NATIONAL ENVIRONMENTAL, ECONOMIC AND DEVELOPMENT STUDY (NEEDS) FOR CLIMATE CHANGE: GHANA COUNTRY REPORT

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LIST OF ACRONYMS

BAU	-	Business-As-Usual scenario
CC	-	Climate Change Scenario
CFL	-	Compact Florescent Lamp
CH_4	-	Methane
CO_2	-	Carbon Dioxide
EPA	-	Environmental Protection Agency
GERMP	-	Ghana Environment Resource Management Project
Gg	-	Gigagrams
GHASTINET	-	Ghana National Scientific and Technological Information Network
GHG	-	Greenhouse Gas
GOG	-	Government Of Ghana
GRATIS	-	Ghana Regional Appropriate Technology Industrial Service
GWh	-	Gigawatt hour
GWP	-	Global Warming Potential
ha	-	Hectare
IGF	-	internally generated Fund
IIR	-	Institute of Industrial Research
INSTI	-	Institute for Scientific and Technological Information
ITTU	-	Intermediate Technology Transfer Units
HIPC	-	Highly Indebted Poor Country
Km	-	kilometre
ktC	-	kilo-ton Carbon
LPG	-	Liquefied Petroleum Gas
MDAs	-	Ministries, Departments and Agencies
MES	-	Ministry Of Environment and Science
MJ	-	Megajoule
Mm	-	Millimetre
MPSD	-	Ministry for Private Sector Development
MW	-	Megawatt
N_2O	-	Nitrous Oxide
NEAP	-	National Environmental Action Plan
NEEDS	-	National Environmental, Economic and Development Study
NEP	-	National Environment Policy
STEPRI	-	Science and Technology Policy Research Institute
UNFCC	-	United Nations Framework On Climate Change
UNEP	-	United Nations Environment Programme

SECTION A: EXECUTIVE SUMMARY

A. OVERVIEW

NATIONAL DEVELOPMENT PLANS AND PRIORITIES IN THE CONTEXT OF CLIMATE CHANGE

The major goals of Ghana's long-term sustainable development as a middle income country by 2020 has embedded some environmental objectives which are built on the following foundations: to establish and maintain a sound built and natural environment that can sustain productive economic activities and pleasant living conditions for both present and future generations; and to establish an environmentally conscious society that can exercise self-discipline at all times with regard to individual and community behaviours towards the environment. The set targets include the following:

- ✓ Reduction of present levels of both chemicals and particulate air pollution by 50% by the year 2020;
- ✓ Stoppage and reversal of the process of deforestation and desertification by year 2020;
- ✓ Achievement of sustainable exploitation and protection of forests resources;
- ✓ Substantial increases in the use of renewable sources of energy;
- ✓ Substantial decreases in the use of chemical fertilizers; and
- ✓ Improvement in the quality of water and air.

GHG STATUS, PROJECTIONS AND MITIGATION SCENARIOS

Current status of GHG emissions

Inventory of GHG emissions in Ghana indicate that carbon dioxide accounts for the largest share of Ghana's greenhouse gas emissions by sources. On the other hand, carbon sinks in forested and afforested lands offset the total CO_2 emissions which then make Ghana a net CO_2 removal by sinks. CO_2, CH_4 and N_2O emissions by sources increased by 6.6%, 14.7% and 12% respectively from 1990-1996. The carbon dioxide equivalent (CO_2 eqv.) was estimated based on Global Warming Potential (GWP) of CO_2, CH_4 and N_2O. The results also indicate that total methane emissions are lower than CO_2 emissions. However, the CO_2 equivalent of CH_4 was about 2-3 times higher than CO_2 assuming global warming potential of 24.5 for CH_4 . Methane emissions are largely due to agriculture and biomass burning for energy. Nitrous oxide (N_2O) contributed just about 6.8% of the total CO_2 equivalent emissions for 1994. The main sources of N_2O emissions are agriculture (65%), biomass combustion (26%), human waste (5%) and land use change and forestry and grassland conversion (4%).

Projections of GHG emissions at 2020 and 2050 time horizons under the Business-As-Usual case

The energy sector in Ghana is currently the largest emitter of GHG. Projection of GHG emissions by the National Communication (2000) indicate that CO_2 equivalent emissions would increase from 7,278 Gg to 118,405 Gg between 1994 and 2020, move up to 234,135 Gg by 2030, and then to 519,826 Gg by 2050 (see Table 1.1).

Table 1.1: Projections of CO_2 Equivalent GHG Emissions under the Business-As-Usual Scenario

Year	1994	1996	2000	2004	2008	2020	2030	2050
Biomass consumed TJ	233033.10	2975550.97	485163.67	791046.56	1289780.54	5590583.56	10515000.22	22828048.99
CO_2 emissions from fossil fuels (Gg)	3048.40	3892.50	6343.62	10348.00	16872.14	73132.68	146263.63	328505.93
Methane emissions from biomass (Gg)	155.80	198.94	324.37	528.87	862.31	3737.72	7475.29	16789.35
Nitrogen oxide emissions from biomass (Gg)	0.80	1.02	1.67	2.72	4.43	19.19	38.38	86.20
CO_2 equivalent of CH_4 (Gg)	3817.00	4873.93	7946.81	12957.06	21126.15	91571.78	183140.05	411328.81
CO2 equivalent of N_2O (Gg)	256.00	326.89	532.98	869.01	1416.90	6141.57	9125.76	20382.38
Business-As-Usual CO_2 equivalent	7278.00	9093.32	14826.41	24174.07	39415.19	**118404.87**	234135.02	**519825.62**

Source: First National Communication to the UNFCC, 2000

Abatement scenarios at 2020 and 2050 time horizons

Abatement scenarios under climate change in Ghana has principally focused on two major sectors that were potential sources for greenhouse gas emissions and reductions according to the National Communication (2000). Greenhouse Gas inventory results showed that the Energy Sector was responsible for the highest emissions of CO_2 while the Forestry Sector emerged as the potential for increasing the country's carbon sink base.

Abatement scenarios under the Energy Sector

Four abatement scenarios have been considered in this sector and these are as follows:

I. Replacing some biomass with LPG: replacement of fuelwood and charcoal with LPG at the rate of 10% a year from 1995 to 2020.
II. Use of biogas and LPG to replace some biomass from 2010 to 2015 when only LPG and biogas will be used with the largest proportion of energy for cooking coming from biogas.
III. Gradual penetration of solar PVs to the existing mix: this option integrates the options in scenario two and other options aimed at reduction in the use of petroleum products and electricity. The first option is 5% reduction in the use of petroleum products and electricity from 2000 to 2004, which then moves to 10% from 2005 to 2010, 20% from 2011 to 2014 and finally 50% from 2015 to 2020.
IV. Gradual penetration of biogas instead of a huge penetration as in the second and third scenarios: this option was an adjustment of the third option by just a gradual penetration rate for biogas for cooking by 10% of households per year from 2010 to 2020.

Estimated CO_2 equivalent reductions from the abatement scenarios above are 494,506 Gg, 700,044 Gg, 712,515 Gg and 543,778 Gg for scenarios I, II, III and IV with their projected cost savings of 33.22 \$/Gg, 27701.56\$/Gg, 6932.22 \$/Gg and 9448.86\$/Gg respectively (see Table 1.2).

Table 1.2: Emissions reduction and cost savings under different abatement scenarios

Options	CO_2 Reduction (Gg)	$/Gg
I	494,506	33.22
II	700,044	27,701.56
III	712,515	6,932.22
IV	543,778	9,448.86

Source: First National Communication to the UNFCC, 2000

Vulnerability and Adaptation Assessment Scenarios

Assessment of Ghana's vulnerability to climate change and the corresponding adaptation measures needed to offset the impact on the national economy has been carried out on some important sectors which include water resources, coastal resources and some agricultural crops. In the case of the water resources sector, the major findings with respect to vulnerability include temperature rise of about 1^{o} C over a 30 year period and reductions in rainfall and runoff of approximately 20 % to 30% respectively.

With respect to agriculture, vulnerability will be noticed by the impact of temperature increases as well increases in solar radiation over all agroclimatic zones in the country. Temperature increases are in the range of 0.4 ^{o}C and 0.6 ^{o}C by year 2020. This is expected to increase between 1.5 ^{o}C and 1.8 ^{o}C by 2030 and between 3.7 ^{o}C and 5.4 ^{o}C by 2050 while average solar radiation will increase in the range of 0.15 MJ/m^2 and 0.39 MJ/m^2 by 2020, 0.51 MJ/m^2 and 1.35 MJ/m^2 by 2030, and 1.23 MJ/m^2 and 3.29 MJ/m^2 by 2050. However projected mean annual rainfall will decrease by a range of 14.8mm and 38mm by 2020, 51.7mm and 132.2mm by 2030 and 125.9mm and 321.8 mm by 2050 in all agroclimatic zones except the high forest zone which will record increases in mean annual rainfall by 22m by 2020, 76.9mm by 2030 and 187.5mm by 2050.

Finally, vulnerability in the coastal zone will be manifest in sea-level rise which is expected to reach 1m by year 2100. This indicates that a total of 1, 110 km^2 of land area may be lost as result of the 1m rise in sea-level. The estimated population at risk is 132,200 most of whom are within the east coast.

B. KEY FINDINGS

Cost of Implementing Priority Mitigation and Adaptation Measures

The cost of implementing mitigation measures due to climate change in 2020 as well as 2050 has been estimated using a discount rate of 37.5%. This rate is the opportunity cost of capital for investments and is based on the Bank of Ghana's prime rate and charges on lending by commercial banks. This rate has been used because there is no explicit public discount rate established by government Ministries, Departments or Agencies (MDAs). The costs have been estimated based on assumption that there will be a 5% change in the climate change conditions based on the BAU (scenario).

<u>Mitigation</u>

The major sectors for mitigation include the energy and forestry sectors. National communications (2000) indicates that the transport sector is responsible for about 60% of all petroleum consumed in Ghana. This means that this subsector is a major contributor of GHG emissions in Ghana and therefore included as a standalone subsector. Results indicate that the energy sector will require additional investments of about US$ 309 million in 2020 and US$ 314 million in 2050. These investments will be needed in energy-efficient equipment that are ultimately expected to reduce emissions by 5%. Additional investment in the forestry sector is mainly geared towards reforestation which eventually will reduce GHG emissions by sinks. In that wise, additional costs needed will be about US$ 3.9 million in 2020 and US$ 81.1 in 2050. The transport subsector will require additional investment to the tune of US$ 6.58 million in 2020 and US$ 6.55 million in 2050.

Results from the analysis indicate that on the whole Ghana will need about US $ 340.6 million by 2020 and US$ 422.7 million by 2050 to execute mitigation measures (mainly in the energy sector and forestry subsector).

Adaptation

Investments in the Health and Agricultural sectors were used. The incremental cost of adaptation in climate change in the health sector will be about US$ 350 million by 2020 if there are no adaptation measures. This figure may go up to about US$ 352 million by 2050. Investment in controlling malaria will be about US$ 7.6 million in 2020 and US$ 7.54 in 2050. The agricultural sector will require about US$ 334.24 million in 2020 and US$ 336.30 million in 2050 for adaptation to effects of climate change.

In total, Ghana will need about US$ 697.2 million by 2020 and US$ 701.7 million by 2050 to implement adaptation measures to contain the effects of climate change (mainly in agriculture, health and coastal zone).

Financial and Policy Instruments

Resources are generated domestically from various sources. Notable among these are: tax revenue- indirect, direct and international taxes; national health insurance levy; import exemptions and banking and private sector investments. Presently there are no specific budget allocations for climate change mitigation or adaptation from domestic resources. The few projects on the ground are either integrated into the sectors specific projects or stand alone projects. The private sector is currently not actively involved in climate change mitigation or adaptation projects.

International resources available to the country are Official Development Assistance (ODAs) in the form of grants and there are multilateral agencies currently playing a role in climate change adaptation mainly and mitigation to a very little extent. Countries like the Netherlands, Japan, and EU are involved in various adaptation projects. Agencies like UNDP, World Bank, Danida, UNEP (CCDARE) and UNFCCC are also playing important roles. The Convention Funds: Global Environment Facility (GEF), Clean Development Mechanism (CDM), Adaptation Fund and Special Climate Change Fund are also involved in diverse climate activities. Most projects on the ground are adaptation projects. There has been little success in CDM projects and other mitigation projects. It is to be noted that most of these interventions are sector specific projects.

There is currently a national project underway which seeks to mainstream climate change into national policy with the expectation of climate change activities receiving specific budget allocation. With climate change mainstreamed into national policy the government will have to look into various financing options to meet the extra demand. To ensure that these climate change issues remain an integral part of development agenda, development partners must increase ODAs mostly in grants directly to the government and through multilateral and bilateral agencies. The private sector should be given incentives to initiate climate change initiatives and foreign direct investments (FDI) in mitigation and adaptation strategies should be encouraged. To ensure sustainability it will be important to pass legislature, laws and by-laws for example building codes etc to protect climate change activities as well as to act as incentives for foreign investors interested in climate change activities.

Existing and Potential Institutional Arrangements to Support Integration of Climate Change Priorities into National Development

Currently, most projects are stand alone projects and funding is through multilateral, bilateral and non governmental agencies. There is no national institutional framework through which money for climate change activities can be channelled.

The Environmental Protection Agency (EPA) co-ordinates all climate change issues in Ghana. EPA together with the National Development Planning Commission (NDPC), the Regional Coordinating Councils and particularly the districts are coordinating the mainstreaming activities. NDPC leads the mainstreaming processes but works closely with Ministry of Environment, Science and Technology (MEST), EPA, Ministry of Finance and Economic planning (MOFEP), the regions and the districts. Other sectors such as health, agriculture, forestry and land management, transport, energy are also involved. The mainstreaming process seeks to target policy formulation, planning, budgeting, implementation and monitoring and evaluation.

The Ministry of Finance and Economic Planning (MOFEP) will be the main budgeting and implementation institution for climate change funds as it is the institution in Ghana already in charge of national budgets and funds allocation. As soon as the lead organization, NDPC ensures that climate change priorities are mainstreamed into national policy MOFEP can allocate funds for national programmes. This institutional arrangement which is already working in the country is an important framework to ensure the sustainability of climate change programmes as a national agenda.

C. LESSONS LEARNED

Challenges and Opportunities

The challenge is how to implement strategies earmarked for adoption to achieve the targets set. These strategies are:

- ✓ Integrating environmental consideration into national and sub-national levels of development decision-making;
- ✓ Increasing access to information on and improving the understanding of environmental issues;
- ✓ Establishing an appropriate institutional framework and mechanisms to facilitate integration of development and environment;

- ✓ Encouraging the adoption of more effective management practices and technology
- ✓ Ensuring compliance with environmental standards and regulations; and
- ✓ Applying the "polluter pays principle" to check reckless environmental destruction.

Some of the key challenges are: (i) poor and inadequate infrastructure; (ii) limited human resource capacity; (iii) weak sub-regional network; (iv) inadequate financial resources/low budgetary allocation; (v) flooding; and (vi) drought among others.

Next Steps

Integrating climate change and disaster risk into National Polices, Development Plans and programmes. This will specifically

- create and deepen awareness about the critical role of climate change and disasters in national development efforts;
- ensure that climate change and disaster issues are fully integrated and sustained in the national planning processes;
- assist districts to integrate climate change and disaster risk in their District Medium Term Development Plans; and
- take up adaptation and mitigation measures.

SECTION B: OVERVIEW

2.0 An Overview of the National Climate Policy Development Framework

2.1 Introduction

As a prelude to the development of a national climate change policy in Ghana, the country carried out proximate estimates of the cost of environmental degradation in 1988. The analysis of the study revealed that the cost of environmental degradation was equivalent to about 4% of GDP. This exercise ended in the preparation of a strategy to address key issues relating to the protection of the environment and better management of the natural resources of the country especially as related to climate change. The major objective of this exercise became the basis of the National Environmental Action Plan (NEAP) which defines a set of policy actions, related investments, and institutional strengthening activities to make Ghana's development strategy more environmentally sustainable.

2.1.1 Sectoral Development Policies versus Climate Change

The major driving force of the broad policy framework in Ghana has been geared towards achieving a level of industrialisation which provides significant employment opportunities and economic diversification as a priority and becoming a middle income level industrial country by the year 2020. This requires substantial financial investments and energy inputs. The rate of electrification presents the challenge of providing energy in a suitable form to a large population (both urban and rural) while at the same time minimizing Greenhouse Gas (GHG) emissions and maximising carbon sequestration (carbon dioxide-fixing by vegetation). Switching the form of energy used by the poor in the urban areas from charcoal to kerosene or LPG can reduce the rate of deforestation due to the reduced demand for biomass for fuelwood or charcoal. The impact of climate change on energy and industrial production has already started manifesting with the most conspicuous being the effect of highly variable precipitation patterns on hydro power generation. Other effects of climate change on development in Ghana are a decrease in biomass production especially as a result of decreased precipitation and increased temperatures in some areas to water stress on woody plants and also to general land degradation. Another impact of climate change is the decrease in agricultural productivity due to changing agro-ecological zones, lack of water for irrigation, and outbreaks of pests and diseases which are likely to decrease the amount of biomass available for energy.

2.1.2 Role of Key Documents as Inputs into the NEEDS Project

The overall input into the NEEDS project is the constitution of the Republic of Ghana (the 1992 constitution) which affirms the country's resolve to sound environment management. Article 36(9) of the constitution spells out the role of the nation in taking steps to protect and safeguard the national and international environment for posterity while article 41 (k) stipulates the duties of Ghanaian citizens in protecting and safeguarding the environment sustainably. The establishment of the Ministry Of Environment, Science and Technology was done as part of efforts aimed at ensuring that development is undertaken in a more sustainable and environmentally sound manner. Furthermore, the parliament of Ghana enacted and promulgated the Environmental Protection Agency (EPA) Act 1994 (Act 490) which conferred on the agency, implementation objectives and regulatory functions. In that regard, Act (490) ensured that non-compliance to environmental regulations becomes criminal, liable on conviction to fines or terms of imprisonment in Ghana. Since 1997 the EPA has established within its jurisdiction, a special conventions and projects implementation department which serves as the focal point for national, regional and international projects and conventions. It also liaises with other departments to generally facilitate the coordination of Ghana's involvement in the preparation, ratification and implementation of conventions and protocols on the environment and finally the department acts as the 'desk' for the implementation of climate change issues. The Ghana Environment Resource Management Project (GERMP) was established as a medium for implementing the National Environmental Action Plan (NEAP). The main goal of the project was to develop capacity for the government and people of Ghana to manage the environment more effectively. The project was based on the following framework: developing an environmental resource management system for Ghana through institutional and technical capabilities for effective environmental monitoring, policy formulation and coordination; developing and supporting a programme to combat soil degradation and erosion, as these are pervasive environmental problems; and preventing further destruction of the fragile resource in the coastal zone through demarcation and management of five coastal wetland sites as Ramsar sites.

2.2 National Development Plans And Priorities In The Context Of Climate Change

The major goals of Ghana's long-term sustainable development as a middle income country by 2020 has embedded some environmental objectives which are built on the following foundations: (i) to establish and maintain a sound built and natural environment that can sustain productive economic activities and pleasant living conditions for both present and future generations; and (ii) to establish an environmentally conscious society that can exercise self-discipline at all times with regard to individual and community behaviours towards the environment. The set targets include the following:

- ✓ Reduction of present levels of both chemicals and particulate air pollution by 50% by the year 2020;
- ✓ Stoppage and reversal of the process of deforestation and desertification by year 2020;
- ✓ Achievement of sustainable exploitation and protection of forests resources;
- ✓ Substantial increases in the use of renewable sources of energy;
- ✓ Substantial decreases in the use of chemical fertilizers; and
- ✓ Improvement in the quality of water and air.

The strategies earmarked for adoption to achieving the above targets are:

- ✓ Integrating environmental consideration into national and sub-national levels of development decision-making;
- ✓ Increasing access to information on and improving the understanding of environmental issues;
- ✓ Establishing an appropriate institutional framework and mechanisms to facilitate integration of development and environment;
- ✓ Encouraging the adoption of more effective management practices and technology;
- ✓ Ensuring compliance with environmental standards and regulations; and
- ✓ Applying the "polluter pays principle" to check reckless environmental destruction.

2.2.1 Sectoral Project Contributions to Climate Change Issues

The Renewable Energy Programme was initiated to promote the development of renewable energy technologies that are less polluting than the conventional fossil fuels. The projects under this programme include biomass energy project which entails developing a national woodfuel policy, conserving forests through improved methods for charcoal and firewood production, decreasing consumption of firewood and charcoal by using more efficient cooking devices, and switching to natural gas and propane, expanding the productivity and use of existing bio-energy sources such as biogas from organic, animal and municipal waste. Another project under renewable energy programme is the solar energy project which is yet to take off since direct solar energy does not represent a major form of energy in Ghana except its use in the natural form for drying. However, feasibility studies are underway to identify the prospects for solar water heating and crop drying in Ghana, as well as off-grid solar PV electrification which is to be piloted in selected districts in Ghana. There are plans underway for a feasibility study on a pilot solar thermal plant in Ghana.

Other programmes aimed at mitigating the effects of climate change in Ghana are the National LPG Programme which was initiated in 1990 to promote the wider use of LPG as a sustainable substitute for charcoal and firewood, the Energy Efficiency and Conservation Programme which covers the following areas: energy conservation in industry, residential, commercial and public sectors as well as the transport sector. So far energy efficiency and energy conservation has been conducted in the whole country since 2007. Towards this end, the Ministry of Energy launched the National Compact Florescent Exchange Programme which involved replacement of incandescent bulbs with six million CFLs in a sample of the population in selected districts nationwide. This project had the following achievements: peak electricity demand savings of 124 MW and energy savings of 172.8 GWh/annum; CO_2 savings of about 112,320 tonnes per annum; delay in thermal generation expansion investments of US$ 105 million, mean household income savings of about GH¢31.00 in 25 districts nationwide over six months; a reduction of 148,000 barrels light crude oil for thermal electricity generation and finally energy cost savings of US$ 33.3 million per annum.

2.2.2 Formulation of National Development Priorities

Prominent among Ghana's road map to sustainable development is the management of the country's environmental resources which are based on policy formulation, planning, legislation, institutional capacity building, monitoring/evaluation and problem solving, implementation of decisions, and compliance and enforcement. The plan rolled out is that at each stage the operation of the system will be made dependent on an effective process for reaching decisions and clear responsibilities for implementing those decisions. It's worth noting that most environmental concerns are inter-sectoral and decisions involve choices between alternative as well as conflicting courses of action, which carry costs and benefits.

Local management of the environment is viewed as more effective than a centralised top-down approach and these concerns are embedded in government policy on decentralisation and the identification of district assemblies as district planning authorities. Strategies involved in the integration of climate change concerns into the national development framework include: reduction of greenhouse gases that could be achieved by the creation of a 'climate and greenhouse gases database' which involves inventory of climate and air pollution data and CO_2 emissions; more effective monitoring of climate and greenhouse gases; and sea level monitoring through an inventory of the existing tidal stations and data collecting sub-centres, establishment of the computerised tidal data processing system, forum for interagency coordination of tidal and sea level rise monitoring, the installation of additional tidal gauges and establishment of maritime monitoring stations along the coastal zone in Ghana.

2.3 GHG Status, Projections and Mitigation Scenarios

2.3.1 Current status of GHG emissions

National inventory of GHG emissions in Ghana are available from 1990 to 1996 and results indicate that carbon dioxide accounts for the largest share of Ghana's greenhouse gas emissions by sources. On the other hand, carbon sinks in forested and afforested lands offset the total CO_2 emissions which then make Ghana a net CO_2 removal by sinks. CO_2, CH_4 and N_2O emissions by sources increased by 6.6%, 14.7% and 12% respectively from 1990-1996. The carbon dioxide equivalent (CO_2 eqv.) was estimated based on Global Warming Potential (GWP) of CO2, CH_4 and N_2O. The results also indicate that total methane emissions are lower than CO_2, emissions. However, the CO_2, equivalent of CH_4 was about 2-3 times higher than CO_2, assuming global warming potential of 24.5 for CH_4 . Methane emissions are largely due to agriculture and biomass burning for energy. Nitrous oxide (N_2O) contributed just about 6.8% of the total CO_2, equivalent emissions for 1994. The main sources of N_2O emissions are agriculture (65%), biomass combustion (26%), human waste (5%), land use change and forestry and grassland conversion (4%).

2.3.2 Projections of GHG emissions at 2020 and 2050 time horizons under the Business-As-Usual case

The energy sector in Ghana is currently the largest emitter of GHG. Projection of GHG emissions by the National Communication to the United Nations Framework Convention On Climate Change report (2000) indicate that CO_2 equivalent emissions would increase from 7,278 Gg to 118,405 Gg between 1994 and 2020, move up to 234,135 Gg by 2030, and then to 519,826 Gg by 2050 (Table 2.1).

Table 2.1: Projections of CO_2 Equivalent GHG Emissions under the Business-As-Usual Scenario

Year	1994	1996	2000	2004	2008	2020	2030	2050
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Methane emissions from biomass (Gg)	155.80	198.94	324.37	528.87	862.31	3737.72	7475.29	16789.35
Nitrogen oxide emissions from biomass (Gg)	0.80	1.02	1.67	2.72	4.43	19.19	38.38	86.20
CO_2 equivalent of CH_4 (Gg)	3817.00	4873.93	7946.81	12957.06	21126.15	91571.78	183140.05	411328.81
CO2 equivalent of N_2O (Gg)	256.00	326.89	532.98	869.01	1416.90	6141.57	9125.76	20382.38
Business-As-Usual CO_2 equivalent	7278.00	9093.32	14826.41	24174.07	39415.19	**118404.87**	234135.02	**519825.62**

Source: First National Communication to the UNFCC, 2000.

2.3.3 Abatement scenarios at 2020 and 2050 time horizons

Abatement scenarios under climate change in Ghana have principally focused on two major sectors that were potential sources for greenhouse gas emissions and reductions according to the National Communication to the United Nations Framework Convention on Climate Change report (2000). As already indicated, greenhouse gas inventory results show that the Energy

Sector is responsible for the highest emissions of CO_2 in Ghana while the Forestry Sector has emerged as the potential for increasing the country's carbon sink base.

2.3.3.1 Abatement scenarios under the Energy Sector

Four abatement scenarios have been considered in this sector and these are as follows:

i. Replacing some biomass with LPG. This scenario involves replacement of fuel wood and charcoal with LPG at the rate of 10% a year from 1995 to 2020.
ii. Use of biogas and LPG to replace some biomass from 2010 to 2015 when only LPG and biogas will be used with the largest proportion of energy for cooking coming from biogas. This second alternative is strategically such that there is 10% increase in the use of LPG from 1995 to 2020 and a penetration rate for biogas use of 10% a year from 2010 to 2015 and thereafter 100% use of biogas for cooking purposes.
iii. Gradual penetration of solar PVs to the existing mix. This third scenario integrates the options in scenario two and other choices aimed at reduction in the use of petroleum products and electricity. The first option is 5% reduction in the use of petroleum products and electricity from 2000 to 2004, which then moves to 10% from 2005 to 2010; 20% from 2011 to 2014; and finally 50% from 2015 to 2020.
iv. Gradual penetration of biogas instead of a huge penetration as in the second and third scenarios. This fourth scenario is an adjustment of the third scenario by just a gradual penetration rate for biogas for cooking by 10% of households per year from 2010 to 2020.

Estimated CO_2 equivalent reductions from the abatement scenarios above are 494,506 Gg, 700,044 Gg, 712,515 Gg and 543,778 Gg for scenarios (I), (II), (III) and (IV) with their projected cost savings of 33.22 $/Gg, 27701.56$/Gg, 6932.22 $/Gg and 9448.86$/Gg respectively (see Table 2.2)..

Table 2.2: Emissions reduction and cost savings under different abatement scenarios

Options	CO_2 Reduction (Gg)	$/Gg*
I	494,506	33.22
II	700,044	27,701.56
III	712,515	6,932.22
IV	543,778	9,448.86

Note: * calculation of cost savings was not provided in the reference source.
Source: First National Communication to the UNFCC, 2000.

2.3.3.2 Abatement Scenarios under Forestry Sector

The forest protection abatement scenario is generally geared towards increased surveillance of protected/managed permanent forest and wildlife reserves and involvement of stakeholders, especially local communities in their protection. As a result, an additional 42,000 ha of unreserved high forests above the baseline situation (which is expected to protect 3,000 ha) would be maintained and managed as productive dedicated forests by communities and landowners. In the end the total carbon density would increase from 213 tC/ha in 2001 to 272 tC/ha in 2020 in the high forest zone and from 55tC/ha to 62tC/ha in the savannah woodland zone over the same period. Another abatement option is the reforestation abatement scenario which will ensure that an additional 112,000 ha of land is reforested, largely as industrial plantations by private enterprise (small, medium and large scale). This area is approximately equivalent to the unreserved high forests that would be deforested and lost even under the forest protection option outlined earlier. Consequently, the incremental carbon that would be sequestered is estimated at 6,060 ktC.

According to the first national communications of the UNFCC (UNFCC, 2000), the cost of the reforestation option would amount to US$ 93.6 million between 2001 and 2020 for the 112,000 ha of land to be reforested with an initial establishment cost of US$ 836/ha. This also translates into about US$ 15.45/KtC sequestered. The UNFCCC (2000) used a net present benefit approach with a discount rate over a 20-year rotation and this was estimated at US$ 330/ha or US$ 6.10/KtC. The estimation was based on indicative costs and benefits developed for private sector industrial forest plantation programs in Ghana.

2.4 Vulnerability and Adaptation Assessment Scenarios[2]

Assessment of Ghana's vulnerability to climate change and the corresponding adaptation measures needed to offset the impact on the national economy has been carried out in some sectors which include water resources, coastal resources and some agricultural crops. In the case of the water resources sector, the major findings with respect to vulnerability include temperature rise of about 1^{o} C over a 30 year period and reductions in rainfall and runoff of approximately 20 % to 30% respectively. It's worth noting that a 10% change in precipitation or a 1^{o} C rise in temperature can cause reduction in runoff in excess of 10%; reductions in groundwater recharge between 5% and 22% by the year 2020, and between 30% and 40% by year 2050; the projected increases in irrigation water demand due to climate change by 2020 will be 40% and 150% by 2050 in the humid part of Ghana in relation to the base period(1994) water demand while in the case of the dry interior savannah, irrigation water demand will be 150% by 2020 and 1200% by 2050. On the other hand, relative increases in water demand due to climate change over the scenario without climate change in the same period are 5% for 2020 and 17% for 2050 in the humid areas, and 4% and 12% by 2020 and 2050 respectively for the dry interior savannah; and by 2020 and 2050, all basins in Ghana will be marginally vulnerable in that the country will face water management problems. The major adaptation options suggested were generally geared towards water conservation and efficient water use for projected reduction in water resources.

With respect to agriculture, vulnerability will be noticed by the impact of temperature increases as well as increases in solar radiation over all agroclimatic zones in the country. Temperature increases are in the range of 0.4 ^{o}C and 0.6 ^{o}C by 2020. This is expected to increase between 1.5 ^{o}C and 1.8 ^{o}C by 2030 and between 3.7 ^{o}C and 5.4 ^{o}C by 2050 while average solar radiation will increase in the range of 0.15 MJ/m^2 and 0.39 MJ/m^2 by 2020, 0.51 MJ/m^2 and 1.35 MJ/m^2 by 2030, and 1.23 MJ/m^2 and 3.29 MJ/m^2 by 2050. However projected mean annual rainfall will decrease by a range of 14.8mm and 38mm by 2020, 51.7mm and 132.2mm by 2030 and 125.9mm and 321.8 mm by 2050 in all agroclimatic zones except the high forest zone which will record increases in mean annual rainfall by 22m by 2020, 76.9mm by 2030 and 187.5mm by

[2]The first national communication to the UNFCC – Ghana (UNFCC, 2000) served as the major source for this subsection. Details of costing were not provided in the report.

2050. The likely impacts of these projections are that maize yield would decrease in the transitional zone from 0.5% in 2000 to 6.9% in 2020, 12.7% in 2030 and 24.3% by 2050 while yield of millet is not expected to be affected by climate change because it is more tolerant to drought and therefore not very sensitive to rises in temperature. Adaptation strategies proposed include anticipatory and adaptive strategies. While the anticipatory strategies deal with the effect of climate change on agricultural production (especially production of cereals) when there is an indication that climate change may negatively impact on future production, the reactive measures are considered if actual impacts of climate change occur unexpectedly. In this case no preparatory steps are put in place and therefore ad hoc and urgent decisions are taken to deal with the situation as it arises.

Vulnerability in the coastal zone will be manifest in sea-level rise which is expected to reach 1m by year 2100. This indicates that a total of 1,110 km^2 of land area may be lost as a result of the 1m rise in sea-level. The estimated population at risk is 132,200 most of whom are within the east coast. The estimated cost of protecting all shorelines which are at risk with seawalls is US$ 1,144 million. With regards to adaptation, several measures have been anticipated. First is the 'do nothing' option which simply means no intervention whatsoever allowing nature to take its own course. The second option is protection of important areas while the third option is full protection of areas at risk. The fourth adaptation option is the set back and controlled abandonment which attempts to prevent construction of immovable structures within hazard areas. The final option is the setting up of a coastal management board since there is no central coordinating body to harmonise management of issues related to the objectives of various institutions involved with coastal management in Ghana.

