xiii. Capitalize the fund;

xiv. Launch;

xv. Identify beneficiaries ;

xvi. Implement the project;

xvii. Monitor and evaluate the project.

Time Frame: 2016 to 2030

Type of Support:

iii. Financial

iv. Technical

Co-Benefits:

- Avoided GHG emissions- instead of using firewood and charcoal
- Job creation and IGA opportunities
- Reduced demand for grid electricity- hence available capacity to serve other customers
- Healthier lives- no indoor air pollution
- Reduced demand for firewood hence less deforestation

MRV framework: national indicators will used during project implementation progress and final impacts

Project Title: Promoting sustainable production and use of bio-fuels in Malawi

Background and justification:

Malawi has been producing ethanol that is used for blending with petrol for many years. Malawi has also successfully tested 100% ethanol fuel car. The performance is very positive and there are plans to roll out the technology.

It is reported that countries like India do use ethanol as a fuel for both cooking and lighting purposed. Potentially, ethanol could be extended to these other household applications. It is not only renewable but also locally produced and is available at industrial level. Department of Energy and Ethanol Company have been experimenting on a household stove produced in South Africa since 2006. The technology requires more field trials before it could be disseminated at a wider scale

Malawi also experimented on gel fuel which was being imported from Zimbabwe and South Africa. The product was launched and was available in the market for some time. Unfortunately, the business proved not to be financially viable as it was competing with paraffin whose prices are often subsidized. Another product that is being tried is Blue Wave. This is yet to be field tried a wider scale and be launched.

Zimbabwe has succeeded in growing of *Jatropha curcas* using small scale farmers for the production of bio-diesel. Locally, some growing trials have been going on for a few years championed by Bio-Energy Resources Limited (BERL) and smallholder farmers in a number of districts. Growing of such energy crops must not displace land meant for food production.

Main and Specific Objectives:

Main Objective: To promote sustainable production and use of bio-fuels in Malawi

Specific Objectives:

i. Review regulatory framework and enhance capacity.

ii. Assessment of supply chain for bio-fuels- production, quality and safety, and distribution infrastructure;

iii. Technology transfer for production various end use devices;

iv. Procure motor vehicle fuel conversion retrofits.

v. Incentivize alternative uses of bio-fuels at various levels.

Target Group:

Domestic, institutional, commercial and industrial hot water users

Lead Organization:

Department of Energy Affairs, Presscane Ltd, Ethanol Company Ltd.

Key Stakeholders/Partners:

Malawi Polytechnic, Mzuzu University, Malawi University of Science and Technology, MIRTDC, Private sector,

Main Activities:

i. Review appropriate laws that govern distribution and use of flammable material in mass market environment;

ii. Raise public awareness in the safe storage, handling and use of ethanol as household fuel;

iii. Raise public awareness in the safe storage, handling and use of biodiesel as household fuel;

iv. Identify private sector partners who will be involved in the supply chain for biofuels for household applications and as fuel for motor vehicles;

v. Identify private sector partner who will be willing to procure and stock end-use technologies

vi. Identify academic and research institutions to be involved in technology transfer arrangements;

vii. Monitor and evaluate the project.

Time Frame: 2016 to 2030

Type of Support:

v. Financial

vi. Technical

Co-Benefits:

- Avoided GHG emissions- instead of using paraffin, petrol or/and diesel
- Job creation and IGA opportunities
- Reduced demand for firewood hence less deforestation

MRV framework: national indicators will used during project implementation progress and final impacts

Project Title: Community Based Sustainable Biomass Production and Utilization in Malawi

a) **Background and justification:**

The Malawi Energy Policy, 2003, The objectives of the energy policy include: improving efficiency and effectiveness of the commercial energy supply industries; improving the security and reliability of energy supply systems; increasing access to affordable and modern energy services; stimulating economic development and rural transformation for poverty reduction; improving energy sector governance; and mitigating environmental, safety, and health impacts of energy production and utilisation.

