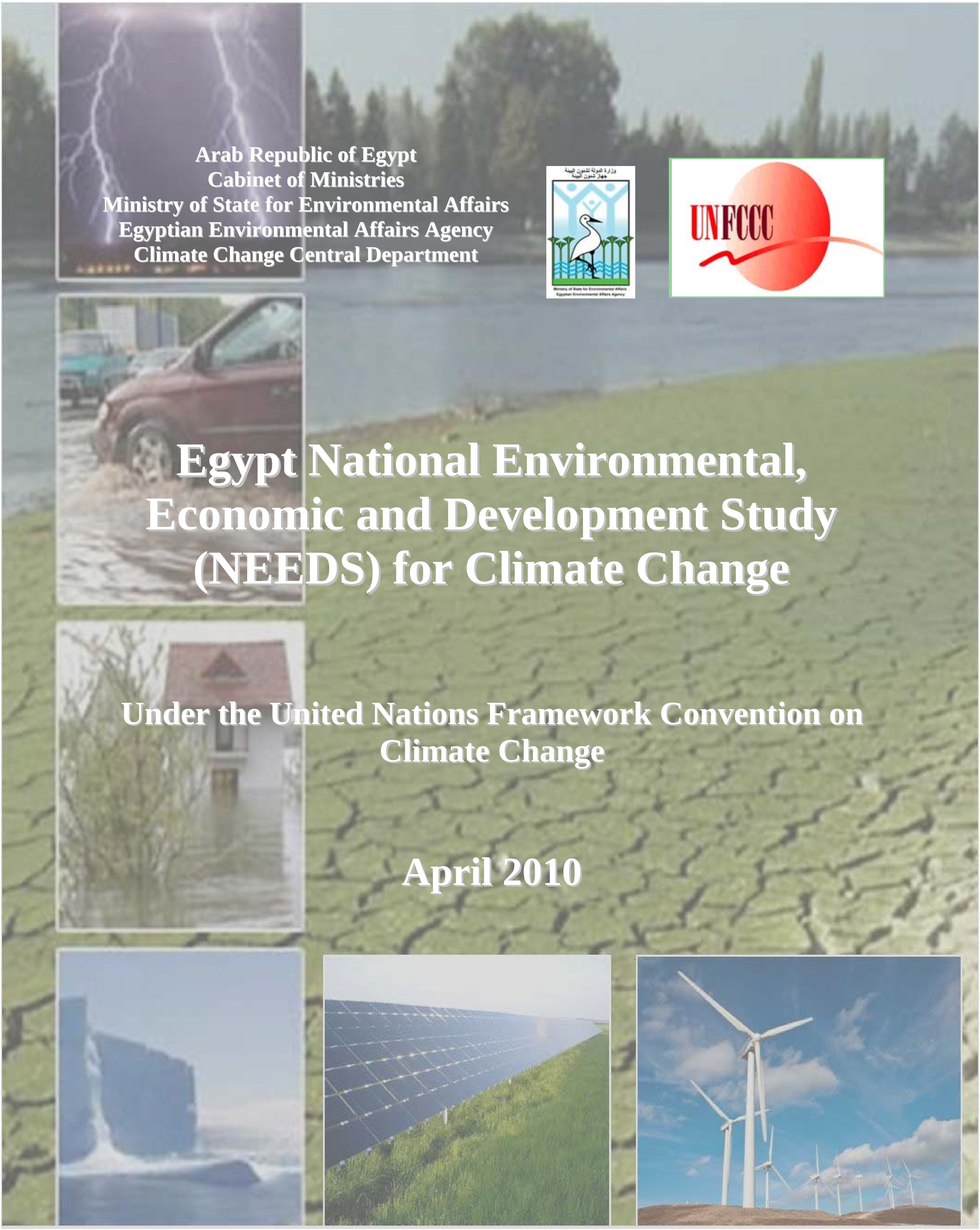

Arab Republic of Egypt
Cabinet of Ministries
Ministry of State for Environmental Affairs
Egyptian Environmental Affairs Agency
Climate Change Central Department

Egypt National Environmental, Economic and Development Study (NEEDS) for Climate Change

Under the United Nations Framework Convention on Climate Change

April 2010

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Abbreviations

APMAU	Adaptation Policy Monitoring and Assessment Unit
BAU	Business as Usual
BOOT	Build-Own-Operate-Transfer
CDM	Clean Development Mechanism
CH_4	Methane
CIF	Climate Investment Fund
CO_2	Carbon dioxide
CO_2e	Equivalent carbon dioxide
CTF	Clean Technology Fund
EIA	Environmental Impact Assessment
EMS	Energy Management System
ESCO	Energy Service Company
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	Greenhouse gas
HFCs	Hydrofluorocarbons
ICCSS	Integrated combined cycle solar system
kWh	Kilowatt hour
LE	Egyptian pound
MENA	Middle East and North Africa
$MtCO_2e$	Million tons carbon dioxide equivalent
MW	Megawatt
N_2O	Nitrous oxide
NAPA	National Action Plan for Adaptation
NEAP	National Environmental Action Plan
NEEDS	National Environmental, Economic and Development Study
NGOs	Non Governmental Organizations
PFCs	Perfluorocarbons
PV	Photovoltaic
RCM	Regional circulation models
SF_6	Sulphur hexafluoride
SNAP	Support for National Action Plan
SNC	Second National Communication
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
US$	United States dollars
USAID	Unites States Agency for International Development

A. Executive Summary

A.1. Overview

In 1999 Egypt produced its "Initial National Communication", following a number of relevant documents in this regard, such as the First National Environmental Action Plan (NEAP), the Support for National Action Plan (SNAP). Currently, Egypt has just finished the "Second National Communication" (SNC) to the UNFCCC. In this respect, this report is a study of the national environmental, economic and development aspects of climate change. It is primarily based on the outputs of the SNC and the related background papers, with the economic analysis specifically carried out here in order to address the associated financial needs.

Under the Egyptian conditions, designing an adaptation strategy for the coastal zones and the agriculture sector should focus on the simple and low cost adaptation measures, which may be inspired by traditional knowledge, meeting local conditions and being compatible with sustainable development requirements. To enhance the planning of adaptation strategies for these sectors under Egyptian conditions, it is important to improve the scientific capacity, use a bottom-up approach, develop community-based measures by stakeholders' involvement in adaptation planning, as well as increasing public awareness and the adaptive capacity of the community.

Adaptation priorities for coastal zones and the agriculture sector in the adaptation entail: conducting a national program for integrated coastal zones management; improving current crop patterns; developing a calendar to be adapted to the projected climate changes; improving the on-farm irrigation system; and developing a special fund program for adaptation and risk reduction activities for coastal zones and the agriculture sector.

With regards to the Energy sector, Egypt's Strategy for Energy Supply and Use comprehensively integrated the main policies and measures that could meet the longer term challenges. These include security of energy supplies; sustainability of current energy usage; and the abatement of GHG emissions**.** Further reductions of GHG emissions from the energy sector up to the year 2027 can be achieved through numerous actions, which are prioritized in Egypt's mid-term strategy to include renewable energy; energy efficiency; lower carbon fuels; nuclear power; and improved transportation fleets.

Within the energy sector, current GHG emissions status is dependent on the fact that the energy system of Egypt is characterized by relying heavily on hydrocarbon resources for fuelling economic and social development. In this respect, estimates for the expected growth of consumption during the period (2006/07-2026/27) were made according to 3 different scenarios.

(i) The base case: represents country implementation capacity at the business as usual (BAU) scenario. It includes technology options such as wind farms with a capacity of producing 220 MW annually, a nuclear power plant with a 1000 MW capacity up to 2017, and solar energy, among others.

(ii) Scenario II: includes additional options to meet the country's actual demand needs and promote energy efficiency, such as options to increase wind farm capacity by 500 MW annually and nuclear power capacity by 400 MW' annually till 2026, as well as energy management systems (EMS). (adopting these innovative technologies into the local context needs international financial and technological support)

(iii) Scenario III: adds *more* innovative technologies to promote clean energy production beyond 2020 and includes options such as grid-connected PV and fuel cells. *Group 4* includes measures to support capacity and institutional building in the energy sector. However, since options of this last group do not have stated abatement targets, the group was excluded from the economic and financial analysis. (Necessitating international financial and technological support)

Projections of GHG emissions under the Business As Usual (BAU) module lead to hydrocarbons consumption amounting to about 251, 205 and 192 million tons of CO_2 in 2026/2027 for the three scenarios respectively, with the projected GHG emissions for the period (2006/07-2026/27) being about 691, 568 and 535 million tons of CO_2 for each of the three scenarios, respectively.

Abatement alternatives at 2020 and 2050 time horizons rely on 10 mitigation priority programs identified as a result of NEEDS assessment for climate change. These programs comprise the large-scale grid-connected wind farms; integrated combined cycle solar system (ICCSS) plants; the expansion of the use of domestic solar water heating units; the expansion of the use of photovoltaic systems for different applications; the expansion of the use of efficient lighting systems; the construction of nuclear power plants; the construction of gas-fired combined cycle power plants and gas-fired steam thermal power plants; and the replacement of aging taxi vehicles in the Greater Cairo Region.