SECTION C: KEY FINDINGS ON COST OF IMPLEMENTING MITIGATION AND ADAPTATION MEASURES

3.1 Cost of Implementing Mitigation Measures

Energy

The major assumption under the mitigation scenario in the energy sector is the implementation of strong policies that seek to increase energy efficiency significantly to provide the same services with 15 per cent less energy and shift the energy supply to more climate friendly technologies. It is also assumed that increased energy efficiency will limit the rate of growth of electricity demand under the current mix by 2020 and 2050. The scenario also assumes a substantial shift in electricity generation in Ghana, with significant investments in nuclear and renewable energy. Finally, the mitigation scenario suggests that energy subsidies especially on the price of LPG should be incorporated into the cost of petroleum product build-up. The logic is that the subsidies on LPG prices can reduce emissions by curbing deforestation when households (especially rural and to a large extent urban) switch from firewood and biomass burning (charcoal) to LPG. The energy sector will require additional investments of about US$ 286 million in 2020 and US$ 287 million in 2050. These investments will be needed in energy-efficient equipment that are ultimately expected to reduce emissions by 5%. Additionally, the electricity subsector will need investment flows up to US $ 21.9 million by 2020 and US $22 million by 2050. Emissions due to electricity generation are mainly from thermal electricity generation are projected to increase by 2.73% by 2020 and 7.31% by 2050 in the Business-As-Usual scenario from 2004 (Appendices 1-2 and 5-6).

Transport

The mitigation scenario in the transport subsector is based on increased use of bio-fuels and investments in vehicles which are fuel-efficient by both Government and private stakeholders by 2020 and 2050. These measures will need to be driven by policies and must be enforced. In this scenario, the subsector will require additional investment to the tune of US$ 6.58 million in 2020 and US$ 6.55 in 2050 (Appendices 3-4).

Forestry

The financial flow needed to reduce deforestation/ degradation is estimated as the opportunity cost of converting forest to other land uses. The mitigation scenarios advanced for the forestry sector are a reduction in deforestation; better management of productive forests (proper forest management); and forestation to increase the forest area (afforestation and reforestation). Additional investment in the forestry sector is mainly geared towards reforestation which eventually will reduce GHG emissions by sinks. Therefore, additional costs needed would be about US$ 3.9 million in 2020 and US$ 81.1 in 2050 (Appendices 7-8).

3.1.1 Methodology for Estimating Cost of Investment in Mitigation Scenarios[3]

The cost of implementing mitigation measures due to climate change in 2020 and 2050 has been estimated using a discount rate of 37.5%. Investments by private as well as public sources in the base year have been calculated for time horizons 2020 and 2050. This rate is the opportunity cost of capital for investments and is based on the Bank of Ghana's prime rate and charges on lending

[3] Detailed write up on the methodology used is presented in Appendix 17.

by commercial banks. This rate has been used because there is no explicit public discount rate established by government Ministries, Departments and Agencies (MDAs). The costs have been estimated based on assumption that there will be additional investment in the various sectors which will see implementation of mitigation measures. The major sectors for mitigation include energy and forestry. The estimations in the forestry sector were based on cost of plantations and maintenance of reforests by the forestry commission of Ghana while that of the energy sector was based on government budgetary allocation in 2006.

The estimations of the transport subsector were based on investment flow and operations and maintenance costs of Metro mass Transit Ltd (a public-private entity) in Ghana. National communications to the UNFCC report on Ghana (2000) indicates that the transport sector is responsible for about 60% of all petroleum consumed in Ghana with 1990 as the base year. This means that this subsector is a major contributor of GHG emissions in Ghana and therefore included as a standalone subsector.

Estimations of investment flows and operations and maintenance flows needed in the electricity generation subsector were based on figures from the Takoradi combined cycle plant (this plant uses both fossil fuel and/or natural gas to generate electricity) and the main sources of funds have been a combination of both private and public sources.

Results from Table 3.1 indicate the additional investments that will be needed to mitigate effects of climate change relative to the Business-As-Usual scenarios. On the whole Ghana will need about US $ 340.6 million by 2020 and US$ 422.7 million by 2050 to execute mitigation measures (mainly in the energy sector and forestry subsector).

3.2 Cost of implementing Adaptation Measures

Health

In the health sector, climate change is projected to increase the burden of climate-sensitive health determinants and outcomes with the impacts being manifest in changes in the location and incidence of infectious and diarrhoeal diseases, increases in air and water pollution, and increases in risk of heat stress. The adaptation scenario suggests specific measures that can be taken to reduce vulnerability to climate change and these could include improved monitoring systems to detect the arrival or presence of infectious diseases and also investment in heat-watch warning systems to warn the populations about heat waves. The incremental cost of adaptation in climate change in the health sector will be about US$ 350 million by 2020. This figure will go up to about US$ 352 million by 2050 (Appendices 9-10). Scenarios for discount rates of 25% and 20% are presented in Appendix 18.

Table 3.1: Incremental Cumulative Investment by sectors - Mitigation in Climate Change (Constant US Dollars)

Sector	B-A-U	CC Scenario	Amount Needed
Mitigation			
Energy (Whole Sector)**			
2006	2,467,339,219.04	2,344,008,456.34	123,330,762.69
2020	6,170,139,519.43	5,861,724,081.97	308,415,437.46
2050	6,263,953,049.11	5,950,848,947.30	313,104,101.81
Transport*			
2003	58,362,691.80	55,516,820.39	2,845,871.41
2020	134,642,518.96	128,065,336.68	6,577,182.28
2050	133,584,576.74	127,031,741.84	6,552,834.90
Electricity			
2004	189,379,644.81	179,944,689.76	9,434,955.05
2020	437,679,960.80	415,874,475.83	21,805,484.97
2050	440,540,600.16	418,590,437.08	21,950,163.08
Forestry- Reforestation***			
2006	14,355,817.84	13,638,165.67	717,652.17
2020	77,259,104.33	73,397,179.79	3,861,924.54
2050	***154,501,687.42	73,401,214.35	81,100,473.07

Note:
* estimations based on investment and O&M cost by Metro Mass Transit Ltd,
*** estimations based on government budgetary allocation in 2006 for the sector.*
**** investment is required to establish new plantations since forest plantations have average lifespan of about 30 years.*

Discount rate (37.5%) = Bank of Ghana prime rate (18%) + Commercial Bank's margin (11.5%) which together forms the bank's base rate + margin on lending (8% - ceiling) charged by commercial banks. Discount factor = $(1/1+0.375)^n$, *Average interbank rate for 2006 (US$ to GH□)* = 0.9131, *B-A-U = Business-As-Usual scenario, CC= Climate Change.*

Source: Authors' Estimation

Malaria treatment forms about 50% of outpatient care in public hospitals. Health expenditure on malaria in Ghana comes from both the public and private sectors. It is a fact that government spending is a major expenditure item in malaria treatment in Ghana but the payment by the private sector in treating malaria is significant. Government expenditure mainly goes into operation of health facilities that treat malaria while the families of those affected pay for the cost of treatment although this trend is expected to change in the adaptation scenario due to the sustained operation of the National Health Insurance Scheme (NHIS) which has helped in lifting this burden off the shoulders of many households. The estimations do not include the costs of setting up new infrastructure (such as new hospitals). Additional investment in controlling malaria will be about US$ 7.6 million in 2020 and US$ 7.54 million in 2050 (Appendices 11-12). This additional investment is needed to avoid an episode of malaria.

Agriculture
The potential effects of climate change on agriculture have been discussed in section 2.4. The agricultural sector will require about US$ 334.24 million in 2020 and US$ 336.30 million in 2050 for adaptation to effects of climate change and the investments will mainly be in research into production of drought resistant crops, change in management of crops and fisheries, moisture and irrigation management, Extension and training, pest and disease management, fire management in crop production, among others (Appendices 13-14).

Coastal Zones
Climate change will result in higher sea levels, increased intensity of coastal storms and the destruction of many coral reefs and coastal wetlands. The combination of these and continued expansion of human settlements in coastal areas is likely to lead to an increasing need for protection from coastal hazards. Protection of natural ecosystems such as wetlands and coral reefs can increase the resilience to climate change. The major abatement scenario for adaptation is that of protection which is to reduce the risk of the effect of climate change by decreasing the probability of the occurrence of sea-level rise. The major suggestion in this adaptation scenario is the development and integration of coastal zone management institutions and processes. This could increase the efficiency of adaptation to climate change and sea level rise in respect of protection of the coastal zone in Ghana. Additional investments needed for adaptation at the Ada Coastal Zone by 2020 will be US$5.7 million and this will increase to US$5.9 million in 2050 (Appendices 15-16).

3.2.1 Methodology for Estimating Cost of Investment in Adaptation Scenarios[4]

The methodology for calculating the cost estimation in the various sectors earmarked for adaptation to climate change followed the same procedure as that for mitigation measures. While the mitigation scenario incorporates measures to lessen Greenhouse Gas (GHG) emissions, the adaptation scenario incorporates new measures to respond to the potential impacts of climate change on health, agriculture and coastal zones. Investment in the base year was used in estimating time horizons 2020 and 2050. Government budgetary allocation for the Health and Agricultural sectors in 2006 were appropriately discounted and used for estimating the adaptation cost in 2020 and 2050. Scenarios were made using the Business-As-Usual figures. In the case of malaria, the cost estimations have been based on costs per episode and the prevalence rate for the Business-As-usual. The cost estimations for adaptation to climate change in the coastal zone was done using investment alternative proposed by the Ada Coastal Protection Works and Volta River Estuary Report (2007). Appropriate discounting was undertaken for the Business-As-Usual case as well as the climate change scenario.

In total, Ghana will need about US$ 697.2 million by 2020 and US$ 701.7 million by 2050 to implement adaptation measures to contain the effects of climate change (Table 3.2). Scenarios for discount rates of 25% and 20% are presented in Appendix 18.

[4] Detailed write up of the methodology used is presented in Appendix 17.

Table 3.2: Incremental Cumulative Investment by sectors - Adaptation in Climate Change (Constant US Dollars)

Sector	B-A-U	CC Scenario	Amount Needed
Adaptation			
Health (Whole Sector)**			
2006	3,026,296,286.27	2,874,981,471.96	151,314,814.31
2020	6,994,167,839.42	6,644,459,447.45	349,708,391.97
2050	7,042,217,556.47	6,690,106,678.65	352,110,877.82
Malaria*			
2003	66,556,045.48	63,228,243.20	3,327,802.27
2020	151,042,279.36	143,490,165.39	7,552,113.97
2050	150,818,247.73	143,277,335.34	7,540,912.39
Agriculture (Whole Sector)**			
2006	2,892,473,220.30	2,747,850,675.87	144,622,544.43
2020	6,684,882,753.24	6,350,641,190.39	334,241,562.85
2050	6,726,013,733.67	6,389,715,633.50	336,298,100.16
Coastal Zone Management***			
2006	49,763,250.00	47,275,087.50	2,488,162.50
2020	115,009,400.87	109,258,930.83	5,750,470.04
2050	115,717,064.60	109,931,211.37	5,785,853.23

Note:
* estimations based on costing of malaria in 2003 by Asante *et al (2005).*
*** estimations based on government budgetary allocation in 2006 for the sector.*
**** estimations are based on Ada Coastal Protection Works Report (2007.*

Discount rate (37.5%) = Bank of Ghana prime rate (18%) + Commercial Bank's margin (11.5%) which together forms the bank's base rate + margin on lending (8% - ceiling) charged by commercial banks. Discount factor = $(1/1+0.375)^n$, *Average interbank rate for 2006 (US$ to GH□)* = 0.9131, *B-A-U = Business-As-Usual scenario, CC= Climate Change.*

Source: Authors' Estimation

3.3 Limitations in Estimating Adaptation Costs

Estimation of the cost of adaptation under various scenarios is fraught with uncertainties which include differences in adaptive capacity; the fact that most adaptations will not be solely for the purpose of adapting to climate change; the uncertainties associated with any readily available methods to estimate adaptation costs; and the existence of an adaptation deficit. These culminate in the fact that there is uncertainty about adaptive capacity of people and societies in responding to stresses related to climate change. Therefore all scenarios used in this study leave many key aspects of adaptive capacity undefined. Also most adaptations to climate change will most likely not be made solely to adapt to climate change. This implies that most activities that need to be undertaken to adapt to climate change will have benefits even if the climate does not change. Thus it will be difficult to attribute all benefits of adaptation measures to scenarios under climate change.

SECTION D: Key Findings On Financial and Policy Instruments for Addressing Climate Change

4.1 Financial Instruments

4.1.1 Existing Financial Instruments for Addressing Climate Change Impacts

When considering means to enhance investment and financial flows to address climate change, it is key to focus on the role of private-sector investments as they constitute the largest share of investment and financial flows (UNFCC, 2007). Some of the major measures that have been proposed to guarantee financing of climate change investments include the need to ensure the right investment climate. The creation of a favourable investment environment can be addressed from two different angles.

First through the reduction of financing barriers posed by the local economy, and secondly through the intensification of capacity building and knowledge transfer to increase the awareness of emission reduction opportunities and ability to take appropriate action. These measures could be made known to the private sector operators who are likely to invest in climate change related projects. Moreover, financial institutions are usually well experienced in addressing business risks. These financial institutions could therefore alert the private sector concerning risks in climate change related investments and how to avoid these risks. Another instrument for stimulating investment in climate change impact projects is the reduction in the risk of low carbon investments. Currently there are a range of barriers including lack of policy predictability as well as an absence of the transparent rules and procedures needed to provide stable conditions for investment into low carbon technologies. Nevertheless, there is a variety of public finance mechanisms which are available to address these risks, including debt guarantees. The UNEP report (2009) suggests the creation of a mechanism whereby the home government of a foreign investor issues guarantees in order to facilitate low carbon investments in host countries. Credit risk guarantees and other risk sharing instruments can considerably lower the investment barriers for many investors and keep the risks associated with direct investments at a reasonable level. Design of credible policy mechanisms that can boost public and private flows of finance for both mitigation and adaptation are also important. The contributions of insurance industry operators are also significant in financing climate change impacts. Insurance companies could supply climate-related risk projections to regional and national authorities in order to adapt infrastructure regulation and codes to future climatic requirements. In all these the public sector has the overall responsibility of enabling the private finance sector to operate more effectively by providing good governance and economic stability.

Resources are generated domestically from various sources. Notable among these are: tax revenue- indirect, direct and international taxes; national health insurance levy; import exemptions and banking and private sector investments. Presently there are no specific budget allocations for climate change mitigation or adaptation from domestic resources. The few projects on the ground are either integrated into the sectors specific projects or stand alone projects. The private sector is currently not actively involved in climate change mitigation or adaptation projects

4.1.2 Potential Financial Instruments Under Discussion to Address Climate Change Impacts

The most potent drive in formulating potential financial instruments to address climate change impacts is the provision of national policies that can assist in shifting investments and financial flows made by private and public investors into more climate-friendly alternatives and optimize the use of available funds by spreading the risk across private and public investors (UNFCC, 2007). A very pertinent emerging issue related to financing of climate change impacts is that of carbon markets. Carbon market and policies to promote renewable energy sources are already playing an important role in shifting investment flows in many parts of the world. However, a thorny issue is how to shift more public investment into lower carbon, more climate-proof measures without compromising development priorities. In discussing such issues, climate change adaptation and mitigation measures must be integrated into national development plans. Another potential financial instrument that could be used to address climate change is that of financial incentives. These incentives will have to be made available to rural households whose main source of energy for cooking is firewood since they contribute significantly to GHG emission by burning of biomass for energy. The incentives will be needed to achieve significant reductions in emissions through reduced deforestation and forest management.

There is currently a national project underway which seeks to mainstream climate change into national policy with the expectation of climate change activities receiving specific budget allocation. With climate change mainstreamed into national policy the government will have to look into various financing options to meet the extra demand. To ensure that these climate change issues remain an integral part of development agenda, development partners must increase ODAs mostly in grants directly to the government and through multilateral and bilateral agencies. The private sector should be given incentives to initiate climate change initiatives and foreign direct investments (FDI) in mitigation and adaptation strategies should be encouraged. To ensure sustainability it will be important to pass legislature, laws and by-laws for example building codes etc to protect climate change activities as well as to act as incentives for foreign investors interested in climate change activities.

4.2 Policy Instruments

4.2.1 Policy Instruments and Initiatives That Are Being Used To Implement Activities That Address Climate Change.

Ghana has no specific legislation or policy on technology transfer in the very strict sense. However, there are laws, guidelines, standards and related policies, which need to be considered if there is an intention to introduce a new technology into the country. The focus of this is therefore not on technology transfer in strict sense but on institutions, policies, guidelines and related framework that may be relevant to technology transfer. The broader framework of the National Environmental Action Plan (NEAP) which was adopted in 1991 encompasses Ghana's National Environment Policy (NEP). The principal objective of the NEP is to improve the surroundings, living conditions and the quality of life of the entire citizenry of present and future generations. It seeks to ensure reconciliation between economic development and natural resource conservation, to make high quality environment a key element in supporting the country's economic and social development and natural resource conservation. Among other things, the policy seeks to guide development in accordance with quality requirements to prevent, reduce and as far as possible eliminate pollution and nuisances. It also seeks to integrate environmental considerations in sectoral, structural and socio-economic planning at the national, regional, district and grassroots levels. The NEP also invokes a number of principles deemed to be effective for achieving its objectives. Among these are;

- Use of the most cost-effective means to achieve environmental objectives;
- Use of incentives in addition to regulatory measures; and
- Polluter pays for the cost of preventing and eliminating pollution and nuisances.

Currently, most projects are stand alone projects and funding is through multilateral, bilateral and non governmental agencies. There is no national institutional framework through which money for climate change activities can be channeled.

The Environmental Protection Agency (EPA) co-ordinates all climate change issues in Ghana. EPA together with the National Development Planning Commission (NDPC), the Regional Coordinating Councils and particularly the districts are coordinating the mainstreaming activities. NDPC leads the mainstreaming processes but works closely with Ministry of Environment, Science and Technology (MEST), EPA, Ministry of Finance and Economic planning (MOFEP), the regions and the districts. Other sectors such as health, agriculture, forestry and land management, transport, energy are also involved. The mainstreaming process seeks to target policy formulation, planning, budgeting, implementation and monitoring and evaluation.

4.2.2 Policy Statement

Ghana's specific policy statement on environmental protection is that it must be guided by the preventive approach so that socio-economic activity can take place without undermining the integrity of the environment.

Specifically, Government has promised to do the following:

- Commit itself to the environmentally sound use of both renewable and non-renewable resources in the process of national development;
- Institute and implement an environmental quality control programme by requiring prior environmental impact assessments of all new investments that would be deemed to affect the quality of the environment;
- Promote and support research programmes aimed at better understanding of the different ecozones and the factors affecting them, as health-related environmental problems, and the development of appropriate technologies for environmentally sound management and use of local resources, including energy resources; and
- Establish an adequate legislation and institutional framework for monitoring, co-ordinating and enforcing environmental matters.

4.2.3 Management Of Environmental Resources:- Energy Resources

The NEP recognises that wood fuels constitute the primary source of energy for most Ghanaian households while the industrial sector depends almost entirely on hydro-power. To reduce the pressure on forest for wood fuels, the development of renewable energy resources will be promoted, while the efficiency of production, conversion and use of wood fuels would be improved. Industries would be given the appropriate incentives so they can promote the use of renewable energy sources.

4.2.4 Waste Management

It is known that a substantial percentage of the urban waste in Ghana is biodegradable and therefore potentially re-useable or re-cyclable for raw material or energy but the appropriate technology and resources are not readily available. NEP therefore proposes the adoption of a more comprehensive policy for waste management. Such a policy will cover prevention, reclamation and disposal. Additionally, the policy will focus on three broad themes: reduction in the volume of waste, increase of recycling and reuse and safe disposal of unavoidable wastes.

4.2.5 Energy policy

To ensure an environmentally sustainable development, the energy sector institutions have committed themselves to the following strategic policy objectives in the energy sector.

a) Strategic Objectives

To ensure sustained provision and security of energy supply to all sectors of the economy and all parts of the country by:

- Restoring improved productivity and efficiency in the procurement, transformation, distribution and use of all energy sources;
- Reducing the country's vulnerability to short-term disruptions in the energy resources and supply basis;
- Ensuring the availability and equitable distribution of energy to all socio-economic sectors and geographical regions;
- Consolidating and accelerating the development and the use of the country's indigenous energy sources, especially wood fuels, hydro-power, petroleum and solar energy; and
- Securing future supply through thermal complementation of hydro-based electricity generation.

b) Renewable Energy

In the short-term, the following are the objectives to guide the development of Ghana's renewable resources:

- To improve the efficiency of production, conversion and the use of wood fuels in all the socio-economic sectors and
- To promote the development of renewable energy industries that have strong indigenisation prospects over the short and medium terms.

In the medium to long term, the objectives are:

- To demonstrate and evaluate renewable energy technologies with the potential to meet the needs of prioritized socio-economic and welfare objectives; and
- To provide support for research, development and demonstration of renewable energy technologies with the greatest potential to increase and diversify the country's future energy supply base.

c) Biomass

The objectives in this area are to ensure better and sustainable use of existing bio-energy resources. This is aimed at;

- Conserving forest resources through improved methods for charcoal and firewood production;
- Decreasing consumption of firewood and charcoal by using more efficient cooking devices;
- Expanding the productivity and use of bio-energy such as biogas and the production of charcoal briquettes from logging and wood processing residues;
- Planning for the future security of biomass supply through the implementation of a sustained programme of forest regeneration and afforestation; and
- Substituting LPG for firewood and charcoal as sources of energy.

d) Solar Energy

Activities on solar energy are focused around a strategy whose principal objectives are to:

- Evaluate the technical and economic viability of proven solar technologies to meet the prioritized socio-economic and developmental needs of the country
- Demonstrate appropriate solar energy technologies for selected applications;
- Concentrate support for research development and demonstration on renewable energy technologies with the greatest prospects for operation within local technical and user absorption capacities;
- Promote development of solar energy industries that have strong indigenisation prospects over the short to medium term; and
- Exploit the country's enormous solar resources to pump irrigation water, improve communication and health facilities and provide opportunities for access to modern recreational and educational facilities

e) Power Sector

Policies and actions in this sector have to do with two areas of operation, namely;

- assuring future security of power supply by developing complimentary power generation capacity from other energy sources and improvement of existing hydro-power sources; and
- extension of the reach of electricity to all parts of the country especially the north and rural areas.

4.3 National Science and Technology Policy

The vision of the policy on national science and technology is: "to support national socio-economic development goals with a view to lifting Ghana to a middle income status by the year 2020 through the perpetuation of a science and technology culture at all levels of society, which is driven by the promotion of innovation and the mastery of known and proven technologies and their application in industry and other sectors of the economy."

The basic objectives of the policy are to:

- seek to master scientific and technological capabilities;
- Develop infrastructure which will enable industry and other sectors of the economy to provide the basic needs of society and for the citizenry; and
- Adopt a science and technology culture.

The long term objective of the policy is the acquisition of endogenous science and technology capacities appropriate to national needs, priorities and resources, and to create a science and technology culture whereby solutions to socio-cultural and economic problems of the individual, and community and the nation are recognised and sought within the domain of science and technology.

4.3.1 Policy Measures

To enable the policy to have the desired impact government's specific actions will be to:

- create the enabling environment and advocacy for the promotion of science and technology as key factors in Ghana's development process;
- promote the development and utilisation of science and technology capabilities, including entrepreneurial skills development;
- promote science and technology capacity building;
- encourage the improvement of the quality of research and development (R&D) activities, especially within the private sector institutions;
- strengthen the protection of intellectual and innovative property rights;
- ensure environmental sustainability;
- promote participation of women in science and technology;
- safeguard the generation, use and application of science and technology;
- promote international and local co-operation and linkages;
- promote a science and technology culture; and
- establish mechanisms for the finance, management and evaluation of the performance of science and technology.

The policy covers all sectors of the economy. The sectors covered include; Agriculture, Environment, Energy, Trade, Industry, Natural Resources (Land, minerals, water), and Communication. The objective under this sector is to employ science and technology to ensure the supply of sustainable, affordable, safe and reliable energy.

The strategies employed to achieve the objectives are:

- Promotion of a research and development programme relating to alternate energy sources to supplement the traditional energy sources;
- Facilitation of efforts to acquire and adapt sustainable safe and economical energy technologies for national development;
- Support research aimed at upgrading hydropower energy production technology;
- Promotion of research and development efforts aimed at popularisation and dissemination of energy technology for rural and urban development; and
- Promotion of public supports for energy conservation and encourage private investment in energy technologies.

4.4 Financing Science and Technology

It is important that all sectors of the economy, especially the private sector, recognise the central role of science and technology and provide adequate resources to support activities in this area since inadequate funding can be a major constraint in development.

To ensure the availability of funds to meet the demands of innovation, Government will;

- Take stock of all existing funding lines established to support development in science, technology and industry with the aim of streamlining them to achieve economies in their operations;
- Strengthen and modify the national science and technology foundation to incorporate support for innovation in its sphere of operation;
- Encourage the private sector to support the funding of R & D activities, especially to cater for the needs of the small, micro and medium enterprises (SMMEs)
- Accelerate the formation of a venture capital (high risk) fund administrating authority for the commercialisation of new technologies from scientific and technological institutions,
- Accelerate the allocation of a minimum of 2% of GPD to support the science and technology sector;
- Institute an attractive tax incentive mechanism for contributors to the fund or directly to R & D activities in a way that will not result in erosion of the national tax base; and
- Encourage public procurement of products and services from S & T institutions as a means of facilitating their promotion.

4.5 Ghana Poverty Reduction Strategy (GPRS II), 2006- 2009

The previous strategy paper GPRS I which was issued in 2003 reflected a policy framework that was directed primarily at the attainment of the anti-poverty objectives of the UN's MDGs. This was intended to introduce a shift of strategic focus highlighting on accelerating the growth of the economy so that Ghana can achieve middle-income status within a measurable planning period.

4.5.1 Support services for the energy sector

To support a growing agro-industrial and services sector, as well as the needs of households, the policy thrust for the energy sector is set within the context of ensuring a reliable supply of high quality energy services. The broad policy interventions outlined to achieve this overall goal include: ensure increased access to modern forms of energy to the poor and vulnerable; modernise and expand power infrastructure; improve the regulatory environment in the power sector; ensure full cost recovery for power supply and delivery while protecting the poor; and to ensure productive and efficient use of energy and minimise the environmental impacts of energy supply and consumption through increased energy efficient technologies. The GPRS II also seeks to promote and encourage private sector participation in the energy sector; diversify the energy mix by implementing programmes to support renewable energy sources in Ghana (i.e. hydro, wind, solar PV, etc)

SECTION E: INSTITUTIONAL FRAMEWORK

5.1 Existing and Potential Institutional Arrangements to Support Integration of Climate Change Priorities into National Development

There are a number of institutions that provide focus and direction exclusively for general policy and legislative framework as opposed to that concerning technology transfer.

5.1.2 Ministry of Environment and Science

The Ministry Of Environment and Science (MES) was established in 1994. Its creation was in response to a national development need to integrate environmental, scientific and technological considerations into the country's sectoral, structural and socio-economic planning processes at all levels. Among the main areas of policy thrust for MES, are sanitation and waste management (technical optional) and science and technology promotion, education and acculturation.

5.1.3 The Judiciary

By the Judiciary is meant the complete infrastructure established to hear, adjudicate upon and dispense justice to parties who bring their grievances before properly constituted courts of law.
The courts constitute the forum for the enforcement of the laws of the land through the decision they hand down in disputes brought before them. It is therefore crucial to guarantee the independence of the judiciary and ensure nothing is done to compromise its integrity.

5.1.4 Science and Technology Policy Research Institute (STEPRI)

The mandate of this institute is to provide research support for national science and technology policy development, monitoring and evaluation. These include technology transfer and technology policy formulation through diagnostic studies; science and technology culture; and private sector and technology-led development

5.1.5 Institute of Industrial Research (IIR)

The mandate of the institute of industrial research is to undertake research into process and product design and development and to promote adaptive technology among others. Among its objectives is to promote technology transfer to enhance the efficiency and competitiveness of Ghanaian industry.

5.1.6 Institute for Scientific and Technological Information (INSTI)

The mandate of INSTI is to develop a national capacity for the efficient and effective provision of scientific and technological information to the Ghanaian society through the publication and dissemination of the results of scientific and technological research in appropriately packaged form. The nodal points of resource centres of the Ghana National Scientific and Technological Information Network (GHASTINET) – a division of INSTI are Ministry of Food and Agriculture Library; Water Research Institute, Energy Information Centre (under the Ministry of Energy); Institute of Industrial Research Library, Ministry of Roads and Transport Library and Building and Road Research Institute Library.

5.1.7 Ghana Regional Appropriate Technology Industrial Service (GRATIS)

Established in 1987, GRATIS runs a network of Intermediate Technology Transfer Units (ITTU's) located in all the regional capitals of Ghana. These Units provide training in machining and other industrial skills to apprentices, produce spare parts for local industry and offer manufacturing extension services with particular emphasis on small-scale enterprises. Strategies that could be helpful in integrating climate change concerns into national development framework have also focused on efforts at reducing greenhouse emissions. The main elements that need to be considered include: a programme to promote the use of appliances which are highly energy efficient; energy conservation (which entails promoting energy conservation in large energy-consuming industries such as mining, cement and steel industry, information and training on energy conservation and national energy campaigns and technical guidance regarding new and alternative energies; a programme to promote the use of energy-efficient equipment in the public sector; application of clean energy technology such as small scale hydro power systems; promotion in the use of LPG; promotion of the use of alternative energy sources such as solar, wind and wave energy; technical improvements in agriculture and animal husbandry with the aim of reducing emissions of methane and nitrous oxide; monitoring of greenhouse gas emissions from industry; controlling emissions from the transportation sector (inventory of technologies producing lower CO_2 emissions, promotion of the use of natural gas in vehicles, promotion of catalytic converters for motor vehicles; increases in GHG emission sinks by enhancement of phytoplankton activity in the sea and forest management (reforestation, measuring of CO_2 sink capacity of different forests, and inventory of biomass of typical forests to determine the capacity of CO_2 sinks); and finally improvement in waste management which entails research and development on methane reduction practices and increased recycling.

SECTION F: LESSONS LEARNED

6.1 Challenges and Opportunities

The challenge is how to implement strategies earmarked for adoption to achieve the targets set. These strategies are:

- ✓ Integrating environmental consideration into national and sub-national levels of development decision-making;
- ✓ Increasing access to information on and improving the understanding of environmental issues;
- ✓ Establishing an appropriate institutional framework and mechanisms to facilitate integration of development and environment;
- ✓ Encouraging the adoption of more effective management practices and technology
- ✓ Ensuring compliance with environmental standards and regulations; and
- ✓ Applying the "polluter pays principle" to check reckless environmental destruction.

Some of the key challenges are as follows:

1. Poor and Inadequate Infrastructure;
2. Limited Human Resource Capacity;
3. Weak sub-regional network;
4. Inadequate financial resources/Low budgetary allocation;
5. Flooding
    - Siltation of river beds

- High rainfall in a short period generating high run-off
- Settlements, farms etc located in flood plains
- Improper farming methods leading to compaction of the soil which restricts infiltration
- Land degradation along the river banks
- Absence of proper flood management systems
- Improper disposal of solid waste that could choke drains and exacerbate flooding conditions

6. Drought
   - deforestation
   - long dry season
   - scanty rainfall
7. General
   1. Lack of framework, inadequate human and financial capacity and logistics for the water resources management in the river basins.
   2. Inadequate water harvesting systems.
   3. Farming along the river banks causing siltation and reducing the carrying and storage capacities of the rivers.
   4. Higher temperatures, in combination with favorable rainfall patterns, could prolong disease transmission seasons in some locations where certain diseases already exist. In other locations, climate change will decrease transmission via reductions in rainfall or temperatures that are too high for transmission.

The public health sector of Ghana is characterized by the following:

- Limited access to health care (Facilities, Nurses, Doctors, Paramedics and inadequate community health workers)
- Inaccessible health facilities (road network, transportation, financial constraints)
- Inadequately equipped health facilities

Some of the areas that are weak in terms of research and awareness creation are

- Inadequate climate information center
- Poor information on delivery services
- Weak operational and well resourced Research and development systems
- Inadequate climate change education into school curriculum
- Inadequate health education and awareness creation
- Need for policy and budgetary allocation for climate change research and education
- Relationships between scientific knowledge and traditional or indigenous knowledge is weak

6.2 Next Steps

Climate Change Adaptation in Ghana has been implemented through an integrated Water Resources Management Project which was launched in July 2009 by the Water Resources Commission. Inventory and validation of climate change and variability driven hazards and disasters and interventions including preparedness, mitigation, response and management:. Some of the current programmes on climate change include;

- Hydrological modelling, mapping/demarcating flood prone communities and landscapes, water accessibility and conservation strategy: Facilitated by GEOHYDRONOMICS Ltd., Accra.
- Integrating Climate Change and Disaster Risk into National Polices, Development Plans and programmes. The programme will specifically
  - create and deepen awareness about the critical role of climate change and disasters in national development efforts
  - ensure that climate change and disaster issues are fully integrated and sustained in the national planning processes.
  - assist pilot districts to integrate climate change and disaster risk in their District Medium Term Development Plans
  - take up adaptation and mitigation measures

A draft tool has been developed and shared with ten pilot districts-one selected from each region. Few of the pilot districts have prepared and submitted proposals on adaptation projects to be implemented in their districts.