The Forestry Policy, 1996

Forestry policy is concerned with production of wood resources in man-made plantations, woodlots, and natural woodlands. The policy provides a framework for sustainable production and conservation of wood resources and recognises the importance of wood fuels in the national energy supply and the need to bring about improvements in their sustainable production and supply. The policy specifically mentions the wood fuel needs of farmers in its general objectives and strategies, and recognises the importance of forest products in improving the quality of life in rural communities and providing a stable local economy. Additionally, the policy calls for a reduction in the dependence on wood-fuel as a source of energy through switching to alternative sources of fuel and adopting wood-fuel-saving devices so that 50% of energy should be sourced from non-biomass sources.

The Malawi Biomass Energy Strategy, 2009

The overall objective of the Biomass Energy Strategy is to ensure a sustainable supply of affordable wood-fuels. Its three specific objectives are to:

i. Increase the supply of sustainable wood-fuels;
ii. increase the efficiency of energy use; and
iii. create the institutional capacity to manage the biomass energy sector.

The Policy, now under review, shows that energy consumption is a balance amongst fuel wood, petroleum, electricity, coal and other biomass fuels. Malawi's consumption of these sources is in the ratio 93%, 3.5%, 2.3%, 1% and 0.2% respectively. Of the 93%, firewood is the main source of energy in rural areas while charcoal is mostly used in urban areas. The overall wood consumption exceeds sustainable supply by at least 2.37 million cubic meters. Expressed in terms of deforestation, this deficit translates into net clearing of minimum 50,000 hectares of woodland a year. Deforestation removes the ground cover, thereby exposing the soil to erosion. Siltation that has frequently interrupted water supply and hydroelectric power generation has been associated with deforestation within the Shire River Basin. About 85% of the Malawi's population is rural and over 99% of these depend on wood fuel as the major source of energy for domestic (cooking, water heating, space heating) and agro-processing purposes. In rural areas, cooking and heating uses the three-stone fireplace which is very inefficient.

There is need for Malawi to undertake community based sustainable biomass production and utilization projects based on water resource areas (WRA) in customary lands.

b) **Development and implementation of land use plans:**

Unsustainable land use results in degradation of the environment. Hill sides and river banks are exploited for firewood, communal livestock grazing and winter cropping leading to land degradation. Development of land use plans at local levels using participatory methods has the potential of restoring the land resources for sustainable supply of ecosystem services for sustainable livelihoods.

Land registers for households can be made with government for land user rights to ensure perpetual investment in land resources. The following activities shall be undertaken to address community's biomass needs;

c) Tree regeneration and enrichment tree planting:

d) Agro-forestry and Coppice Management:

e) Sustainable Charcoal Production using Bamboos and other energy trees:

f) Biomass Gasification for rural electrification:

g) Sustainable Energy Management:

h) Bushfire Control:

i) Community Livelihood Support for Natural Resources Recovery:

- **Other supporting livelihood activities**

In support of other livelihood activities, communities will be undertaking income generating activities like rearing rabbits, local chickens and guinea fowl, wild mushroom collections, growing mushrooms and bee keeping. Bamboo planting for charcoal making, sustainable charcoal making using modern techniques and sustainable wood harvesting will promoted.

- Supporting IGAs like rabbits, chickens, and Guinea fowl,
- Supporting wild Mushroom collection and mushroom Production:
- Supporting bee-keeping and honey production

Main and Specific Objectives:

Main Objective: To promote sustainable biomass production to support local energy needs in Malawi

Specific Objectives:

v. To promote sustainable community utilization of natural resources and the environment for their proper management and rehabilitation by way of development of participatory land use plans (PLUP),

vi. To promote, sustainable forest management and environmental education;

vii. To increase tree cover in gardens, village forest areas and family woodlots through agroforestry, regeneration, alley planting and enrichment planting to increase biomass;

viii. To enhance community interest for increased participation in CBNRM activities by way of livelihood support activities that enhance natural resources recovery and improved livestock management;