As for vulnerability and adaptation assessments and scenarios, these comprise the following:
For the water sector, the vulnerability of Egypt's water resources to climate change entails those affecting Nile flows, rainfall, and ground water resources. Different ideas considered for adaptation fall within the management of water storage capacities; improving irrigation and draining systems; developing new water resources; as well as a number of soft interventions. As for the agriculture sector, climate change studies predict a reduction in the productivity of two major crops in Egypt: wheat and maize by 15% and 19% respectively by 2050. Moreover, projected temperature rises are likely to increase crop-water requirements thereby directly decreasing crop water use efficiency and increase irrigation demands of the agriculture sector. Additionally, temperature increases is expected to have adverse effects on livestock and fish production. The most important adaptation measures being considered in this sector include changing sowing dates and cultivars; improving surface irrigation system efficiencies and applying deficit irrigation; and improving the current low productivity cattle and buffalo's breeds. Further studies on the impacts, vulnerability, and adaptation to climate change are still needed in the agriculture sector in order to be able to develop an effective adaptation strategy for the sector. As for coastal resources, these are expected to suffer direct impacts through sea level rise and inundation of low elevation areas, as well as indirect impacts such as salt water

intrusion and contamination of ground water resources. These impacts are expected to lead to the immigration of 6 to 7 million people from the Nile Delta. Necessary adaptation policies entail changes in land use; integrated coastal zones management, and proactive planning for protecting coastal zones. For the tourism sector, coral reefs, constituting a major attraction in Red Sea resorts, are highly vulnerable to climate change. In addition, sea level rise on the low elevation Mediterranean coast will definitely lead to losses of beaches. Increasing frequencies and severity of extreme events are expected to negatively impact the archaeological heritage in Egypt. For the health sector, climate change will contribute to the burden of diseases in Egypt through direct and indirect effects. Increased incidence of diseases associated with climate change include communicable diseases; such as parasitic, bacterial and viral diseases, and non-communicable diseases; such as cardiovascular diseases, respiratory diseases, cancers, and malnutrition.

A. 2. Key Findings on Cost of Implementing Priority Mitigation and Adaptation Measures

For the energy sector, several mitigation measures were proposed by sector experts, varying from utilizing cleaner fossil fuel systems such as clean-coal technologies and nuclear power for energy generation to utilizing renewable energy sources such as wind and solar power, to fuel switching to natural gas. Adaptation measures varied from energy efficiency and demand side management actions to institutional and regulatory reform actions. Abatement measures were encoded with numbers to facilitate data tabulation and preserve the confidential nature of the cost data. Not all measures were included in the analysis as the data needed to calculate the cost was not sufficient or the abatement potential of the measure could not be determined.

Mitigation priority technology options to abate GHG emissions were classified by the energy experts into four groups based on the country's energy demand objectives and financing mechanisms. The first group includes programs for meeting country's actual demand, and represents country implementation capacity and the business as usual (BAU) scenario. It includes technology options such as wind farms with an installed capacity of 700 MW’s annually, a nuclear power plant with a 1000 MW capacity up to 2017, gas-fired combined cycle (GFCC) power plants, gas-fired steam thermal (GFST) power plants, integrated combined cycle solar system (ICCS) plants and Photovoltaic system. Finance for these programs is guaranteed through normal financing mechanism. The second group or scenario includes additional options for achieving more cuts of CO_2 through energy efficiency and renewable, such as expanding the use of efficient lighting systems, replacing again taxi vehicles in Cairo, expanding the use of solar water heating units and energy management systems (EMS), among others. Finance for these programs is needed. The third group adds innovative technologies to achieve more CO_2 cuts and promote clean energy production beyond 2020 and includes options such as grid-connected PV, clean oil shale technology, fuel cells, and CO_2 capture and storage. Financing for these programs is needed. The forth group includes measures to support capacity and institutional building in the energy sector. It includes programs such as customer-focused education, GHG mitigation research, management performance and efficiency and/demand-side management (DSM) regulations and incentives. Finance for the fourth group of mitigation options is also needed. In order to facilitate the economic analysis, mitigation programs are divided into two groups or scenarios only: a business as usual (BAU) scenario and a scenario for achieving more CO_2 cuts (which basically includes programs from the second, third and fourth groups above).

Abatement options were collated by group or scenario in order to facilitate comparisons among abatement scenarios in terms of the potential abatement achieved and aggregate abatement cost. It should be noted, however, that these scenarios or groups of abatement options should not be treated as complete substitutes with regard to their potential levels of abatement or energy capacities, but rather as complements. The choice of which measures or combinations of measures to implement will depend on their comparative cost-efficiency in terms achieving the targeted level of CO_2 abatement (reduction) at the lowest possible cost.

Total financial needs required to implement priority mitigation measures in the energy sector are estimated at 420 million US dollars annually till the year 2020 for an aggregate abatement of 4.5 million tons of Co2 equivalent emissions of GHGs, annually. This amounts for an average abatement cost of $94 per ton of Co2 reduction. Extrapolating these figures into the future, projected financial needs for mitigation measures in the energy sector are estimated to be 4.2 and 12.6 billion dollars for the 2020 and 2050 time horizons, respectively. It should be noted that these estimates of abatement costs were based on the cost of electricity (COE) production, and did not include other environmental costs (or benefits) that arise from adopting a specific measure or technology.

A. 3. Key Findings on Financial and Policy Instruments for Addressing Climate Change

Existing financial and policy instruments available on the local, national, regional and international levels that are being used to address climate change impacts comprise the national budget; international cooperation (bilateral and multilateral); the financial mechanism of the UNFCCC; the Adaptation Fund,; the Clean Development Mechanism ; other relevant funds established by the World Bank; the international adaptation fund by the Convention for vulnerable countries; as well as the international fund for Technology Transfer.

There is public recognition of the potential vulnerability of the agriculture sector, coastal zones and the Nile basin due to possible climate changes. This is recognized by high level policy makers and there are efforts underway to address climate change issues in national plans. Additionally, sector and legislative reforms are being carried out on a national level aiming at encouraging private-public partnership and enhancing private sector involvement in climate change mitigation and adaptation projects.

A. 4. Institutional Framework

In 1992, Egypt established a climate change unit in the Egyptian Environmental Affairs Agency, representing the focal point of the UNFCCC and Kyoto Protocol, aiming at coordinating and integrating all national and international activities relevant to climate change. This unit has recently been upgraded to be a central department for climate change. Meanwhile Egypt established a National Committee of Climate Change in 1997, and restructured it in 2007 to supervise the climate change policies. Additionally, in 2005 Egypt established the designated national authority for clean development mechanism to benefit from KP. Both committees are headed by the Minister of State for Environmental Affairs and are composed of high level representatives from different relevant sectors including the scientific community.

Egypt is facing increasing challenges with regards to climate change. In this respect, adaptation issues together with the need to develop capacities to be able to properly address them are of particular significance. Potential institutional arrangements, additional to existing ones, which would be conducive to this end, include the establishment of an independent national scientific and technological committee to offer advisory support to top level decision makers. Additionally, the establishment of a virtual national virtual centre of excellence focusing on the different aspects of climate change is planned. This center would allow networking with existing research institutes in sectors relevant to climate change, as well as represent a think tank for decision makers to determine and prioritize climate change needs and the policy instruments for meeting these needs.

A. 5. Lessons Learned

Challenges and opportunities include extending the NEEDS project to cover other important sectors; establishing a virtual centre of excellence for climate change information networked with other relevant databases in different sectors, national, regional and international; mainstreaming climate change activities into national action plans; and increasing public awareness and fostering monitoring and observation systems for climate change.

It was noticed during the implementation of this project that there is no system that could monitor climate change greenhouse gases from different sectors systematically, such a system could have facilitated the follow up of investigating the impacts of climate changes on such sectors,

Data basis of experts, knowledge or research work related to climate change does not exist sufficiently. Such a data system will pave the road towards the assessing the capacity needs and requirements,

Possible next steps include developing a national strategy for climate change; developing a national action plan for adaptation (NAPA) and a national low carbon economy plan; and establishing a strong information dissemination system for climate change and its impacts on agriculture.

B. Overview

B.1 National Policy Framework

In 1999 Egypt produced its "Initial National Communication", following a number of relevant documents in this regard, such as the National Environmental Action Plan (NEAP), the Support for National Action Plan (SNAP). Currently, Egypt has just finished the "Second National Communication” (SNC) to the UNFCCC. In this respect, this report is a study of the national environmental, economic and development aspects of climate change. It is primarily based on the outputs of the SNC and the related background papers, with the economic analysis specifically carried out here in order to address the associated financial needs.

B.2. National Development Plans and Priorities in the Context of Climate Change

Sectors strategies and policies are set for national development with mitigation goals taken into consideration.

As a non-annex I country, Egypt is not requested to meet any specific emission reduction or limitation targets in terms of its commitments under the UNFCCC or the Kyoto protocol. However, mitigation measures based on national plans are already in progress, and accelerated developments are taking place for introducing renewable sources of energy; fuel switching in industry and transport from oil to natural gas; implementing domestic and industrial energy efficiency programs; promoting energy-efficient buildings; and developing agriculture and plantation schemes aiming at enhancing public participation and cooperation with the purpose of creating low carbon economic structure that prioritizes energy efficiency.