- Mitigation efforts on health and climate Change
- Supporting integrated and Comprehensive Approaches to Climate Change Adaptation in Africa . The project is intended to promote systemic change for a more integrated and holistic approach to climate change adaptation through providing inputs to a comprehensive programme that will develop early warning systems in a country as well as develop capacity

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APPENDICES

APPENDIX 1: B-A-U SCENARIO FOR THE MINISTRY OF ENERGY (US$ 2006 CONSTANT) – COST OF MITIGATION MEASURES

Energy Sector (2006 US $)

				GOG Discretionary + Statutory						IGF + Donor						HIPC								
Discount period	Year	Disc factor	GHG emission	A	B	C	D	E	Disc. Subtotal	A	B	C	D	E	Disc. Subtotal	A	B	C	D	E	Disc. Subtotal	Disc. Grand total	Incremental	Cost of adaptation
0	2006	1	6995	857387282.2	568282536.7	3315.724	59737025.66	168950915.4	1654361076	29602377.49	651904347.9	1560.884	1224573.532	3664170.572	686397030.3	72502.6	84159817.4	0	0	41996092	126228412	2466986518	352700.97	2,467,339,219.04
1	2007	0.72727273	7081	623554387.1	413296390.3	2411.4356	43445109.57	122873393	1203171691	21529001.81	474112253	1135.18836	890598.9324	2664851.325	499197840.2	38348.48	44514283.58	0	0	22212808.99	66765441.06	1769134973	249847.76	
2	2008	0.52892562	6848	329813890.7	218603049.4	1275.4701	22979231.51	64990885.56	636388332.7	11387240.63	250770117.3	600.430209	471060.5923	1409508.139	264038527.1	14751.63	17123450.94	0	0	8544671.829	25682874.4	926109734.1	135237.99	
3	2009	0.38467318	6402	126870557.5	84090729.76	490.63913	8839494.013	25000250.49	244801522.4	4380366.041	96464537.98	230.969397	181204.3751	542199.9753	101568539.3	4126.951	4790496.211	0	0	2390477.14	7185100.302	353555162	55225.736	
4	2010	0.27976231	6302	35493600.4	23525416.92	137.26234	2472957.276	6994127.862	68486239.72	1225461.328	26987142.11	64.6165322	50694.1548	151687.1183	28415049.32	839.6839	974691.1218	0	0	486374.8436	1461905.649	98363194.69	15607.425	
5	2011	0.2034635	6512	7221652.135	4786563.645	27.927876	503156.5406	1423049.728	13934449.98	249336.6499	5490898.365	13.1471058	10314.41012	30862.79186	5781425.363	124.2509	144228.4118	0	0	71970.5655	216323.2282	19932198.57	3060.8761	
6	2012	0.14797345	6867	1068612.809	708284.3549	4.1325842	74453.81118	210573.5834	2061928.692	36895.20527	812507.1961	1.94542265	1526.258891	4566.873909	855497.4796	13.37152	15521.43727	0	0	7745.260478	23280.06927	2940706.24	428.23817	
7	2013	0.10761706	6974	115000.9661	76223.47808	0.4447366	8012.500071	22661.30941	221898.6983	3970.553423	87439.63356	0.20936066	164.2514907	491.4735316	92066.12137	1.046548	1214.815568	0	0	606.1979211	1822.060037	315786.8797	45.277551	
8	2014	0.07826695	6777	9000.774956	5965.779211	0.0348082	627.1139491	1773.631589	17367.33451	310.7631096	6843.633501	0.01638602	12.85546334	38.46613473	7205.734594	0.059571	69.14902568	0	0	34.50564573	103.7142424	24676.78335	3.6412813	
9	2015	0.05692142	6517	512.3368807	339.5806169	0.0019813	35.69621572	100.9576265	988.5733211	17.6890771	389.5493285	0.00093272	0.731751213	2.189546964	410.1606365	0.002466	2.862589563	0	0	1.428443863	4.29349951	1403.027457	0.2152726	
10	2016	0.0413974	6405	21.20941247	14.05775309	8.202E-05	1.47773036	4.17938279	40.92436074	0.732281721	16.12632761	3.8612E-05	0.030292594	0.090641542	16.97958208	7.42E-05	0.086184547	0	0	0.04300644	0.129265234	58.03320805	0.00906	
11	2017	0.0301072	6560	0.638555953	0.423239538	2.469E-06	0.044490319	0.1258295	1.232117779	0.02204695	0.485518518	1.1625E-06	0.000912025	0.002728963	0.511207618	1.63E-06	0.001887109	0	0	0.000941675	0.00283041	1.746155807	0.0002662	
12	2018	0.02189614	6784	0.013981913	0.009267313	5.407E-08	0.000974166	0.002755181	0.026978627	0.000482743	0.010630983	2.5454E-08	1.99698E-05	5.97538E-05	0.011193475	2.59E-08	3.00512E-05	0	0	1.49957E-05	4.50728E-05	0.038217175	5.633E-06	
13	2019	0.01592447	6873	0.000222655	0.000147577	8.611E-10	1.55131E-05	4.38748E-05	0.00042962	7.68743E-06	0.000169293	4.0535E-10	3.18009E-07	9.51547E-07	0.00017825	3E-10	3.48036E-07	0	0	1.73671E-07	5.22007E-07	0.000608392	8.852E-08	
14	2020	0.01158143	6756	2.57866E-06	1.70915E-06	9.972E-12	1.79664E-07	5.08133E-07	4.97562E-06	8.90314E-08	1.96065E-06	4.6945E-12	3.683E-09	1.10203E-08	2.06439E-06	2.53E-12	2.93146E-09	0	0	1.46281E-09	4.39679E-09	7.04441E-06	1.043E-09	
									3,823,445,537.42												227,565,266.90	5,637,364,413.00	812,158.13	5,638,176,571.14
15	2021	0.00842286	6873	2167841641	1436861232	8383.568	151040742.5	427180152.1	4182932151	74847467.32	1648292925	3946.58214	3096245.477	9264589.888	1735505174	144059.5	167221840.5	0	0	83444380.19	250810280.2	6169247606	897632.03	
16	2022	0.00612572	6756	13279581.34	8801803.255	51.355353	925232.6315	2616784.119	25623452.7	458494.2976	10096973.67	24.1756397	18966.7192	56752.24274	10631211.11	882.4673	1024353.436	0	0	511156.5409	1536392.444	37791056.25	5593.4643	
17	2023	0.00445507	6567	59161.40982	39212.61341	0.2287915	4121.972333	11657.94566	114154.17	2042.622304	44982.68295	0.10770407	84.49798367	252.8349806	47362.74592	3.93145	4563.562048	0	0	2277.236068	6844.729566	168361.6455	25.63907	
18	2024	0.00324005	6494	191.6858026	127.0507464	0.0007413	13.35538787	37.77230255	369.8649807	6.618194142	145.7460482	0.00034897	0.273777516	0.819197452	153.4575663	0.012738	14.78615971	0	0	7.378353977	22.17725177	545.4997988	0.0839951	
19	2025	0.0023564	6583	0.451688135	0.299382186	1.747E-06	0.031470616	0.089006596	0.87154928	0.015595103	0.343435767	8.223E-07	0.000645129	0.001930356	0.361607177	3E-05	0.034842084	0	0	0.017386342	0.052258442	1.285414899	0.0001952	
20	2026	0.00171374	6739	0.000774078	0.000513065	2.994E-09	5.39326E-05	0.000152535	0.001493613	2.6726E-05	0.000588561	1.4092E-09	1.10559E-06	3.30814E-06	0.000619702	5.14E-08	5.97104E-05	0	0	2.97957E-05	8.95576E-05	0.002202873	3.269E-07	
21	2027	0.00124636	6805	9.64779E-07	6.39463E-07	3.731E-12	6.72194E-08	1.90113E-07	1.86158E-06	3.33102E-08	7.33559E-07	1.7564E-12	1.37796E-09	4.12313E-09	7.72372E-07	6.41E-11	7.44207E-08	0	0	3.71362E-08	1.11621E-07	2.74557E-06	4.035E-10	
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24	2030	0.00047944	6548	2.76402E-16	1.83202E-16	1.069E-21	1.92579E-17	5.4466E-17	5.33329E-16	9.54314E-18	2.10159E-16	5.0319E-22	3.94775E-19	1.18125E-18	2.21279E-16	1.84E-20	2.1321E-17	0	0	1.06393E-17	3.19786E-17	7.86587E-16	1.201E-19	
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34	2040	1.9848E-05	6700	4.38779E-57	2.90826E-57	1.697E-62	3.05712E-58	8.64628E-58	8.46641E-57	1.51494E-58	3.33621E-57	7.988E-63	6.26691E-60	1.87519E-59	3.51273E-57	2.92E-61	3.38463E-58	0	0	1.68894E-58	5.07649E-58	1.24868E-56	1.864E-60	
35	2041	1.4435E-05	6643	6.33361E-62	4.19796E-62	2.449E-67	4.41284E-63	1.24806E-62	1.22209E-61	2.18676E-63	4.81569E-62	1.153E-67	9.04606E-65	2.70676E-64	5.07049E-62	4.21E-66	4.88559E-63	0	0	2.43793E-63	7.32773E-63	1.80242E-61	2.713E-65	
36	2042	1.0498E-05	6612	6.64897E-67	4.40699E-67	2.571E-72	4.63256E-68	1.3102E-67	1.28294E-66	2.29564E-68	5.05547E-67	1.2105E-72	9.49647E-70	2.84153E-69	5.32295E-67	4.42E-71	5.12885E-68	0	0	2.55932E-68	7.69258E-68	1.89216E-66	2.862E-70	
37	2043	7.6348E-06	6633	5.07638E-72	3.36466E-72	1.963E-77	3.53689E-73	1.00032E-72	9.79508E-72	1.75269E-73	3.85977E-72	9.2416E-78	7.25041E-75	2.16947E-74	4.06399E-72	3.37E-76	3.9158E-73	0	0	1.954E-73	5.87317E-73	1.44464E-71	2.178E-75	
38	2044	5.5526E-06	6680	2.81872E-77	1.86827E-77	1.09E-82	1.9639E-78	5.55438E-78	5.43883E-77	9.73199E-79	2.14318E-77	5.1315E-83	4.02587E-80	1.20462E-79	2.25658E-77	1.87E-81	2.17429E-78	0	0	1.08498E-78	3.26114E-78	8.02152E-77	1.201E-80	
39	2045	4.0383E-06	6706	1.13827E-82	7.54456E-83	4.402E-88	7.93073E-84	2.24301E-83	2.19634E-82	3.93003E-84	8.65473E-83	2.0722E-88	1.62575E-85	4.86458E-85	9.11266E-83	7.56E-87	8.78036E-84	0	0	4.38143E-84	1.31694E-83	3.2393E-82	4.83E-86	
40	2046	2.9369E-06	6690	3.34302E-88	2.21578E-88	1.293E-93	2.32919E-89	6.58753E-89	6.45048E-88	1.15422E-89	2.54183E-88	6.086E-94	4.77471E-91	1.42869E-90	2.67631E-88	2.22E-92	2.57872E-89	0	0	1.28679E-89	3.86773E-89	9.51357E-88	1.422E-91	
41	2047	2.1359E-06	6652	7.14049E-94	4.73277E-94	2.76E-99	4.97502E-95	1.40706E-94	1.37779E-93	2.46535E-95	5.42919E-94	1.3E-99	1.01985E-96	3.05159E-96	5.71645E-94	4.75E-98	5.508E-95	0	0	2.74851E-95	8.26125E-95	2.03204E-93	3.055E-97	
42	2048	1.5534E-06	6629	1.1092E-99	7.3519E-100	4.29E-105	7.7283E-101	2.1857E-100	2.1403E-99	3.8297E-101	8.4338E-100	2.019E-105	1.5842E-102	4.7404E-102	8.88E-100	7.4E-104	8.5562E-101	0	0	4.2696E-101	1.2833E-100	3.1566E-99	4.76E-103	
43	2049	1.1298E-06	6642	1.2531E-105	8.3059E-106	4.85E-111	8.731E-107	2.4693E-106	2.418E-105	4.3266E-107	9.5281E-106	2.281E-111	1.7898E-108	5.3555E-108	1.0032E-105	8.3E-110	9.6664E-107	0	0	4.8236E-107	1.4498E-106	3.5662E-105	5.37E-109	
44	2050	8.2164E-07	6673	1.0296E-111	6.8244E-112	3.98E-117	7.1738E-113	2.0289E-112	1.9867E-111	3.5549E-113	7.8287E-112	1.874E-117	1.4706E-114	4.4003E-114	8.2429E-112	6.8E-116	7.9423E-113	0	0	3.9632E-113	1.1912E-112	2.9301E-111	4.39E-115	
									4,208,670,129.01												252,353,539.61	6,207,207,570.43	903,251.21	6,208,110,821.65

Note: Average inter bank rate fo 0.9236

A=Compensation to employees, B =Use of goods, C= Consumption of fixed capital, D= Social benefits E= Other expenditure

Source: Government of Ghana budgetary allocation to the Ministry of Energy in 2006

APPENDIX 2: CLIMATE CHANGE SCENARIO FOR THE MINISTRY OF ENERGY (US$ 2006 CONSTANT)-COST OF MITIGATION MEASURES

Energy Sector (2006 US $)

					GOG Discretionary + Statutory						IGF + Donor						HIPC									
Discount period	Year	Disc factor	GHG emissior	CC Scenario (!	A	B	C	D	E	Disc. Subtotal	A	B	C	D	E	Disc. Subtotal	A	B	C	D	E	Disc. Subtotal	Disc. Grand total	5% reduction	Incremental	Cost of adaptation
0	2006	1	6995	6645	857387282.2	568282536.7	3315.724	59737025.66	168950915.4	**1654361076**	29602377.49	651904347.9	1560.884	1224573.532	3664170.572	**686397030.3**	72502.6	84159817.4	0	0	41996092	**126228412**	**2466986518**	**2343637192**	371264.18	**2,344,008,456.34**
1	2007	0.72727273	7081	6727	623554387.1	413296390.3	2411.4356	43445109.57	122873393	**1203171691**	21529001.81	474112253	1135.18836	890598.9324	2664851.325	**499197840.2**	38348.48	44514283.58	0	0	22212808.99	**66765441.06**	**1769134973**	**1680678224**	262997.64	
2	2008	0.52892562	6848	6506	329813890.7	218603049.4	1275.4701	22979231.51	64990885.56	**636388332.7**	11387240.63	250770117.3	600.430209	471060.5923	1409508.139	**264038527.1**	14751.63	17123450.94	0	0	8544671.829	**25682874.4**	**926109734.1**	**879804247.4**	142355.78	
3	2009	0.38467318	6402	6082	126870557.5	84090729.76	490.63913	8839494.013	25000250.49	**244801522.4**	4380366.041	96464537.98	230.969397	181204.3751	542199.9753	**101568539.3**	4126.951	4790496.211	0	0	2390477.14	**7185100.302**	**353555162**	**335877403.9**	58132.354	
4	2010	0.27976231	6302	5987	35493600.4	23525416.92	137.26234	2472957.276	6994127.862	**68486239.72**	1225461.328	26987142.11	64.6165322	50694.1548	151687.1183	**28415049.32**	839.6839	974691.1218	0	0	486374.8436	**1461905.649**	**98363194.69**	**93445034.96**	16428.868	
5	2011	0.2034635	6512	6186	7221652.135	4786563.645	27.927876	503156.5406	1423049.728	**13934449.98**	249336.6499	5490898.365	13.1471058	10314.41012	30862.79186	**5781425.363**	124.2509	144228.4118	0	0	71970.5655	**216323.2282**	**19932198.57**	**18935588.64**	3221.9749	
6	2012	0.14797345	6867	6524	1068612.809	708284.3549	4.1325842	74453.81118	210573.5834	**2061928.692**	36895.20527	812507.1961	1.94542265	1526.258891	4566.873909	**855497.4796**	13.37152	15521.43727	0	0	7745.260478	**23280.06927**	**2940706.24**	**2793670.928**	450.77702	
7	2013	0.10761706	6974	6626	115000.9661	76223.47808	0.4447366	8012.500071	22661.30941	**221898.6983**	3970.553423	87439.63356	0.20936066	164.2514907	491.4735316	**92066.12137**	1.046548	1214.815568	0	0	606.1979211	**1822.060037**	**315786.8797**	**299997.5358**	47.66058	
8	2014	0.07826695	6777	6438	9000.774956	5965.779211	0.0348082	627.1139491	1773.631589	**17367.33451**	310.7631096	6843.633501	0.01638602	12.85546334	38.46613473	**7205.734594**	0.059571	69.14902568	0	0	34.50564573	**103.7142424**	**24676.78335**	**23442.94418**	3.8329277	
9	2015	0.05692142	6517	6192	512.3368807	339.5806169	0.0019813	35.69621572	100.9576265	**988.5733211**	17.6890771	389.5493285	0.00093272	0.731751213	2.189546964	**410.1606365**	0.002466	2.862589563	0	0	1.428443863	**4.29349951**	**1403.027457**	**1332.876084**	0.2266028	
10	2016	0.0413974	6405	6085	21.20941247	14.05775309	8.202E-05	1.47773036	4.17938279	**40.92436074**	0.732281721	16.12632761	3.8612E-05	0.030292594	0.090641542	**16.97958208**	7.42E-05	0.086184547	0	0	0.04300644	**0.129265234**	**58.03320805**	**55.13154765**	0.0095369	
11	2017	0.0301072	6560	6232	0.638555953	0.423239538	2.469E-06	0.044490319	0.1258295	**1.232117779**	0.02204695	0.485518518	1.1625E-06	0.000912025	0.002728963	**0.511207618**	1.63E-06	0.001887109	0	0	0.000941675	**0.00283041**	**1.746155807**	**1.658848017**	0.0002802	
12	2018	0.02189614	6784	6445	0.013981913	0.009267313	5.407E-08	0.000974166	0.002755181	**0.026978627**	0.000482743	0.010630983	2.5454E-08	1.99698E-05	5.97538E-05	**0.011193475**	2.59E-08	3.00512E-05	0	0	1.49957E-05	**4.50728E-05**	**0.038217175**	**0.036306316**	5.93E-06	
13	2019	0.01592447	6873	6529	0.000222655	0.000147577	8.611E-10	1.55131E-05	4.38748E-05	**0.00042962**	7.68743E-06	0.000169293	4.0535E-10	3.18009E-07	9.51547E-07	**0.00017825**	3E-10	3.48036E-07	0	0	1.73671E-07	**5.22007E-07**	**0.000608392**	**0.000577973**	9.318E-08	
14	2020	0.01158143	6756	6418	2.57866E-06	1.70915E-06	9.972E-12	1.79664E-07	5.08133E-07	**4.97562E-06**	8.90314E-08	1.96065E-06	4.6945E-12	3.683E-09	1.10203E-08	**2.06439E-06**	2.53E-12	2.93146E-09	0	0	1.46281E-09	**4.39679E-09**	**7.04441E-06**	**6.69219E-06**	1.098E-09	
										3,823,445,537.42												**227,565,266.90**	**5,637,364,413.00**	**5,355,496,192.35**	**854,903.30**	**5,356,351,095.65**
15	2021	0.00842286	6873	6529	2167841641	1436861232	8383.568	151040742.5	427180152.1	**4182932151**	74847467.32	1648292925	3946.58214	3096245.477	9264589.888	**1735505174**	144059.5	167221840.5	0	0	83444380.19	**250810280.2**	**6169247606**	**5860785225**	944875.82	
16	2022	0.00612572	6756	6418	13279581.34	8801803.255	51.355353	925232.6315	2616784.119	**25623452.7**	458494.2976	10096973.67	24.1756397	18966.7192	56752.24274	**10631211.11**	882.4673	1024353.436	0	0	511156.5409	**1536392.444**	**37791056.25**	**35901503.44**	5887.8572	
17	2023	0.00445507	6567	6238	59161.40982	39212.61341	0.2287915	4121.972333	11657.94566	**114154.17**	2042.622304	44982.68295	0.10770407	84.49798367	252.8349806	**47362.74592**	3.93145	4563.562048	0	0	2277.236068	**6844.729566**	**168361.6455**	**159943.5632**	26.988495	
18	2024	0.00324005	6494	6170	191.6858026	127.0507464	0.0007413	13.35538787	37.77230255	**369.8649807**	6.618194142	145.7460482	0.00034897	0.273777516	0.819197452	**153.4575663**	0.012738	14.78615971	0	0	7.378353977	**22.17725177**	**545.4997988**	**518.2248089**	0.0884159	
19	2025	0.0023564	6583	6254	0.451688135	0.299382186	1.747E-06	0.031470616	0.089006596	**0.87154928**	0.015595103	0.343435767	8.223E-07	0.000645129	0.001930356	**0.361607177**	3E-05	0.034842084	0	0	0.017386342	**0.052258442**	**1.285414899**	**1.221144154**	0.0002055	
20	2026	0.00171374	6739	6402	0.000774078	0.000513065	2.994E-09	5.39326E-05	0.000152535	**0.001493613**	2.6726E-05	0.000588561	1.4092E-09	1.10559E-06	3.30814E-06	**0.000619702**	5.14E-08	5.97104E-05	0	0	2.97957E-05	**8.95576E-05**	**0.002202873**	**0.002092729**	3.441E-07	
21	2027	0.00124636	6805	6464	9.64779E-07	6.39463E-07	3.731E-12	6.72194E-08	1.90113E-07	**1.86158E-06**	3.33102E-08	7.33559E-07	1.7564E-12	1.37796E-09	4.12313E-09	**7.72372E-07**	6.41E-11	7.44207E-08	0	0	3.71362E-08	**1.11621E-07**	**2.74557E-06**	**2.60829E-06**	4.247E-10	
22	2028	0.00090644	6732	6395	8.74518E-10	5.79637E-10	3.382E-15	6.09306E-11	1.72327E-10	**1.68742E-09**	3.01938E-11	6.64929E-10	1.5921E-15	1.24904E-12	3.73738E-12	**7.00111E-10**	5.81E-14	6.74581E-11	0	0	3.36619E-11	**1.01178E-10**	**2.4887E-09**	**2.36427E-09**	3.891E-13	
23	2029	0.00065923	6606	6275	5.7651E-13	3.82115E-13	2.23E-18	4.01674E-14	1.13603E-13	**1.1124E-12**	1.99047E-14	4.38342E-13	1.0495E-18	8.23407E-16	2.4638E-15	**4.61535E-13**	3.83E-17	4.44705E-14	0	0	2.2191E-14	**6.66998E-14**	**1.64063E-12**	**1.5586E-12**	2.614E-16	
24	2030	0.00047944	6548	6221	2.76402E-16	1.83202E-16	1.069E-21	1.92579E-17	5.4466E-17	**5.33329E-16**	9.54314E-18	2.10159E-16	5.0319E-22	3.94775E-19	1.18125E-18	**2.21279E-16**	1.84E-20	2.1321E-17	0	0	1.06393E-17	**3.19786E-17**	**7.86587E-16**	**7.47257E-16**	1.264E-19	
25	2031	0.00034868	6606	6275	9.63772E-20	6.38795E-20	3.727E-25	6.71492E-21	1.89914E-20	**1.85963E-19**	3.32755E-21	7.32793E-20	1.7546E-25	1.37652E-22	4.11882E-22	**7.71565E-20**	6.4E-24	7.4343E-21	0	0	3.70974E-21	**1.11504E-20**	**2.7427E-19**	**2.60557E-19**	4.371E-23	
26	2032	0.00025359	6709	6374	2.44402E-23	1.61991E-23	9.452E-29	1.70283E-24	4.81601E-24	**4.71582E-23**	8.43828E-25	1.85828E-23	4.4494E-29	3.4907E-26	1.04449E-25	**1.9566E-23**	1.62E-27	1.88525E-24	0	0	9.40749E-25	**2.82763E-24**	**6.95519E-23**	**6.60743E-23**	1.091E-26	
27	2033	0.00018443	6759	6421	4.50746E-27	2.98757E-27	1.743E-32	3.14049E-28	8.88209E-28	**8.6973E-27**	1.55626E-28	3.42719E-27	8.2059E-33	6.43783E-30	1.92633E-29	**3.60853E-27**	3E-31	3.47694E-28	0	0	1.73501E-28	**5.21494E-28**	**1.28273E-26**	**1.2186E-26**	1.998E-30	
28	2034	0.00013413	6714	6378	6.04583E-31	4.00722E-31	2.338E-36	4.21233E-32	1.19135E-31	**1.16657E-30**	2.0874E-32	4.59688E-31	1.1007E-36	8.63503E-34	2.58377E-33	**4.8401E-31**	4.02E-35	4.6636E-32	0	0	2.32716E-32	**6.99477E-32**	**1.72052E-30**	**1.6345E-30**	2.697E-34	
29	2035	9.7549E-05	6629	6297	5.89763E-35	3.90899E-35	2.281E-40	4.10908E-36	1.16215E-35	**1.13797E-34**	2.03623E-36	4.48419E-35	1.0737E-40	8.42336E-38	2.52044E-37	**4.72146E-35**	3.92E-39	4.54928E-36	0	0	2.27011E-36	**6.82331E-36**	**1.67835E-34**	**1.59443E-34**	2.665E-38	
30	2036	7.0945E-05	6587	6257	4.18405E-39	2.77322E-39	1.618E-44	2.91517E-40	8.2448E-40	**8.07328E-39**	1.4446E-40	3.18129E-39	7.6171E-45	5.97592E-42	1.78811E-41	**3.34962E-39**	2.78E-43	3.22747E-40	0	0	1.61052E-40	**4.84077E-40**	**1.1907E-38**	**1.13116E-38**	1.903E-42	
31	2037	5.1596E-05	6621	6290	2.1588E-43	1.43087E-43	8.349E-49	1.50411E-44	4.25399E-44	**4.16549E-43**	7.45354E-45	1.64142E-43	3.9301E-49	3.08334E-46	9.22596E-46	**1.72827E-43**	1.43E-47	1.66525E-44	0	0	8.30965E-45	**2.49765E-44**	**6.14353E-43**	**5.83635E-43**	9.767E-47	
32	2038	3.7524E-05	6691	6357	8.10078E-48	5.36925E-48	3.133E-53	5.64408E-49	1.59628E-48	**1.56308E-47**	2.7969E-49	6.15933E-48	1.4748E-53	1.157E-50	3.46199E-50	**6.48523E-48**	5.38E-52	6.24874E-49	0	0	3.11814E-49	**9.37226E-49**	**2.30532E-47**	**2.19005E-47**	3.627E-51	
33	2039	2.729E-05	6727	6391	2.21074E-52	1.46529E-52	8.549E-58	1.5403E-53	4.35633E-53	**4.26571E-52**	7.63286E-54	1.68091E-52	4.0247E-58	3.15752E-55	9.44792E-55	**1.76985E-52**	1.47E-56	1.70531E-53	0	0	8.50956E-54	**2.55773E-53**	**6.29133E-52**	**5.97676E-52**	9.844E-56	
34	2040	1.9848E-05	6700	6365	4.38779E-57	2.90826E-57	1.697E-62	3.05712E-58	8.64628E-58	**8.46641E-57**	1.51494E-58	3.33621E-57	7.988E-63	6.26691E-60	1.87519E-59	**3.51273E-57**	2.92E-61	3.38463E-58	0	0	1.68894E-58	**5.07649E-58**	**1.24868E-56**	**1.18624E-56**	1.962E-60	
35	2041	1.4435E-05	6643	6311	6.33361E-62	4.19796E-62	2.449E-67	4.41284E-63	1.24806E-62	**1.22209E-61**	2.18676E-63	4.81569E-62	1.153E-67	9.04606E-65	2.70676E-64	**5.07049E-62**	4.21E-66	4.88559E-63	0	0	2.43793E-63	**7.32773E-63**	**1.80242E-61**	**1.7123E-61**	2.856E-65	
36	2042	1.0498E-05	6612	6281	6.64897E-67	4.40699E-67	2.571E-72	4.63256E-68	1.3102E-67	**1.28294E-66**	2.29564E-68	5.05547E-67	1.2105E-72	9.49647E-70	2.84153E-69	**5.32295E-67**	4.42E-71	5.12885E-68	0	0	2.55932E-68	**7.69258E-68**	**1.89216E-66**	**1.79756E-66**	3.012E-70	
37	2043	7.6348E-06	6633	6301	5.07638E-72	3.36466E-72	1.963E-77	3.53689E-73	1.00032E-72	**9.79508E-72**	1.75269E-73	3.85977E-72	9.2416E-78	7.25041E-75	2.16947E-74	**4.06399E-72**	3.37E-76	3.9158E-73	0	0	1.954E-73	**5.87317E-73**	**1.44464E-71**	**1.37241E-71**	2.293E-75	
38	2044	5.5526E-06	6680	6346	2.81872E-77	1.86827E-77	1.09E-82	1.9639E-78	5.55438E-78	**5.43883E-77**	9.73199E-79	2.14318E-77	5.1315E-83	4.02587E-80	1.20462E-79	**2.25658E-77**	1.87E-81	2.17429E-78	0	0	1.08498E-78	**3.26114E-78**	**8.02152E-77**	**7.62044E-77**	1.264E-80	
39	2045	4.0383E-06	6706	6371	1.13827E-82	7.54456E-83	4.402E-88	7.93073E-84	2.24301E-83	**2.19634E-82**	3.93003E-84	8.65473E-83	2.0722E-88	1.62575E-85	4.86458E-85	**9.11266E-83**	7.56E-87	8.78036E-84	0	0	4.38143E-84	**1.31694E-83**	**3.2393E-82**	**3.07734E-82**	5.085E-86	
40	2046	2.9369E-06	6690	6356	3.34302E-88	2.21578E-88	1.293E-93	2.32919E-89	6.58753E-89	**6.45048E-88**	1.15422E-89	2.54183E-88	6.086E-94	4.77471E-91	1.42869E-90	**2.67631E-88**	2.22E-92	2.57872E-89	0	0	1.28679E-89	**3.86773E-89**	**9.51357E-88**	**9.03789E-88**	1.497E-91	
41	2047	2.1359E-06	6652	6319	7.14049E-94	4.73277E-94	2.76E-99	4.97502E-95	1.40706E-94	**1.37779E-93**	2.46535E-95	5.42919E-94	1.3E-99	1.01985E-96	3.05159E-96	**5.71645E-94**	4.75E-98	5.508E-95	0	0	2.74851E-95	**8.26125E-95**	**2.03204E-93**	**1.93044E-93**	3.216E-97	
42	2048	1.5534E-06	6629	6298	1.1092E-99	7.3519E-100	4.29E-105	7.7283E-101	2.1857E-100	**2.1403E-99**	3.8297E-101	8.4338E-100	2.019E-105	1.5842E-102	4.7404E-102	**8.88E-100**	7.4E-104	8.5562E-101	0	0	4.2696E-101	**1.2833E-100**	**3.1566E-99**	**2.9988E-99**	5.01E-103	
43	2049	1.1298E-06	6642	6309	1.2531E-105	8.3059E-106	4.85E-111	8.731E-107	2.4693E-106	**2.418E-105**	4.3266E-107	9.5281E-106	2.281E-111	1.7898E-108	5.3555E-108	**1.0032E-105**	8.3E-110	9.6664E-107	0	0	4.8236E-107	**1.4498E-106**	**3.5662E-105**	**3.3879E-105**	5.65E-109	
44	2050	8.2164E-07	6673	6339	1.0296E-111	6.8244E-112	3.98E-117	7.1738E-113	2.0289E-112	**1.9867E-111**	3.5549E-113	7.8287E-112	1.874E-117	1.4706E-114	4.4003E-114	**8.2429E-112**	6.8E-116	7.9423E-113	0	0	3.9632E-113	**1.1912E-112**	**2.9301E-111**	**2.7836E-111**	4.62E-115	
										4,208,670,129.01												**252,353,539.61**	**6,207,207,570.43**	**5,896,847,191.91**	**950,790.75**	**5,897,797,982.66**

Note: Average inter bank rate fo 0.9236

A=Compensation to employees, B =Use of goods, C= Consumption of fixed capital, D= Social benefits E= Other expenditure

Source: Government of Ghana budgetary allocation to the Ministry of Energy in 2006

APPENDIX 3: B-A-U SCENARIO FOR THE TRANSPORT SUBSECTOR (US$ 2006 CONSTANT)-COST OF MITIGATION MEASURES

Transport sector (2006 US $)