Target Group:

Smallholder Farmers and NSAs working with local communities in SLM

Lead Organization:

Department of Forestry**,** Department of Energy Affairs, Ministry of Agriculture Irrigation and Water Development

Key Stakeholders/Partners:

EAD, EP&D Department, Forestry Department, Land Resources and Conservation Department, Lands Department, District Councils, Department of Energy Affairs, Ministry of Women Affairs, Ministry of Industry and Trade, MITC, NSAs

Main Activities:

xviii. Community mobilisation and capacity building to restore local governance structures at ADC and VDC level;

xix. Developing and implementing of participatory Land use plans(PLUP) and land tenure matters to sustain investments in land management at village and individual level;

xx. Assisting communities in forest regeneration and tree planting in village forest areas and family woodlots including homestead, boundary and agroforestry;

xxi. Developing Bushfire control measures;

xxii. IGA support to communities with pass-on rabbits, chickens and Guinea fowl for alternative livelihoods;

xxiii. Promoting beekeeping, wild mushroom collection and mushroom production as supporting livelihood activities

xxiv. Promoting sustainable energy management through capacity building in construction of energy saving stoves and biogas,

xxv. Assist in procuring the right bamboo species and nursery propagation

xxvi. Promoting gasification technology for rural electricity and improved charcoal making;

xxvii. Training farmers in bee keeping and honey production;

xxviii. Developing demonstration centres for R& D and promotion of technologies.

Time Frame: 2016 to 2030

Type of Support:

vii. Financial Grant $14 m, Soft Loan $5 m

viii. Technical

Co-Benefits:

Economic	➢ Business opportunities in energy services ➢ Job creation ➢ Revenue generation from biomass value chains, sale of honey and mushrooms ➢ Savings of foreign exchange by using renewable power replacing kerosene for lighting
Social	➢ Energy security ➢ Security of tenure ➢ Renewable power supporting agro-processing and education, ➢ Sustainable local governance structures
Environmental	➢ Temperature moderation in homesteads ➢ Reduced indoor air pollution ➢ Use of renewable energy ➢ Improved biodiversity status ➢ Improved ecosystem services ➢ Efficient use of biomass

MRV framework: national indicators will used during project implementation progress and final impacts

Project Title: Sustainable Agriculture for Improved Livelihoods in Malawi

a) **Background and justification:**

The Malawi Growth and Development Strategy II (MGDS II) recognizes the importance and contribution of agriculture sector to the national economy. This is so because:

Agriculture employs 85% of the labour force, accounts for 43% of GDP and contributes 90% of export revenues. The major contributing factors affecting productivity in the smallholder farming sub-sector in Malawi is low input use, over-reliance on rain-fed agriculture, inadequate access to agricultural credit, and failures in technology development and transfer. This is further exacerbated by climate change effects such as erratic rains and droughts.

The agriculture sector has been experiencing growth in productivity of maize and tobacco. However, this growth has been slow and below the expected potential. The country's self sufficiency in food has been premised on the implementation of the Farm Inputs Subsidy Programme (FISP). Other food crops such as rice, cassava, sorghum, and potatoes are alternatives to maize in many parts of the country complemented by livestock and fish products.

Climate change and climate variability caused by Green House Gas (GHG) emissions negatively impact on the agriculture sector. The need to address climate change issues to ensure food security, alleviate poverty and arrest environmental degradation are more urgent now than at any other time in the past.

In the face of climate change, increased agricultural production and food security will be attained in Malawi by increasing smallholder farmer's output per unit area; increased agricultural diversification; improvement on applied and appropriate agricultural research, technology generation and dissemination; increased livestock and fish production; reduced land degradation and to develop an effective early warning system.