Since the late 1990s the most significant mitigation measures implemented primarily fall within the energy sector. They comprise fuel substitution of oil with natural gas in the electricity generation and the industrial sector; combined heat and power generation; efficient lighting systems; the use of large-scale grid-connected wind farms in electricity generation; steam condensate recovery; the use of solar thermal energy in electricity generation; the use of natural gas in commercial vehicles as well as extending the underground metro lines. In addition, mitigation of CO_2 and CH_4 emissions from rice cultivation and livestock and increasing the country's CO_2 absorptive capacity through planting trees have been carried out.

With regards to the energy sector, the Supreme Council for Energy adopted in 2007 a strategy for energy supply and use which comprehensively integrates the main policies and measures that could meet the longer term challenges facing the national energy industry. The strategy confirms the ongoing activities, adding to them nuclear power generation, carbon capture and storage, the reduction of electricity losses through transmission and distribution systems and demand-side management. The adoption of these innovative technologies into the local context necessitates international financial and technological support.

For the industrial sector, a series of policies and measures have been adopted over the years to result in a general decrease in GHG emissions per unit of product in industrial processes and product use (excluding those related to energy). The main barriers that currently prevent the industrial sector from achieving full energy conservation and considerable GHG emissions reduction include a lack of information about GHG emissions reduction opportunities in the sector; long payback periods on some GHG emissions reduction investments; and financial barriers such as the lack of access to investment capital and/or high interest rate on investments.

With regards to the transport sector, energy intensity in this sector in Egypt is particularly high due to the low efficient-engines using hydrocarbons fuels, and the fact that it relies heavily on road transport as the main means of transportation in Egypt. Based on a Cabinet of Ministers decision, the Ministry of Transport adopted a strategy for improving national transport and urban traffic, in addition to achieving the control of exhaust emissions from road-going vehicles. The strategy includes improving public transport; improving energy efficiency; fuel switching; the development and use of new propulsion technologies; the development of rail transport and new methods for freight transport; the development of power train technologies; shifting from diesel to electrified railways; and the development and use of fuel cells technology.

In the agricultural sector, national efforts yielded positive impacts on the mitigation of GHG from paddy rice cultivation, livestock production, and soil management. Other mitigation efforts include improving feeding patterns and technologies to enhance veterinary care, and improving breeding programs for livestock production; sustaining rice cultivated areas under 1.47 million acres, then reducing these to 1.26 million acres by 2017 while switching from conventional cultivars to short duration cultivars, applying intermittent irrigation. Barriers of implementing mitigation policies in the agriculture sector include institutional capacity constrains; the limited awareness of the sector stakeholders of the threats of climate change; the limited ability of the agriculture sector to get support from the current UNFCCC and Kyoto Protocol mitigation fund mechanisms; as well as the limited knowledge and technology levels of the small farmers.

In the waste sector, the Egyptian relevant ministries, in collaboration with concerned governorates, have developed several plans and programs over the past ten years to improve the process of collection, reuse and recycling of waste. There are however several barriers to achieving the goals of these programs. These include financial constraints for the mitigation of GHG emissions from the waste sector; the significant dependence on external financial support (such as grants and concessionary loans) complicating the planning process and slowing down implementation; limited public awareness about the economic benefits of reuse and recycling of waste leading to a hesitation of funding institutions in considering waste management activities as viable options; the need of technology transfer and high investments for some waste treatment options, such as anaerobic digestion; the weak enforcement of existing laws and regulations for violations in handling waste.

B. 3. GHG Status

Assessment of GHG emissions for Egypt in the year 2000 revealed that the total emissions in the year 2000 were about 193 MtCO_2e, compared to about 117 MtCO_2e in 1990, representing an average increase of 5.1% annually. Estimated total GHG emissions in 2008 are about 288 MtCO_2e. GHG emissions by gas type reveal that CO_2 represents 66% of emissions, with CH_4 representing 20%, N_2O representing 13%, PFCs representing 1%, SF_6 representing 0.06% and HFCs representing 0.03%.

The energy sector is the primary contributor to emissions of GHGs in Egypt, followed by agriculture, industrial processes and then the waste sector. GHG emissions per capita show a 37% increase in the year 2000 relative to 1990. Meanwhile, GHG emissions per thousand US$ of Egypt GDP went down from 3.32 ton CO_2e to 1.98 ton CO_2e indicating the use of low carbon activities. The share of Egypt in the total world GHG emissions in 1990 was 0.4% and was still limited to 0.58% in 2000.

B. 4. Projection and Mitigation Scenarios for the Energy Sector

A focus is placed on the energy sector, as it represents the primary contributor to GHG emissions in Egypt. In this respect, this sector is characterized in Egypt by a heavy reliance on hydrocarbon resources for fuelling economic and social development. Estimates for expected growth of consumption during the period (2006/07-2026/27) were made according to three different scenarios:

(i) The base case: represents country implementation capacity at the business as usual (BAU) scenario. It includes technology options such as wind farms with a capacity of producing 220 MW annually, a nuclear power plant with a 1000 MW capacity up to 2017, and solar energy, among others.

(ii) Scenario II: includes additional options to meet the country's actual demand needs and promote energy efficiency, such as options to increase wind farm capacity by 500 MW annually and nuclear power capacity by 400 MW' annually till 2026, as well as energy management systems (EMS). (adopting these innovative technologies into the local context needs international financial and technological support)

(iii) Scenario III: adds *more* innovative technologies to promote clean energy production beyond 2020 and includes options such as grid-connected PV and fuel cells. *Group 4* includes measures to support capacity and institutional building in the energy sector. However, since options of this last group do not have stated abatement targets, the group was excluded from the economic and financial analysis. (necessitating international financial and technological support).

Projections of GHG emissions under the Business As Usual (BAU) module lead to hydrocarbons consumption amounting to about 251, 205 and 192 million tons of CO_2 in 2026/2027 for the three scenarios respectively, with the projected GHG emissions for the period (2006/07-2026/27) being about 691, 568 and 535 million tons of CO_2 for each of the three scenarios, respectively.

Abatement alternatives at 2020 and 2050 time horizons rely on 10 mitigation priority programs identified as a result of NEEDS assessment for climate change. These programs comprise the large-scale grid-connected wind farms; integrated combined cycle solar system (ICCSS) plants; the expansion of the use of domestic solar water heating units; the expansion of the use of photovoltaic systems for different applications; the expansion of the use of efficient lighting systems; the construction of nuclear power plants; the construction of gas-fired combined cycle power plants and gas-fired steam thermal power plants; and the replacement of aging taxi vehicles in the Greater Cairo Region.

B. 5. Vulnerability and Adaptation Assessments:

Vulnerability and adaptation measures to climate change in Egypt comprise the following:

For water resources, the total fresh water budget in Egypt is estimated at about 58 billion m^3 per year, with a total annual consumption of 78 billion m^3. The annual per capita share of fresh water is 700 m^3 per year. By considering the expected population growth, this value is estimated to become 350 m^3 in 2040, without considering climate change impacts on Egypt's water resources. The vulnerability of Egypt's water resources to climate change entails those affecting Nile flows (hypersensitivity to Ethiopian rain; sensitivity to temperature increase in equatorial lakes and Bahr El Ghazal, and uncertainty due to significant differences in the Global Circulation Models output of water flow into the Nile), rainfall (the possibility of a 50% reduction of rainfall on Egypt's Mediterranean coast), and ground water (increased levels and salinity due to sea level rise and consequent sea water intrusion). Different ideas are being considered for the adaptation to the reduction of water resources or the increase of Nile flows. These primarily include: keeping the water level in Lake Nasser low; increasing water storage capacity; improving irrigation and draining systems; changing cropping patterns and farm irrigation systems; reducing surface water evaporation by a redesign of canal cross section; developing new water resources through upper Nile projects, rain harvesting, desalination, wastewater recycling, increased use of deep groundwater reservoirs; and using a number of soft interventions such as increasing public awareness about the need for rational use of water, enhancing precipitation measurement networks in upstream countries of the Nile Basin, encouraging data exchange between Nile Basin countries, and developing Circulation Models for the prediction of the impact of climate change on the local and regional water resources.

For the agriculture sector, climate change studies predict a reduction in the productivity of two major crops in Egypt: wheat and maize by 15% and 19% respectively by 2050. Losses in crop productivity are mainly attributed to the projected temperature increase, crop-water stress, pests and disease, as well as the inundation and Stalinization of 12% to 15% of the most fertile arable land in the Nile Delta as a result of sea level rise and salt water intrusion. Projected future temperature rises are likely to increase crop-water requirements thereby directly decreasing crop water use efficiency and increase irrigation demands of the agriculture sector. Crop water requirements of the important strategic crops in Egypt are expected to increase by a range of 6% to 16% by 2100. The high vulnerability of on-farm irrigation systems in Egypt is attributed to low efficacy and irrigation management patterns. For livestock production, current evidence shows that temperature increases induce harmful heat stress impacts on animals' productivity. New animal diseases emerged in Egypt, and have strong negative impacts on livestock production. These are the blue tongue disease and rift valley fever. Both are attributed to some observed changes in the Egyptian climate. The availability of fodder is subject to decrease due to climate change impacts on crops productivity, and higher competition for land and water resources between fodder and cereal crops. Climate change is expected to increase sea temperature causing fish distribution to shift northwards and to go into deeper waters. In addition, increased water salinity in the coastal lakes in Egypt is expected to affect fish population and species in these lakes.