Discount Period	Year	GHG Emissions (Gg)	Disc. Factor	IF	O&M	Discounted Grand total	Incremental cost c	Additional cost of M
0	2006	39.38	1	38,202,019.27	18,715,408.94	56917428.22	1445263.582	**58,362,691.80**
1	2007	42.96	0.727272727	27783286.74	13611206.50	41394493.25	963521.5123	
2	2008	46.54	0.52892562	14695292.16	7199315.84	21894608	470433.9586	
3	2009	50.12	0.384673178	5652884.738	2769383.70	8422268.441	168038.9498	
4	2010	53.70	0.279762311	1581464.1	774769.1856	2356233.286	43877.25725	
5	2011	71.65	0.203463499	321770.2196	157637.2495	479407.4691	6690.702986	
6	2012	75.23	0.147973454	47613.45076	23326.12828	70939.57904	942.9390742	
7	2013	78.81	0.107617057	5124.019463	2510.289286	7634.308749	96.86729019	
8	2014	82.39	0.078266951	401.0413794	196.4726881	597.5140675	7.252117447	
9	2015	85.97	0.056921419	22.82784431	11.18350416	34.01134847	0.39561282	
10	2016	89.55	0.041397395	0.945013299	0.462967945	1.407981243	0.015722687	
11	2017	93.13	0.030107197	0.028451701	0.013938667	0.042390368	0.000455171	
12	2018	96.71	0.021896143	0.000622983	0.000305203	0.000928186	9.5976E-06	
13	2019	100.29	0.015924468	9.92067E-06	4.8602E-06	1.47809E-05	1.47381E-07	
14	2020	103.87	0.011581431	1.14895E-07	5.6288E-08	1.71184E-07	1.64806E-09	
				88,289,879.55	**43,253,765.97**	**131,543,645.52**	**3098873.434**	**134,642,518.96**
15	2021	107.45	0.008422859	**88,289,879.55**	43,253,765.97	131543645.5	1224241.711	
16	2022	111.03	0.006125716	540,838.69	264,960.27	805798.9605	7257.572933	
17	2023	114.61	0.004455066	2409.472006	1180.415454	3589.88746	31.32309097	
18	2024	118.19	0.003240048	7.806804753	3.824602633	11.63140739	0.098414478	
19	2025	121.77	0.002356398	0.018395943	0.009012288	0.027408231	0.000225086	
20	2026	125.35	0.001713744	3.15259E-05	1.54448E-05	4.69707E-05	3.74725E-07	
21	2027	128.93	0.00124636	3.92927E-08	1.92497E-08	5.85424E-08	4.54074E-10	
22	2028	132.51	0.000906443	3.56166E-11	1.74488E-11	5.30653E-11	4.00474E-13	
23	2029	136.09	0.000659231	2.34796E-14	1.15028E-14	3.49823E-14	2.5706E-16	
24	2030	139.67	0.000479441	1.12571E-17	5.51491E-18	1.6772E-17	1.20087E-19	
25	2031	143.25	0.000348684	3.92516E-21	1.92296E-21	5.84813E-21	4.08259E-23	
26	2032	146.83	0.000253589	9.95377E-25	4.87641E-25	1.48302E-24	1.01006E-26	
27	2033	150.40	0.000184428	1.83576E-28	8.99348E-29	2.7351E-28	1.8185E-30	
28	2034	153.98	0.00013413	2.46229E-32	1.20629E-32	3.66858E-32	2.38244E-34	
29	2035	157.56	9.75488E-05	2.40193E-36	1.17672E-36	3.57866E-36	2.27124E-38	
30	2036	161.14	7.09446E-05	1.70404E-40	8.3482E-41	2.53886E-40	1.57553E-42	
31	2037	164.72	5.1596E-05	8.79218E-45	4.30734E-45	1.30995E-44	7.95245E-47	
32	2038	168.30	3.75244E-05	3.29921E-49	1.6163E-49	4.91551E-49	2.92064E-51	
33	2039	171.88	2.72905E-05	9.0037E-54	4.41097E-54	1.34147E-53	7.80456E-56	
34	2040	175.46	1.98476E-05	1.78702E-58	8.75472E-59	2.66249E-58	1.51742E-60	
35	2041	179.04	1.44346E-05	2.5795E-63	1.26371E-63	3.84321E-63	2.14654E-65	
36	2042	182.62	1.04979E-05	2.70793E-68	1.32663E-68	4.03456E-68	2.20925E-70	
37	2043	186.20	7.63484E-06	2.06746E-73	1.01286E-73	3.08033E-73	1.6543E-75	
38	2044	189.78	5.55261E-06	1.14798E-78	5.62404E-79	1.71039E-78	9.01244E-81	
39	2045	193.36	4.03826E-06	4.63586E-84	2.27114E-84	6.90699E-84	3.57209E-86	
40	2046	196.94	2.93692E-06	1.36151E-89	6.67014E-90	2.02853E-89	1.03002E-91	
41	2047	200.52	2.13594E-06	2.90812E-95	1.4247E-95	4.33282E-95	2.1608E-97	
42	2048	204.10	1.55341E-06	4.5175E-101	2.2132E-101	6.7307E-101	3.2977E-103	
43	2049	207.68	1.12975E-06	5.1037E-107	2.5003E-107	7.604E-107	3.6614E-109	
44	2050	211.26	8.21639E-07	4.1934E-113	2.0544E-113	6.2477E-113	2.9574E-115	
						132,353,046.03	**1231530.705**	**133,584,576.74**

Note

Average inter bank 0.9236

Discount rate = (37.5%):Bank of Ghana base rate+ 8% default charged by commercial banks

IF (Investment Flows) = Total of GOG Grant, Loans, Shareholders' contribution and Capital

O&M = Maintenance, spare parts, fuel, general and administrative expenses and interest on loans

The transport sector consumed 60% of all petroleum products in Ghana- 1990 base year (source: National communication to the UNFCC, 2000 report)

This means that by extension the Transport sector consume 60% of all fuel combustion in the Energy sector and contibutes this much to GHG emissins from the sector

GHG emissions have been projected using a factor of 3579.63 g/km (Source: Vehicular Emissions Report, 2006)

APPENDIX 4: CLIMATE CHANGE SCENARIO FOR THE TRANSPORT SUBSECTOR (US$ 2006 CONSTANT) - COST OF MITIGATION MEASURES

Transport sector (2006 US $)

Discount Period	Year	GHG Emissions (C(	CC Scenario: 5% d	Disc. Factor	IF	O&M	Discounted Grand total	5% reduction in inv	Incremental cost	Additional cost of M
0	2006	39.38	37.41	1	38,202,019.27	18,715,408.94	56917428.22	54071556.8	1445263.582	**55,516,820.39**
1	2007	42.96	40.81	0.727272727	27783286.74	13611206.50	41394493.25	39324768.59	963521.5123	
2	2008	46.54	44.21	0.52892562	14695292.16	7199315.84	21894608	20799877.6	470433.9586	
3	2009	50.12	47.61	0.384673178	5652884.738	2769383.70	8422268.441	8001155.019	168038.9498	
4	2010	53.70	51.02	0.279762311	1581464.1	774769.1856	2356233.286	2238421.621	43877.25725	
5	2011	71.65	68.07	0.203463499	321770.2196	157637.2495	479407.4691	455437.0956	6690.702986	
6	2012	75.23	71.47	0.147973454	47613.45076	23326.12828	70939.57904	67392.60009	942.9390742	
7	2013	78.81	74.87	0.107617057	5124.019463	2510.289286	7634.308749	7252.593311	96.86729019	
8	2014	82.39	78.27	0.078266951	401.0413794	196.4726881	597.5140675	567.6383641	7.252117447	
9	2015	85.97	81.67	0.056921419	22.82784431	11.18350416	34.01134847	32.31078104	0.39561282	
10	2016	89.55	85.07	0.041397395	0.945013299	0.462967945	1.407981243	1.337582181	0.015722687	
11	2017	93.13	88.47	0.030107197	0.028451701	0.013938667	0.042390368	0.04027085	0.000455171	
12	2018	96.71	91.87	0.021896143	0.000622983	0.000305203	0.000928186	0.000881776	9.5976E-06	
13	2019	100.29	95.28	0.015924468	9.92067E-06	4.8602E-06	1.47809E-05	1.40418E-05	1.47381E-07	
14	2020	103.87	98.68	0.011581431	1.14895E-07	5.6288E-08	1.71184E-07	1.62624E-07	1.64806E-09	
					88,289,879.55	**43,253,765.97**	**131,543,645.52**	124,966,463.25	**3,098,873.43**	**128,065,336.68**
15	2021	107.45	102.08	0.008422859	**88,289,879.55**	43,253,765.97	131543645.5	124966463.2	1288675.485	
16	2022	111.03	105.48	0.006125716	540,838.69	264,960.27	805798.9605	765509.0125	7639.550456	
17	2023	114.61	108.88	0.004455066	2409.472006	1180.415454	3589.88746	3410.393087	32.9716747	
18	2024	118.19	112.28	0.003240048	7.806804753	3.824602633	11.63140739	11.04983702	0.103594187	
19	2025	121.77	115.68	0.002356398	0.018395943	0.009012288	0.027408231	0.026037819	0.000236933	
20	2026	125.35	119.08	0.001713744	3.15259E-05	1.54448E-05	4.69707E-05	4.46222E-05	3.94447E-07	
21	2027	128.93	122.48	0.00124636	3.92927E-08	1.92497E-08	5.85424E-08	5.56153E-08	4.77973E-10	
22	2028	132.51	125.88	0.000906443	3.56166E-11	1.74488E-11	5.30653E-11	5.04121E-11	4.21551E-13	
23	2029	136.09	129.28	0.000659231	2.34796E-14	1.15028E-14	3.49823E-14	3.32332E-14	2.7059E-16	
24	2030	139.67	132.68	0.000479441	1.12571E-17	5.51491E-18	1.6772E-17	1.59334E-17	1.26407E-19	
25	2031	143.25	136.08	0.000348684	3.92516E-21	1.92296E-21	5.84813E-21	5.55572E-21	4.29747E-23	
26	2032	146.83	139.48	0.000253589	9.95377E-25	4.87641E-25	1.48302E-24	1.40887E-24	1.06322E-26	
27	2033	150.40	142.88	0.000184428	1.83576E-28	8.99348E-29	2.7351E-28	2.59835E-28	1.91421E-30	
28	2034	153.98	146.29	0.00013413	2.46229E-32	1.20629E-32	3.66858E-32	3.48515E-32	2.50783E-34	
29	2035	157.56	149.69	9.75488E-05	2.40193E-36	1.17672E-36	3.57866E-36	3.39972E-36	2.39078E-38	
30	2036	161.14	153.09	7.09446E-05	1.70404E-40	8.3482E-41	2.53886E-40	2.41192E-40	1.65845E-42	
31	2037	164.72	156.49	5.1596E-05	8.79218E-45	4.30734E-45	1.30995E-44	1.24445E-44	8.371E-47	
32	2038	168.30	159.89	3.75244E-05	3.29921E-49	1.6163E-49	4.91551E-49	4.66974E-49	3.07436E-51	
33	2039	171.88	163.29	2.72905E-05	9.0037E-54	4.41097E-54	1.34147E-53	1.27439E-53	8.21533E-56	
34	2040	175.46	166.69	1.98476E-05	1.78702E-58	8.75472E-59	2.66249E-58	2.52937E-58	1.59728E-60	
35	2041	179.04	170.09	1.44346E-05	2.5795E-63	1.26371E-63	3.84321E-63	3.65105E-63	2.25952E-65	
36	2042	182.62	173.49	1.04979E-05	2.70793E-68	1.32663E-68	4.03456E-68	3.83284E-68	2.32553E-70	
37	2043	186.20	176.89	7.63484E-06	2.06746E-73	1.01286E-73	3.08033E-73	2.92631E-73	1.74137E-75	
38	2044	189.78	180.29	5.55261E-06	1.14798E-78	5.62404E-79	1.71039E-78	1.62487E-78	9.48678E-81	
39	2045	193.36	183.69	4.03826E-06	4.63586E-84	2.27114E-84	6.90699E-84	6.56164E-84	3.76009E-86	
40	2046	196.94	187.09	2.93692E-06	1.36151E-89	6.67014E-90	2.02853E-89	1.9271E-89	1.08424E-91	
41	2047	200.52	190.49	2.13594E-06	2.90812E-95	1.4247E-95	4.33282E-95	4.11618E-95	2.27452E-97	
42	2048	204.10	193.89	1.55341E-06	4.5175E-101	2.2132E-101	6.7307E-101	6.3941E-101	3.4713E-103	
43	2049	207.68	197.29	1.12975E-06	5.1037E-107	2.5003E-107	7.604E-107	7.2238E-107	3.8541E-109	
44	2050	211.26	200.70	8.21639E-07	4.1934E-113	2.0544E-113	6.2477E-113	5.9353E-113	3.113E-115	
							132,353,046.03	**125,735,393.73**	**1,296,348.11**	**127,031,741.84**

Note

Average inter ba 0.9236

IF (Investment Flow)= Total of GOG Grant, Loans, Shareholders' contribution and Capital

O&M = Maintenance, spare parts, fuel, general and administrative expenses and interest on loans

The transport sector consumed 60% of all petroleum products in Ghana- 1990 base year (source: National communication to the UNFCC, 2000 report)

This means that by extension the Transport sector consume 60% of all fuel combustion in the Energy sector

GHG emissions have been projected using a factor of 3579.63 g/km (Source: Vehicular Emissions Report, 2006)

APPENDIX 5: B-A-U SCENARIO FOR ELECTRICITY GENERATION (US$ 2004 CONSTANT)-COST OF MITIGATION MEASURES

Electricity Generation (2004 US $)

Discount period	Year	GHG Emissions (CO2 Eqv.)	Disc factor	IF	O&M	Discounted Gran	Incremental cost	Additional cost of
0	2004	570.2	1	181237911.1	7810186.72	189048097.8	331546.9972	**189,379,644.81**
1	2005	571.2	0.727272727	131809389.9	5680135.796	137489525.7	240702.9511	
2	2006	572.2	0.52892562	69717363.25	3004369.347	72721732.59	127091.4586	
3	2007	573.2	0.384673178	26818399.69	1155700.305	27974099.99	48803.38449	
4	2008	574.2	0.279762311	7502777.482	323321.3884	7826098.87	13629.56961	
5	2009	575.2	0.203463499	1526541.36	65784.10104	1592325.461	2768.298784	
6	2010	576.2	0.147973454	225887.5976	9734.300643	235621.8982	408.9238081	
7	2011	577.2	0.107617057	24309.35855	1047.576791	25356.93534	43.93093441	
8	2012	578.2	0.078266951	1902.619371	81.9906412	1984.610012	3.432393656	
9	2013	579.2	0.056921419	108.299794	4.667023624	112.9668176	0.195039395	
10	2014	580.2	0.041397395	4.483329402	0.193202623	4.676532025	0.008060207	
11	2015	581.2	0.030107197	0.13498048	0.005816789	0.14079727	0.000242253	
12	2016	582.2	0.021896143	0.002955552	0.000127365	0.003082917	5.29529E-06	
13	2017	583.2	0.015924468	4.70656E-05	2.02822E-06	4.90938E-05	8.41801E-08	
14	2018	584.2	0.011581431	5.45087E-07	2.34897E-08	5.68577E-07	9.73257E-10	
15	2019	585.2	0.008422859	4.59119E-09	1.97851E-10	4.78904E-09	8.1836E-12	
16	2020	586.2	0.006125716	2.81243E-11	1.21198E-12	2.93363E-11	5.00449E-14	
				418,864,595.26	**18,050,366.39**	**436,914,961.65**	**764,999.15**	**437,679,960.80**
17	2021	587.2	0.004455066	420257560.3	18110394.21	438367954.5	746539.4321	
18	2022	588.2	0.003240048	1361654.633	58678.54505	1420333.178	2414.711285	
19	2023	589.2	0.002356398	3208.600914	138.2700346	3346.870949	5.680364814	
20	2024	590.2	0.001713744	5.498721696	0.236959491	5.735681187	0.009718199	
21	2025	591.2	0.00124636	0.006853384	0.000295337	0.007148721	1.20919E-05	
22	2026	592.2	0.000906443	6.2122E-06	2.67706E-07	6.47991E-06	1.09421E-08	
23	2027	593.2	0.000659231	4.09528E-09	1.7648E-10	4.27176E-09	7.20122E-12	
24	2028	594.2	0.000479441	1.96345E-12	8.46119E-14	2.04806E-12	3.44675E-15	
25	2029	595.2	0.000348684	6.84623E-16	2.95028E-17	7.14126E-16	1.19981E-18	
26	2030	596.2	0.000253589	1.73613E-19	7.48159E-21	1.81094E-19	3.03747E-22	
27	2031	597.2	0.000184428	3.20191E-23	1.37981E-24	3.33989E-23	5.59258E-26	
28	2032	598.2	0.00013413	4.2947E-27	1.85074E-28	4.47977E-27	7.48876E-30	
29	2033	599.2	9.75488E-05	4.18943E-31	1.80537E-32	4.36996E-31	7.293E-34	
30	2034	600.2	7.09446E-05	2.97217E-35	1.28081E-36	3.10025E-35	5.16536E-38	
31	2035	601.2	5.1596E-05	1.53352E-39	6.60849E-41	1.59961E-39	2.66069E-42	
32	2036	602.2	3.75244E-05	5.75445E-44	2.4798E-45	6.00243E-44	9.9675E-47	
33	2037	603.2	2.72905E-05	1.57042E-48	6.76748E-50	1.63809E-48	2.71567E-51	
34	2038	604.2	1.98476E-05	3.1169E-53	1.34318E-54	3.25122E-53	5.38103E-56	
35	2039	605.2	1.44346E-05	4.49913E-58	1.93884E-59	4.69301E-58	7.75448E-61	
36	2040	606.2	1.04979E-05	4.72315E-63	2.03537E-64	4.92668E-63	8.12716E-66	
37	2041	607.2	7.63484E-06	3.60605E-68	1.55397E-69	3.76145E-68	6.19474E-71	
38	2042	608.2	5.55261E-06	2.0023E-73	8.62862E-75	2.08859E-73	3.43404E-76	
39	2043	609.2	4.03826E-06	8.08581E-79	3.48447E-80	8.43426E-79	1.38448E-81	
40	2044	610.2	2.93692E-06	2.37474E-84	1.02336E-85	2.47707E-84	4.05945E-87	
41	2045	611.2	2.13594E-06	5.0723E-90	2.18584E-91	5.29089E-90	8.65656E-93	
42	2046	612.2	1.55341E-06	7.87938E-96	3.3955E-97	8.21893E-96	1.34252E-98	
43	2047	613.2	1.12975E-06	8.9018E-102	3.8361E-103	9.2854E-102	1.5142E-104	
44	2048	614.2	8.21639E-07	7.314E-108	3.1519E-109	7.6292E-108	1.2421E-110	
45	2049	615.2	5.97556E-07	4.3705E-114	1.8834E-115	4.5589E-114	7.4104E-117	
46	2050	616.2	4.34586E-07	1.8994E-120	8.1851E-122	1.9812E-120	3.2152E-123	
						439,791,640.33	**748,959.83**	**440,540,600.16**

Note
Average interbank rate = 0.9051
Source: Investment flow in Takoradi Combined Cycle Plant
Financiers: Agence France, IDA, EIB, CDC, Kwati Fund, Bedea

APPENDIX 6: CLIMATE CHANGE SCENARIO FOR ELECTRICITY GENERATION (US$ 2004 CONSTANT)-COST OF MITIGATION MEASURES

Electricity Generation (2004 US $)

Discount period	Year	GHG Emissions (CO2 Eqv.)	CC Scenario: 5% decrease	Disc factor	IF	O&M	Discounted Grand total	5% reduction in i	Incremental cost	Additional cost o
0	2004	570.2	541.69	1	181237911.1	7810186.72	189048097.8	179595692.9	348996.8392	**179,944,689.76**
1	2005	571.2	542.64	0.727272727	131809389.9	5680135.796	137489525.7	130615049.4	253371.5275	
2	2006	572.2	543.59	0.52892562	69717363.25	3004369.347	72721732.59	69085645.96	133780.4827	
3	2007	573.2	544.54	0.384673178	26818399.69	1155700.305	27974099.99	26575394.99	51371.98368	
4	2008	574.2	545.49	0.279762311	7502777.482	323321.3884	7826098.87	7434793.927	14346.91538	
5	2009	575.2	546.44	0.203463499	1526541.36	65784.10104	1592325.461	1512709.188	2913.99872	
6	2010	576.2	547.39	0.147973454	225887.5976	9734.300643	235621.8982	223840.8033	430.4461137	
7	2011	577.2	548.34	0.107617057	24309.35855	1047.576791	25356.93534	24089.08858	46.24308885	
8	2012	578.2	549.29	0.078266951	1902.619371	81.9906412	1984.610012	1885.379511	3.613045953	
9	2013	579.2	550.24	0.056921419	108.299794	4.667023624	112.9668176	107.3184767	0.205304626	
10	2014	580.2	551.19	0.041397395	4.483329402	0.193202623	4.676532025	4.442705424	0.008484428	
11	2015	581.2	552.14	0.030107197	0.13498048	0.005816789	0.14079727	0.133757406	0.000255003	
12	2016	582.2	553.09	0.021896143	0.002955552	0.000127365	0.003082917	0.002928771	5.57399E-06	
13	2017	583.2	554.04	0.015924468	4.70656E-05	2.02822E-06	4.90938E-05	4.66391E-05	8.86106E-08	
14	2018	584.2	554.99	0.011581431	5.45087E-07	2.34897E-08	5.68577E-07	5.40148E-07	1.02448E-09	
15	2019	585.2	555.94	0.008422859	4.59119E-09	1.97851E-10	4.78904E-09	4.54959E-09	8.61431E-12	
16	2020	586.2	556.89	0.006125716	2.81243E-11	1.21198E-12	2.93363E-11	2.78695E-11	5.26788E-14	
					418,864,595.26	**18,050,366.39**	**436,914,961.65**	**415,069,213.56**	**805,262.26**	**415,874,475.83**
17	2021	587.2	557.84	0.004455066	420257560.3	18110394.21	438367954.5	416449556.8	785830.9812	
18	2022	588.2	558.79	0.003240048	1361654.633	58678.54505	1420333.178	1349316.519	2541.801353	
19	2023	589.2	559.74	0.002356398	3208.600914	138.2700346	3346.870949	3179.527401	5.979331384	
20	2024	590.2	560.69	0.001713744	5.498721696	0.236959491	5.735681187	5.448897128	0.010229683	
21	2025	591.2	561.64	0.00124636	0.006853384	0.000295337	0.007148721	0.006791285	1.27283E-05	
22	2026	592.2	562.59	0.000906443	6.2122E-06	2.67706E-07	6.47991E-06	6.15591E-06	1.1518E-08	
23	2027	593.2	563.54	0.000659231	4.09528E-09	1.7648E-10	4.27176E-09	4.05817E-09	7.58023E-12	
24	2028	594.2	564.49	0.000479441	1.96345E-12	8.46119E-14	2.04806E-12	1.94565E-12	3.62816E-15	
25	2029	595.2	565.44	0.000348684	6.84623E-16	2.95028E-17	7.14126E-16	6.78419E-16	1.26296E-18	
26	2030	596.2	566.39	0.000253589	1.73613E-19	7.48159E-21	1.81094E-19	1.72039E-19	3.19734E-22	
27	2031	597.2	567.34	0.000184428	3.20191E-23	1.37981E-24	3.33989E-23	3.17289E-23	5.88692E-26	
28	2032	598.2	568.29	0.00013413	4.2947E-27	1.85074E-28	4.47977E-27	4.25579E-27	7.8829E-30	
29	2033	599.2	569.24	9.75488E-05	4.18943E-31	1.80537E-32	4.36996E-31	4.15147E-31	7.67684E-34	
30	2034	600.2	570.19	7.09446E-05	2.97217E-35	1.28081E-36	3.10025E-35	2.94524E-35	5.43723E-38	
31	2035	601.2	571.14	5.1596E-05	1.53352E-39	6.60849E-41	1.59961E-39	1.51963E-39	2.80073E-42	
32	2036	602.2	572.09	3.75244E-05	5.75445E-44	2.4798E-45	6.00243E-44	5.70231E-44	1.04921E-46	
33	2037	603.2	573.04	2.72905E-05	1.57042E-48	6.76748E-50	1.63809E-48	1.55619E-48	2.8586E-51	
34	2038	604.2	573.99	1.98476E-05	3.1169E-53	1.34318E-54	3.25122E-53	3.08866E-53	5.66424E-56	
35	2039	605.2	574.94	1.44346E-05	4.49913E-58	1.93884E-59	4.69301E-58	4.45836E-58	8.16261E-61	
36	2040	606.2	575.89	1.04979E-05	4.72315E-63	2.03537E-64	4.92668E-63	4.68035E-63	8.5549E-66	
37	2041	607.2	576.84	7.63484E-06	3.60605E-68	1.55397E-69	3.76145E-68	3.57337E-68	6.52078E-71	
38	2042	608.2	577.79	5.55261E-06	2.0023E-73	8.62862E-75	2.08859E-73	1.98416E-73	3.61478E-76	
39	2043	609.2	578.74	4.03826E-06	8.08581E-79	3.48447E-80	8.43426E-79	8.01255E-79	1.45735E-81	
40	2044	610.2	579.69	2.93692E-06	2.37474E-84	1.02336E-85	2.47707E-84	2.35322E-84	4.2731E-87	
41	2045	611.2	580.64	2.13594E-06	5.0723E-90	2.18584E-91	5.29089E-90	5.02634E-90	9.11216E-93	
42	2046	612.2	581.59	1.55341E-06	7.87938E-96	3.3955E-97	8.21893E-96	7.80798E-96	1.41318E-98	
43	2047	613.2	582.54	1.12975E-06	8.9018E-102	3.8361E-103	9.2854E-102	8.8211E-102	1.5939E-104	
44	2048	614.2	583.49	8.21639E-07	7.314E-108	3.1519E-109	7.6292E-108	7.2478E-108	1.3075E-110	
45	2049	615.2	584.44	5.97556E-07	4.3705E-114	1.8834E-115	4.5589E-114	4.3309E-114	7.8004E-117	
46	2050	616.2	585.39	4.34586E-07	1.8994E-120	8.1851E-122	1.9812E-120	1.8822E-120	3.3845E-123	
							439,791,640.33	**417,802,058.31**	**788,378.77**	**418,590,437.08**

Note

Average interbank rate = 0.9051

Source: Investment flow in Takoradi Combined Cycle Plant

Financiers: Agence France, IDA, EIB, CDC, Kwati Fund, Bedea

APPENDIX 7: B-A-U SCENARIO FOR THE FORESTRY SECTOR (US$ 2005 CONSTANT) - COST OF MITIGATION MEASURES

	Forestry Sector (2005 US$)									
Discount Period	**Disc. Factor**	**Year**	**Net GH**	**Unit cost for plantation/h**	**Maintenance cost/h**	**Total (discounted)**	**Total # of plantations planted(ha)**	**Grand total(discounted)**	**Incremental c**	**Additional cost c**
0	1	2005	10620	853.6195378	0	853.6195378	16816	14354466.15	1351.687073	**14,355,817.84**
1	0.727272727	2006	7273	620.8142093	341.4478151	962.2620245	34590	33284643.43	4576.466854	
2	0.52892562	2007	7197	328.3645405	248.3256837	576.6902242	51344	29609582.87	4114.304508	
3	0.384673178	2008	9214	126.3130313	131.3458162	257.6588475		257.6588475	0.027964854	
4	0.279762311	2009	12406	35.3376256	50.52521254	85.86283814		85.86283814	0.006921136	
5	0.203463499	2010	12710	7.189916956	14.13505024	21.3249672		21.3249672	0.001677747	
6	0.147973454	2011	10875	1.063916845	2.875966782	3.939883628		3.939883628	0.000362299	
7	0.107617057	2012	8363	0.1144956	0.425566738	0.540062338		0.540062338	6.45765E-05	
8	0.078266951	2013	7894	0.008961222	0.04579824	0.054759462		0.054759462	6.93643E-06	
9	0.056921419	2014	9605	0.000510085	0.003584489	0.004094574		0.004094574	4.26277E-07	
10	0.041397395	2015	11443	2.11162E-05	0.000204034	0.00022515		0.00022515	1.96752E-08	
11	0.030107197	2016	11997	6.3575E-07	8.44648E-06	9.08223E-06		9.08223E-06	7.57041E-10	
12	0.021896143	2017	10649	1.39205E-08	2.543E-07	2.6822E-07		2.6822E-07	2.51864E-11	
13	0.015924468	2018	9044	2.21676E-10	5.56819E-09	5.78986E-09		5.78986E-09	6.40182E-13	
14	0.011581431	2019	8621	2.56733E-12	8.86704E-11	9.12378E-11		9.12378E-11	1.05832E-14	
15	0.008422859	2020	9648	2.16242E-14	1.02693E-12	1.04855E-12		1.04855E-12	1.08684E-16	
								77,249,061.83	**10,042.50**	**77,259,104.33**
16	0.006125716	2021	11015	1972.826767	789.1307068	2761.957474		2761.957474	0.250739123	
17	0.004455066	2022	11363	8.789073228	789.1307068	797.9197801		797.9197801	0.070219254	
18	0.003240048	2023	10564	0.028477018	3.515629291	3.54410631		3.54410631	0.000335505	
19	0.002356398	2024	9438	6.71032E-05	0.011390807	0.011457911		0.011457911	1.214E-06	
20	0.001713744	2025	9104	1.14998E-07	2.68413E-05	2.69563E-05		2.69563E-05	2.96083E-09	
21	0.00124636	2026	9761	1.43329E-10	4.59991E-08	4.61424E-08		4.61424E-08	4.72706E-12	
22	0.000906443	2027	10675	1.29919E-13	5.73314E-11	5.74613E-11		5.74613E-11	5.38258E-15	
23	0.000659231	2028	10981	8.56468E-17	5.19677E-14	5.20533E-14		5.20533E-14	4.74045E-18	
24	0.000479441	2029	10455	4.10626E-20	3.42587E-17	3.42998E-17		3.42998E-17	3.28071E-21	
25	0.000348684	2030	9702	1.43179E-23	1.6425E-20	1.64394E-20		1.64394E-20	1.69443E-24	
26	0.000253589	2031	9435	3.63085E-27	5.72716E-24	5.73079E-24		5.73079E-24	6.07422E-28	
27	0.000184428	2032	9847	6.69632E-31	1.45234E-27	1.45301E-27		1.45301E-27	1.47559E-31	
28	0.00013413	2033	10472	8.98174E-35	2.67853E-31	2.67942E-31		2.67942E-31	2.55854E-35	
29	9.75488E-05	2034	10704	8.76158E-39	3.5927E-35	3.59357E-35		3.59357E-35	3.35732E-39	
30	7.09446E-05	2035	10379	6.21586E-43	3.50463E-39	3.50525E-39	16826	77252625.27	7443.010653	
31	5.1596E-05	2036	9864	3.20714E-47	2.48634E-43	2.48666E-43	34600	8.60386E-39	8.72261E-43	
32	3.75244E-05	2037	9661	1.20346E-51	1.28286E-47	1.28298E-47	51354	6.58859E-43	6.81964E-47	
33	2.72905E-05	2038	9918	3.2843E-56	4.81384E-52	4.81416E-52		4.81416E-52	4.85395E-56	
34	1.98476E-05	2039	10341	6.51854E-61	1.31372E-56	1.31378E-56		1.31378E-56	1.27045E-60	
35	1.44346E-05	2040	10518	9.40927E-66	2.60742E-61	2.60751E-61		2.60751E-61	2.47898E-65	
36	1.04979E-05	2041	10316	9.87777E-71	3.76371E-66	3.76381E-66		3.76381E-66	3.64866E-70	
37	7.63484E-06	2042	9968	7.54152E-76	3.95111E-71	3.95118E-71		3.95118E-71	3.96383E-75	
38	5.55261E-06	2043	9814	4.18752E-81	3.01661E-76	3.01665E-76		3.01665E-76	3.07371E-80	
39	4.03826E-06	2044	9973	1.69103E-86	1.67501E-81	1.67502E-81		1.67502E-81	1.67949E-85	
40	2.93692E-06	2045	10259	4.96642E-92	6.76412E-87	6.76417E-87		6.76417E-87	6.59328E-91	
41	2.13594E-06	2046	10392	1.0608E-97	1.98657E-92	1.98658E-92		1.98658E-92	1.9117E-96	
42	1.55341E-06	2047	10267	1.6479E-103	4.24319E-98	4.24321E-98		4.24321E-98	4.1327E-102	
43	1.12975E-06	2048	10033	1.8617E-109	6.5914E-104	6.5914E-104		6.5914E-104	6.57E-108	
44	8.21639E-07	2049	9919	1.5296E-115	7.4467E-110	7.4467E-110		7.4467E-110	7.5078E-114	
45	5.97556E-07	2050	10016	9.1404E-122	6.1185E-116	6.1185E-116		6.1185E-116	6.1089E-120	
						6325.390319		**77,256,188.70**	**7443.331948**	**77,263,632.03**

Note:
Average interban 0.9131
A =Net GHG Eqv. Emissions by sources and removals by sinks (Source: National Communications to the UNFCC Report, 2000)
* Figures are in negatives since Ghana is expected to record net sinks as a result of mitigation measures in the Forestry sector

Source: National forest plantation development report, 2007

APPENDIX 8: CLIMATE CHANGE SCENARIO FOR THE FORESTRY SECTOR (US$ 2005 CONSTANT) - COST OF MITIGATION MEASURES

Forestry Sector (2005 US$)