In order to increase agricultural production and food security, technological and management measures will be applied. These include reducing green house gas emissions like animal housing system, manure management, animal feed management and resource use efficiency (energy, water, feed and nutrients) and sequestrating carbon such as improved varieties, sink enlargement and agro-forestry ecosystems to increase photosynthetic storage of carbon based on community's development aspirations and security of tenure supported by robust technical backstopping as outlined below;

b) **Development and implementation of land use plans:**

Unsustainable land use results in degradation of the environment. Hill sides and river banks are exploited for firewood, communal livestock grazing and winter cropping leading to land degradation. Development of land use plans at local levels using participatory methods has the potential of restoring the land resources for sustainable supply of ecosystem services for sustainable livelihoods. Arable land, fragile land, dambo areas, land for infrastructure development like roads, commercial, cultural, institutional and forestry can be identified.

Land registers for households can be made with government for land user rights to ensure perpetual investment in land resources.

c) **Improved fertilizer management**

Improved fertilizer management and minimizing the use of fertilizer by encouraging application of organic manure is an option that can help reduce N_2O and CH_4 emissions. Topdressing fertilizer granule size can be increased from 0,1g to 1g for slow release and will also be effective in decreased quantities while maintaining crop yields. Fortified organic fertilizer, application timing, placement, rate of application and coordination with irrigation or rainfall events can reduce leaching, reduce chemical fertilizer quantities, increase uptake by plants, increase crop yields and reduce GHG emissions. Improved fertilizer management technologies are expounded below;

- **Use of fortified organic fertilizer:** Locally found organic components are mixed with fertilizer in the ratio 2.5: 2.5: 5.0: 5.0 of fertilizer, ash, maize bran and chicken/ pig manure respectively. Only 1/6 of the organic fertilizer is from inorganic source and its application is the same as conventional fertilizer.

- **Fertilizer N timing:** Crop nitrogen intake capacity is generally low at the beginning of the growing season, increasing rapidly during vegetative growth and dropping sharply as the crop nears maturity.

- **Fertilizer N placement:** Placement of N fertilizer into the soil near the zone of active root uptake may reduce surface N loss and increase plant N use resulting in a reduction in N2O emissions and application of urea, ammonium nitrate at a deeper level in soil profile (10-15cm) resulted in lower emission of N2O compared to shallow injection (5cm) or surface application.

- **Fertilizer N rate:** The emission of N2O correlates well with fertilizer N rate and increasing the amount of N applied to soil results in increasing emissions of N2O.

  In case of maize, basal fertilizer can be applied before or at planting and before 21 days after germination. Top dressing fertilizer can be applied at knee stage and at tussling stage using 5g cup respectively.

- **Coordination with irrigation and rainfall events:** Application of fertilizer immediately after rain or irrigation will increase N use efficiency of plants and mitigate N2O emissions.

d) **Intercropping, mixed cropping and crop rotation:**

Leguminous crops fix nitrogen into the soil that leads to reduction in amount of fertiliser applied in the cultivation fields. Some of the leguminous crops include ground nuts, cow peas, soybeans, velvet beans and *Mucuna purens (kalongonda) w*hich can be used in intercropping with cereals, relay cropping and cover crops to reduce the reliance on fertilizer for nitrogen. Mixed cropping can be practiced to increase output per unit area.

e) **Use of improved crop varieties:**

Use of improved crop varieties will increase crop yields and reduce land for food production while providing more agricultural wastes for C sequestration. Increase in crop yields results in C sink enlargement in the grains.

f) **On-the-farm tree regeneration and agroforestry:**

On-the-farm tree regeneration has the potential in Malawi's miombo woodland to be one of the most viable approaches to addressing the problem of deforestation. If tree CoPpices in the gardens left in the garden for one growing/rainy season, the CoPpices from all indigenous trees will sprout in large numbers and grow to between 1.2 to 1.5 metres in height depending on the species. This is so because the miombo woodland species are deep rooted and fast growing from this already established root stock. Enrichment planting with exotic agroforestry trees and shrubs like *Fidherbia albida, Gliricidia sepium, Sesbania sesban and lucaena lucosifala, Thephrosia vulgeri* and *Thephrosia candida* are examples which fix nitrogen in the soil. All trees in gardens can be managed to control excessive shading while also functioning as wind breaks and source of firewood and construction poles.