Modest efforts and steps are taking place in scientific research related to climate change mitigation and adaptation in the agriculture sector in Egypt. Changing sowing dates and management practices are among the important adaptation measures oriented to mitigate the impact of climate change. Changing cultivars to those tolerant to heat, salinity and pests, and changing crop pattern are the most promising adaptation measures at the national level. Moreover, using different combinations of different levels of improved surface irrigation system efficiencies and applying deficit irrigation are considered as means of increasing the capacity of surface irrigation system in old land in order to overcome the negative impacts of climate change. For livestock, improving the current low productivity cattle and buffalo's breeds and the feeding programs are being considered. No clear adaptation options have been defined for fisheries. Further studies on the impacts, vulnerability, and adaptation to climate change are still needed in the agriculture sector in order to be able to develop an adaptation strategy for the sector addressing the barriers to implementing adaptation measures. These barriers include limited scientific information; policy perceptions; poor adaptive capacity and lack of financial support.

Table (B.1): Impact of climate change on the Nile Delta: affected area according to a "worst case" (A1F1) scenario and "considering adaptation measures" (A1M1) scenario.[1]

Year	**2025**		**2050**		**2075**		**2100**	
	A1F1	A1M1	A1F1	A1M1	A1F1	A1M1	A1F1	A1M1
Total area affected (km^2)	701	153	767	256	2348	450	2938	761
Fraction of the total Nile Delta area (%)	2.8	0.6	3.1	1.0	9.4	1.8	11.8	3.0

- [1] There are four groups of scenarios developed by the Intergovernmental Panel for Climate Change (IPCC), and known as SRES published by IPCC (http://www.grida.no/publications/other/ipcc%5Fsr/?src=/Climate/ipcc/emission/016.htm). The four groups are A1, A2, B1, and B2, The A1 groups are distinguished by their technological emphasis - on coal (A1C), oil and gas (A1G), non-fossil energy sources (A1T), or a balance across all sources (A1B). The A1C and A1G scenario groups are combined into one fossil intensive group A1FI. All scenario groups are equally sound.

Table (B.2): Projected changes in crop production of some major crops in Egypt under climate change conditions.

Crop	Change %	
	2050s	2100s
Wheat	- 15%*	- 36%**
Rice	- 11%	
Maize	- 14%	- 20%
Soybeans	- 28%	
Barley	- 20%	
Cotton	+ 17%*	+ 31%**

* Temperature increase by 2°C
** Temperature increase by 4°C

Coastal resources are expected to suffer direct impacts through sea level rise and inundation of low elevation areas. It is estimated that a sea level rise of 50 cm combined with local Nile Delta subsidence present serious impacts on low land Delta regions and adjacent highly populated cities such as Alexandria and Port Said. Coastal zones are expected to suffer from indirect impacts such as salt water intrusion and contamination of ground water resources, exacerbating soil salinity and affecting food security. In addition, the increase in frequency and severity of storm surges will definitely impact coastal structures. Furthermore, coastal areas below sea level constitute high risk areas. Direct and indirect impacts are expected to lead to the immigration of 6 to 7 million people from the Nile Delta. As for adaptation options, it is realized that these are site dependant. However, changes in land use, integrated coastal zones management, and proactive planning for protecting coastal zones, are necessary adaptation policies. The creation of job opportunities in safe areas is considered an important priority for successfully absorbing migrant populations.

For the tourism sector, coral reefs, constituting a major attraction in Red Sea resorts, are highly vulnerable to climate change. On the other hand, sea level rise on the low elevation Mediterranean coast will definitely lead to losses of beaches. In addition the impact of increasing temperatures and frequencies and severity of extreme events are expected to negatively impact the archaeological heritage in Egypt.

For the health sector, climate change will contribute to the burden of diseases in Egypt through direct and indirect effects. Direct impacts are perceived to include heat strokes and heat related phenomena especially to the elderly and children, skin cancers, eye cataracts and deaths. The indirect impacts are perceived to be mainly linked with the shortage of water supply and decreased agricultural land area leading to shortage of essential food with the possible emergence of malnutrition. Increased incidence of diseases associated with climate change include communicable diseases; such as parasitic, bacterial and viral diseases, and non-communicable diseases; such as cardiovascular diseases, respiratory diseases, cancers, and malnutrition.

The following additional adaptation policies and measures are being considered by national authorities in Egypt: building institutional capacities for integrated monitoring and geographic data collection and analysis, identifying indicators and carrying out full assessment of vulnerable sectors, sites and stakeholders; enforcing environmental regulations, identifying and carrying out protection measures of vulnerable touristic and archaeological sites and roads against extreme events (flash floods, dust storms and storm surges); building capacities on regional circulation models, proactive planning, integrated coastal zone management and risk reduction; upgrading resilience of stakeholders through increased awareness of energy and water conservation needs, improving health and socioeconomic infrastructure, establishing employment opportunities in safe areas, strengthening research institutions particularly in areas of renewable energy and the establishment of early warning systems, as well as improving the management of Red Sea diving sites.

C. Key Findings on Cost of Implementing Priority Mitigation and Adaptation Measures

C.1. Cost of Implementing Priority Mitigation Measures

Total financial needs required to implement priority mitigation measures in the energy sector are estimated at 420 million US dollars annually till the year 2020 for an aggregate abatement of 4.5 million tons of Co2 equivalent emissions of GHGs, annually. This amounts for an average abatement cost of $94 per ton of Co2 reduction. Extrapolating these figures into the future, projected financial needs for mitigation measures in the energy sector are estimated to be 4.2 and 12.6 billion dollars for the 2020 and 2050 time horizons, respectively. It should be noted that these estimates of abatement costs were based on the cost of electricity (COE) production, and did not include other environmental costs (or benefits) that arise from adopting a specific measure or technology.

C.1.1 Identifying and Collating Mitigation Measures

For the energy sector, several mitigation measures were proposed by sector experts, varying from utilizing cleaner fossil fuel systems such as clean-coal technologies and nuclear power for energy generation to utilizing renewable energy sources such as wind and solar power, to fuel switching to natural gas. Adaptation measures varied from energy efficiency and demand side management actions to institutional and regulatory reform actions. Abatement measures were encoded with numbers to facilitate data tabulation and preserve the confidential nature of the cost data. Not all measures were included in the analysis as the data needed to calculate the cost was not sufficient or the abatement potential of the measure could not be determined.

Mitigation priority technology options to abate GHG emissions were classified by the energy experts into four groups based on the country's energy demand objectives and financing mechanisms. The first group includes programs for meeting country's actual demand, and represents country implementation capacity and the business as usual (BAU) scenario. It includes technology options such as wind farms with an installed capacity of 700 MW’s annually, a nuclear power plant with a 1000 MW capacity up to 2017, gas-fired combined cycle (GFCC) power plants, gas-fired steam thermal (GFST) power plants, integrated combined cycle solar system (ICCS) plants and Photovoltaic system. Finance for these programs is guaranteed through normal financing mechanism. The second group or scenario includes additional options for achieving more cuts of CO_2 through energy efficiency and renewable, such as expanding the use of efficient lighting systems, replacing again taxi vehicles in Cairo, expanding the use of solar water heating units and energy management systems (EMS), among others. Finance for these programs is needed. The third group adds innovative technologies to achieve more CO_2 cuts and promote clean energy production beyond 2020 and includes options such as grid-connected PV, clean oil shale technology, fuel cells, and CO_2 capture and storage. Financing for these programs is needed. The forth group includes measures to support capacity and institutional building in the energy sector. It includes programs such as customer-focused education, GHG mitigation research, management performance and efficiency and/demand-side management (DSM) regulations and incentives. Finance for the fourth group of mitigation options is also needed. In order to facilitate the economic analysis, mitigation programs are divided into two groups or scenarios only: a business as usual (BAU) scenario and a scenario for achieving more CO_2 cuts (which basically includes programs from the second, third and fourth groups above).

Abatement options were collated by group or scenario in order to facilitate comparisons among abatement scenarios in terms of the potential abatement achieved and aggregate abatement cost. It should be noted, however, that these scenarios or groups of abatement options should not be treated as complete substitutes with regard to their potential levels of abatement or energy capacities, but rather as complements. The choice of which measures or combinations of measures to implement will depend on their comparative cost-efficiency in terms achieving the targeted level of CO_2 abatement (reduction) at the lowest possible cost.

C.1.2 Mitigation Potential and Total Abatement Cost

To facilitate comparison among the different mitigation measures, annual CO_2 reduction and the corresponding annual abatement costs were calculated for each measure or technology. Not all measures were included in the economic analysis; only measures for which GHG reductions and GHG abatement costs could be calculated. Also, only measures or technologies used for power generation were included in the analysis, since the cost structure for other measures (such as efficient lighting and CO_2 capture) is different and as such cannot be compared to a reference technology in order to compute the incremental cost associated with CO_2 reduction. Table-9 details the mitigation measures and the associated abatement levels and annual abatement costs for the two scenarios or groups of mitigation technologies considered for economic analysis in the energy sector. Six measures representing the business as usual (BAU) scenario-GFCC, GFST, wind farms, ICCS, photovoltaics and nuclear- as well as 3 measures representing the scenario for achieving more cuts of CO_2- gird-connected PV, clean oil shale and fuel cells were included in the analysis as shown in Table C.1.