Disc. Period	Disc. Factor	Year	Net GH	Unit cost for plantation/h	Maintenance cost/h	Total (discounted)	Total # of plantations planted(ha)	Grand total(discounted)	Incremental cos	Additional cost of Mitigation
0	1	2005	10620	853.6195378	0	853.6195378	16816	14354466.15	1351.687073	**14,355,817.84**
1	0.727272727	2006	7273	620.8142093	341.4478151	962.2620245	34590	33284643.43	4576.466854	
2	0.52892562	2007	7197	328.3645405	248.3256837	576.6902242	51344	29609582.87	4114.304508	
3	0.384673178	2008	9214	126.3130313	131.3458162	257.6588475		257.6588475	0.027964854	
4	0.279762311	2009	12406	35.3376256	50.52521254	85.86283814		85.86283814	0.006921136	
5	0.203463499	2010	12710	7.189916956	14.13505024	21.3249672		21.3249672	0.001677747	
6	0.147973454	2011	10875	1.063916845	2.875966782	3.939883628		3.939883628	0.000362299	
7	0.107617057	2012	8363	0.1144956	0.425566738	0.540062338		0.540062338	6.45765E-05	
8	0.078266951	2013	7894	0.008961222	0.04579824	0.054759462		0.054759462	6.93643E-06	
9	0.056921419	2014	9605	0.000510085	0.003584489	0.004094574		0.004094574	4.26277E-07	
10	0.041397395	2015	11443	2.11162E-05	0.000204034	0.00022515		0.00022515	1.96752E-08	
11	0.030107197	2016	11997	6.3575E-07	8.44648E-06	9.08223E-06		9.08223E-06	7.57041E-10	
12	0.021896143	2017	10649	1.39205E-08	2.543E-07	2.6822E-07		2.6822E-07	2.51864E-11	
13	0.015924468	2018	9044	2.21676E-10	5.56819E-09	5.78986E-09		5.78986E-09	6.40182E-13	
14	0.011581431	2019	8621	2.56733E-12	8.86704E-11	9.12378E-11		9.12378E-11	1.05832E-14	
15	0.008422859	2020	9648	2.16242E-14	1.02693E-12	1.04855E-12		1.04855E-12	1.08684E-16	
								77,249,061.83	**10,042.50**	**77,259,104.33**
16	0.006125716	2021	11015	1972.826767	789.1307068	2761.957474		2761.957474	0.250739123	
17	0.004455066	2022	11363	8.789073228	789.1307068	797.9197801		797.9197801	0.070219254	
18	0.003240048	2023	10564	0.028477018	3.515629291	3.54410631		3.54410631	0.000335505	
19	0.002356398	2024	9438	6.71032E-05	0.011390807	0.011457911		0.011457911	1.214E-06	
20	0.001713744	2025	9104	1.14998E-07	2.68413E-05	2.69563E-05		2.69563E-05	2.96083E-09	
21	0.00124636	2026	9761	1.43329E-10	4.59991E-08	4.61424E-08		4.61424E-08	4.72706E-12	
22	0.000906443	2027	10675	1.29919E-13	5.73314E-11	5.74613E-11		5.74613E-11	5.38258E-15	
23	0.000659231	2028	10981	8.56468E-17	5.19677E-14	5.20533E-14		5.20533E-14	4.74045E-18	
24	0.000479441	2029	10455	4.10626E-20	3.42587E-17	3.42998E-17		3.42998E-17	3.28071E-21	
25	0.000348684	2030	9702	1.43179E-23	1.6425E-20	1.64394E-20		1.64394E-20	1.69443E-24	
26	0.000253589	2031	9435	3.63085E-27	5.72716E-24	5.73079E-24		5.73079E-24	6.07422E-28	
27	0.000184428	2032	9847	6.69632E-31	1.45234E-27	1.45301E-27		1.45301E-27	1.47559E-31	
28	0.00013413	2033	10472	8.98174E-35	2.67853E-31	2.67942E-31		2.67942E-31	2.55854E-35	
29	9.75488E-05	2034	10704	8.76158E-39	3.5927E-35	3.59357E-35		3.59357E-35	3.35732E-39	
30	7.09446E-05	2035	10379	6.21586E-43	3.50463E-39	3.50525E-39	16826	77252625.27	7443.010653	
31	5.1596E-05	2036	9864	3.20714E-47	2.48634E-43	2.48666E-43	34600	8.60386E-39	8.72261E-43	
32	3.75244E-05	2037	9661	1.20346E-51	1.28286E-47	1.28298E-47	51354	6.58859E-43	6.81964E-47	
33	2.72905E-05	2038	9918	3.2843E-56	4.81384E-52	4.81416E-52		4.81416E-52	4.85395E-56	
34	1.98476E-05	2039	10341	6.51854E-61	1.31372E-56	1.31378E-56		1.31378E-56	1.27045E-60	
35	1.44346E-05	2040	10518	9.40927E-66	2.60742E-61	2.60751E-61		2.60751E-61	2.47898E-65	
36	1.04979E-05	2041	10316	9.87777E-71	3.76371E-66	3.76381E-66		3.76381E-66	3.64866E-70	
37	7.63484E-06	2042	9968	7.54152E-76	3.95111E-71	3.95118E-71		3.95118E-71	3.96383E-75	
38	5.55261E-06	2043	9814	4.18752E-81	3.01661E-76	3.01665E-76		3.01665E-76	3.07371E-80	
39	4.03826E-06	2044	9973	1.69103E-86	1.67501E-81	1.67502E-81		1.67502E-81	1.67949E-85	
40	2.93692E-06	2045	10259	4.96642E-92	6.76412E-87	6.76417E-87		6.76417E-87	6.59328E-91	
41	2.13594E-06	2046	10392	1.0608E-97	1.98657E-92	1.98658E-92		1.98658E-92	1.9117E-96	
42	1.55341E-06	2047	10267	1.6479E-103	4.24319E-98	4.24321E-98		4.24321E-98	4.1327E-102	
43	1.12975E-06	2048	10033	1.8617E-109	6.5914E-104	6.5914E-104		6.5914E-104	6.57E-108	
44	8.21639E-07	2049	9919	1.5296E-115	7.4467E-110	7.4467E-110		7.4467E-110	7.5078E-114	
45	5.97556E-07	2050	10016	9.1404E-122	6.1185E-116	6.1185E-116		6.1185E-116	6.1089E-120	
						6325.390319		**77,256,188.70**	**7443.331948**	**77,263,632.03**

Note: Discount rate = 37.5% (Bank of Ghana base rate +8% default charged by commercial banks

Average interb 0.9131

Source: National forest plantation development report, 2007

APPENDIX 9: B-A-U SCENARIO FOR THE MINISTRY OF HEALTH (2006 US DOLLAR CONSTANT) – COST OF ADAPTATION MEASURES

Health sector (2006 US $)

			GOG Discretionary + Statutory						IGF + Donor						HIPC							
Discount period	Year	Disc factor	A	B	C	D	E	Discounted Subtotal	A	B	C	D	E	Discounted Subtotal	A	B	C	D	E	Discounted Subtotal	Discounted Grand total
0	2006	1	1,005,211,953.2	665,839,432.7	3,887.0	69,933,997.4	198,072,120.0	**1,939,061,390.2**	34,716,738.8	898,808,488.5	1,829.8	1,435,621.5	4,296,903.4	**939,259,582.1**	84,993.5	98,659,051.5	0	0	49,231,268.9	147,975,314.0	**3,026,296,286.27**
1	2007	0.727273	731063238.7	484246860.1	2826.883	50861089.02	144052450.9	**1410226466**	25248537.34	653678900.7	1330.761	1044088.35	3125020.67	**683097877.9**	61813.46	71752037.48	0	0	35804559.23	**107618410.2**	**2200942754**
2	2008	0.528926	386678076.7	256130570.6	1495.211	26901733.03	76193031.87	**745904907.4**	13354598.26	345747517.7	703.8736	552245.078	1652903.49	**361307968.5**	32694.72	37951490.9	0	0	18937948.69	**56922134.31**	**1164135010**
3	2009	0.384673	148744684.6	98526560.61	575.1675	10348375.14	29309415.72	**286929611.3**	5137155.756	132999796.5	270.7613	212433.869	635827.64	**138985484.5**	12576.78	14598920.62	0	0	7284920.907	**21896418.31**	**447811514.1**
4	2010	0.279762	41613156.77	27564018.32	160.9102	2895085.348	8199669.884	**80272091.24**	1437182.568	37208330.46	75.74881	59430.9902	177880.61	**38882900.38**	3518.51	4084227.774	0	0	2038046.311	**6125792.595**	**125280784.2**
5	2011	0.203463	8466758.487	5608271.618	32.73935	589044.1952	1668333.526	**16332440.57**	292414.1942	7570537.113	15.41212	12092.0372	36192.2114	**7911250.968**	715.8883	830991.2743	0	0	414668.0338	**1246375.196**	**25490066.73**
6	2012	0.147973	1252855.497	829875.3218	4.844555	87162.90408	246869.0742	**2416767.641**	43269.53829	1120238.525	2.280584	1789.30051	5355.48653	**1170655.131**	105.9325	122964.649	0	0	61359.86119	**184430.4427**	**3771853.215**
7	2013	0.107617	134828.6219	89308.74014	0.521357	9380.215251	26567.32333	**260085.422**	4656.540385	120556.7736	0.24543	192.559256	576.341701	**125982.4604**	11.40014	13233.09369	0	0	6603.367704	**19847.86154**	**405915.7439**
8	2014	0.078267	10552.62512	6989.922774	0.040805	734.1608459	2079.343389	**20356.09294**	364.4532174	9435.611072	0.019209	15.0710258	45.1085076	**9860.263032**	0.892254	1035.713893	0	0	516.8254554	**1553.431603**	**31769.78757**
9	2015	0.056921	600.6703939	397.8763215	0.002323	41.78947697	118.3591758	**1158.697691**	20.74519422	537.0883694	0.001093	0.85786417	2.56764025	**561.2601614**	0.050788	58.95430427	0	0	29.41843819	**88.42353083**	**1808.381383**
10	2016	0.041397	24.86618985	16.47104343	9.62E-05	1.729975505	4.899761611	**47.96706655**	0.858797009	22.23405964	4.53E-05	0.03551334	0.10629362	**23.23470887**	0.002103	2.440554649	0	0	1.21784672	**3.660503876**	**74.8622793**
11	2017	0.030107	0.748651269	0.495896945	2.89E-06	0.052084713	0.147518087	**1.444153909**	0.02585597	0.669405207	1.36E-06	0.00106921	0.0032002	**0.699531951**	6.33E-05	0.073478259	0	0	0.036665951	**0.11020751**	**2.253893369**
12	2018	0.021896	0.016392575	0.01085823	6.34E-08	0.001140454	0.003230077	**0.031621401**	0.000566146	0.014657392	2.98E-08	2.3412E-05	7.0072E-05	**0.015317052**	1.39E-06	0.00160889	0	0	0.000802843	**0.002413119**	**0.049351572**
13	2019	0.015924	0.000261043	0.000172912	1.01E-09	1.81611E-05	5.14373E-05	**0.000503554**	9.01557E-06	0.000233411	4.75E-10	3.7282E-07	1.1159E-06	**0.000243916**	2.21E-08	2.56207E-05	0	0	1.27848E-05	**3.84276E-05**	**0.000785898**
14	2020	0.011581	3.02325E-06	2.00256E-06	1.17E-11	2.10332E-07	5.95717E-07	**5.83188E-06**	1.04413E-07	2.70324E-06	5.5E-12	4.3177E-09	1.2923E-08	**2.8249E-06**	2.56E-10	2.96725E-07	0	0	1.48067E-07	**4.45047E-07**	**9.10182E-06**
								4,481,425,323.6						**2,170,752,147.3**						**341,990,368.5**	**6,994,167,839.42**
15	2021	0.008423	2,323,996,134.2	1,539,661,705.5	828,386.0	162,446,047.7	458,590,063.7	**4,485,522,337.1**	80,263,238.6	2,077,997,029.4	4,230.4	3,319,079.9	9,934,210.3	**2,171,517,788.6**	196,500.4	228,094,436.8	0	0	113,820,053.9	**342,110,991.2**	**6,999,151,116.9**
16	2022	0.006126	14236139.36	9431529.717	5074.457	995098.2873	2809192.304	**27477034.12**	491669.7724	12729218.8	25.91417	20331.7394	60854.1469	**13302100.38**	1203.706	1397241.648	0	0	697229.2791	**2095674.633**	**42874809.13**
17	2023	0.004455	63422.93879	42018.08629	22.60704	4433.228433	12515.1368	**122411.9974**	2190.42123	56709.50845	0.115449	90.5792386	271.109234	**59261.7336**	5.362588	6224.803602	0	0	3106.202376	**9336.368566**	**191010.0995**
18	2024	0.00324	205.4933607	136.140613	0.073248	14.36387255	40.54964292	**396.620737**	7.097069744	183.7415247	0.000374	0.29348107	0.87840691	**192.0108565**	0.017375	20.16866194	0	0	10.06424454	**30.25028152**	**618.8818751**
19	2025	0.002356	0.484224244	0.320801534	0.000173	0.033847008	0.095551117	**0.934596504**	0.016723524	0.43296825	8.81E-07	0.00069156	0.00206988	**0.452454091**	4.09E-05	0.047525404	0	0	0.023715371	**0.071281718**	**1.458332313**
20	2026	0.001714	0.000829837	0.000549772	2.96E-07	5.80051E-05	0.00016375	**0.001601659**	2.86598E-05	0.000741997	1.51E-09	1.1852E-06	3.5472E-06	**0.000775391**	7.02E-08	8.14464E-05	0	0	4.06421E-05	**0.000122159**	**0.002499209**
21	2027	0.001246	1.03427E-06	6.85213E-07	3.69E-10	7.22952E-08	2.04092E-07	**1.99624E-06**	3.57205E-08	9.24795E-07	1.88E-12	1.4771E-09	4.4211E-09	**9.66416E-07**	8.75E-11	1.01511E-07	0	0	5.06546E-08	**1.52254E-07**	**3.11491E-06**
22	2028	0.000906	9.37511E-10	6.21107E-10	3.34E-13	6.55315E-11	1.84997E-10	**1.80948E-09**	3.23786E-11	8.38274E-10	1.71E-15	1.3389E-12	4.0075E-12	**8.76001E-10**	7.93E-14	9.20144E-11	0	0	4.59156E-11	**1.38009E-10**	**2.82349E-09**
23	2029	0.000659	6.18037E-13	4.09453E-13	2.2E-16	4.32004E-14	1.21956E-13	**1.19287E-12**	2.1345E-14	5.52617E-13	1.13E-18	8.8267E-16	2.6419E-15	**5.77487E-13**	5.23E-17	6.06588E-14	0	0	3.0269E-14	**9.098E-14**	**1.86133E-12**
24	2030	0.000479	2.96312E-16	1.96309E-16	1.06E-19	2.07121E-17	5.84708E-17	**5.7191E-16**	1.02337E-17	2.64947E-16	5.39E-22	4.2319E-19	1.2666E-18	**2.76871E-16**	2.51E-20	2.90823E-17	0	0	1.45122E-17	**4.36196E-17**	**8.924E-16**
25	2031	0.000349	1.03319E-19	6.84498E-20	3.68E-23	7.22198E-21	2.03879E-20	**1.99416E-19**	3.56832E-21	9.23829E-20	1.88E-25	1.4756E-22	4.4165E-22	**9.65407E-20**	8.74E-24	1.01406E-20	0	0	5.06018E-21	**1.52095E-20**	**3.11166E-19**
26	2032	0.000254	2.62007E-23	1.73581E-23	9.34E-27	1.83141E-24	5.17013E-24	**5.05696E-23**	9.04885E-25	2.34273E-23	4.77E-29	3.7419E-26	1.12E-25	**2.44816E-23**	2.22E-27	2.57153E-24	0	0	1.2832E-24	**3.85695E-24**	**7.89082E-23**
27	2033	0.000184	4.83214E-27	3.20132E-27	1.72E-30	3.37764E-28	9.53517E-28	**9.32646E-27**	1.66886E-28	4.32065E-27	8.8E-33	6.9012E-30	2.0656E-29	**4.5151E-27**	4.09E-31	4.74262E-28	0	0	2.36659E-28	**7.1133E-28**	**1.45529E-26**
28	2034	0.000134	6.48132E-31	4.29392E-31	2.31E-34	4.53041E-32	1.27895E-31	**1.25095E-30**	2.23844E-32	5.79526E-31	1.18E-36	9.2565E-34	2.7705E-33	**6.05608E-31**	5.48E-35	6.36126E-32	0	0	3.17429E-32	**9.54103E-32**	**1.95197E-30**
29	2035	9.75E-05	6.32245E-35	4.18866E-35	2.25E-38	4.41936E-36	1.2476E-35	**1.22029E-34**	2.18357E-36	5.65321E-35	1.15E-40	9.0296E-38	2.7026E-37	**5.90763E-35**	5.35E-39	6.20533E-36	0	0	3.09648E-36	**9.30716E-36**	**1.90412E-34**
30	2036	7.09E-05	4.48543E-39	2.97163E-39	1.6E-42	3.13529E-40	8.85103E-40	**8.65729E-39**	1.54912E-40	4.01064E-39	8.16E-45	6.406E-42	1.9174E-41	**4.19114E-39**	3.79E-43	4.40234E-40	0	0	2.19679E-40	**6.60292E-40**	**1.35087E-38**
31	2037	5.16E-05	2.31431E-43	1.53324E-43	8.25E-47	1.61769E-44	4.56678E-44	**4.46682E-43**	7.99286E-45	2.06933E-43	4.21E-49	3.3052E-46	9.8928E-46	**2.16246E-43**	1.96E-47	2.27143E-44	0	0	1.13345E-44	**3.40685E-44**	**6.96997E-43**
32	2038	3.75E-05	8.68429E-48	5.7534E-48	3.1E-51	6.07027E-49	1.71366E-48	**1.67615E-47**	2.99927E-49	7.76505E-48	1.58E-53	1.2403E-50	3.7122E-50	**8.11451E-48**	7.34E-52	8.52342E-49	0	0	4.25322E-49	**1.2784E-48**	**2.61544E-47**
33	2039	2.73E-05	2.36998E-52	1.57013E-52	8.45E-56	1.65661E-53	4.67665E-53	**4.57428E-52**	8.18515E-54	2.11912E-52	4.31E-58	3.3848E-55	1.0131E-54	**2.21449E-52**	2E-56	2.32608E-53	0	0	1.16072E-53	**3.48881E-53**	**7.13765E-52**
34	2040	1.98E-05	4.70385E-57	3.11633E-57	1.68E-60	3.28797E-58	9.28203E-58	**9.07886E-57**	1.62456E-58	4.20594E-57	8.56E-63	6.7179E-60	2.0107E-59	**4.39523E-57**	3.98E-61	4.61671E-58	0	0	2.30376E-58	**6.92445E-58**	**1.41665E-56**
35	2041	1.44E-05	6.78984E-62	4.49831E-62	2.42E-65	4.74606E-63	1.33983E-62	**1.3105E-61**	2.34499E-63	6.07112E-62	1.24E-67	9.6971E-65	2.9024E-64	**6.34435E-62**	5.74E-66	6.66406E-63	0	0	3.32539E-63	**9.99519E-63**	**2.04489E-61**
36	2042	1.05E-05	7.12791E-67	4.72228E-67	2.54E-70	4.98237E-68	1.40654E-67	**1.37575E-66**	2.46175E-68	6.37341E-67	1.3E-72	1.018E-69	3.0469E-69	**6.66024E-67**	6.03E-71	6.99587E-68	0	0	3.49097E-68	**1.04929E-67**	**2.1467E-66**
37	2043	7.63E-06	5.44205E-72	3.60539E-72	1.94E-75	3.80396E-73	1.07387E-72	**1.05036E-71**	1.87951E-73	4.866E-72	9.91E-78	7.7722E-75	2.3263E-74	**5.08499E-72**	4.6E-76	5.34123E-73	0	0	2.6653E-73	**8.01113E-73**	**1.63898E-71**
38	2044	5.55E-06	3.02176E-77	2.00193E-77	1.08E-80	2.11219E-78	5.96278E-78	**5.83227E-77**	1.04362E-78	2.7019E-77	5.5E-83	4.3156E-80	1.2917E-79	**2.8235E-77**	2.55E-81	2.96578E-78	0	0	1.47994E-78	**4.44827E-78**	**9.1006E-77**
39	2045	4.04E-06	1.22027E-82	8.08434E-83	4.35E-86	8.52959E-84	2.40793E-83	**2.35522E-82**	4.2144E-84	1.0911E-82	2.22E-88	1.7428E-85	5.2162E-85	**1.1402E-82**	1.03E-86	1.19766E-83	0	0	5.97638E-84	**1.79633E-83**	**3.67506E-82**
40	2046	2.94E-06	3.58382E-88	2.37431E-88	1.28E-91	2.50507E-89	7.0719E-89	**6.9171E-88**	1.23774E-89	3.20447E-88	6.52E-94	5.1183E-91	1.532E-90	**3.34869E-88**	3.03E-92	3.51743E-89	0	0	1.75521E-89	**5.27568E-89**	**1.07934E-87**
41	2047	2.14E-06	7.65484E-94	5.07138E-94	2.73E-97	5.35069E-95	1.51052E-94	**1.47745E-93**	2.64373E-95	6.84456E-94	1.4E-99	1.0932E-96	3.2722E-96	**7.1526E-94**	6.47E-98	7.51303E-95	0	0	3.74903E-95	**1.12685E-94**	**2.3054E-93**
42	2048	1.55E-06	1.1891E-99	7.8779E-100	4.2E-103	8.3118E-101	2.3465E-100	**2.2951E-99**	4.1068E-101	1.0632E-99	2.2E-105	1.698E-102	5.083E-102	**1.1111E-99**	1E-103	1.1671E-100	0	0	5.8238E-101	**1.7505E-100**	**3.5812E-99**
43	2049	1.13E-06	1.3434E-105	8.9001E-106	4.8E-109	9.3903E-107	2.6509E-106	**2.5929E-105**	4.6397E-107	1.2012E-105	2.4E-111	1.919E-108	5.743E-108	**1.2553E-105**	1.1E-109	1.3185E-106	0	0	6.5795E-107	**1.9776E-106**	**4.0459E-105**
44	2050	8.22E-07	1.1038E-111	7.3127E-112	3.9E-115	7.7155E-113	2.1781E-112	**2.1304E-111**	3.8121E-113	9.8696E-112	2E-117	1.576E-114	4.718E-114	**1.0314E-111**	9.3E-116	1.0833E-112	0	0	5.4059E-113	**1.6249E-112**	**3.3243E-111**
								4,513,122,180.7						**2,184,879,343.2**						**344,216,032.5**	**7,042,217,556.47**

Note:

Average inter bank rate for 2 0.9236

A=Compenstion to employees, B =Use of goods, C= Consumption of fixed capital, D= Social benefits E= Other expenditure

Source: Government of Ghana budgetary allocation to the Minstry of Health in 2006

A=Compensation to employees, B =Use of goods, C= Consumption of fixed capital, D= Social benefits E= Other expenditure

Source: Government of Ghana budgetary allocation to the Ministry of Health in 2006

APPENDIX 10: CLIMATE CHANGE SCENARIO FOR THE MINISTRY OF HEALTH (US$ 2006 CONSTANT) – COST OF ADAPTATION MEASURES

Health sector (2006 US $)

			GOG Discretionary + Statutory						IGF + Donor						HIPC							
Discount period	Year	Disc factor	A	B	C	D	E	Discounted Subto	A	B	C	D	E	Discounted Subtotal	A	B	C	D	E	Discounted Subtotal	Discounted Grand total	CC Scenario: 5% Re
0	2006	1	1,005,211,953.2	665,839,432.7	3,887.0	69,933,997.4	198,072,120.0	1,939,061,390.2	34,716,738.8	898,808,488.5	1,829.8	1,435,621.5	4,296,903.4	939,259,582.1	84,993.5	98,659,051.5	0	0	49,231,268.9	147,975,314.0	3026296286	2874981472
1	2007	0.727273	731063238.7	484246860.1	2826.883	50861089.02	144052450.9	1410226466	25248537.34	653678900.7	1330.761	1044088.35	3125020.67	683097877.9	61813.46	71752037.48	0	0	35804559.23	107618410.2	2200942754	2090895616
2	2008	0.528926	386678076.7	256130570.6	1495.211	26901733.03	76193031.87	745904907.4	13354598.26	345747517.7	703.8736	552245.078	1652903.49	361307968.5	32694.72	37951490.9	0	0	18937948.69	56922134.31	1164135010	1105928260
3	2009	0.384673	148744684.6	98526560.61	575.1675	10348375.14	29309415.72	286929611.3	5137155.756	132999796.5	270.7613	212433.869	635827.64	138985484.5	12576.78	14598920.62	0	0	7284920.907	21896418.31	447811514.1	425420938.4
4	2010	0.279762	41613156.77	27564018.32	160.9102	2895085.348	8199669.884	80272091.24	1437182.568	37208330.46	75.74881	59430.9902	177880.61	38882900.38	3518.51	4084227.774	0	0	2038046.311	6125792.595	125280784.2	119016745
5	2011	0.203463	8466758.487	5608271.618	32.73935	589044.1952	1668333.526	16332440.57	292414.1942	7570537.113	15.41212	12092.0372	36192.2114	7911250.968	715.8883	830991.2743	0	0	414668.0338	1246375.196	25490066.73	24215563.39
6	2012	0.147973	1252855.497	829875.3218	4.844555	87162.90408	246869.0742	2416767.641	43269.53829	1120238.525	2.280584	1789.30051	5355.48653	1170655.131	105.9325	122964.649	0	0	61359.86119	184430.4427	3771853.215	3583260.554
7	2013	0.107617	134828.6219	89308.74014	0.521357	9380.215251	26567.32333	260085.422	4656.540385	120556.7736	0.24543	192.559256	576.341701	125982.4604	11.40014	13233.09369	0	0	6603.367704	19847.86154	405915.7439	385619.9567
8	2014	0.078267	10552.62512	6989.922774	0.040805	734.1608459	2079.343389	20356.09294	364.4532174	9435.611072	0.019209	15.0710258	45.1085076	9860.263032	0.892254	1035.713893	0	0	516.8254554	1553.431603	31769.78757	30181.29819
9	2015	0.056921	600.6703939	397.8763215	0.002323	41.78947697	118.3591758	1158.697691	20.74519422	537.0883694	0.001093	0.85786417	2.56764025	561.2601614	0.050788	58.95430427	0	0	29.41843819	88.42353083	1808.381383	1717.962314
10	2016	0.041397	24.86618985	16.47104343	9.62E-05	1.729975505	4.899761611	47.96706655	0.858797009	22.23405964	4.53E-05	0.03551334	0.10629362	23.23470887	0.002103	2.440554649	0	0	1.21784672	3.660503876	74.8622793	71.11916533
11	2017	0.030107	0.748651269	0.495896945	2.89E-06	0.052084713	0.147518087	1.444153909	0.02585597	0.669405207	1.36E-06	0.00106921	0.0032002	0.699531951	6.33E-05	0.073478259	0	0	0.036665951	0.11020751	2.253893369	2.141198701
12	2018	0.021896	0.016392575	0.01085823	6.34E-08	0.001140454	0.003230077	0.031621401	0.000566146	0.014657392	2.98E-08	2.3412E-05	7.0072E-05	0.015317052	1.39E-06	0.00160889	0	0	0.000802843	0.002413119	0.049351572	0.046883993
13	2019	0.015924	0.000261043	0.000172912	1.01E-09	1.81611E-05	5.14373E-05	0.000503554	9.01557E-06	0.000233411	4.75E-10	3.7282E-07	1.1159E-06	0.000243916	2.21E-08	2.56207E-05	0	0	1.27848E-05	3.84276E-05	0.000785898	0.000746603
14	2020	0.011581	3.02325E-06	2.00256E-06	1.17E-11	2.10332E-07	5.95717E-07	5.83188E-06	1.04413E-07	2.70324E-06	5.5E-12	4.3177E-09	1.2923E-08	2.8249E-06	2.56E-10	2.96725E-07	0	0	1.48067E-07	4.45047E-07	9.10182E-06	8.64673E-06
																					6,994,167,839.42	6,644,459,447.45
15	2021	0.008423	2,323,996,134.2	1,539,661,705.5	828,386.0	162,446,047.7	458,590,063.7	4,485,522,337.1	80,263,238.6	2,077,997,029.4	4,230.4	3,319,079.9	9,934,210.3	2,171,517,788.6	196,500.4	228,094,436.8	0	0	113,820,053.9	342,110,991.2	6999151117	6649193561
16	2022	0.006126	14236139.36	9431529.717	5074.457	995098.2873	2809192.304	27477034.12	491669.7724	12729218.8	25.91417	20331.7394	60854.1469	13302100.38	1203.706	1397241.648	0	0	697229.2791	2095674.633	42874809.13	40731068.68
17	2023	0.004455	63422.93879	42018.08629	22.60704	4433.228433	12515.1368	122411.9974	2190.42123	56709.50845	0.115449	90.5792386	271.109234	59261.7336	5.362588	6224.803602	0	0	3106.202376	9336.368566	191010.0995	181459.5945
18	2024	0.00324	205.4933607	136.140613	0.073248	14.36387255	40.54964292	396.620737	7.097069744	183.7415247	0.000374	0.29348107	0.87840691	192.0108565	0.017375	20.16866194	0	0	10.06424454	30.25028152	618.8818751	587.9377813
19	2025	0.002356	0.484224244	0.320801534	0.000173	0.033847008	0.095551117	0.934596504	0.016723524	0.43296825	8.81E-07	0.00069156	0.00206988	0.452454091	4.09E-05	0.047525404	0	0	0.023715371	0.071281718	1.458332313	1.385415697
20	2026	0.001714	0.000829837	0.000549772	2.96E-07	5.80051E-05	0.00016375	0.001601659	2.86598E-05	0.000741997	1.51E-09	1.1852E-06	3.5472E-06	0.000775391	7.02E-08	8.14464E-05	0	0	4.06421E-05	0.000122159	0.002499209	0.002374248
21	2027	0.001246	1.03427E-06	6.85213E-07	3.69E-10	7.22952E-08	2.04092E-07	1.99624E-06	3.57205E-08	9.24795E-07	1.88E-12	1.4771E-09	4.4211E-09	9.66416E-07	8.75E-11	1.01511E-07	0	0	5.06546E-08	1.52254E-07	3.11491E-06	2.95917E-06
22	2028	0.000906	9.37511E-10	6.21107E-10	3.34E-13	6.55315E-11	1.84997E-10	1.80948E-09	3.23786E-11	8.38274E-10	1.71E-15	1.3389E-12	4.0075E-12	8.76001E-10	7.93E-14	9.20144E-11	0	0	4.59156E-11	1.38009E-10	2.82349E-09	2.68232E-09
23	2029	0.000659	6.18037E-13	4.09453E-13	2.2E-16	4.32004E-14	1.21956E-13	1.19287E-12	2.1345E-14	5.52617E-13	1.13E-18	8.8267E-16	2.6419E-15	5.77487E-13	5.23E-17	6.06588E-14	0	0	3.0269E-14	9.098E-14	1.86133E-12	1.76827E-12
24	2030	0.000479	2.96312E-16	1.96309E-16	1.06E-19	2.07121E-17	5.84708E-17	5.7191E-16	1.02337E-17	2.64947E-16	5.39E-22	4.2319E-19	1.2666E-18	2.76871E-16	2.51E-20	2.90823E-17	0	0	1.45122E-17	4.36196E-17	8.924E-16	8.4778E-16
25	2031	0.000349	1.03319E-19	6.84498E-20	3.68E-23	7.22198E-21	2.03879E-20	1.99416E-19	3.56832E-21	9.23829E-20	1.88E-25	1.4756E-22	4.4165E-22	9.65407E-20	8.74E-24	1.01406E-20	0	0	5.06018E-21	1.52095E-20	3.11166E-19	2.95608E-19
26	2032	0.000254	2.62007E-23	1.73581E-23	9.34E-27	1.83141E-24	5.17013E-24	5.05696E-23	9.04885E-25	2.34273E-23	4.77E-29	3.7419E-26	1.12E-25	2.44816E-23	2.22E-27	2.57153E-24	0	0	1.2832E-24	3.85695E-24	7.89082E-23	7.49628E-23
27	2033	0.000184	4.83214E-27	3.20132E-27	1.72E-30	3.37764E-28	9.53517E-28	9.32646E-27	1.66886E-28	4.32065E-27	8.8E-33	6.9012E-30	2.0656E-29	4.5151E-27	4.09E-31	4.74262E-28	0	0	2.36659E-28	7.1133E-28	1.45529E-26	1.38252E-26
28	2034	0.000134	6.48132E-31	4.29392E-31	2.31E-34	4.53041E-32	1.27895E-31	1.25095E-30	2.23844E-32	5.79526E-31	1.18E-36	9.2565E-34	2.7705E-33	6.05608E-31	5.48E-35	6.36126E-32	0	0	3.17429E-32	9.54103E-32	1.95197E-30	1.85437E-30
29	2035	9.75E-05	6.32245E-35	4.18866E-35	2.25E-38	4.41936E-36	1.2476E-35	1.22029E-34	2.18357E-36	5.65321E-35	1.15E-40	9.0296E-38	2.7026E-37	5.90763E-35	5.35E-39	6.20533E-36	0	0	3.09648E-36	9.30716E-36	1.90412E-34	1.80892E-34
30	2036	7.09E-05	4.48543E-39	2.97163E-39	1.6E-42	3.13529E-40	8.85103E-40	8.65729E-39	1.54912E-40	4.01064E-39	8.16E-45	6.406E-42	1.9174E-41	4.19114E-39	3.79E-43	4.40234E-40	0	0	2.19679E-40	6.60292E-40	1.35087E-38	1.28333E-38
31	2037	5.16E-05	2.31431E-43	1.53324E-43	8.25E-47	1.61769E-44	4.56678E-44	4.46682E-43	7.99286E-45	2.06933E-43	4.21E-49	3.3052E-46	9.8928E-46	2.16246E-43	1.96E-47	2.27143E-44	0	0	1.13345E-44	3.40685E-44	6.96997E-43	6.62147E-43
32	2038	3.75E-05	8.68429E-48	5.7534E-48	3.1E-51	6.07027E-49	1.71366E-48	1.67615E-47	2.99927E-49	7.76505E-48	1.58E-53	1.2403E-50	3.7122E-50	8.11451E-48	7.34E-52	8.52342E-49	0	0	4.25322E-49	1.2784E-48	2.61544E-47	2.48467E-47
33	2039	2.73E-05	2.36998E-52	1.57013E-52	8.45E-56	1.65661E-53	4.67665E-53	4.57428E-52	8.18515E-54	2.11912E-52	4.31E-58	3.3848E-55	1.0131E-54	2.21449E-52	2E-56	2.32608E-53	0	0	1.16072E-53	3.48881E-53	7.13765E-52	6.78077E-52
34	2040	1.98E-05	4.70385E-57	3.11633E-57	1.68E-60	3.28797E-58	9.28203E-58	9.07886E-57	1.62456E-58	4.20594E-57	8.56E-63	6.7179E-60	2.0107E-59	4.39523E-57	3.98E-61	4.61671E-58	0	0	2.30376E-58	6.92445E-58	1.41665E-56	1.34582E-56
35	2041	1.44E-05	6.78984E-62	4.49831E-62	2.42E-65	4.74606E-63	1.33983E-62	1.3105E-61	2.34499E-63	6.07112E-62	1.24E-67	9.6971E-65	2.9024E-64	6.34435E-62	5.74E-66	6.66406E-63	0	0	3.32539E-63	9.99519E-63	2.04489E-61	1.94264E-61
36	2042	1.05E-05	7.12791E-67	4.72228E-67	2.54E-70	4.98237E-68	1.40654E-67	1.37575E-66	2.46175E-68	6.37341E-67	1.3E-72	1.018E-69	3.0469E-69	6.66024E-67	6.03E-71	6.99587E-68	0	0	3.49097E-68	1.04929E-67	2.1467E-66	2.03937E-66
37	2043	7.63E-06	5.44205E-72	3.60539E-72	1.94E-75	3.80396E-73	1.07387E-72	1.05036E-71	1.87951E-73	4.866E-72	9.91E-78	7.7722E-75	2.3263E-74	5.08499E-72	4.6E-76	5.34123E-73	0	0	2.6653E-73	8.01113E-73	1.63898E-71	1.55703E-71
38	2044	5.55E-06	3.02176E-77	2.00193E-77	1.08E-80	2.11219E-78	5.96278E-78	5.83227E-77	1.04362E-78	2.7019E-77	5.5E-83	4.3156E-80	1.2917E-79	2.8235E-77	2.55E-81	2.96578E-78	0	0	1.47994E-78	4.44827E-78	9.1006E-77	8.64557E-77
39	2045	4.04E-06	1.22027E-82	8.08434E-83	4.35E-86	8.52959E-84	2.40793E-83	2.35522E-82	4.2144E-84	1.0911E-82	2.22E-88	1.7428E-85	5.2162E-85	1.1402E-82	1.03E-86	1.19766E-83	0	0	5.97638E-84	1.79633E-83	3.67506E-82	3.49131E-82
40	2046	2.94E-06	3.58382E-88	2.37431E-88	1.28E-91	2.50507E-89	7.0719E-89	6.9171E-88	1.23774E-89	3.20447E-88	6.52E-94	5.1183E-91	1.532E-90	3.34869E-88	3.03E-92	3.51743E-89	0	0	1.75521E-89	5.27568E-89	1.07934E-87	1.02537E-87
41	2047	2.14E-06	7.65484E-94	5.07138E-94	2.73E-97	5.35069E-95	1.51052E-94	1.47745E-93	2.64373E-95	6.84456E-94	1.4E-99	1.0932E-96	3.2722E-96	7.1526E-94	6.47E-98	7.51303E-95	0	0	3.74903E-95	1.12685E-94	2.3054E-93	2.19013E-93
42	2048	1.55E-06	1.1891E-99	7.8779E-100	4.2E-103	8.3118E-101	2.3465E-100	2.2951E-99	4.1068E-101	1.0632E-99	2.2E-105	1.698E-102	5.083E-102	1.1111E-99	1E-103	1.1671E-100	0	0	5.8238E-101	1.7505E-100	3.5812E-99	3.4022E-99
43	2049	1.13E-06	1.3434E-105	8.9001E-106	4.8E-109	9.3903E-107	2.6509E-106	2.5929E-105	4.6397E-107	1.2012E-105	2.4E-111	1.919E-108	5.743E-108	1.2553E-105	1.1E-109	1.3185E-106	0	0	6.5795E-107	1.9776E-106	4.0459E-105	3.8436E-105
44	2050	8.22E-07	1.1038E-111	7.3127E-112	3.9E-115	7.7155E-113	2.1781E-112	2.1304E-111	3.8121E-113	9.8696E-112	2E-117	1.576E-114	4.718E-114	1.0314E-111	9.3E-116	1.0833E-112	0	0	5.4059E-113	1.6249E-112	3.3243E-111	3.1581E-111
																					7,042,217,556.47	6,690,106,678.65