g) **Conservation Tillage and Residue Management**

Tillage of the soil stimulates microbial decomposition of soil organic matter, which results in emissions of

CO2 to the atmosphere. Therefore, minimizing the amount of tillage promotes sequestration of carbon in the soil. Conservation tillage is a tillage system that conserves soil, water and energy resources through the reduction of tillage intensity and retention of crop residue in the garden to form mulch. Conservation tillage involves the planting, growing and harvesting of crops with limited disturbance to the soil surface.

Incorporation of agricultural residues into the soil is a clearance mechanism that avoids open burning of agricultural residues. The challenge of this technology is the immobilisations of nutrients in the soil as the wastes are still decomposing, making the nutrients unavailable to plants. Secondly, the soil is still exposed to soil erosion as it is exposed to raindrop effects.

h) Improved Livestock and Manure Management:

As human population increases, land for grazing livestock is decreasing. Low lying areas are now being turned into farmlands for planting winter crops as they are close to sources of water. Where land for communal grazing livestock is scarce, there are now growing conflicts between livestock farmers and winter crop growers. With reduced grazing space, a new livestock feed management regime is needed. As animals move in search for food they destroy vegetation and young tree saplings. Grass and crop residues can be used to make silage using appropriate technologies for intensified livestock management. Putting animals in enclosures will result in animal dung to accumulate at one place.

Animal dung can be used for generating biogas for domestic and institutional heating. Sludge from biogas production can be used as organic fertilizer that can be applied to crops and fodder to reduce use of chemical fertilizers.

i) Improved Rice Cultivation:

Rice production is practiced mainly in low lying areas in flooded rice fields. Upland rice production is possible so that more rice can be produced. **I**n flooded rice fields methane emissions occur as a result of anaerobic decomposition of organic material. This gas escapes into the atmosphere primarily by diffusive transport through the rice plant during growing season. Upland rice, which is not flooded, does not produce a significant quantity of CH_4.

J) **Uncontrolled Burning of Crop Residues:**

Crop residues are a store for nutrients on the land. Uncontrolled and unmanaged burning of crop residues destroys these nutrients which can return to the soil through decomposition. Uncontrolled burning also destroy trees, grasses, Coppice growth, beneficial microorganisms, etc. and changes soil properties, leaves the land bare and very susceptible to soil erosion especially at the beginning of the rain season. In order to sustain soil productivity, community members can identify challenges they face in controlling bush fires and find potential solutions to control burning of crop residues using participatory methodologies at local level. Crop residues and wild grass can be used as mulch in gardens under conservation tillage.

Main and Specific Objectives:

Main Objective: To improve food security and incomes of smallholder farmers while also improving ecosystem services in Malawi

Specific Objectives:

i. To increase smallholder farmer's output per unit area resulting in higher maize yields through efficient fertilizer use including mixed cropping and intercropping to increase output per unit area,

ii. To increase agricultural diversification by using extra land to grow nontraditional commercial crops such as birds eye chilies, ground nuts, beans, cow peas, etc, livestock and fish production,

iii. To improve on applied and appropriate agricultural research, technology generation and dissemination by promoting farmer-led training and extension, irrigation farming, strengthening farmer institutions, farmer based research, agriculture extension, open days and agricultural shows,

iv. To reduce land degradation by promoting soil and water conservation techniques, conservation tillage technologies and promote carbon sequestration in biomass and soil,

Target Group:

Smallholder Farmers and NSAs working with local communities in sustainable agriculture

Lead Organization:

Ministry of Agriculture, Irrigation and Water Development

Key Stakeholders/Partners:

EAD, EP&D Department, Land Resources and Conservation Department, Agriculture Research, Agriculture Extension, Academia, Lands Department, District Councils, Ministry of Women Affairs, Development Partners