CO_2 abatement cost is the incremental cost of CO_2 reduction in power plants, and was derived by comparing the cost of electricity (COE) production with and without CO_2 reduction. In other words, each mitigation technology considered was compared to a reference technology that emits more CO_2 per unit of power generated. Since natural gas is the dominant fuel used for electricity generation in Egypt currently, the two gas-fired power generation technologies in the BAU scenario, gas-fired combined cycle (GFCC) power plants and gas-fired steam thermal (GFST) power plants, were used as reference technologies for other technologies included in the analysis such as nuclear power, solar systems, wind farms and the others. Each mitigation technology was assumed to be replacing 50% of power generated using GFCC and 50% of power generated using GFST. For example, the 700 MW yearly capacity for wind farms is assumed to replace 350 MW of GFCC capacity and 350 MW of GFST capacity. For the GFCC and GFST power plants, the reference technology is using fuel oil instead of natural gas in power plants at approximately the same costs. Thus by replacing fuel oil with natural gas in power plants, CO2 reduction is an incidental benefit. For calculating the incremental cost associated with CO2 reduction, COE equals the production cost (O&M plus fuel) and is assumed to represent 40% of the total required cost (based on previous studies in the literature that analyzed the economics of CO2 reduction at power plants).

C.1.3 Methodology

The method utilized in this study is the derivation of abatement cost curves. Abatement cost curves can be used to estimate the cost of reaching a required level of abatement, and to determine the most efficient route to achieve this level (Beaumont and Tinch, 2004). The conceptual basis for deriving abatement cost curves is cost effectiveness analysis. Cost effectiveness analysis basically focuses on producing a predetermined or required target at the lowest possible cost. In the case of abatement cost curves, the target is the required level of abatement or emission reduction. Abatement cost curves allow the direct evaluation of the impact of abatement measures on the economy and facilitate negotiations between government regulators and industries. The production of abatement curves also increases awareness of abatement technologies, which in turn improves the likelihood of reaching a win-win situation for both industry and environment.

The method and accuracy of estimating the cost of abatement measures varies with the type of measure. Some measures or technologies have big investment or initial cost and low cost of operation, others have costs that are fairly distributed over the life of the technology, and some others have costs that decrease as time goes and the industry gets more efficient in using and developing the technology. The production of abatement cost curves requires the standardization of abatement costs across all technologies so that comparability and compatibility analyses could be done. Abatement measures are usually adopted for a period of years, making it necessary to determine the lifetime of the capital equipment and to estimate the cost of capital employed. This pigs the question of the appropriate discount rate to use: for the entity providing finance (national or international) the cost of capital may be greater than the social discount rate, which is more appropriate when dealing with environmental or social issues.

Significant assumptions are generally required in order to derive abatement cost curves. First, there is the assumption of the appropriate discount rate to use, social or commercial. Second, abatement technologies are not always compatible with the industry or with each other, making it necessary to take this into consideration when a cost-effective combination of technologies is to be applied. Also, secondary effects whether negative or positive, of applying some abatement measures have to be taken into account and included in the calculation of abatement costs, if possible. Examples of detrimental side effects are increasing the production of different pollutants and the premature replacement of equipment. Increased energy efficiency can result as a positive side effect of some abatement measures.

In the current study, an integrated stepwise methodology was applied, as adapted from Beaumont and Tinch (2004) and Wickborn (1996) in order to derive GHG abatement cost curves for the energy sector in Egypt. This methodology comprised the following 5 steps:

1- Identify the types of mitigation and/or adaptation measures, as provided by energy sector experts.
2- Collate all available mitigation/adaptation measures.
3- Calculate the total cost of abatement for all techniques, and identify possible combinations and incompatibilities.
4- Standardize and manipulate data.
5- Derive the abatement cost curves.

C.1.4 Economic Model Results

Excluding GFCC and GFST power plants as reference technologies in the BAIT scenario, CO_2 reduction cost is lowest for ICCS plants at $87/ton and highest for wind farms at $71 I/ton. In the scenario for achieving more CO_2 cuts, reduction cost is lowest for grid-connected PV at $41 Aon and highest for fuel cells at $173/ton. Considering all measures for mitigation, abatement cost is lowest for grid-connected PV and highest for wind farms. The average cost of CO_2 reduction for all measures considered is $94/ton.

However, it is worth noting that for all measures, except for GFCC and GFST, these cost figures represent the cost of incremental CO_2 reductions beyond the reductions achieved through GFCC and GFST technologies. In other words, the cost of CO_2 reduction through GFCC and GFST technologies, though stated as zero in the table, is somehow incorporated in the cost of CO_2 reduction for other mitigation measures.

With regard to estimating the financial needs for mitigating GHG emissions in the energy sector, Table C.1 shows that implementing all mitigation measures considered will require $420 million annually to achieve a total reduction of 4.5 million tons of CO_2 equivalent emissions per year. Extrapolating these estimates into the future, the projected financial needs for mitigation options in the energy sector are estimated at $4 billion and $12 billion for the 2020 and 2050 time horizons, respectively, as shown in Table C.3.

Table (C.1)*: Abatement Cost Estimates for GHG Mitigation Priority Options in the Energy Sector*

code	**Measure/ Technology**	**Yearly Capacity (MW)**	**Technology Co2 Abatement (tons/MW)**	**Reference Technology Co2 Abatement (tons/MW)**	**Technology Net Co2 Abatement (tons/MW)**	**Technology COE* ($mills/MW)**	**Reference Technology COE ($mills/MW)**	**Co2 Abatement Cost ($/ton)**	**Yearly Abatement Cost ($mills)**	**Yearly Abatement (1000 tons)**
1	GFCC Power Plants**	875	1700	0	1700	0.3	0.3	0	0.0	1,488
2	GFST Power Plants**	1175	1750	0	1750	0.42	0.42	0	0.0	2,056
	Reference Technology (50% GFCC, 50% GFST)	*1025*	*1725*			*0.36*				
3	Wind Farms***	700	2400	1725	675	0.84	0.36	$711	336.0	473
4	ICCS Plants	10	6227	1725	4502	0.752	0.36	$87	3.9	45
5	Photovolatics	2	2700	1725	975	1.4	0.36	$1,067	2.1	2
6	Nuclear	100	3500	1725	1775	0.92	0.36	$315	56.0	178
	Total								***398.0***	***4,241***
7	Grid-Connected PV	5	2700	1725	975	0.4	0.36	$41	0.2	5
8	Clean Oil Shale	32.5	7000	1725	5275	0.7	0.36	$64	11.1	171
9	Fuel Cells	50	3000	1725	1275	0.58	0.36	$173	11.0	64
	Total								***22.3***	***240***
	Grand Total							***$94***	***420.3***	***4,481***

* COE includes production cost (O&M plus fuel) and is assumed to represent 40% of required total cost (based on previous studies).

** For Measures 1 and 2, the reference technology is using fuel oil instead of natural gas to generate power at approximately the same cost.

*** For Measures 3 through 9, the reference technology comprised of 50% GFCC and 50% GFST power plants.

Table (C.2): ***Yearly Financial Needs by Scenario***

Scenario	Aggregate Yearly Abatement (1000 tons of CO_2)	Aggregate Annual Cost ($million)
BAU	4241	398
More CO_2 Cuts	240	22
All Measures	4481	420

Table (C.3)***: Projected Financial Needs at 2020 and 2050 Time Horizons***

Group	Projected Financial Needs at 2020 ($billion)	Projected Financial Needs at 2050 ($billion)
All Measures	4	12

C.2. Cost of Implementing Priority Adaptation Measures

C.2.1. Agriculture sector

Table (C.4) presents the estimated periodic and total costs necessary for the priority adaptation measures for the agriculture sector aggregated over the time period of 2010 to 2035. Details of the estimates are in Annex II for each of the five programs.

Table (C.4): Estimated costs for adaptation needs of the agriculture sector over the period 2010-2035.