Note:

Average inter bank rate for 2 0.9236

A=Compenstion to employees, B =Use of goods, C= Consumption of fixed capital, D= Social benefits E= Other expenditure

Source: Government of Ghana budgetary allocation to the Minstry of Health in 2006

A=Compensation to employees, B =Use of goods, C= Consumption of fixed capital, D= Social benefits E= Other expenditure

Source: Government of Ghana budgetary allocation to the Ministry of Health in 2006

APPENDIX 11: B-A-U SCENARIO FOR MALARIA TREATMENT (US$ 2003 CONSTANT) – COST OF ADAPTATION MEASURES

Cost of Malaria per Episode (2003 CONSTANT US Dollars)

				Household			**Government** Direct						
Year	**Discount period**	Malaria **Pre. Rate (A)**	**Disc. Factor**	**Direct (B)**	**Indirect (C)**	**Total (Discounted)**	**Facility (D)**	**Personnel (E)**	**Treatment (Exemption) - I**	**M-Specific Exp (G)**	T. Direct **(Discounted)**	**Total Discounted (c)**	**Grand Total (d)**
2003	0	3552896	1	6.87	8.92	56100227.84	1.6118	0.4816	0.1214	0.7281	2.9429	10455817.64	**66,556,045.48**
2004	1	3416033	0.727272727	4.996363636	6.487272727	39228480.78	1.172218182	0.350254545	0.088290909	0.529527273	2.140290909	7311304.375	46539785.15
2005	2	3452949	0.52892562	2.642704733	3.431284748	20973175.91	0.620016228	0.185258603	0.046699324	0.280080541	1.132054696	3908927.13	24882103.04
2006	3	3511452	0.384673178	1.016577628	1.319923209	8204510.538	0.238503613	0.071264015	0.017963977	0.107739472	0.435471078	1529135.786	9733646.325
2007	4	3473959	0.279762311	0.284400107	0.369264768	2270805.192	0.066724322	0.019936986	0.005025644	0.030141444	0.121828395	423226.8904	2694032.083
2008	5	3460145	0.203463499	0.057865041	0.075131902	460188.6618	0.013575964	0.004056449	0.001022535	0.006132684	0.024787632	85768.79119	545957.453
2009	6	3479453	0.147973454	0.00856249	0.011117527	68475.70282	0.002008882	0.000600247	0.000151308	0.000907474	0.003667911	12762.32716	81238.02998
2010	7	3481852	0.107617057	0.00092147	0.001196436	7374.233555	0.00021619	6.45968E-05	1.62833E-05	9.76597E-05	0.00039473	1374.390876	8748.624431
2011	8	3471186	0.078266951	7.21206E-05	9.36414E-05	575.3907268	1.69205E-05	5.05579E-06	1.27445E-06	7.64353E-06	3.08943E-05	107.2398588	682.6305856
2012	9	3473817	0.056921419	4.10521E-06	5.3302E-06	32.77688004	9.63141E-07	2.87783E-07	7.25433E-08	4.3508E-07	1.75855E-06	6.108871455	38.88575149
2013	10	3477497	0.041397395	1.69945E-07	2.20656E-07	1.358315028	3.98715E-08	1.19135E-08	3.0031E-09	1.80112E-08	7.27993E-08	0.253159297	1.611474325
2014	11	3475618	0.030107197	5.11657E-09	6.64334E-09	0.040872962	1.20042E-09	3.58681E-10	9.0415E-11	5.42267E-10	2.19178E-09	0.007617799	0.04849076
2015	12	3474167	0.021896143	1.12033E-10	1.45464E-10	0.000894586	2.62846E-11	7.85373E-12	1.97974E-12	1.18735E-11	4.79916E-11	0.000166731	0.001061317
2016	13	3475644	0.015924468	1.78407E-12	2.31643E-12	1.42519E-05	4.18568E-13	1.25066E-13	3.15263E-14	1.8908E-13	7.6424E-13	2.65623E-06	1.69081E-05
2017	14	3475761	0.011581431	2.06621E-14	2.68276E-14	1.65063E-07	4.84761E-15	1.44845E-15	3.6512E-16	2.18982E-15	8.851E-15	3.07639E-08	1.95827E-07
2018	15	3475143	0.008422859	1.74034E-16	2.25965E-16	1.39005E-09	4.08308E-17	1.22001E-17	3.07535E-18	1.84445E-17	7.45507E-17	2.59074E-10	1.64913E-09
2019	16	3475190	0.006125716	1.06608E-18	1.3842E-18	8.51518E-12	2.50118E-19	7.47342E-20	1.88387E-20	1.12986E-19	4.56676E-19	1.58704E-12	1.01022E-11
2020	17	3475516	0.004455066	4.74946E-21	6.16669E-21	3.79392E-14	1.11429E-21	3.32946E-22	8.39278E-23	5.03359E-22	2.03452E-21	7.07102E-15	4.50103E-14
						127,313,848.42						**23,728,430.94**	**151,042,279.36**
2021	18	3475365	0.003240048	15.87747151	20.61529052	126825654.1	3.725081306	1.113040797	0.280571331	1.682734644	6.801428078	23637442.53	150463096.7
2022	19	3475283	0.002356398	0.03741365	0.048577839	298844.7632	0.008777776	0.002622768	0.000661138	0.003965193	0.016026875	55697.92614	354542.6894
2023	20	3475357	0.001713744	6.41174E-05	8.325E-05	512.154417	1.50429E-05	4.49475E-06	1.13302E-06	6.79533E-06	2.7466E-05	95.45403634	607.6084533
2024	21	3475388	0.00124636	7.99134E-08	1.03759E-07	0.638334211	1.87488E-08	5.60208E-09	1.41215E-09	8.46942E-09	3.42325E-08	0.118971105	0.757305316
2025	22	3475335	0.000906443	7.24369E-11	9.4052E-11	0.000578605	1.69947E-11	5.07797E-12	1.28004E-12	7.67705E-12	3.10298E-11	0.000107839	0.000686444
2026	23	3475343	0.000659231	4.77527E-14	6.20021E-14	3.81435E-07	1.12035E-14	3.34756E-15	8.4384E-16	5.06095E-15	2.04558E-14	7.1091E-08	4.52526E-07
2027	24	3475360	0.000479441	2.28946E-17	2.97263E-17	1.82877E-10	5.3714E-18	1.60496E-18	4.04571E-19	2.42643E-18	9.80736E-18	3.40841E-11	2.16961E-10
2028	25	3475355	0.000348684	7.98299E-21	1.03651E-20	6.37662E-14	1.87292E-21	5.59623E-22	1.41068E-22	8.46058E-22	3.41967E-21	1.18846E-14	7.56508E-14
2029	26	3475346	0.000253589	2.0244E-24	2.62847E-24	1.61703E-17	4.74952E-25	1.41914E-25	3.57732E-26	2.14551E-25	8.6719E-25	3.01379E-18	1.91841E-17
2030	27	3475353	0.000184428	3.73356E-28	4.84765E-28	2.98227E-21	8.75946E-29	2.61729E-29	6.59758E-30	3.95692E-29	1.59934E-28	5.55828E-22	3.5381E-21
2031	28	3461479	0.00013413	5.0078E-32	6.50213E-32	3.98414E-25	1.1749E-32	3.51056E-33	8.84931E-34	5.3074E-33	2.14519E-32	7.42553E-26	4.72669E-25
2032	29	3452737	9.75488E-05	4.88505E-36	6.34274E-36	3.87666E-29	1.1461E-36	3.42451E-37	8.63239E-38	5.1773E-37	2.09261E-36	7.22522E-30	4.59918E-29
2033	30	3443995	7.09446E-05	3.46568E-40	4.49983E-40	2.74332E-33	8.13097E-41	2.42951E-41	6.12421E-42	3.67301E-41	1.48459E-40	5.11292E-34	3.25461E-33
2034	31	3435254	5.1596E-05	1.78815E-44	2.32173E-44	1.41185E-37	4.19526E-45	1.25353E-45	3.15985E-46	1.89513E-45	7.6599E-45	2.63137E-38	1.67499E-37
2035	32	3452737	3.75244E-05	6.70993E-49	8.71217E-49	5.32485E-42	1.57425E-49	4.70379E-50	1.18571E-50	7.11136E-50	2.87433E-49	9.92431E-43	6.31728E-42
2036	33	3443995	2.72905E-05	1.83117E-53	2.37759E-53	1.4495E-46	4.29619E-54	1.28369E-54	3.23587E-55	1.94072E-54	7.84418E-54	2.70153E-47	1.71965E-46
2037	34	3443995	1.98476E-05	3.63444E-58	4.71895E-58	2.8769E-51	8.52691E-59	2.54781E-59	6.42243E-60	3.85187E-59	1.55688E-58	5.3619E-52	3.41309E-51
2038	35	3443995	1.44346E-05	5.24618E-63	6.81163E-63	4.1527E-56	1.23083E-63	3.67767E-64	9.27054E-65	5.56003E-64	2.2473E-63	7.7397E-57	4.92667E-56
2039	36	3446909	1.04979E-05	5.50739E-68	7.15079E-68	4.36316E-61	1.29211E-68	3.86078E-69	9.73213E-70	5.83687E-69	2.3592E-68	8.13194E-62	5.17635E-61
2040	37	3443995	7.63484E-06	4.20481E-73	5.45951E-73	3.32839E-66	9.86507E-74	2.94765E-74	7.43033E-75	4.45636E-74	1.80121E-73	6.20336E-67	3.94872E-66
2041	38	3444967	5.55261E-06	2.33477E-78	3.03146E-78	1.84865E-71	5.47769E-79	1.63672E-79	4.12577E-80	2.47444E-79	1.00014E-78	3.44546E-72	2.19319E-71
2042	39	3444967	4.03826E-06	9.4284E-84	1.22418E-83	7.46532E-77	2.21204E-84	6.60949E-85	1.6661E-85	9.99246E-85	4.03884E-84	1.39137E-77	8.85669E-77
2043	40	3445290	2.93692E-06	2.76905E-89	3.59533E-89	2.19271E-82	6.49658E-90	1.94115E-90	4.89319E-91	2.93471E-90	1.18618E-89	4.08672E-83	2.60138E-82
2044	41	3444643	2.13594E-06	5.91452E-95	7.67941E-95	4.68262E-88	1.38763E-95	4.14619E-96	1.04516E-96	6.26836E-96	2.5336E-95	8.72735E-89	5.55536E-88
2045	42	3445075	1.55341E-06	9.1877E-101	1.1929E-100	7.27495E-94	2.1556E-101	6.4407E-102	1.6236E-102	9.7373E-102	3.9357E-101	1.35589E-94	8.63084E-94
2046	43	3444967	1.12975E-06	1.038E-106	1.3477E-106	8.2187E-100	2.4353E-107	7.2765E-108	1.8342E-108	1.1001E-107	4.4464E-107	1.5318E-100	9.7504E-100
2047	44	3445003	8.21639E-07	8.5285E-113	1.1073E-112	6.7528E-106	2.0009E-113	5.9786E-114	1.5071E-114	9.0387E-114	3.6533E-113	1.2586E-106	8.0114E-106
2048	45	3444895	5.97556E-07	5.0962E-119	6.617E-119	4.0351E-112	1.1957E-119	3.5726E-120	9.0056E-121	5.4011E-120	2.1831E-119	7.5205E-113	4.7871E-112
2049	46	3445015	4.34586E-07	2.2148E-125	2.8756E-125	1.7536E-118	5.1961E-126	1.5526E-126	3.9137E-127	2.3473E-126	9.4873E-126	3.2684E-119	2.0805E-118
2050	47	3444955	3.16063E-07	7E-132	9.0888E-132	5.5425E-125	1.6423E-132	4.9071E-133	1.237E-133	7.4188E-133	2.9986E-132	1.033E-125	6.5755E-125
						127,125,011.70						**23,693,236.03**	**150,818,247.73**

NOTE:
NPV has been calculated for the time horizons under review
The 3 period moving average =(y1+y2+Y3)/3
The prevalence rate has been forecasted using the 3 period moving average
A=Malaria Prevalence rate under the B-A-U scenario
B= Direct cost of malaria to household
C= Indirect cost of malaria to household
D= Cost of treating an episode of malaria per public facility
E=Compensation to a health personell per malaria episode treated
F=
G= Malaria-specific expenditure
Discount rate of 37.5% is used = Discount factor(1/1+0.375)^n

APPENDIX 12: CLIMATE CHANGE SCENARIO FOR MALARIA TREATMENT (US$ 2003 CONSTANT) – COST OF ADAPTATION MEASURES

Cost of Malaria per Episode (2003 US Dollars)

5% Reduction i	Year	Discount period	Malaria Pre. Rate (A)	Disc. Factor	Household Direct (B)	Indirect (C)	Total (Discounted)	Government Direct Facility (D)	Personnel (E)	Treatment (Ex	M-Specific Exp	T. Direct (Discounted)	Total Discounted (c)	Grand Total (d)
3375251	2003	0	3552896	1	6.87	8.92	53295216.45	1.6118	0.4816	0.1214	0.7281	2.9429	9933026.756	**63,228,243.20**
3245231	2004	1	3416033	0.727272727	4.996363636	6.487272727	37267056.74	1.172218182	0.350254545	0.088290909	0.529527273	2.140290909	6945739.156	44212795.9
3280302	2005	2	3452949	0.52892562	2.642704733	3.431284748	19924517.11	0.620016228	0.185258603	0.046699324	0.280080541	1.132054696	3713480.773	23637997.88
3335879	2006	3	3511452	0.384673178	1.016577628	1.319923209	7794285.012	0.238503613	0.071264015	0.017963977	0.107739472	0.435471078	1452678.997	9246964.008
3300261	2007	4	3473959.333	0.279762311	0.284400107	0.369264768	2157264.933	0.066724322	0.019936986	0.005025644	0.030141444	0.121828395	402065.5459	2559330.479
3287137	2008	5	3460144.667	0.203463499	0.057865041	0.075131902	437179.2288	0.013575964	0.004056449	0.001022535	0.006132684	0.024787632	81480.35163	518659.5804
3305481	2009	6	3479453.444	0.147973454	0.00856249	0.011117527	65051.91768	0.002008882	0.000600247	0.000151308	0.000907474	0.003667911	12124.2108	77176.12848
3307759	2010	7	3481852	0.107617057	0.00092147	0.001196436	7005.521877	0.00021619	6.45968E-05	1.62833E-05	9.76597E-05	0.00039473	1305.671332	8311.193209
3297627	2011	8	3471185.815	0.078266951	7.21206E-05	9.36414E-05	546.6211905	1.69205E-05	5.05579E-06	1.27445E-06	7.64353E-06	3.08943E-05	101.8778658	648.4990563
3300126	2012	9	3473816.704	0.056921419	4.10521E-06	5.3302E-06	31.13803604	9.63141E-07	2.87783E-07	7.25433E-08	4.3508E-07	1.75855E-06	5.803427882	36.94146392
3303622	2013	10	3477497.086	0.041397395	1.69945E-07	2.20656E-07	1.290399277	3.98715E-08	1.19135E-08	3.0031E-09	1.80112E-08	7.27993E-08	0.240501332	1.530900609
3301837	2014	11	3475618.173	0.030107197	5.11657E-09	6.64334E-09	0.038829314	1.20042E-09	3.58681E-10	9.0415E-11	5.42267E-10	2.19178E-09	0.007236909	0.046066222
3300458	2015	12	3474166.535	0.021896143	1.12033E-10	1.45464E-10	0.000849857	2.62846E-11	7.85373E-12	1.97974E-12	1.18735E-11	4.79916E-11	0.000158394	0.001008251
3301862	2016	13	3475643.988	0.015924468	1.78407E-12	2.31643E-12	1.35393E-05	4.18568E-13	1.25066E-13	3.15263E-14	1.8908E-13	7.6424E-13	2.52342E-06	1.60627E-05
3301973	2017	14	3475760.598	0.011581431	2.06621E-14	2.68276E-14	1.56809E-07	4.84761E-15	1.44845E-15	3.6512E-16	2.18982E-15	8.851E-15	2.92257E-08	1.86035E-07
3301386	2018	15	3475142.898	0.008422859	1.74034E-16	2.25965E-16	1.32055E-09	4.08308E-17	1.22001E-17	3.07535E-18	1.84445E-17	7.45507E-17	2.46121E-10	1.56667E-09
3301431	2019	16	3475190.374	0.006125716	1.06608E-18	1.3842E-18	8.08942E-12	2.50118E-19	7.47342E-20	1.88387E-20	1.12986E-19	4.56676E-19	1.50769E-12	9.59711E-12
3301740	2020	17	3475515.828	0.004455066	4.74946E-21	6.16669E-21	3.60423E-14	1.11429E-21	3.32946E-22	8.39278E-23	5.03359E-22	2.03452E-21	6.71747E-15	4.27597E-14
							120,948,156.00						**22,542,009.39**	**143,490,165.39**
3301596	2021	18	3475364.623	0.003240048	15.87747151	20.61529052	120484371.4	3.725081306	1.113040797	0.280571331	1.682734644	6.801428078	22455570.41	142939941.8
3301519	2022	19	3475283.033	0.002356398	0.03741365	0.048577839	283902.5251	0.008777776	0.002622768	0.000661138	0.003965193	0.016026875	52913.02983	336815.5549
3301589	2023	20	3475356.942	0.001713744	6.41174E-05	8.325E-05	486.5466962	1.50429E-05	4.49475E-06	1.13302E-06	6.79533E-06	2.7466E-05	90.68133452	577.2280307
3301618	2024	21	3475387.828	0.00124636	7.99134E-08	1.03759E-07	0.606417501	1.87488E-08	5.60208E-09	1.41215E-09	8.46942E-09	3.42325E-08	0.11302255	0.71944005
3301568	2025	22	3475334.866	0.000906443	7.24369E-11	9.4052E-11	0.000549675	1.69947E-11	5.07797E-12	1.28004E-12	7.67705E-12	3.10298E-11	0.000102447	0.000652122
3301575	2026	23	3475342.601	0.000659231	4.77527E-14	6.20021E-14	3.62364E-07	1.12035E-14	3.34756E-15	8.4384E-16	5.06095E-15	2.04558E-14	6.75364E-08	4.299E-07
3301592	2027	24	3475359.879	0.000479441	2.28946E-17	2.97263E-17	1.73733E-10	5.3714E-18	1.60496E-18	4.04571E-19	2.42643E-18	9.80736E-18	3.23799E-11	2.06113E-10
3301587	2028	25	3475355.099	0.000348684	7.98299E-21	1.03651E-20	6.05779E-14	1.87292E-21	5.59623E-22	1.41068E-22	8.46058E-22	3.41967E-21	1.12903E-14	7.18682E-14
3301578	2029	26	3475345.782	0.000253589	2.0244E-24	2.62847E-24	1.53618E-17	4.74952E-25	1.41914E-25	3.57732E-26	2.14551E-25	8.6719E-25	2.8631E-18	1.82249E-17
3301585	2030	27	3475352.526	0.000184428	3.73356E-28	4.84765E-28	2.83316E-21	8.75946E-29	2.61729E-29	6.59758E-30	3.95692E-29	1.59934E-28	5.28037E-22	3.36119E-21
3288405	2031	28	3461478.5	0.00013413	5.0078E-32	6.50213E-32	3.78493E-25	1.1749E-32	3.51056E-33	8.84931E-34	5.3074E-33	2.14519E-32	7.05426E-26	4.49036E-25
3280100	2032	29	3452736.9	9.75488E-05	4.88505E-36	6.34274E-36	3.68283E-29	1.1461E-36	3.42451E-37	8.63239E-38	5.1773E-37	2.09261E-36	6.86396E-30	4.36922E-29
3271796	2033	30	3443995.3	7.09446E-05	3.46568E-40	4.49983E-40	2.60615E-33	8.13097E-41	2.42951E-41	6.12421E-42	3.67301E-41	1.48459E-40	4.85728E-34	3.09188E-33
3263491	2034	31	3435253.7	5.1596E-05	1.78815E-44	2.32173E-44	1.34126E-37	4.19526E-45	1.25353E-45	3.15985E-46	1.89513E-45	7.6599E-45	2.4998E-38	1.59124E-37
3280100	2035	32	3452736.9	3.75244E-05	6.70993E-49	8.71217E-49	5.0586E-42	1.57425E-49	4.70379E-50	1.18571E-50	7.11136E-50	2.87433E-49	9.4281E-43	6.00141E-42
3271796	2036	33	3443995.3	2.72905E-05	1.83117E-53	2.37759E-53	1.37702E-46	4.29619E-54	1.28369E-54	3.23587E-55	1.94072E-54	7.84418E-54	2.56646E-47	1.63367E-46
3271796	2037	34	3443995.3	1.98476E-05	3.63444E-58	4.71895E-58	2.73306E-51	8.52691E-59	2.54781E-59	6.42243E-60	3.85187E-59	1.55688E-58	5.0938E-52	3.24244E-51
3271796	2038	35	3443995.3	1.44346E-05	5.24618E-63	6.81163E-63	3.94507E-56	1.23083E-63	3.67767E-64	9.27054E-65	5.56003E-64	2.2473E-63	7.35272E-57	4.68034E-56
3274564	2039	36	3446909.167	1.04979E-05	5.50739E-68	7.15079E-68	4.145E-61	1.29211E-68	3.86078E-69	9.73213E-70	5.83687E-69	2.3592E-68	7.72535E-62	4.91754E-61
3271796	2040	37	3443995.3	7.63484E-06	4.20481E-73	5.45951E-73	3.16197E-66	9.86507E-74	2.94765E-74	7.43033E-75	4.45636E-74	1.80121E-73	5.8932E-67	3.75129E-66
3272718	2041	38	3444966.589	5.55261E-06	2.33477E-78	3.03146E-78	1.75621E-71	5.47769E-79	1.63672E-79	4.12577E-80	2.47444E-79	1.00014E-78	3.27319E-72	2.08353E-71
3272718	2042	39	3444966.589	4.03826E-06	9.4284E-84	1.22418E-83	7.09206E-77	2.21204E-84	6.60949E-85	1.6661E-85	9.99246E-85	4.03884E-84	1.3218E-77	8.41386E-77
3273026	2043	40	3445290.352	2.93692E-06	2.76905E-89	3.59533E-89	2.08308E-82	6.49658E-90	1.94115E-90	4.89319E-91	2.93471E-90	1.18618E-89	3.88238E-83	2.47131E-82
3272411	2044	41	3444642.826	2.13594E-06	5.91452E-95	7.67941E-95	4.44849E-88	1.38763E-95	4.14619E-96	1.04516E-96	6.26836E-96	2.5336E-95	8.29099E-89	5.27759E-88
3272821	2045	42	3445074.51	1.55341E-06	9.1877E-101	1.1929E-100	6.91121E-94	2.1556E-101	6.4407E-102	1.6236E-102	9.7373E-102	3.9357E-101	1.28809E-94	8.1993E-94
3272718	2046	43	3444966.589	1.12975E-06	1.038E-106	1.3477E-106	7.8077E-100	2.4353E-107	7.2765E-108	1.8342E-108	1.1001E-107	4.4464E-107	1.4552E-100	9.2629E-100
3272752	2047	44	3445002.563	8.21639E-07	8.5285E-113	1.1073E-112	6.4152E-106	2.0009E-113	5.9786E-114	1.5071E-114	9.0387E-114	3.6533E-113	1.1956E-106	7.6108E-106
3272650	2048	45	3444894.642	5.97556E-07	5.0962E-119	6.617E-119	3.8333E-112	1.1957E-119	3.5726E-120	9.0056E-121	5.4011E-120	2.1831E-119	7.1444E-113	4.5478E-112
3272764	2049	46	3445014.554	4.34586E-07	2.2148E-125	2.8756E-125	1.666E-118	5.1961E-126	1.5526E-126	3.9137E-127	2.3473E-126	9.4873E-126	3.105E-119	1.9765E-118
3272707	2050	47	3444954.598	3.16063E-07	7E-132	9.0888E-132	5.2654E-125	1.6423E-132	4.9071E-133	1.237E-133	7.4188E-133	2.9986E-132	9.8135E-126	6.2468E-125
							120,768,761.11					**6.82**	**22,508,574.23**	**143,277,335.34**

NOTE:
NPV has been calculated for the time horizons under review
The 3 period moving average =(y1+y2+Y3)/3
The prevalence rate has been forecasted using the 3 period moving average
A=Malaria Prevalence rate under the B-A-U scenario
B= Direct cost of malaria to household
C= Indirect cost of malaria to household
D= Cost of treating an episode of malaria per public facility
E=Compensation to a health personell per malaria episode treated
F=
G= Malaria-specific expenditure
Discount rate of 37.5% is used = Discount factor(1/1+0.375)^n
CC Scenario = 5% reduction in annual prevalence rate of Malaria

APPENDIX 13: B-A-U SCENARIO FOR THE MINISTRY OF FOOD AND AGRICULTURE (2006 US DOLLAR CONSTANT) – COST OF ADAPTATION MEASURES

Agriculture Sector (2006 US $)