Main Activities:

i. Reducing land degradation through developing and using land use plans using participatory methodologies (PLUP) and addressing land tenure matters to incentivise investments in land management,

ii. Improving fertilizer management by using low chemical N in fertilizer, reducing N loss and application efficiency through- timing, rate, frequency and placement,

iii. Promoting intercropping, mixed cropping, crop rotation to increase output per unit area, improve soil fertility and ground cover to protect the soil,

iv. Using improved crop varieties to get high yields per unit area and also generate biomass for carbon sequestration,

v. Promoting on-the-farm tree regeneration to support farmers in fruits, firewood,

vi. Promoting alley planting along farm boundaries as wind break and as biomass energy source,

vii. Promoting agro-forestry to support farmers on fodder and fertiliser,

viii. Assisting farmers to identify commercial crops for income generation

ix. Providing technical backstopping to farmers in production and marketing of commercial crops,

x. Promoting conservation tillage and residue management to increase land productivity by controlling soil erosion, conserving moisture, improving soil water holding capacity and guarantee stable harvest even in a drought year,

xi. Promoting farmer based structures for better dissemination of information and technology uptake,

xii. Improving livestock management by promoting intensification and feed management,

xiii. Training livestock farmers in feed preparation so that animals in enclosures have year round feed,

xiv. Promoting manure management to produce biogas for heating and using sludge as manure for gardens

xv. Conducting open days and agriculture shows to encourage information sharing and promotion.

xvi. .To increase agricultural diversification and increase livestock and fish production. This will entail using the released land from maize to grow nontraditional commercial crops like birds eye chilies, ground nuts, beans, cow peas, etc, livestock and fish production;

v. To improve on applied and appropriate agricultural research, technology generation and dissemination. This entails promoting farmer-led training and extension, promoting irrigation, strengthening farmer institutions, farmer based research, agriculture extension, primary research and open days and agricultural shows;

vi. Promoting soil and water conservation techniques reduced tillage technologies and promotes carbon sequestration in biomass and soil.

GHG Mitigation potential:

Carbon sequestration; SOC in conservation tillage, intercropping, agroforestry, alley planting(short term forestry)

Avoided emissions; efficient use of fertilizer, reduced use of chemical fertilizer, manure management, biogas, ammonisation of feed**,** control of bushfires,

Co benefits:

Economic	➢ Improved family incomes ➢ Job creation ➢ Savings on food imports ➢ Increased agriculture exports
Social	➢ Sustainable families ➢ Farmer organisations assist to bargain for better prices of produce ➢ Food security ➢ Improved health of local farmers ➢ Improved nutrition ➢ National pride upheld
Environ-mental	➢ Carbon sequestration from SOC, agroforestry, alley planting, ➢ Emission reductions from biogas, ammonised feeds, efficient use of fertilizer, reduction in use of chemical fertilizer quantities, manure management ➢ Reduced bushfires resulting in reduced air pollution ➢ Water more available for local use due to in-situ water harvesting ➢ Use of clean energy using biogas ➢ Use of renewable biomass from alley tree planting and agroforestry tree prunings
Time Frame: 2016 to 2030	
Type of Support: ix. Financial Grants $12 m, loans $ 5 m x. Technical assistance	
MRV framework: leveraging of private finance, job creation, food security, competitiveness and productivity, public expenditure, technology transfer, change in per capita income, natural resources protection, natural resources exploited, energy security.	

Proposal Name: Sustainable Solid Waste Management

Background and Justification:

The Malawi Constitution 1994 recognizes the right to decent livelihood and sustainable management of natural resources. The Local Government Act, 1998 and the Decentralisation Policy 1998 devolved governance powers to district and city councils. The councils are mandated by the Local Government Act to develop district development plans and provide essential services including waste management and sanitation. The National Sanitation Policy 2006 recognizes the role of city councils in sanitation provision but separates waste water to be managed by water boards. The MGDS 11 recognizes the importance of sanitation as rural and urban development priority.