Code	Program	Estimated total budget (million US$)		Estimated budget distributed over the period 2010-2035 (million US$)				
				10-15	15-20	20-25	25-30	30-35
1	Observation and control of climate change in agriculture	international	100	*40*	*15*	*15*	*15*	*15*
		national	50	*30*	*5*	*5*	*5*	*5*
		Total	**150**[2]	***70***	***20***	***20***	***20***	***20***
2	Land and agriculture production	international	565	*140*	*125*	*100*	*100*	*100*
		national	83	*28.4*	*17.4*	*16.4*	*10.4*	*10.4*
		Total	**648**[3]	***168.4***	***142.4***	***116.4***	***110.4***	***110.4***
3	Farm irrigation	international	1600	*783*	*772*	*15*	*15*	*15*
		national	506	*250*	*250*	*2*	*2*	*2*
		Total	**2106**[4]	***1033***	***1022***	***17***	***17***	***17***
4	Socio-economic studies	international	7	*7*	-----	-----	-----	-----
		national	15	*7*	*2*	*2*	*2*	*2*
		Total	**22**[5]	***14***	***2***	***2***	***2***	***2***
5	Capacity building, enlightenment and training	international	14	*6*	*2*	*2*	*2*	*2*
		national	21	*5*	*4*	*4*	*4*	*4*
		Total	**35**[6]	***11***	***6***	***6***	***6***	***6***
Total finance required		international	2286	*976*	*914*	*132*	*132*	*132*
		national	675	*320.4*	*278.4*	*29.4*	*23.4*	*23.4*
		Grand Total	**2961**	***1296.4***	***1192.4***	***161.4***	***155.4***	***155.4***

C.2.2. Coastal zones

For coastal zones, priority adaptation measures entail the following objectives:

1- Integrating and coordinating activities on climate adaptation on the national level;
2- Developing strategies, action plans, systematic monitoring systems and assessment policies and guidelines;
3- Mainstreaming projects funds towards strategies and action plans;

[2] Details are in Annex II, Table: AII.2
[3] Details are in Annex II, Table: AII.3
[4] Details are in Annex II, Table: AII.4
[5] Details are in Annex II, Table: AII.5
[6] Details are in Annex II, Table: AII.6

4- Establishing and carrying out a complete monitoring program of various indicators of climate change in coastal zones, together with building up a database for national climate observations indicators;
5- Completing a vulnerability assessment for coastal zones and identifying options for protection and reducing risks;
6- Identifying employment opportunities in safe areas of high elevation to reduce vulnerability in the high density Delta regions.

The following are the specific needs for facing impacts of sea level rise:

Institutional needs (at an estimated total cost of 20 million US$)

- Establishing and promoting an institutional capacity for "Adaptation". This is to be carried out through initiating a national center for climate change, which would be responsible for: integrating activities and outputs of various vulnerability assessments of coastal zones (as well as other vulnerable sectors); integrating already existing results; building up a geographic database for vulnerability indices; integrating success stories; and advising various sectors on proper policy and measures of adaptation;
- Upgrading environmental regulations through adopting Strategic Environmental Assessment for large scale and national projects in coastal zones, including a component for climate change in project EIA;
- Development of a national strategic action plan for adaptation to sea level rise with recommended policies for each sector in the coastal zones;
- Establishment of an Adaptation Policy Monitoring and Assessment Unit (APMAU);
- Building institutional capacities and carrying out training.

Monitoring needs (at an estimated total cost of 50 million US$)

Establishing an integrated monitoring network to carry out the following:

- Establishing a virtual network center for integrating climate research at the ministries of Water Resources and Irrigation, Agriculture, Scientific Research and the different universities; building capacities on monitoring and systematic observations of coastal indicators; vulnerability assessments and policy oriented subjects;
- Establishing a strong on-the-ground monitoring network including:
  - Tide gauges for monitoring of sea level along the Nile Delta coast and a number of vulnerable sites;
  - Piezometric network for monitoring of ground water salinity in the Delta region;
  - Monitoring of soil salinity network based on ground based observations;
  - Establishing a coral reef monitoring network in the Red Sea based on periodic analysis and interpretation of actual coral conditions as well as high resolution satellite imagery analysis;
  - Establishing a land use monitoring network for coastal zones by sector (in coordination with the National Land Use Center);
  - Enhancing and networking already existing research activities on monitoring indicators of the coastal processes and assessment of extreme events;

- Carrying out training courses for capacity building on the above mentioned aspects;
- Building up and periodic updating of an integrated geographic database for climate parameters and making data available for the scientific community.

Modelling needs (at an estimated total cost of 20 million US$)

- Building up capacity on Regional Circulation Models (RCM) and integrating national activities in this line;
- Integrating efforts for analysis of results of various sectors with an emphasis on early warning systems of coastal processes;
- Building capacities for modelling and establishing systems for early warning of climate change extreme events and disasters such as flash floods, Tsunamis, marine surges and droughts;
- Exploring adaptation models and integrated coastal zone management, with the development of contingency plans for risk reduction.

Research needs (at an estimated total cost of 40 million US$)

- Upgrading Regional Circulation Models accuracy so as to be able to predict coastal zone conditions with sufficient accuracy;
- Assessing impacts on natural and cultural heritage including antiquities in coastal zones;
- Vulnerability assessment of grazing areas and animal productivity in coastal zones;
- Studying fish productivity in northern and southern lakes;
- Studying and developing capacities in early warning systems, risk assessment of storm surges, and disaster reduction techniques and success stories;
- Carrying out and upgrading of resilience of vulnerable communities in coastal zones.

Implementation needs (at an estimated total cost of 20 million US$)

- Identifying and assessing criteria for selecting and evaluating options of adaptation for vulnerable sites in coastal zones along the Nile Delta. Past experience indicates that protection measures for the Delta amounts to about 10,000 US$ per meter for vulnerable areas along the coast. If we consider that 80% of the 250 km Delta coast needs protection, this would amount to about 2 million US$;
- Identifying and protecting high risk areas such as areas below sea level south of Abu Qir Bay and south of Port Said, with an enforcement of week structures;
- Exploring already existing policies for protection, testing effectiveness (cost/benefit analysis) and identifying ways of activation;
- Coastal protection measures along vulnerable and non-vulnerable sites with an emphasis on flash floods, dust storms and heat waves;

Upgrading resilience of vulnerable communities of coastal zones (at an estimated total cost of 20 million US$)

- Establishing a program for upgrading awareness of vulnerable communities and decision makers;

- Upgrading participation of the civil society and establishing employment opportunities in safe areas to attract high density vulnerable population to these new opportunities;
- Carrying out a program for upgrading awareness of decision makers in coastal areas.

Protection against salt water intrusion (at an estimated total cost of 40 million US$)

- Identifying and assessing vulnerable land, prices and loss of revenues;
- Assessing impacts on health and socioeconomic aspects of population;
- Identifying potential socioeconomic changes and loss of employment, together with the cost of creating new employment opportunities in safe areas;
- Investigating the plantation of salt-tolerant plants.

Protection against extreme events (at an estimated total cost of 20 million US$)

- Assessing the increased risk by investigating records of time series of dust storms, marine storms, heat waves and their impacts;
- Establishing greenbelts around vulnerable areas for protection against dust and sand storms;
- Carrying out correlations with data from other sectors so as to test relations to other sectors of development;
- Estimating the cost of implementation of protection measures of greenbelts on the western sides of satellite cities.

Coral reef protection (at an estimated total cost of 30 million US$)

- Implementing a program for the management of existing coral reef communities;
- Carrying out research and investigation of artificial coral cultivation;
- Expanding coral protectorates and strengthening management and protection.

C.2.3. Estimated overall cumulative costs for adaptation measures in agriculture

Table (C.5) summarizes the estimated overall costs for adaptation measures for the agriculture sector and the coastal zones at the 2020 and 2050 time horizons.

Table (C.5): Total cumulative cost estimates for adaptation measures and programs of the agriculture and coastal regions sectors at 2020 and 2050.

Program	Cumulative Finance needed (million US$)	
	2020	**2050**
Observation and control of climate change	90	210
Land and agriculture production	311	948
Irrigation	2055	2150
Socio-economic studies	16	28
Capacity building, enlightenment and training	17	51
Coasts and sea shore regions	330	620
Total	**2719**	**4007**

D. Key Findings on Financial and Policy Instruments for Addressing Climate Change

D.1. Financial Instruments

Existing financial and policy instruments available on the local, national, regional and international levels that are being used to address climate change impacts comprise:

- National budget
- International cooperation (bilateral and multilateral)
- Financial mechanism of the UNFCCC - GEF
- Adaptation Fund
- Clean Development Mechanism (CDM)
- Other funds established by World Bank such a CTF, CIF, etc.
- International adaptation fund by the convention for vulnerable countries
- International fund for technology transfer

D.1.1. Energy sector

Through support from USAID and UNDP in Cairo, at least thirteen Egyptian ESCOs have been established in Egypt with the objective of investing in energy efficiency technologies. A national association for ESCOs has been established. Many investors view investment in the energy efficiency sector as a potentially rewarding business area, primarily due to three reasons. First, energy intensity figures in many local industries are high which implies there is a good chance for improving energy utilization. Second, old manufacturing technologies and processes in industries like oil refineries, textile, iron and steel, aluminium, fertilizers, and food processing all create good opportunities for investing in energy efficiency. Third, cogeneration in large service-based buildings like hospitals and hotels offers an equally attractive opportunity for improving energy utilization. A USAID study (by the Energy Efficiency Policy Program) estimates that the “net present-value energy-savings figure is about LE 12 billion,” where the potential for energy savings is roughly equivalent to 50% of current energy consumption. Many ESCOs are hoping that the government continues its gradual removal of electricity subsidies, which would increase the attractiveness of investing in energy efficiency technologies in the long run. The current USAID program supporting ESCOs is helping several potential energy efficiency projects in securing financing from commercial banks in order to set precedence and eventually create a market for energy efficiency investment. The speeding up of the privatization program by the government may lead to bigger interest in energy efficiency from newly privatized industrial entities in which the new management would like to improve the efficiency of the production process and minimize cost of production which were typically compromised under state or public ownership.