				GOG Discretionary + Statutory						IGF + Donor						HIPC								
Discount period	Year	GHG emissi	Disc factor	A	B	C	D	E	Disc. Subtotal	A	B	C	D	E	Disc. Subtotal	A	B	C	D	E	Disc. Subtotal	Disc. Grand total	Incremental cost for adaptation	Cost of adaptation
0	2006	6167	1	1005099805	666187472.9	3886.9641	70028649	198058142.1	1939377956	34702338.67	764215829.4	1829.79645	1435545.691	4295441.75	804650985.3	84993.5	98659051.54	0	0	49231268.9	147975314	2892004255	468965.2132	2,892,473,220.30
1	2007	6184	0.7272727	730981676.4	484499980.3	2826.8829	50929926	144042285.1	1410456695	25238064.49	555793330.4	1330.76105	1044033.23	3123957.636	585200716.6	61813.46	71752037.48	0	0	35804559.2	107618410.2	2103275822	340097.4217	
2	2008	6204	0.5289256	386634936.3	256264452.4	1495.2108	26938143	76187654.94	746026681.7	13349058.9	293973331.8	703.873615	552215.9231	1652341.229	309527651.7	32694.72	37951490.9	0	0	18937948.7	56922134.31	1112476468	179323.4944	
3	2009	6195	0.3846732	148728089.7	98578061.33	575.1675	10362381	29307347.36	286976454.6	5135024.913	113083655.8	270.7613	212422.6541	635611.3518	119066985.5	12576.78	14598920.62	0	0	7284920.91	21896418.31	427939858.4	69080.33108	
4	2010	6187	0.2797623	41608514.13	27578426.28	160.91019	2899004	8199091.235	80285196.23	1436586.438	31636544.92	75.7488072	59427.85269	177820.1009	33310455.06	3518.51	4084227.774	0	0	2038046.31	6125792.595	119721443.9	19350.36806	
5	2011	6164	0.2034635	8465813.879	5611203.112	32.73935	589841.4	1668215.792	16335106.95	292292.9035	6436882.131	15.4121174	12091.39886	36179.89994	6777461.745	715.8883	830991.2743	0	0	414668.034	1246375.196	24358943.89	3951.736667	
6	2012	6175	0.1479735	1252715.72	830309.1052	4.8445547	87280.87	246851.6527	2417162.196	43251.59049	952487.6813	2.28058424	1789.206051	5353.664757	1002884.423	105.9325	122964.649	0	0	61359.8612	184430.4427	3604477.062	583.7069776	
7	2013	6185	0.1076171	134813.5795	89355.42263	0.5213567	9392.911	26565.44848	260127.8828	4654.608897	102503.9215	0.24542977	192.5490903	576.1456474	107927.4705	11.40014	13233.09369	0	0	6603.3677	19847.86154	387903.2149	62.71726952	
8	2014	6194	0.078267	10551.4478	6993.576469	0.040805	735.1545	2079.19665	20359.41621	364.3020457	8022.669382	0.01920904	15.07023019	45.09316306	8447.15403	0.892254	1035.713893	0	0	516.825455	1553.431603	30360.00185	4.901283438	
9	2015	6195	0.0569214	600.6033791	398.084295	0.0023227	41.84604	118.3508232	1158.886857	20.73658931	456.6617237	0.00109341	0.857818884	2.566766819	480.8239921	0.050788	58.95430427	0	0	29.4184382	88.42353083	1728.134379	0.278947422	
10	2016	6182	0.0413974	24.86341561	16.479653	9.615E-05	1.732317	4.899415836	47.97489752	0.858440788	18.90460598	4.5264E-05	0.035511468	0.106257461	19.90486096	0.002103	2.440554649	0	0	1.21784672	3.660503876	71.54026235	0.011572372	
11	2017	6175	0.0301072	0.748567745	0.496156155	2.895E-06	0.052155	0.147507676	1.444389677	0.025845246	0.569164691	1.3628E-06	0.001069151	0.003199114	0.599279564	6.33E-05	0.073478259	0	0	0.03666595	0.11020751	2.153876752	0.000348782	
12	2018	6175	0.0218961	0.016390746	0.010863906	6.339E-08	0.001142	0.003229849	0.031626563	0.000565911	0.012462512	2.984E-08	2.34103E-05	7.00483E-05	0.013121911	1.39E-06	0.00160889	0	0	0.00080284	0.002413119	0.047161593	7.63783E-06	
13	2019	6185	0.0159245	0.000261014	0.000173002	1.009E-09	1.82E-05	5.14336E-05	0.000503636	9.01183E-06	0.000198459	4.7518E-10	3.72796E-07	1.11548E-06	0.000208959	2.21E-08	2.56207E-05	0	0	1.2785E-05	3.84276E-05	0.000751023	1.21431E-07	
14	2020	6191	0.0115814	3.02291E-06	2.00361E-06	1.169E-11	2.11E-07	5.95675E-07	5.83283E-06	1.0437E-07	2.29844E-06	5.5033E-12	4.31751E-09	1.29189E-08	2.42005E-06	2.56E-10	2.96725E-07	0	0	1.4807E-07	4.45047E-07	8.69792E-06	1.40482E-09	
									4,482,156,948.29						1,859,654,016.26						341,990,368.50	6,683,801,333.06	1,081,420.18	6,684,882,753.24
15	2021	6190	0.0084229	2322917543	1539646670	8983.284	1.62E+08	457738356.2	4482156948	80201658.45	1766203065	4228.89971	3317734.469	9927329.547	1859654016	196431.1	228014014.5	0	0	113779923	341990368.5	6683801333	1079687.909	
16	2022	6184	0.0061257	14229532.21	9431437.611	55.029043	991418.9	2803974.986	27456418.71	491292.5497	10819257.65	25.9050369	20323.49777	60811.9974	11391711.6	1203.281	1396749.004	0	0	696983.448	2094935.733	40943066.05	6620.585994	
17	2023	6177	0.0044551	63393.50352	42017.67595	0.245158	4416.836	12491.8933	122320.1543	2188.740678	48200.50569	0.11540865	90.54252159	270.9214551	50750.82575	5.360697	6222.608839	0	0	3105.10718	9333.076716	182404.0568	29.52771168	
18	2024	6178	0.00324	205.397989	136.1392834	0.0007943	14.31076	40.47433288	396.3231612	7.091624675	156.171948	0.00037393	0.293362108	0.877798496	164.4351072	0.017369	20.16155081	0	0	10.0606961	30.23961577	590.9978842	0.095656693	
19	2025	6184	0.0023564	0.48399951	0.320798401	1.872E-06	0.033722	0.095373657	0.933895297	0.016710694	0.368003342	8.8113E-07	0.000691278	0.002068443	0.387474638	4.09E-05	0.047508648	0	0	0.02370701	0.071256585	1.392626519	0.00022521	
20	2026	6189	0.0017137	0.000829451	0.000549766	3.208E-09	5.78E-05	0.000163446	0.001600458	2.86379E-05	0.000630664	1.51E-09	1.18467E-06	3.54478E-06	0.000664032	7.01E-08	8.14177E-05	0	0	4.0628E-05	0.000122116	0.002386606	3.85625E-07	
21	2027	6189	0.0012464	1.03379E-06	6.85207E-07	3.998E-12	7.2E-08	2.03713E-07	1.99475E-06	3.56931E-08	7.86034E-07	1.882E-12	1.47653E-09	4.41807E-09	8.27623E-07	8.74E-11	1.01476E-07	0	0	5.0637E-08	1.522E-07	2.97457E-06	4.80643E-10	
22	2028	6184	0.0009064	9.37076E-10	6.21101E-10	3.624E-15	6.53E-11	1.84654E-10	1.80812E-09	3.23537E-11	7.12495E-10	1.706E-15	1.33839E-12	4.00473E-12	7.50193E-10	7.92E-14	9.1982E-11	0	0	4.5899E-11	1.37961E-10	2.69628E-09	4.36007E-13	
23	2029	6180	0.0006592	6.1775E-13	4.09449E-13	2.389E-18	4.3E-14	1.2173E-13	1.19197E-12	2.13286E-14	4.69699E-13	1.1246E-18	8.82309E-16	2.64005E-15	4.94551E-13	5.22E-17	6.06374E-14	0	0	3.0258E-14	9.0948E-14	1.77747E-12	2.87618E-16	
24	2030	6180	0.0004794	2.96175E-16	1.96307E-16	1.145E-21	2.06E-17	5.83622E-17	5.7148E-16	1.02258E-17	2.25193E-16	5.3919E-22	4.23015E-19	1.26575E-18	2.37108E-16	2.5E-20	2.90721E-17	0	0	1.4507E-17	4.36042E-17	8.52193E-16	1.379E-19	
25	2031	6184	0.0003487	1.03272E-19	6.84491E-20	3.994E-25	7.2E-21	2.035E-20	1.99266E-19	3.56558E-21	7.85213E-20	1.8801E-25	1.47499E-22	4.41346E-22	8.26759E-20	8.73E-24	1.0137E-20	0	0	5.0584E-21	1.52041E-20	2.97146E-19	4.80536E-23	
26	2032	6187	0.0002536	2.61885E-23	1.73579E-23	1.013E-28	1.82E-24	5.16053E-24	5.05317E-23	9.04191E-25	1.99121E-23	4.7676E-29	3.7404E-26	1.1192E-25	2.09657E-23	2.21E-27	2.57062E-24	0	0	1.2828E-24	3.85559E-24	7.53529E-23	1.2179E-26	
27	2033	6187	0.0001844	4.82989E-27	3.20129E-27	1.868E-32	3.37E-28	9.51746E-28	9.31946E-27	1.66758E-28	3.67235E-27	8.7929E-33	6.89835E-30	2.06413E-29	3.86666E-27	4.08E-31	4.74095E-28	0	0	2.3658E-28	7.11079E-28	1.38972E-26	2.24611E-30	
28	2034	6184	0.0001341	6.47832E-31	4.29387E-31	2.505E-36	4.51E-32	1.27657E-31	1.25002E-30	2.23672E-32	4.92571E-31	1.1794E-36	9.25273E-34	2.7686E-33	5.18633E-31	5.48E-35	6.35902E-32	0	0	3.1732E-32	9.53767E-32	1.86403E-30	3.01415E-34	
29	2035	6181	9.755E-05	6.31952E-35	4.18862E-35	2.444E-40	4.4E-36	1.24528E-35	1.21937E-34	2.18189E-36	4.80497E-35	1.1505E-40	9.02592E-38	2.70074E-37	5.0592E-35	5.34E-39	6.20314E-36	0	0	3.0954E-36	9.30388E-36	1.81833E-34	2.94169E-38	
30	2036	6181	7.094E-05	4.48335E-39	2.9716E-39	1.734E-44	3.12E-40	8.83459E-40	8.6508E-39	1.54793E-40	3.40886E-39	8.162E-45	6.4034E-42	1.91603E-41	3.58923E-39	3.79E-43	4.40079E-40	0	0	2.196E-40	6.60059E-40	1.29001E-38	2.08701E-42	
31	2037	6184	5.16E-05	2.31323E-43	1.53323E-43	8.946E-49	1.61E-44	4.5583E-44	4.46347E-43	7.98673E-45	1.75884E-43	4.2113E-49	3.3039E-46	9.88594E-46	1.8519E-43	1.96E-47	2.27063E-44	0	0	1.1331E-44	3.40564E-44	6.65593E-43	1.0764E-46	
32	2038	6186	3.752E-05	8.68026E-48	5.75334E-48	3.357E-53	6.05E-49	1.71047E-48	1.67489E-47	2.99697E-49	6.59994E-48	1.5803E-53	1.23977E-50	3.70964E-50	6.94914E-48	7.34E-52	8.52041E-49	0	0	4.2517E-49	1.27795E-48	2.4976E-47	4.03751E-51	
33	2039	6186	2.729E-05	2.36888E-52	1.57011E-52	9.161E-58	1.65E-53	4.66796E-53	4.57085E-52	8.17887E-54	1.80115E-52	4.3126E-58	3.38339E-55	1.01238E-54	1.89645E-52	2E-56	2.32526E-53	0	0	1.1603E-53	3.48758E-53	6.81606E-52	1.10182E-55	
34	2040	6184	1.985E-05	4.70167E-57	3.1163E-57	1.818E-62	3.28E-58	9.26479E-58	9.07205E-57	1.62331E-58	3.57486E-57	8.5594E-63	6.71522E-60	2.00933E-59	3.76401E-57	3.98E-61	4.61509E-58	0	0	2.3029E-58	6.92201E-58	1.35283E-56	2.18754E-60	
35	2041	6182	1.443E-05	6.78669E-62	4.49826E-62	2.625E-67	4.73E-63	1.33734E-62	1.30952E-61	2.34319E-63	5.16018E-62	1.2355E-67	9.69316E-65	2.90039E-64	5.4332E-62	5.74E-66	6.66171E-63	0	0	3.3242E-63	9.99166E-63	1.95275E-61	3.15866E-65	
36	2042	6182	1.05E-05	7.1246E-67	4.72224E-67	2.755E-72	4.96E-68	1.40393E-67	1.37472E-66	2.45986E-68	5.41711E-67	1.297E-72	1.01758E-69	3.0448E-69	5.70373E-67	6.02E-71	6.9934E-68	0	0	3.4897E-68	1.04892E-67	2.04998E-66	3.31607E-70	
37	2043	6184	7.635E-06	5.43952E-72	3.60536E-72	2.104E-77	3.79E-73	1.07188E-72	1.04958E-71	1.87806E-73	4.13588E-72	9.9027E-78	7.76906E-75	2.32466E-74	4.35471E-72	4.6E-76	5.33935E-73	0	0	2.6644E-73	8.00831E-73	1.56513E-71	2.53112E-75	
38	2044	6185	5.553E-06	3.02036E-77	2.00191E-77	1.168E-82	2.1E-78	5.95171E-78	5.82789E-77	1.04282E-78	2.29649E-77	5.4986E-83	4.31386E-80	1.29079E-79	2.418E-77	2.55E-81	2.96474E-78	0	0	1.4794E-78	4.4467E-78	8.69056E-77	1.40505E-80	
39	2045	6185	4.038E-06	1.2197E-82	8.08426E-83	4.717E-88	8.5E-84	2.40346E-83	2.35346E-82	4.21117E-84	9.27385E-83	2.2205E-88	1.74205E-85	5.21257E-85	9.76453E-83	1.03E-86	1.19724E-83	0	0	5.9743E-84	1.7957E-83	3.50948E-82	5.67374E-86	
40	2046	6184	2.937E-06	3.58216E-88	2.37428E-88	1.385E-93	2.5E-89	7.05876E-89	6.91191E-88	1.23679E-89	2.72365E-88	6.5214E-94	5.11626E-91	1.53089E-90	2.86776E-88	3.03E-92	3.51619E-89	0	0	1.7546E-89	5.27382E-89	1.03071E-87	1.66667E-91	
41	2047	6183	2.136E-06	7.65129E-94	5.07133E-94	2.96E-99	5.33E-95	1.50771E-94	1.47634E-93	2.6417E-95	5.81757E-94	1.393E-99	1.0928E-96	3.26989E-96	6.12538E-94	6.47E-98	7.51038E-95	0	0	3.7477E-95	1.12646E-94	2.20153E-93	3.56072E-97	
42	2048	6183	1.553E-06	1.1886E-99	7.8779E-100	4.6E-105	8.3E-101	2.3421E-100	2.2934E-99	4.1037E-101	9.0371E-100	2.164E-105	1.6976E-102	5.0795E-102	9.5152E-100	1E-103	1.1667E-100	0	0	5.822E-101	1.7499E-100	3.4199E-99	5.5315E-103	
43	2049	6184	1.13E-06	1.3428E-105	8.9E-106	5.19E-111	9.4E-107	2.646E-106	2.5909E-105	4.6361E-107	1.021E-105	2.445E-111	1.9178E-108	5.7386E-108	1.075E-105	1.1E-109	1.3181E-106	0	0	6.577E-107	1.9769E-106	3.8636E-105	6.2482E-109	
44	2050	6185	8.216E-07	1.1033E-111	7.3126E-112	4.27E-117	7.7E-113	2.1741E-112	2.1288E-111	3.8092E-113	8.3887E-112	2.009E-117	1.5758E-114	4.715E-114	8.8325E-112	9.3E-116	1.083E-112	0	0	5.404E-113	1.6243E-112	3.1745E-111	5.1328E-115	
																					344,094,667.62	6,724,927,395.55	1,086,338.12	6,726,013,733.67

Note: Average inter bank rate for 2006 (G 0.9236

A=Compenstion to employees, B =Use of goods, C= Consumption of fixed capital, D= Social benefits E= Other expenditure

Source: Government of Ghana budgetary allocation to the Minstry of Food and Agriculture in 2006

A=Compensation to employees, B =Use of goods, C= Consumption of fixed capital, D= Social benefits E= Other expenditure

Source: Government of Ghana budgetary allocation to the Ministry of Food and Agriculture in 2006

APPENDIX 14: CLIMATE CHANGE SCENARIO FOR THE MINISTRY OF FOOD AND AGRICULTURE (US$ 2006 CONSTANT) – COST OF ADAPTATION MEASURES

Agriculture Sector (2006 US $)

					GOG Discretionary + Statutory						IGF + Donor						HIPC									
Discount period	Year	GHG emissi	CC Scenario	Disc facto	A	B	C	D	E	Disc. Subtotal	A	B	C	D	E	Disc. Subtotal	A	B	C	D	E	Disc. Subtotal	Disc. Grand total	5% reduction	Incremental cost for	Cost of adaptation
0	2006	6167	6475	1	1005099805	666187472.9	3886.9641	70028648.77	198058142.1	**1939377956**	34702338.67	764215829.4	1829.79645	1435545.691	4295441.75	**804650985.3**	84993.5	98659051.54	0	0	49231268.95	**147975314**	**2892004255**	**2747404042**	446633.5363	**2,747,850,675.87**
1	2007	6184	6494	0.72727	730981676	484499980.3	2826.8829	50929926.38	144042285.1	**1410456695**	25238064.49	555793330.4	1330.76105	1044033.23	3123957.636	**585200716.6**	61813.46	71752037.48	0	0	35804559.23	**107618410.2**	**2103275822**	**1998112031**	323902.3064	
2	2008	6204	6514	0.52893	386634936	256264452.4	1495.2108	26938142.88	76187654.94	**746026681.7**	13349058.9	293973331.8	703.873615	552215.9231	1652341.229	**309527651.7**	32694.72	37951490.9	0	0	18937948.69	**56922134.31**	**1112476468**	**1056852644**	170784.2803	
3	2009	6195	6505	0.38467	148728090	98578061.33	575.1675	10362381.03	29307347.36	**286976454.6**	5135024.913	113083655.8	270.7613	212422.6541	635611.3518	**119066985.5**	12576.78	14598920.62	0	0	7284920.907	**21896418.31**	**427939858.4**	**406542865.5**	65790.7915	
4	2010	6187	6496	0.27976	41608514.1	27578426.28	160.91019	2899003.668	8199091.235	**80285196.23**	1436586.438	31636544.92	75.7488072	59427.85269	177820.1009	**33310455.06**	3518.51	4084227.774	0	0	2038046.311	**6125792.595**	**119721443.9**	**113735371.7**	18428.92196	
5	2011	6164	6472	0.20346	8465813.88	5611203.112	32.73935	589841.4303	1668215.792	**16335106.95**	292292.9035	6436882.131	15.4121174	12091.39886	36179.89994	**6777461.745**	715.8883	830991.2743	0	0	414668.0338	**1246375.196**	**24358943.89**	**23140996.7**	3763.55873	
6	2012	6175	6484	0.14797	1252715.72	830309.1052	4.8445547	87280.87371	246851.6527	**2417162.196**	43251.59049	952487.6813	2.28058424	1789.206051	5353.664757	**1002884.423**	105.9325	122964.649	0	0	61359.86119	**184430.4427**	**3604477.062**	**3424253.209**	555.9114073	
7	2013	6185	6494	0.10762	134813.58	89355.42263	0.5213567	9392.910796	26565.44848	**260127.8828**	4654.608897	102503.9215	0.24542977	192.5490903	576.1456474	**107927.4705**	11.40014	13233.09369	0	0	6603.367704	**19847.86154**	**387903.2149**	**368508.0541**	59.73073288	
8	2014	6194	6504	0.07827	10551.4478	6993.576469	0.040805	735.1544874	2079.19665	**20359.41621**	364.3020457	8022.669382	0.01920904	15.07023019	45.09316306	**8447.15403**	0.892254	1035.713893	0	0	516.8254554	**1553.431603**	**30360.00185**	**28842.00175**	4.667888988	
9	2015	6195	6505	0.05692	600.603379	398.084295	0.0023227	41.84603645	118.3508232	**1158.886857**	20.73658931	456.6617237	0.00109341	0.857818884	2.566766819	**480.8239921**	0.050788	58.95430427	0	0	29.41843819	**88.42353083**	**1728.134379**	**1641.72766**	0.265664211	
10	2016	6182	6491	0.0414	24.8634156	16.479653	9.615E-05	1.73231692	4.899415836	**47.97489752**	0.858440788	18.90460598	4.5264E-05	0.035511468	0.106257461	**19.90486096**	0.002103	2.440554649	0	0	1.21784672	**3.660503876**	**71.54026235**	**67.96324924**	0.011021307	
11	2017	6175	6484	0.03011	0.74856774	0.496156155	2.895E-06	0.052155206	0.147507676	**1.444389677**	0.025845246	0.569164691	1.3628E-06	0.001069151	0.003199114	**0.599279564**	6.33E-05	0.073478259	0	0	0.036665951	**0.11020751**	**2.153876752**	**2.046182914**	0.000332173	
12	2018	6175	6483	0.0219	0.01639075	0.010863906	6.339E-08	0.001141998	0.003229849	**0.031626563**	0.000565911	0.012462512	2.984E-08	2.34103E-05	7.00483E-05	**0.013121911**	1.39E-06	0.00160889	0	0	0.000802843	**0.002413119**	**0.047161593**	**0.044803514**	7.27412E-06	
13	2019	6185	6494	0.01592	0.00026101	0.000173002	1.009E-09	1.81857E-05	5.14336E-05	**0.000503636**	9.01183E-06	0.000198459	4.7518E-10	3.72796E-07	1.11548E-06	**0.000208959**	2.21E-08	2.56207E-05	0	0	1.27848E-05	**3.84276E-05**	**0.000751023**	**0.000713472**	1.15648E-07	
14	2020	6191	6501	0.01158	3.0229E-06	2.00361E-06	1.169E-11	2.10617E-07	5.95675E-07	**5.83283E-06**	1.0437E-07	2.29844E-06	5.5033E-12	4.31751E-09	1.29189E-08	**2.42005E-06**	2.56E-10	2.96725E-07	0	0	1.48067E-07	**4.45047E-07**	**8.69792E-06**	**8.26303E-06**	1.33792E-09	
										4,482,156,948.29						**1,859,654,016.26**						**341,990,368.50**	**6,683,801,333.06**	**6,349,611,266.40**	**1,029,923.98**	**6,350,641,190.39**
15	2021	6190	6500	0.00842	2322917543	1539646670	8983.284	161845396.7	457738356.2	**4482156948**	80201658.45	1766203065	4228.89971	3317734.469	9927329.547	**1859654016**	196431.1	228014014.5	0	0	113779922.8	**341990368.5**	**6683801333**	**6349611266**	1028274.199	
16	2022	6184	6493	0.00613	14229532.2	9431437.611	55.029043	991418.8703	2803974.986	**27456418.71**	491292.5497	10819257.65	25.9050369	20323.49777	60811.9974	**11391711.6**	1203.281	1396749.004	0	0	696983.4475	**2094935.733**	**40943066.05**	**38895912.74**	6305.319994	
17	2023	6177	6486	0.00446	63393.5035	42017.67595	0.245158	4416.836387	12491.8933	**122320.1543**	2188.740678	48200.50569	0.11540865	90.54252159	270.9214551	**50750.82575**	5.360697	6222.608839	0	0	3105.10718	**9333.076716**	**182404.0568**	**173283.854**	28.12163017	
18	2024	6178	6487	0.00324	205.397989	136.1392834	0.0007943	14.31076154	40.47433288	**396.3231612**	7.091624675	156.171948	0.00037393	0.293362108	0.877798496	**164.4351072**	0.017369	20.16155081	0	0	10.06069605	**30.23961577**	**590.9978842**	**561.44799**	0.091101612	
19	2025	6184	6493	0.00236	0.48399951	0.320798401	1.872E-06	0.033721857	0.095373657	**0.933895297**	0.016710694	0.368003342	8.8113E-07	0.000691278	0.002068443	**0.387474638**	4.09E-05	0.047508648	0	0	0.023707009	**0.071256585**	**1.392626519**	**1.322995193**	0.000214486	
20	2026	6189	6498	0.00171	0.00082945	0.000549766	3.208E-09	5.77906E-05	0.000163446	**0.001600458**	2.86379E-05	0.000630664	1.51E-09	1.18467E-06	3.54478E-06	**0.000664032**	7.01E-08	8.14177E-05	0	0	4.06278E-05	**0.000122116**	**0.002386606**	**0.002267276**	3.67262E-07	
21	2027	6189	6498	0.00125	1.0338E-06	6.85207E-07	3.998E-12	7.20279E-08	2.03713E-07	**1.99475E-06**	3.56931E-08	7.86034E-07	1.882E-12	1.47653E-09	4.41807E-09	**8.27623E-07**	8.74E-11	1.01476E-07	0	0	5.06368E-08	**1.522E-07**	**2.97457E-06**	**2.82584E-06**	4.57755E-10	
22	2028	6184	6493	0.00091	9.3708E-10	6.21101E-10	3.624E-15	6.52892E-11	1.84654E-10	**1.80812E-09**	3.23537E-11	7.12495E-10	1.706E-15	1.33839E-12	4.00473E-12	**7.50193E-10**	7.92E-14	9.1982E-11	0	0	4.58994E-11	**1.37961E-10**	**2.69628E-09**	**2.56146E-09**	4.15245E-13	
23	2029	6180	6489	0.00066	6.1775E-13	4.09449E-13	2.389E-18	4.30407E-14	1.2173E-13	**1.19197E-12**	2.13286E-14	4.69699E-13	1.1246E-18	8.82309E-16	2.64005E-15	**4.94551E-13**	5.22E-17	6.06374E-14	0	0	3.02583E-14	**9.0948E-14**	**1.77747E-12**	**1.6886E-12**	2.73922E-16	
24	2030	6180	6489	0.00048	2.9617E-16	1.96307E-16	1.145E-21	2.06355E-17	5.83622E-17	**5.7148E-16**	1.02258E-17	2.25193E-16	5.3919E-22	4.23015E-19	1.26575E-18	**2.37108E-16**	2.5E-20	2.90721E-17	0	0	1.45071E-17	**4.36042E-17**	**8.52193E-16**	**8.09583E-16**	1.31333E-19	
25	2031	6184	6493	0.00035	1.0327E-19	6.84491E-20	3.994E-25	7.19527E-21	2.035E-20	**1.99266E-19**	3.56558E-21	7.85213E-20	1.8801E-25	1.47499E-22	4.41346E-22	**8.26759E-20**	8.73E-24	1.0137E-20	0	0	5.05839E-21	**1.52041E-20**	**2.97146E-19**	**2.82289E-19**	4.57654E-23	
26	2032	6187	6496	0.00025	2.6188E-23	1.73579E-23	1.013E-28	1.82464E-24	5.16053E-24	**5.05317E-23**	9.04191E-25	1.99121E-23	4.7676E-29	3.7404E-26	1.1192E-25	**2.09657E-23**	2.21E-27	2.57062E-24	0	0	1.28275E-24	**3.85559E-24**	**7.53529E-23**	**7.15853E-23**	1.15991E-26	
27	2033	6187	6497	0.00018	4.8299E-27	3.20129E-27	1.868E-32	3.36515E-28	9.51746E-28	**9.31946E-27**	1.66758E-28	3.67235E-27	8.7929E-33	6.89835E-30	2.06413E-29	**3.86666E-27**	4.08E-31	4.74095E-28	0	0	2.36575E-28	**7.11079E-28**	**1.38972E-26**	**1.32023E-26**	2.13915E-30	
28	2034	6184	6493	0.00013	6.4783E-31	4.29387E-31	2.505E-36	4.51366E-32	1.27657E-31	**1.25002E-30**	2.23672E-32	4.92571E-31	1.1794E-36	9.25273E-34	2.7686E-33	**5.18633E-31**	5.48E-35	6.35902E-32	0	0	3.17317E-32	**9.53767E-32**	**1.86403E-30**	**1.77082E-30**	2.87062E-34	
29	2035	6181	6490	9.8E-05	6.3195E-35	4.18862E-35	2.444E-40	4.40302E-36	1.24528E-35	**1.21937E-34**	2.18189E-36	4.80497E-35	1.1505E-40	9.02592E-38	2.70074E-37	**5.0592E-35**	5.34E-39	6.20314E-36	0	0	3.09539E-36	**9.30388E-36**	**1.81833E-34**	**1.72742E-34**	2.80161E-38	
30	2036	6181	6490	7.1E-05	4.4834E-39	2.9716E-39	1.734E-44	3.1237E-40	8.83459E-40	**8.6508E-39**	1.54793E-40	3.40886E-39	8.162E-45	6.4034E-42	1.91603E-41	**3.58923E-39**	3.79E-43	4.40079E-40	0	0	2.19601E-40	**6.60059E-40**	**1.29001E-38**	**1.22551E-38**	1.98763E-42	
31	2037	6184	6493	5.2E-05	2.3132E-43	1.53323E-43	8.946E-49	1.61171E-44	4.5583E-44	**4.46347E-43**	7.98673E-45	1.75884E-43	4.2113E-49	3.3039E-46	9.88594E-46	**1.8519E-43**	1.96E-47	2.27063E-44	0	0	1.13306E-44	**3.40564E-44**	**6.65593E-43**	**6.32314E-43**	1.02514E-46	
32	2038	6186	6495	3.8E-05	8.6803E-48	5.75334E-48	3.357E-53	6.04783E-49	1.71047E-48	**1.67489E-47**	2.99697E-49	6.59994E-48	1.5803E-53	1.23977E-50	3.70964E-50	**6.94914E-48**	7.34E-52	8.52041E-49	0	0	4.25172E-49	**1.27795E-48**	**2.4976E-47**	**2.37272E-47**	3.84525E-51	
33	2039	6186	6496	2.7E-05	2.3689E-52	1.57011E-52	9.161E-58	1.65048E-53	4.66796E-53	**4.57085E-52**	8.17887E-54	1.80115E-52	4.3126E-58	3.38339E-55	1.01238E-54	**1.89645E-52**	2E-56	2.32526E-53	0	0	1.16031E-53	**3.48758E-53**	**6.81606E-52**	**6.47526E-52**	1.04935E-55	
34	2040	6184	6493	2E-05	4.7017E-57	3.1163E-57	1.818E-62	3.27581E-58	9.26479E-58	**9.07205E-57**	1.62331E-58	3.57486E-57	8.5594E-63	6.71522E-60	2.00933E-59	**3.76401E-57**	3.98E-61	4.61509E-58	0	0	2.30295E-58	**6.92201E-58**	**1.35283E-56**	**1.28518E-56**	2.08337E-60	
35	2041	6182	6491	1.4E-05	6.7867E-62	4.49826E-62	2.625E-67	4.72851E-63	1.33734E-62	**1.30952E-61**	2.34319E-63	5.16018E-62	1.2355E-67	9.69316E-65	2.90039E-64	**5.4332E-62**	5.74E-66	6.66171E-63	0	0	3.32422E-63	**9.99166E-63**	**1.95275E-61**	**1.85512E-61**	3.00825E-65	
36	2042	6182	6491	1E-05	7.1246E-67	4.72224E-67	2.755E-72	4.96395E-68	1.40393E-67	**1.37472E-66**	2.45986E-68	5.41711E-67	1.297E-72	1.01758E-69	3.0448E-69	**5.70373E-67**	6.02E-71	6.9934E-68	0	0	3.48973E-68	**1.04892E-67**	**2.04998E-66**	**1.94748E-66**	3.15816E-70	
37	2043	6184	6493	7.6E-06	5.4395E-72	3.60536E-72	2.104E-77	3.7899E-73	1.07188E-72	**1.04958E-71**	1.87806E-73	4.13588E-72	9.9027E-78	7.76906E-75	2.32466E-74	**4.35471E-72**	4.6E-76	5.33935E-73	0	0	2.66436E-73	**8.00831E-73**	**1.56513E-71**	**1.48687E-71**	2.41059E-75	
38	2044	6185	6494	5.6E-06	3.0204E-77	2.00191E-77	1.168E-82	2.10438E-78	5.95171E-78	**5.82789E-77**	1.04282E-78	2.29649E-77	5.4986E-83	4.31386E-80	1.29079E-79	**2.418E-77**	2.55E-81	2.96474E-78	0	0	1.47942E-78	**4.4467E-78**	**8.69056E-77**	**8.25604E-77**	1.33814E-80	
39	2045	6185	6495	4E-06	1.2197E-82	8.08426E-83	4.717E-88	8.49806E-84	2.40346E-83	**2.35346E-82**	4.21117E-84	9.27385E-83	2.2205E-88	1.74205E-85	5.21257E-85	**9.76453E-83**	1.03E-86	1.19724E-83	0	0	5.97427E-84	**1.7957E-83**	**3.50948E-82**	**3.33401E-82**	5.40356E-86	
40	2046	6184	6493	2.9E-06	3.5822E-88	2.37428E-88	1.385E-93	2.49581E-89	7.05876E-89	**6.91191E-88**	1.23679E-89	2.72365E-88	6.5214E-94	5.11626E-91	1.53089E-90	**2.86776E-88**	3.03E-92	3.51619E-89	0	0	1.7546E-89	**5.27382E-89**	**1.03071E-87**	**9.79171E-88**	1.58731E-91	
41	2047	6183	6492	2.1E-06	7.6513E-94	5.07133E-94	2.96E-99	5.33091E-95	1.50771E-94	**1.47634E-93**	2.6417E-95	5.81757E-94	1.393E-99	1.0928E-96	3.26989E-96	**6.12538E-94**	6.47E-98	7.51038E-95	0	0	3.74771E-95	**1.12646E-94**	**2.20153E-93**	**2.09145E-93**	3.39117E-97	
42	2048	6183	6492	1.6E-06	1.189E-99	7.8779E-100	4.6E-105	8.2811E-101	2.3421E-100	**2.2934E-99**	4.1037E-101	9.0371E-100	2.164E-105	1.6976E-102	5.0795E-102	**9.5152E-100**	1E-103	1.1667E-100	0	0	5.8217E-101	**1.7499E-100**	**3.4199E-99**	**3.2489E-99**	5.2681E-103	
43	2049	6184	6493	1.1E-06	1.343E-105	8.9E-106	5.19E-111	9.3556E-107	2.646E-106	**2.5909E-105**	4.6361E-107	1.021E-105	2.445E-111	1.9178E-108	5.7386E-108	**1.075E-105**	1.1E-109	1.3181E-106	0	0	6.5771E-107	**1.9769E-106**	**3.8636E-105**	**3.6704E-105**	5.9507E-109	
44	2050	6185	6494	8.2E-07	1.103E-111	7.3126E-112	4.27E-117	7.6869E-113	2.1741E-112	**2.1288E-111**	3.8092E-113	8.3887E-112	2.009E-117	1.5758E-114	4.715E-114	**8.8325E-112**	9.3E-116	1.083E-112	0	0	5.404E-113	**1.6243E-112**	**3.1745E-111**	**3.0158E-111**	4.8884E-115	
										4,509,736,084.41						**1,871,096,643.52**						**344,094,667.62**	**6,724,927,395.55**	**6,388,681,025.77**	**1,034,607.73**	**6,389,715,633.50**

Note: Average inter bank rate for 2006 (GHC to U 0.9236

A=Compenstion to employees, B =Use of goods, C= Consumption of fixed capital, D= Social benefits E= Other expenditure

Source: Government of Ghana budgetary allocation to the Minstry of Food and Agriculture in 2006

A=Compensation to employees, B =Use of goods, C= Consumption of fixed capital, D= Social benefits E= Other expenditure

Source: Government of Ghana budgetary allocation to the Ministry of Food and Agriculture in 2006

APPENDIX 15: B-A-U SCENARIO FOR COASTAL ZONE MANAGEMENT (2006 US DOLLAR CONSTANT) – COST OF ADAPTATION MEASURES

Coastal Zone Management (US $ 2006 constant)

Discount period	Year	Disc factor	Feasibility study	Detailed Design and Coastal Modeling	Construction	Supervision of Construction	Project Sum
0	2006	1	306000	1045500	47557500	854250	**49,763,250.00**
1	2007	0.727272727	222545.4545	760363.6364	34587272.73	621272.7273	36191454.55
2	2008	0.52892562	117709.9925	402175.8077	18294094.67	328607.0624	19142587.53
3	2009	0.384673178	45279.8769	154706.2461	7037247.535	126406.323	7363639.981
4	2010	0.279762311	12667.60302	43280.97698	1968756.636	35363.72509	2060068.941
5	2011	0.203463499	2577.394836	8806.099022	400570.114	7195.22725	419148.8352
6	2012	0.147973454	381.386016	1303.068888	59273.74331	1064.702628	62022.90084
7	2013	0.107617057	41.04364077	140.2324393	6378.865836	114.5801638	6674.72208
8	2014	0.078266951	3.212360614	10.97556543	499.2543788	8.967840048	522.4101449
9	2015	0.056921419	0.182852124	0.624744756	28.41826758	0.510462179	29.73632664
10	2016	0.041397395	0.007569602	0.025862806	1.176442262	0.021131805	1.231006474
11	2017	0.030107197	0.000227899	0.000778657	0.035419379	0.000636219	0.037062154
12	2018	0.021896143	4.99012E-06	1.70496E-05	0.000775548	1.39308E-05	0.000811518
13	2019	0.015924468	7.9465E-08	2.71505E-07	1.23502E-05	2.2184E-07	1.2923E-05
14	2020	0.011581431	9.20318E-10	3.14442E-09	1.43033E-07	2.56922E-09	1.49667E-07
							115,009,400.87
15	2021	0.008422859	707206.1545	2416287.694	109911623.2	1974283.848	115009400.9
16	2022	0.006125716	4332.143768	14801.49121	673287.3439	12093.90135	704514.8802
17	2023	0.004455066	19.29998591	65.94161853	2999.539477	53.87912734	3138.660209
18	2024	0.003240048	0.062532879	0.213654004	9.718651634	0.174570954	10.16940947
19	2025	0.002356398	0.000147352	0.000503454	0.022901016	0.000411359	0.023963181
20	2026	0.001713744	2.52524E-07	8.62791E-07	3.92465E-05	7.04964E-07	4.10668E-05
21	2027	0.00124636	3.14736E-10	1.07535E-09	4.89152E-08	8.78638E-10	5.1184E-08
22	2028	0.000906443	2.8529E-13	9.74742E-13	4.43389E-11	7.96436E-13	4.63954E-11
23	2029	0.000659231	1.88072E-16	6.42581E-16	2.92296E-14	5.25036E-16	3.05853E-14
24	2030	0.000479441	9.01696E-20	3.0808E-19	1.40139E-17	2.51724E-19	1.46638E-17
25	2031	0.000348684	3.14408E-23	1.07423E-22	4.88642E-21	8.77721E-23	5.11305E-21
26	2032	0.000253589	7.97302E-27	2.72411E-26	1.23914E-24	2.2258E-26	1.29661E-24
27	2033	0.000184428	1.47045E-30	5.02403E-30	2.28532E-28	4.105E-30	2.39132E-28
28	2034	0.00013413	1.97231E-34	6.73871E-34	3.06529E-32	5.50602E-34	3.20746E-32
29	2035	9.75488E-05	1.92396E-38	6.57353E-38	2.99015E-36	5.37106E-38	3.12884E-36
30	2036	7.09446E-05	1.36495E-42	4.66356E-42	2.12135E-40	3.81047E-42	2.21974E-40
31	2037	5.1596E-05	7.04258E-47	2.40621E-46	1.09453E-44	1.96605E-46	1.1453E-44
32	2038	3.75244E-05	2.64268E-51	9.02917E-51	4.10717E-49	7.37749E-51	4.29766E-49
33	2039	2.72905E-05	7.21201E-56	2.4641E-55	1.12087E-53	2.01335E-55	1.17285E-53
34	2040	1.98476E-05	1.43141E-60	4.89065E-60	2.22465E-58	3.99602E-60	2.32783E-58
35	2041	1.44346E-05	2.06619E-65	7.05948E-65	3.2112E-63	5.76811E-65	3.36014E-63
36	2042	1.04979E-05	2.16907E-70	7.41098E-70	3.37109E-68	6.05531E-70	3.52744E-68
37	2043	7.63484E-06	1.65605E-75	5.65817E-75	2.57378E-73	4.62313E-75	2.69315E-73
38	2044	5.55261E-06	9.1954E-81	3.14176E-80	1.42912E-78	2.56705E-80	1.4954E-78
39	2045	4.03826E-06	3.71334E-86	1.26873E-85	5.77116E-84	1.03664E-85	6.03883E-84
40	2046	2.93692E-06	1.09058E-91	3.72615E-91	1.69494E-89	3.04453E-91	1.77355E-89
41	2047	2.13594E-06	2.32941E-97	7.95883E-97	3.6203E-95	6.50295E-97	3.78821E-95
42	2048	1.55341E-06	3.6185E-103	1.2363E-102	5.6238E-101	1.0102E-102	5.8847E-101
43	2049	1.12975E-06	4.0881E-109	1.3968E-108	6.3535E-107	1.1413E-108	6.6482E-107
44	2050	8.21639E-07	3.3589E-115	1.1476E-114	5.2203E-113	9.377E-115	5.4624E-113
							115,717,064.60