The number of people living and working in the cities is increasing while more land is being used for farm production. Urban population in Malawi is around 15% and growing at rates between 2.8% to 4.3% annually. It is accordingly estimated that the urban areas generate around 2,025 tons of mixed waste per day with a per capita waste generation of 0,9Kg. Blantyre and Lilongwe cities generate between 800 and 900 tons of waste respectively per day with the remaining waste shared by other urban areas. With changing eating habits and increase of the middle income in urban areas, the waste stream has become more complex. There is no data on current waste generation or composition in the cities in Malawi. There has been increase in use of plastics for both film and rigid types. Agriculture waste generation is also on the increase due to processing at centralized areas. Rice milling, centralized peanut shelling, tobacco processing and Electronic wastes (E Wastes) are becoming a new problem. There is dumping of old personal computers and other electronic equipment like printers, photoCopiers, scanners, laptops, etc in schools, offices and NGOs. There is need to manage the waste in all its forms based on credible data on waste composition and quantities while also being inclusive of all waste generators and other related services in the management of waste.

Objectives:

i. To quantify and characterize solid wastes in the cities

ii. To build and operate municipal bio-digesters to treat the organic solid waste fraction, in continuous operation to produce power

iii. To promote use of wastes from agro-processing to generate clean energy in rural areas

iv. To build local capacity and technology transfer in operation, management using mechanical biological treatment (MBT) with biogas digester for power generation

Main Activities:

i. Undertaking waste characterization and quantification studies in the cities, urban areas and industrial and domestic agricultural processing

ii. Map out areas in the cities and rural areas for public awareness and mobilization about waste

iii. Hiring consultants to undertake feasibility studies, detailed designs and bidding documents for waste to energy value chain in both rural and urban areas

iv. Identify strategic private sector partners including financing arrangements

v. Identify sites (5 Ha) at strategic places in the cities for the waste to energy plants and compost making

vi. Identify sustainable clean energy solutions for rural areas using agro-processing wastes

vii. Identifying partners to build and operate solid waste management systems in cities and rural energy systems.

Target Group: City, Municipal Councils, other Urban Areas and Agro-processing Centers

Lead Organization: Ministry of Local Government and Rural Development

Key Stakeholders: Environmental Affairs Department, MBS, Academia, MITC, MCCCI, UNDP, UNEP, AfDB, WB, EP&D, Department of Energy, NCST, Ministry of Health and Population, Department of Social welfare, Ministry of Agriculture Irrigation and Water Development

GHG Mitigation Potential:

Types of Support Needed:

i. Technical support for the studies, with technical capacity building of Malawian partners

ii. Financial support (grants, loans and insurance)

iii. Business partners

iv. Selection of private companies to build and operate the plants

Co Benefits

Social;

i. Reduction in sanitation based diseases resulting in healthy people

ii. Job creation for both professionals, semi-skilled and general workers

iii. Power outages reduced in industries and residential areas

iv. Local professionals acquire new knowledge and skills

v. Community participation in waste management brings pride and cultivates their support

vi. Decentralized sustainable rural energy supply made possible using agricultural wastes for power generation

Economic;

i. Potential for FDI

ii. Earnings by staff who in turn support their families

iii. Capital formation

iv. Foreign exchange savings from importation of chemical fertilizers

v. Energy business service opportunities created at local levels

vi. Economic development fostered in rural areas

Environmental;

i. Cleaner environment as organic waste has new use

ii. Substantial reduction in GHG emissions as biogas generated is used as fuel for power generation and releasing CO_2 which is less polluting

iii. Other inorganic waste are valorized for recycling or reused thereby creating new products or supporting other industries

iv. Clean energy is used in rural areas

v. Discarded waste is disposed of at sanitary landfill away from community danger

Time Frame: 2016 to 2030

MRV:

Environmental Affairs Department
Private Bag 394
Lilongwe 3
Malawi

Tel: (265) 1 771 111
Fax: (265) 1 773 379
Email: eadinfo@sdnp.org.mw