There is currently an immediate need for a source of funding that is willing to finance several start-up energy efficiency projects in the Egypt in various industries with soft lending terms. Yet, the need for financing does not seem to be the only barrier facing this sector and other barriers to energy efficiency investment will be presented later in the study.

D.1.2. Agriculture sector

It is expected that the **plan** will be executed during the period 2011-2035. It is expected that the government will play a key role in executing the plan, besides an active participation of Arab, regional and international organization. In addition to the financial institutions and legislative council, private sector, NGOs, and informative institutions, such participation should be performed with a complete harmony and integration. In order to execute the proposed plan, it is suggested that a special ministerial committee would be formed, and a technical consultative subcommittee report to the prime minister.

It is suggested that the state finance the plan according to available funds, with contributions from institutions such as UNEP, banks, national saving funds, Arab and regional development funds, in addition to the private sector. The implementation of this plan may require an increase of about 20% per year of government contribution during the plan period. Estimated necessary costs from national and international sources are presented in table (C.4).

The plan considers the following sources of finance; national and international:

Table (D.1): Summary of budget (International & National)[7]

No.	Program	Total finance required million dollar	
1	Observation and control of climate change in the agriculture	International	100
		National	50
		Total	150
2	Land and Agriculture production	International	565
		National	83
		Total	648
3	Farm Irrigation	International	1600
		National	506
		Total	2106
4	Socio-economic studies	International	7
		National	15
		Total	22
5	Capacity building, enlightenment and training	International	14
		National	21
		Total	35
Total finance required		International	2286
		National	675
		Total	**2961**

[7] Details are in Annex II

D.2. Policy Instruments

D.2.1. Energy sector

In 2007/2008, the total annual amount of electricity generated in Egypt was about 125.129 Milliard kilowatt hours (kWh) produced by a total installed generating capacity of 22,583 MW, including the 305 MW installed capacity of wind farms at Zafarana. This output was generated from 102 state-owned power plant units. Given the current annual increase in demand for power, Egypt needs around 2700 MW of additional generation capacity every year up to 2020. In 1996, the government decided that the private sector would develop new power generation plants. This would be coherent with the national privatization scheme adopted by the government and triggered by the World Bank. There is now 2047 MW of privately owned power generation entities, which roughly represents 9% of total installed capacity. At the time being, two foreign independent power producers have developed two separate power plants under a Build-Own-Operate-Transfer (BOOT) system.

Egypt's power grid is currently connected to grids of neighbouring countries with Jordan and Libya both importing part of their electricity from Egypt. A new power grid connection to Tunisia is currently being finalized. This would ultimately enable Egypt to export power to anywhere in Europe. However, Egypt's energy planners are debating the cost effectiveness of exporting natural gas in a liquefied form versus grid power.

There is public recognition of the potential vulnerability of the agriculture sector, coastal zones and the Nile basin due to possible climate changes. This is recognized by high level policy makers and there are efforts underway to address climate change issues in national plans. Additionally, sector and legislative reforms are being carried out on a national level aiming at encouraging private-public partnership and enhancing private sector involvement in climate change mitigation and adaptation projects.

D.2.2. Agriculture sector

The necessary support in the agricultural sector can be summarized along four main axes. The first is concerned with *policies***,** where there is a vital need for adapting and applying restrictive policies to tackle anticipated shortage of water both with and without climate change. For example, instead of the use of potable water, all future expansion of water uses (industry, tourism, resorts, golf cities, remote areas in the north west coast, Sinai peninsula and the Red Sea etc.) should go for alternative water resources such as desalinization of brackish or sea water and/or humidity harvesting. On the other hand, the limited water resources should be used for food production, with the implementation of high efficiency water delivery system.

The second axis is concerned with *legislation*, with **a**ppropriate legislation developed and adopted to maximize water productivity and restrict utilization to priorities uses based on sector and geographic location. *International technical support* represents the third axis, where Egyptian policies have to focus on attracting technical support primarily for building the capacity of relevant research institutions in order to allow them to carry out the necessary studies related to improving water use efficiencies and to breeding of heat-tolerant varieties of strategic crops. As for the fourth axis, this is concerned with *international financial support,* where Egyptian policies need to focus on attracting the financial support required for implementing the above measures.

E. Institutional Framework

Existing and potential institutional arrangements to support the integration of climate change priorities into national development are as follows:

E.1. Current Institutions

In 1992, Egypt established a climate change unit in the Egyptian Environmental Affairs Agency, representing the focal point of the UNFCCC and Kyoto Protocol, aiming at coordinating and integrating all national and international activities relevant to climate change. This unit has recently been upgraded to be a central department for climate change. Meanwhile Egypt established a National Committee of Climate Change in 1997, and restructured it in 2007 by a prime ministerial decree, for it to oversee climate change policies at the national level. This committee is headed by the Minister of State for Environmental Affairs and is composed of high level government representatives from all relevant ministries and authorities in addition to high level scientific experts from research and scientific institutions as well as civil society.

Additional to the above, Egypt has established in 2005 a designated national authority for the clean development mechanism. This committee is also headed by the Minister of State for Environmental Affairs, and composed of high level government representatives from different relevant sectors, including the business and scientific community as well as NGOs. S far, the committee has reviewed and accepted 55 CDM projects, with investments up to 1.3 billion US$ and an estimated annual reduction of 8.5 million tons CO_2e. Five of these projects are already internationally registered, and are currently operational, achieving emission reduction. Another seven projects are under the final stage of validation prior to registration. This indicates the high potential of CDM in Egypt, rendering the Egyptian designated national authority as one the most active ones in the African and Arab countries.

A New and Renewable Energy Agency was created in 1986 in the Ministry of Electricity with the aim of promoting renewable energy projects and schemes in Egypt. A Supreme Energy Council was established in 2007 with the mandate of supervising and coordinating energy policies on the national level. This Council is composed of relevant ministers and headed by the Prime Minister.

A ministerial committee for climate change has been established within the Ministry of Agriculture. Headed by the Minister of Agriculture, its mandate is to supervise mainstreaming of climate change policies into the national plans. Similarly, the Ministry of Water Resources and Irrigation has established another ministerial committee for climate change headed by the Minister, overseeing the mainstreaming of climate change policies into national plans.

A Regional Center for Renewable Energy and Energy Efficiency was established in 2009. Hosted by Egypt, it is located within the Ministry of Electricity, and it aims at promoting renewable energies and energy efficiency in the MENA countries.

E.2. Opportunities for Improving the Current Framework

Egypt is facing increasing challenges with regards to climate change. In this respect, adaptation issues together with the need to develop capacities to be able to properly address them are of particular significance. Potential institutional arrangements, additional to existing ones, which would be conducive to this end, include the establishment of an independent national scientific and technological committee to offer advisory support to top level decision makers. Additionally, the establishment of a national research center focusing on the different aspects of climate change is planned. This center would allow networking with existing research institutes in sectors relevant to climate change, as well as represent a think tank for decision makers to determine and prioritize climate change needs and the policy instruments for meeting these needs.

F. Lessons Learned

F.1. Challenges and Opportunities

Challenges and opportunities include extending the NEEDS project to cover other important sectors; establishing a virtual centre of excellence for climate change information networked with other relevant databases in different sectors, national, regional and international; mainstreaming climate change activities into national action plans; and increasing public awareness and fostering monitoring and observation systems for climate change.

It was noticed during the implementation of this project that there is no system that could monitor climate change greenhouse gases from different sectors systematically, such a system could have facilitating role in follow up of investigation the climate change anthropogenic emissions from such sectors, which would help in promoting utilization of low carbon technologies in the context of adopting green economy policies;

Roster of experts and database of research related to climate change does not exist sufficiently. Such a data bases will pave the road towards assessing the capacity needs and requirements.

F.2. Next Steps

Next steps consist of developing a national strategy for climate change that include a national action plan for adaptation (NAPA) and a national low carbon economy plan; as well as establishing a strong information dissemination system for climate change and its impacts on different sectors. In addition, pay more attention to future research studies and pilot projects that cover socio-economic aspects relevant to climate change issues. Furthermore, extending the adaptation activities to include adaptation planning, evaluation of adaptation economics, community based adaptation and increase public awareness campaigns.

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Annex I
TABLES FOR Energy NEEDs

Table (AI.1): ENERGY SECTOR Mitigation Priority Technology Options to Abate GHG Emissions and their Respective Cost Estimate

1. Baseline Programs

(Country-implementation Capacity and BAU Scenario)

N0.	Program	Activities	Responsible Entities	Required Finance	Time Duration (Years)
1.	Large-scale Grid-connected Wind Farms	Construct a series of large-scale grid-connected wind farms at the areas of highest potential of wind speed, identified by the Egypt wind map. Yearly total capacity of 220 MW.	MoEE[(1)], NREA[(2),]	1.3 -1.5 M EUR/MW i.e. 2.85-3.3 Billion EUR	10
2.	Integrated Combined Cycle Solar System (ICCS) Plants	Construct two similar 300MWcapacity plants, including solar thermal Portion of 60MW capacity each, by 2020.	MoEE, NREA,	1850-1900 US$/kW i.e. 1.11-1.14 Billion US$	10
3.	Gas-Fired Combined Cycle Power Plants	Program of a series of gas-fired combined cycle modules of a total capacity 9,000 MW up to the year 2020.	MoEE, EEHC and Affiliate Electricity Production Companies, Private Sector	725-775 US $/kW i.e. 6.53-6.98 Billion US$	10

(1) MoEE = Ministry of Electricity & Energy.
(2) NREA = New & Renewable Energy Authority.