Note:
Original figuresare in EUR and converted to US $ (2006 constant)
EUR 1.00 = USD 1.275
Source: Ada Coastal Protection Works and Volta River Estuary - Assessment Study, 2007

Source: Ada Coastal Protection Works and Volta River Estuary – Assessment Study, 2007

APPENDIX 16: CLIMATE CHANGE SCENARIO FOR COASTAL ZONE MANAGEMENT (2006 US DOLLAR CONSTANT) – COST OF ADAPTATION MEASURES

Coastal Zone Management (US $ 2006 constant)

Discount period	Year	Disc factor	Feasibility study	Detailed Design and Coastal Modeling	Construction	Supervision of Construction	Project Sum	CCScenario: 5% re
0	2006	1	306000	1045500	47557500	854250	49763250	**47,275,087.50**
1	2007	0.727272727	222545.4545	760363.6364	34587272.73	621272.7273	36191454.55	34381881.82
2	2008	0.52892562	117709.9925	402175.8077	18294094.67	328607.0624	19142587.53	18185458.15
3	2009	0.384673178	45279.8769	154706.2461	7037247.535	126406.323	7363639.981	6995457.982
4	2010	0.279762311	12667.60302	43280.97698	1968756.636	35363.72509	2060068.941	1957065.494
5	2011	0.203463499	2577.394836	8806.099022	400570.114	7195.22725	419148.8352	398191.3934
6	2012	0.147973454	381.386016	1303.068888	59273.74331	1064.702628	62022.90084	58921.7558
7	2013	0.107617057	41.04364077	140.2324393	6378.865836	114.5801638	6674.72208	6340.985976
8	2014	0.078266951	3.212360614	10.97556543	499.2543788	8.967840048	522.4101449	496.2896376
9	2015	0.056921419	0.182852124	0.624744756	28.41826758	0.510462179	29.73632664	28.2495103
10	2016	0.041397395	0.007569602	0.025862806	1.176442262	0.021131805	1.231006474	1.16945615
11	2017	0.030107197	0.000227899	0.000778657	0.035419379	0.000636219	0.037062154	0.035209046
12	2018	0.021896143	4.99012E-06	1.70496E-05	0.000775548	1.39308E-05	0.000811518	0.000770942
13	2019	0.015924468	7.9465E-08	2.71505E-07	1.23502E-05	2.2184E-07	1.2923E-05	1.22768E-05
14	2020	0.011581431	9.20318E-10	3.14442E-09	1.43033E-07	2.56922E-09	1.49667E-07	1.42183E-07
							115,009,400.87	**109,258,930.83**
15	2021	0.008422859	707206.1545	2416287.694	109911623.2	1974283.848	115009400.9	109258930.8
16	2022	0.006125716	4332.143768	14801.49121	673287.3439	12093.90135	704514.8802	669289.1362
17	2023	0.004455066	19.29998591	65.94161853	2999.539477	53.87912734	3138.660209	2981.727198
18	2024	0.003240048	0.062532879	0.213654004	9.718651634	0.174570954	10.16940947	9.660938998
19	2025	0.002356398	0.000147352	0.000503454	0.022901016	0.000411359	0.023963181	0.022765022
20	2026	0.001713744	2.52524E-07	8.62791E-07	3.92465E-05	7.04964E-07	4.10668E-05	3.90134E-05
21	2027	0.00124636	3.14736E-10	1.07535E-09	4.89152E-08	8.78638E-10	5.1184E-08	4.86248E-08
22	2028	0.000906443	2.8529E-13	9.74742E-13	4.43389E-11	7.96436E-13	4.63954E-11	4.40756E-11
23	2029	0.000659231	1.88072E-16	6.42581E-16	2.92296E-14	5.25036E-16	3.05853E-14	2.9056E-14
24	2030	0.000479441	9.01696E-20	3.0808E-19	1.40139E-17	2.51724E-19	1.46638E-17	1.39306E-17
25	2031	0.000348684	3.14408E-23	1.07423E-22	4.88642E-21	8.77721E-23	5.11305E-21	4.8574E-21
26	2032	0.000253589	7.97302E-27	2.72411E-26	1.23914E-24	2.2258E-26	1.29661E-24	1.23178E-24
27	2033	0.000184428	1.47045E-30	5.02403E-30	2.28532E-28	4.105E-30	2.39132E-28	2.27175E-28
28	2034	0.00013413	1.97231E-34	6.73871E-34	3.06529E-32	5.50602E-34	3.20746E-32	3.04709E-32
29	2035	9.75488E-05	1.92396E-38	6.57353E-38	2.99015E-36	5.37106E-38	3.12884E-36	2.9724E-36
30	2036	7.09446E-05	1.36495E-42	4.66356E-42	2.12135E-40	3.81047E-42	2.21974E-40	2.10875E-40
31	2037	5.1596E-05	7.04258E-47	2.40621E-46	1.09453E-44	1.96605E-46	1.1453E-44	1.08803E-44
32	2038	3.75244E-05	2.64268E-51	9.02917E-51	4.10717E-49	7.37749E-51	4.29766E-49	4.08278E-49
33	2039	2.72905E-05	7.21201E-56	2.4641E-55	1.12087E-53	2.01335E-55	1.17285E-53	1.11421E-53
34	2040	1.98476E-05	1.43141E-60	4.89065E-60	2.22465E-58	3.99602E-60	2.32783E-58	2.21144E-58
35	2041	1.44346E-05	2.06619E-65	7.05948E-65	3.2112E-63	5.76811E-65	3.36014E-63	3.19213E-63
36	2042	1.04979E-05	2.16907E-70	7.41098E-70	3.37109E-68	6.05531E-70	3.52744E-68	3.35107E-68
37	2043	7.63484E-06	1.65605E-75	5.65817E-75	2.57378E-73	4.62313E-75	2.69315E-73	2.55849E-73
38	2044	5.55261E-06	9.1954E-81	3.14176E-80	1.42912E-78	2.56705E-80	1.4954E-78	1.42063E-78
39	2045	4.03826E-06	3.71334E-86	1.26873E-85	5.77116E-84	1.03664E-85	6.03883E-84	5.73689E-84
40	2046	2.93692E-06	1.09058E-91	3.72615E-91	1.69494E-89	3.04453E-91	1.77355E-89	1.68488E-89
41	2047	2.13594E-06	2.32941E-97	7.95883E-97	3.6203E-95	6.50295E-97	3.78821E-95	3.5988E-95
42	2048	1.55341E-06	3.6185E-103	1.2363E-102	5.6238E-101	1.0102E-102	5.8847E-101	5.5904E-101
43	2049	1.12975E-06	4.0881E-109	1.3968E-108	6.3535E-107	1.1413E-108	6.6482E-107	6.3158E-107
44	2050	8.21639E-07	3.3589E-115	1.1476E-114	5.2203E-113	9.377E-115	5.4624E-113	5.1893E-113
							115,717,064.60	**109,931,211.37**

Note:

Original figuresare in EUR and converted to US $ (2006 constant)

EUR 1.00 = USD 1 USD 1.275

Source: Ada Coastal Protection Works and Volta River Estuary - Assessment Study, 2007

Source: Ada Coastal Protection Works and Volta River Estuary – Assessment Study, 2007

Appendix 17

METHODOLOGY FOR ESTIMATION OF ADAPTATION AND MITIGATION COSTS FOR 2020 AND 2050 –

Source: UNDP (2009). Methodology Guidebook for the Assessment of Investment and Financial Flows to Address Climate Change. Version 1.0, 23 March 2009. Work in Progress.

The main focus of this report is a discussion of the investment flow (IF), financial flow (FF) and operation and maintenance (O&M) costs for climate change adaptation and mitigation measures engaged to balance climate change effects in the following sectors: Agriculture, Forestry, Energy, Health, and Coastal Zone Management, and in subsectors – Electricity Generation, Transport and disease burden (Malaria) in Ghana. It is based on the **Methodology Guidebook for the Assessment of Investment and Financial Flows** to address climate change designed by the **United Nations Framework for Climate Change (UNFCC)** secretariat. It provides an assessment of the investment and financial flows that will be necessary in present times to 2020 and 2050 in order to meet worldwide requirements for mitigating and adapting to climate change under different scenarios of social and economic development, especially as they impact the well-being of Ghanaians. It must be noted that dealing with adaptation and mitigation of climate change measures and scenarios is daunting because: adaptation will be widespread and heterogeneous; and the amount of adaptation needed will depend on the magnitude and the nature of climate change. Relevant investment and financial flows are projected for selected scenarios. These future flows are compared with the current flows and the current sources of funds because projections of the sources of future flows are not available from the scenarios. The mitigation sectors in the analysis are Energy, Electricity generation, Transport and Forestry while sectors considered for adaptation are Agriculture, Health, Malaria and Coastal Zone Management. For each of these sectors, investment and financial flows are analysed. It is important to note that this methodology is not the same as what would be required to assess the full (total) cost of addressing mitigation and adaptation in a country. For mitigation, the full costs would entail an accounting of the costs of meeting a national GHG reduction target over a specific period of time.

The procedure for analysis employed in this report is simple. The scope of a sector under consideration is defined. Once the scope of a sector is clearly defined, the relevant investment costs for that sector are projected for two future scenarios: firstly, a baseline scenario, which reflects a continuation of current policies and plans, i.e., a future in which no new measures are taken to address climate change (otherwise referred to as a "business-as-usual" scenario-BAU), and secondly, a climate change scenario, in which new mitigation measures are taken (a "mitigation scenario") or new adaptation measures are taken (an "adaptation scenario"). The investment costs of the baseline and mitigation (or the baseline and adaptation) scenarios are then compared to determine the changes in investments needed to mitigate emissions from the sector (or to adapt to the impacts to the sector).

Assessment Period and Base Year

The assessment period is the time horizon for assessment; i.e., the number of years spanned by the baseline and climate change scenarios and the associated stream of annual IF, FF, and O&M costs. The assessment period for this report is 11 years (2009-2020) and 30 years (2021-2050) . With the base years being 2003, 2004 or 2006 depending the availability of investment data of the sector involved. The end year is 2050 since this year aligns with typical sector development plans, and results in a reasonable assessment period length.

Cost Accounting Issues

Appropriate discounting of future costs (IF, FF, and O&M costs for the baseline and climate change scenarios) are done to properly account for varying opportunity costs and time preferences of investment entities. This is particularly important given the long time frame of the Investment & Financial Flow assessments. The discount rate chosen is 37.5% or 0.375. This is the current discount rate used employed by commercial banks. This is used because there is no explicit public discount rate established by the Ministry of Finance and Economic Planning.

Method of Estimation

The method of analysis involves a calculation of changes in cumulative IF, FF, and O&M costs, by investment entity/funding source combination, for individual investment types and all investment types. These calculations are designed to determine how cumulative investments by each investment entity/funding source combination would change, for each investment type and for all investment types, between the baseline scenario and the climate change scenario.

Firstly, the calculation entails estimating the incremental cumulative IF, FF, and O&M costs needed to implement each investment type in the sector, by individual investment entity/funding source combination. The two steps in this calculation which were carried out for all investment types in each sector, are:

1. For each investment type, a calculation of cumulative IF, FF, and O&M costs for each investment entity/funding source combination, in both the baseline scenario and the climate change scenario, by summing annual estimates over all years in the assessment period 2003-2030.
2. For each investment type, incremental cumulative IF, FF, and O&M costs for each investment entity/funding source combination by subtracting cumulative IF, FF, and O&M costs in the baseline scenario from cumulative IF, FF, and O&M costs in the climate change scenario has been calculated.

Cumulative Baseline Scenario IF for Individual Investment Types, by Funding Source/Investment Entity Combination – Equation 1

$$Cum\ IF(BS, IT_i, IE/FS_j) = \sum_t IF(BS, IT_i, IE/FS_j, YR_t)$$

Where:

$IF(BS, IT_i, IE/FS_j, YR_t)$ = annual IF for investment type (IT) i in the baseline scenario (BS), for investment entity/funding source combination (IE/FS) j, and for year (YR) t

$CumIF(BS, IT_i, IE/FS_j)$ = cumulative IF for investment type (IT) i in the baseline scenario (BS), for investment entity/funding source combination (IE/FS) j

Cumulative Climate Change Scenario IF for Individual Investment Types, by Funding Source/Investment Entity Combination – Equation 2

$$Cum\ IF(CCS, IT_i, IE/FS_j) = \sum_i IF(CCS, IT_i, IE/FS_j, YR_t)$$

Where:
IF(CCS, IT_i, IE/FS_j, YR_t) = annual IF for investment type (IT) i in the climate change scenario (CCS), for investment entity/funding source combination (IE/FS) j, and for year (YR) t
CumIF(CCS, IT_i, IE/FS_j) = cumulative IF for an investment type (IT) i in the climate change scenario (CCS), for investment entity/funding source combination (IE/FS) j

Incremental Cumulative IF for Individual Investment Types, by Investment Entity/Funding Source Combination – Equation 3

$$\Delta Cum\ IF(IT_i, IE/FS_j) = Cum\ IF(CCS, IT_i, IE/FS_j) - Cum\ IF(BS, IT_i, I$$

Where:
ΔCumIF(IT_i, IE/FS_j) = incremental cumulative IF for investment type (IT) i, for investment entity/funding source combination (IE/FS) j

Cumulative Baseline Scenario IF for All Investment Types, by Investment Entity/Funding Source Combination– Equation 4

$$Cum\ IF(BS, IT_{ALL}, IE/FS_j) = \Sigma_i\ Cum\ I$$

Where:
CumIF(BS, IT_i, IE/FS_j) = cumulative IF for investment type (IT) i in the baseline scenario (BS), for investment entity/funding source combination (IE/FS) j
CumIF(BS, IT_{ALL}, IE/FS_j) = cumulative IF for all investment types (IT_{ALL}) in the baseline scenario (BS), for investment entity/funding source combination (IE/FS) j

Cumulative Climate Change Scenario IF for all Investment Types, by Investment Entity/Funding Source Combination – Equation 5

$$Cum\ IF(CCS, IT_{ALL}, IE/FS_j) = \sum_i IF(CCS, IT_i, IE/FS_j)$$

Where:
CumIF(CCS, IT_i, IE/FS_j) = cumulative IF for investment type (IT) i in the climate change scenario (CCS), for investment entity/funding source combination (IE/FS) j
CumIF(CCS, IT_{ALL}, IE/FS_j) = cumulative IF for all investment types (IT_{ALL}) in the climate change scenario (CCS), for investment entity/funding source combination (IE/FS) j

Incremental Cumulative IF for all Investment Types, by Investment Entity/Funding Source Combination – Equation 6

$$\Delta Cum\, IF(IT_{ALL}, IE/FS_j) = Cum\, IF(CCS, IT_{ALL}, IE/FS_j) - Cum\, IF(BS, IT_{ALL}, IE/I$$

Where:
ΔCumIF(IT_{ALL}, IE/FS_j) = incremental cumulative IF for all investment types (IT_{ALL}), for each investment entity/funding source combination (IE/FS) *j*

Estimation of changes in annual IF, FF, and O&M costs for individual investment types, for individual sources of funds, and for all investment types and funding sources

The next array of estimations/calculations are designed to determine how annual investments for each investment type, and for each investment entity/funding source combination, and for all investment types and all investment entity/funding source combinations, would change between the baseline scenario and the climate change scenario.

The first calculation entails estimating the incremental annual IF, FF, and O&M costs for all investment entity/funding source combinations needed to implement each investment type in the sector, in each year of the assessment period. The steps in this calculation are:

1. For each investment type, annual total IF, FF, and O&M costs in both the baseline scenario and the climate change scenario by summing IF, FF, and O&M costs in each year over all investment entity/funding source combinations were calculated.
2. For each investment type, a calculation of incremental annual total IF, FF, and O&M costs by year by subtracting annual total IF, FF, and O&M costs for the baseline scenario from annual total IF, FF, and O&M costs for the climate change scenario.

Annual Total Baseline Scenario IF for each Investment Type – Equation 7

$$IF(BS, IT_i, IE/FS_{ALL}, YR_t) = \sum_i IF(BS, IT_i, IE/FS_j, YR_t)$$

Where:
IF(BS, IT_i, IE/FS_j, YR_t), = annual IF for investment type (IT) *i* in the baseline scenario (BS), for investment entity/funding source combination (IE/FS) *j*, and for year (YR) *t*
IF(BS, IT_i, IE/FS_{ALL}, YR_t) = annual IF for investment type (IT) *i* in the baseline scenario (BS) for all investment entity/funding source combinations.

Incremental Total Annual IF for each Investment Type – Equation 8

$$\Delta IF(IT_i, IE/FS_{ALL}, YR_t) = IF(CCS, IT_i, IE/FS_{ALL}, YR_t) - IF(BS, IT_i, IE/FS_{ALL},$$

Where:
ΔIF(IT_i IE/FS_{ALL}, YR_t) = incremental IF for investment type *i*, for all investment entity/funding source combinations (IE/FS_{ALL}) and for year (YR) *t*

The next step of calculation entails estimating annual incremental I&FF needed to implement all investment types in the sector, for each investment entity/funding source combination, in each year of the assessment period. The steps in this calculation are:

1. Calculation of annual IF, FF, and O&M costs for all investment types, for each source/investment entity in both the baseline scenario and the climate change scenario by summing annual IF, FF, and O&M costs for each investment entity/funding source combination over all investment types.
2. Calculation of incremental annual IF, FF, and O&M costs for each investment entity/funding source combination by subtracting annual IF, FF, and O&M costs for the baseline scenario from annual IF, FF, and O&M costs for the climate change scenario, for each investment entity/funding source combination.

Annual Baseline Scenario IF for all Investment Types, by Investment Entity/Funding Source Combination – Equation 9

$$IF(BS, IT_{ALL}, IE/FS_i, YR_t) = \sum_i IF(BS, IT_i, IE/FS_j, YR_t)$$

Where:
IF(BS, IT_i, $IE/FS_{j,}$, YR_t) = annual IF for investment type (IT) i in the baseline scenario (BS), for investment entity/funding source combination (IE/FS) j and year (YR) t
IF(BS, IT_{ALL}, $IE/FS_{j,}$, YR_t) = annual IF for all investment types (IT_{ALL}) in the baseline scenario (BS), for investment entity/funding source combination (IE/FS) j and year (YR) t

Annual Climate Change Scenario IF for all Investment Types, by Investment Entity/Funding Source Combination – Equation 10

$$IF(CCS, IT_{ALL}, IE/FS_i, YR_t) = \sum_i IF(CCS, IT_i, IE/FS_j, YR_t)$$

Where:
IF(CCS, IT_i, $IE/FS_{j,}$, YR_t) = annual IF for investment type (IT) i in the climate change scenario (CCS), for investment entity/funding source combination (IE/FS) j and year (YR) t
IF(CCS, IT_{ALL}, $IE/FS_{j,}$, YR_t) = annual IF for all investment types (IT_{ALL}) in the climate change scenario (CCS), for investment entity/funding source combination (IE/FS) j and year (YR) t

Limitations

The estimation methods used yield crude estimates of costs and therefore results should be treated as indicative. Again it must be noted that the estimates may be low because the amount actually required for adaptation and mitigation for some sectors and sub sectors that are likely to need additional financial and investment flows to adapt to climate change impacts may not have been included. On the other hand, the estimates may also be high because there could be some double counting and also no consideration of adaptive learning is considered but this could reduce adaptation costs.

Appendix 18:

COST OF IMPLEMENTING MITIGATION AND ADAPTATION MEASURES WITH DIFFERENT DISCOUNT RATES AS SCENARIOS

Cost of Implementing Mitigation Measures under discount rates (37.5%, 25% and 20%) as scenarios

Energy Sector

The major assumption under the mitigation scenario in the energy sector is the implementation of strong policies that seek to increase energy efficiency significantly and to provide the same services with 15 per cent less energy and shift the energy supply to more climate friendly technologies. The energy sector will require additional investments of about US$ 286 million in 2020 and US$ 287 million in 2050 with a discount rate of 37.5%. The same sector will require additional investments to the tune of about US$ 337 million by 2020 and US$ 347 million by 2050 with a discount rate of 25% while investments needed using a discount rate of 20% will amount to US$ 371 million and US$ 392 million by 2020 and 2050 respectively.

On the other hand, the electricity subsector will need investment flows up to US $ 21.9 million by 2020 and US $22 million by 2050 (discount rate of 37.5%). For discount rate scenarios 25% and 20%, the expected investments needed are US $ 26 million and US $ 27 million, and US $ 29 million and US $30 million for 2020 and 2050 respectively. Emissions due to electricity generation are mainly from thermal electricity generation and are projected to increase by 2.73% by 2020 and 7.31% by 2050 in the Business-As-Usual scenario.

Transport

The mitigation scenario in the transport subsector is based on increased use of bio-fuels and investments in vehicles which are fuel-efficient by both Government and private stakeholders by 2020 and 2050. With a discount rate of 37.5%, the subsector will require additional investment to the tune of US$ 6.58 million in 2020 and US$ 6.55 in 2050, whereas a discount rate of 25% requires additional investment of US $ 7.8 million in 2020 and almost US $8 million in 2050. However, with a discount rate of 20% investment needed for mitigation measures in this subsector will be about US $ 8.6 million in 2020 and US $ 9 million in 2050.

Forestry

The mitigation scenarios advanced for the forestry sector are a reduction in deforestation; better management of productive forests (proper forest management); and forestation to increase the forest area (afforestation and reforestation) which will eventually reduce GHG emissions by sinks. This subsector will need additional investment to the tune of US$ 3.9 million in 2020 and US$ 81.1 in 2050 (37.5% discount rate), US$ 4.4 million in 2020 and US$ 90.2 million in 2050 (25% discount rate), and US$ 4.6 million and US$ 94.7 million for 2020 and 2050 respectively (20% discount rate).

The Results show that additional investments that will be needed to mitigate effects of climate change relative to the Business-As-Usual scenario will be US $ 318 million by 2020 (37.5% discount rate), US$ 374.3 million by 2020 (25% discount rate) and US$ 411.8 million by 2020(20% discount rate).

With respect to 2050, mitigation measures will require US$ 422.7 million by 2050 with a discount rate of 37.5%, US$ 470.5 million with a discount rate of 25%, and US$ 524.4 million with a discount rate of 20%.

Incremental Cumulative Investment by sectors - Mitigation in Climate Change (Constant US Dollars) - Scenarios

Mitigation Scenario 1: Discount Rate of 37.5%

Sector		BAU	CC Scenario	Amount Needed
Energy(Whole Sector)**				
	2006	2,467,339,219.04	2,344,008,456.34	123,330,762.69
	2020	5,702,351,149.01	5,417,317,911.47	285,033,237.54
	2050	5,737,446,393.45	5,450,659,747.72	286,786,645.73
Transport*				
	2006	58,362,691.80	55,516,820.39	2,845,871.41
	2020	134,642,518.96	128,065,336.68	6,577,182.28
	2050	133,584,576.74	127,031,741.84	6,552,834.90
Electricity				
	2004	189,379,644.81	179,944,689.76	9,434,955.05
	2020	437,679,960.80	415,874,475.83	21,805,484.97
	2050	440,540,600.16	418,590,437.08	21,950,163.08
Forestry - Reforestation				
	2005	14,355,817.84	13,638,165.67	717,652.17
	2020	77,259,104.33	73,397,179.79	3,861,924.54
	2050	***154501687.4187	73,401,214.35	81,100,473.07

Mitigation Scenario 2: Discount Rate of 25.0%

Sector		BAU	CC Scenario	Amount Needed
Energy(Whole Sector)**				
	2006	2,467,339,219.04	2,344,008,456.34	123,330,762.69
	2020	6,731,491,372.85	6,395,017,011.72	336,474,361.13
	2050	6,925,314,085.77	6,579,151,833.99	346,162,251.78
Transport*				
	2006	58,362,691.80	55,516,820.39	2,845,871.41
	2020	158,863,390.43	151,099,189.03	7,764,201.41
	2050	161,240,534.82	153,330,959.91	7,909,574.92
Electricity				
	2004	189,379,644.81	179,944,689.76	9,434,955.05
	2020	516,669,967.09	490,929,107.52	25,740,859.57
	2050	526,088,406.39	499,875,777.32	26,212,629.07
Forestry - Reforestation				
	2005	14,355,817.84	13,638,165.67	717,652.17
	2020	86,263,565.51	81,951,545.98	4,312,019.53
	2050	***163531515.6463	73,405,316.59	90,126,199.06

Mitigation Scenario 3: Discount Rate of 20.0%

Sector		BAU	CC Scenario	Amount Needed
Energy(Whole Sector)**				
	2006	2,467,339,219.04	2,344,008,456.34	123,330,762.69
	2020	7,409,153,787.15	7,038,806,833.73	370,346,953.42
	2050	7,828,662,458.75	7,437,346,340.23	391,316,118.51
Transport*				
	2006	58,362,691.80	55,516,820.39	2,845,871.41
	2020	174,798,529.45	166,252,707.17	8,545,822.28
	2050	182,271,498.39	173,330,109.34	8,941,389.05
Electricity				
	2004	189,379,644.81	179,944,689.76	9,434,955.05
	2020	568,682,738.96	540,350,535.09	28,332,203.87
	2050	590,701,963.88	561,269,927.08	29,432,036.80
Forestry - Reforestation				
	2005	14,355,817.84	13,638,165.67	717,652.17
	2020	90,756,525.65	86,219,922.04	4,536,603.62
	2050	***168029402.1159ε	73,409,996.65	94,619,405.47

Note:
* estimations based on investment and O&M cost by Metro Mass Transit Ltd, *** estimations based on government budgetary allocation in 2006 for the sector. Average interbank rate for 2006 (US$ to GH□) =* 0.9131, *B-A-U = Business-As-Usual scenario, CC= Climate Change Scenario.*
**** investment is required to establish new plantations since forest plantations have average lifespan of about 30 years.*

Source: Authors' Estimation

Cost of Implementing Adaptation Measures under discount rates (37.5%, 25% and 20%) as scenarios

Health
The adaptation scenario in the health sector suggests specific measures that can be taken to reduce vulnerability to climate change and these could include improved monitoring systems to detect the arrival or presence of infectious diseases. The cost of adaptation to climate change in the health sector will be about US$ 350 million by 2020 and go up to about US$ 352 million by 2050 with 37.5% discount rate. When the discount rate is reduced to 25%, the sector will need additional investment of about US$ 413 million by 2020 and US$ 425 million by 2050.

With malaria, additional investment in controlling the disease will be about US$ 7.6 million in 2020 and US$ 7.54 million in 2050 (discount rate 37.5%), change to about US$ 9 million by 2020 and US$ 10 million by 2050 (discount rate 25%) or further change to about US$ 10 million by 2020 and US$ 10.1 million by 2050 (discount rate 20%). The additional investments are needed to avoid an episode of malaria.

Agriculture
The agricultural sector will require about US$ 334.24 million in 2020 and US$ 336.30 million in 2050 when the discount rate is 37.5%, US$ 395 million in 2020 and US$ 406 million in 2050 when the discount rate is 25% and US$ 435 million in 2020 and US$ 459 million in 2050 when the discount rate is 20%. These investments will mainly be in research into production of drought resistant crops, change in management of crops and fisheries, moisture and irrigation management, Extension and training, pest and disease management, fire management in crop production, among others.

Coastal Zones
The major abatement scenario for adaptation in the coastal zone is that of protection which is to reduce the risk of the effect of climate change by decreasing the probability of the occurrence of sea-level rise. The major suggestion in this adaptation scenario is the development and integration of coastal zone management institutions and processes. Additional investments needed for adaptation at the Ada Coastal Zone by 2020 will be US$ 5.7 million and US$ 5.9 million in 2050 (37.5% discount rate), US$ 6.8 million in 2020 and US$ 7.0 million (25% discount rate), and US$ 7.5 million in 2020 and US$ 7.9 million in 2050 (20% discount rate)

Results indicate that additional investments that will be essential for adapting to the effects of climate change relative to the Business-As-Usual scenario in 2020 will be US $ 700 million using a discount rate of 37.5%, US$ 823.1 million using a discount rate of 25% and US$ 906 million using a discount rate of 20%.

The year 2050 will need US$ 701.7 million with a discount rate of 37.5%, US$ 847 million with a discount rate of 25% and US$ 957 million with a discount rate of 20% to adapt to effects of climate change.

Incremental Cumulative Investment by sectors - Adaptation in Climate Change (Constant US Dollars)

Adaptation Scenario 1: 37.5% Discount rate

Sector		BAU	CC Scenario	Amount Needed
Health (Whole Sector)**				
	2006	3,026,296,286.27	2874981472	151,314,814.31
	2020	6,994,167,839.42	6,644,459,447.45	349,708,391.97
	2050	7,042,217,556.5	6,690,106,678.6	352,110,877.82
Malaria*				
	2003	66556045.48	63228243.2	3,327,802.27
	2020	151,042,279.36	143,490,165.39	7,552,113.97
	2050	150,818,247.73	143,277,335.34	7,540,912.39
Agriculture (Whole Sector)**				
	2006	2,892,473,220.30	2,747,850,675.87	144,622,544.43
	2020	6,684,882,753.24	6,350,641,190.39	334,241,562.85
	2050	6,726,013,733.67	6,389,715,633.50	336,298,100.16
Coastal Zone Mangement***				
	2006	49,763,250.00	47,275,087.50	2,488,162.50
	2020	115,009,400.87	109,258,930.83	5,750,470.04
	2050	115,717,064.60	109,931,211.37	5,785,853.23

Adaptation Scenario 2: 25% Discount rate

Sector		BAU	CC Scenario	Amount Needed
Health (Whole Sector)**				
	2006	3,026,296,286.27	2,874,981,471.96	151,314,814.31
	2020	8,256,442,577.04	7,843,620,448.19	412,822,128.85
	2050	8,494,169,563.77	8,069,461,085.58	424,708,478.19
Malaria*				
	2003	66,556,045.48	63,228,243.20	3,327,802.27
	2020	178,131,476.32	169,224,902.51	8,906,573.82
	2050	180,207,444.13	171,197,071.28	9,010,372.85
Agriculture (Whole Sector)				
	2006	2,892,473,220.30	2,747,850,675.87	144,622,544.43
	2020	7,891,338,801.00	7,496,774,899.59	394,563,901.41
	2050	8,118,551,695.74	7,712,627,233.05	405,924,462.69
Coastal Zone Mangement***				
	2006	49,763,250.00	47,275,087.50	2,488,162.50
	2020	135,765,760.26	128,977,472.25	6,788,288.01
	2050	139,674,851.22	132,691,108.66	6,983,742.56

Adaptation Scenario 3: 20% Discount rate

Sector		BAU	CC Scenario	Amount Needed
Health (Whole Sector)**				
	2006	3,026,296,286.27	2874981472	151,314,814.31
	2020	9,087,617,283.98	8,633,236,419.78	454,380,864.20
	2050	9,602,161,111.59	9,122,053,056.02	480,108,055.58
Malaria*				
	2003	66,556,045.48	63,228,243.20	3,327,802.27
	2020	195,987,845.17	186,188,452.91	9,799,392.26
	2050	201,781,030.04	191,691,978.54	10,089,051.50
Agriculture (Whole Sector)**				
	2006	2,892,473,220.30	2,747,850,675.87	144,622,544.43
	2020	8,685,758,416.60	8,251,473,839.94	434,284,576.66
	2050	9,177,547,156.58	8,718,673,328.20	458,873,828.38
Coastal Zone Mangement***				
	2006	49,763,250.00	47,275,087.50	2,488,162.50
	2020	149,433,276.86	141,961,613.02	7,471,663.84
	2050	157,894,237.29	149,999,525.43	7,894,711.86

Note:
* estimations based on costing of malaria in 2003 by Asante *et al (2005).* ** *estimations based on government budgetary allocation in 2006 for the sector.* *** *estimations are based on Ada Coastal Protection Works Report (2007).Average interbank rate for 2006 (US$ to GH□)* = 0.9131, *B-A-U = Business-As-Usual scenario, CC= Climate Change Scenario.*

Source: Authors' Estimation