N0.	Program	Activities	Responsible Entities	Required Finance	Time Duration (Years)
4.	Gas-Fired Steam Thermal Power Plants	Program of a series of gas-fired steam thermal units, mostly of capacity 650 MW each, in addition to a unit of capacity 350 MW. The total capacity amounts to 11,400 MW up to the year 2020.	MoEE, EEHC and Affiliate Electricity Production Companies, Private Sector	1000-1100 US$/kW i.e. 11.4-12.54 Billion US$	10
5.	Nuclear Power Plants	Implement the first 1000 MW capacity nuclear unit by the year 2017.	MoEE, NPPA[(2)]	2100-2500 EUR/kW i.e. 2.1-2.5 Billion EUR	7

(1) EEHC = Egyptian Electricity Holding Company.
(2) NPPA = Nuclear Power Plants Authority.

N0.	Program	Activities	Responsible Entities	Required Finance	Time Duration (Years)
6.	Expand the Use of Efficient Lighting Systems (Egyptian Efficient Lighting Initiative – EELI).	Program for transforming lighting market towards Compact Fluorescent Lamps (CFL), targeting utilization of additional 80 million lamps during the period 2010 – 2020 . Safe Disposal of burnt lamps should be taken into consideration. Expected reduction of GHG emissions is about 4.0 Mt CO_2eq by the year 2020 . Expected saving is about 1.5 Mtoe.	MoEE, EEHC[(1)] and affiliate Electricity Distribution Companies, Private Sector	25 M EUR	10
7.	Renewal of Aging Taxi Vehicles in the Greater Cairo Region (GCR)	Program for replacing aging fleet of taxi in the Greater Cairo Region (GCR) (about 43,000 taxis having fuel efficiencies of about 14 liters per 100 km and more through phases of implementation with new gasoline vehicles that get about 12 liters per 100km or less, and CNG vehicles that get about 8kg per 100 km) Overall GHG emission reduction estimated at 2,636,713 tons CO_2eq over a period of 10 years.	MoF[(1)], MoI[(2)], Auto Dealers, Commercial Banks, Advertising Firms	508 M US$	5

(1) MoF = Ministry of Finance.
(2) MoI = Ministry of Interior.

Following to Table (AI.1): ENERGY SECTOR Mitigation Priority Technology Options to Abate GHG Emissions and their Respective Cost Estimate

2. Programs for Meeting Country's Actual Demand and Promoting Energy Efficiency

N0.	Program	Activities	Responsible Entities	Required Finance	Time Duration (Years)
1.	Large-scale Grid-connected Wind Farms	Construct a series of large-scale grid-connected wind farms at the areas of highest potential of wind speed, identified by the Egypt wind map. Yearly total capacity of 500 MW to satisfy the 20% target of renewable electricity, including hydro, by 2020, out of which 12% wind energy.	MoEE, NREA, Private Sector	1.3 -1.5 M EUR/MW i.e. 6.5- 7.5 Billion EUR	10
2.	Nuclear Power Plants	Program of a series of 1000 MW capacity nuclear units, with a total of 4 units up to the year 2027	MoEE, NPPA	2100-2500 EUR/kW i.e. 8.4-10.0 Billion EUR	10 (2017-2026)

N0.	Program	Activities	Responsible Entities	Required Finance	Time Duration (Years)
3.	Expand the Use of Domestic Solar Water Heating Units (Solar Water Heaters Initiative – SWHI)	Typical domestic solar water heating units, containing 2 squared meters flat plate collector's area and 150 liters storage water capacity. Program of potential usage of around 500,000 units (i.e. total collector's area of about 100,000m^2) every year up to the year 2020. (Each square meter of solar collectors would result in 0.5 ton of CO_2 eq. emission reduction per year. Expected saving is about 0.018 mtoe annually)	MoEE, NREA, Private Sector	250 M EUR	10
4.	Expand the Use of Photovoltaic Systems for Different Applications.	Program of typical photovoltaic systems applications of total capacity of 20.00 MW up to the year 2020.	MoEE, NREA, Private Sector	6,000US$/kW Up to 2015 and 1,000 US$/kW beyond 2015 Total finance is around 70 M US$	10

N0.	Program	Activities	Responsible Entities	Required Finance	Time Duration (Years)
5.	Expand the Energy Efficiency Labelling (EEL) Applications (Egypt has already developed and issued four standards, together with their corresponding labels, for electric appliances, namely, refrigerators, air conditioners, electric water heaters, and washing machines).	Develop and issue standards, together with their corresponding labels, for electric appliances, such as irons, kettles, kitchen machines, video-audio equipment,… etc.	MoEE, MoTI(*), Private Sector	25 M EUR	10
6.	Expand the Use of Efficient Lighting Systems (Egyptian Efficient Lighting Initiative – EELI).	Program for transforming lighting market towards Compact Fluorescent Lamps (CFL), targeting utilization of additional 80 million lamps during the period 2010 – 2020. Safe Disposal of burnt lamps should be taken into consideration. Expected reduction of GHG emissions is about 4.0 Mt CO_2eq by the year 2020 . Expected saving is about 1.5 Mtoe.	MoEE, EEHC and affiliate Electricity Distribution Companies, Private Sector	25 M EUR	10

(*) MoT I = Ministry of Trade & Industry.

N0.	Program	Activities	Responsible Entities	Required Finance	Time Duration (Years)
7.	Waste Heat Recovery Systems	Wide range of sizes from <25 MW to 300 MW. Water temperature above 60°C to 82°C (140°F to 180°F) is required for domestic applications. Some equipment acts as a silencer to replace or supplement noise reduction equipment needed to meet noise requirements. Waste heat recovery is used extensively at industrial facilities around the world. Represents an opportunity for relatively low-cost increase in power capacity.	MoEE, EEHC, MoTI	Installation costs can be $1000/kW (for industrial systems).	10
8.	Energy Management Systems (EMS)	Relevant for all sizes of systems. May be used with existing or applied to new systems. EMS is typically applied to the largest electrical loads, including HVAC equipment, cooling towers, pumps, water heaters and lighting. Control functions may include basic stop/start functions or more complex chiller optimization routines. Energy management systems have been implemented successfully in several countries including the United States, Argentina, Colombia, Portugal, Germany and more. Site-specific analyses must be conducted to determine the benefit of installing energy management systems. Systems work with distributed and direct networks.	MoEE, EEHC, MoTI	$ 100 Million (Energy savings of about 10% is typically achieved, although exact costs and savings are site-specific). (Typical cost of an energy system in a manufacturing plant with a load of 100 Million kWh/year is about $ 750,000)	10

Following to Table (AI.2): ENERGY SECTOR Mitigation Priority Technology Options to Abate GHG Emissions and their Respective Cost Estimate

3. Innovative Technologies for 2020 and beyond

N0.	Program	Activities	Responsible Entities	Required Finance	Time Duration (Years)
1.	Grid-connected PV	Implement a series of Grid-connected PV power generating plants. Modules range from a few watts to multi-MW. For power generation, modules can be combined to produce 5-25 MW or larger. First pilot project may include two batches of grid-connected PV with capacity 25 MW each or more.	MoEE, NREA, Private Sector	Cost is about $ 1,000/kW by 2015 and as low as $ 700-800/kW by 2020-2030	10
2.	Clean Oil Shale Technology-Fluidized Bed Combustion	Construct and operate a series of power plants utilizing clean Oil Shale fluidized bed combustion technology. Oil sale exists in Egypt within phosphate formations in plentiful quantities. Capacity ranges between 10 to 100 MW equivalent for industrial boilers and 75 to 325 MW for electric utility applications. First Pilot Project will include 325 MW thermal power generating unit by 2020.	MoEE, EEHC, Private Sector	AFBC[(1)] (200 MW): $1,500-2,000/kW PFBC[(2)] (commercial): $1,000-1,5000/kW	10

(1) AFBC = Atmospheric Fluidized Bed Combustion.
(2) PFBC = Pressurized Fluidized Bed Combustion.

N0.	Program	Activities	Responsible Entities	Required Finance	Time Duration (Years)
3.	Use of Fuel-cells Power Generating Modules	Introduce Fuel-cells power generation for distributed applications in industry and electricity sectors. Introduce fuel-cells grid-connected power generating modules. Pilot applications may be within the range of 100-500 MW up to 2020.	MoEE, EEHC, MoTI Private Sector	$ 1,700 – 1,200/kW by 2020	10
4.	CO_2 Capture & Storage (CCS)	Implement a series of projects using Carbon Capture and Storage (CCS) technique, capturing CO_2 emitted from power plants for Enhanced Oil Recovery (EOR) in stranded oil and gas wells. Size will vary according to underground formations and distance between the power plant and the stranded oil/gas wells. Potential storage of 6 Million tons CO_2 at Suez Gulf area as "First Phase" application. First Pilot Project Will capture and store 3Million tons CO_2 at Suez Gulf area to be operational by 2020.	MoP(1), MoEE, MoSfEA(2), Private Sector	$ 60-80/tCO_2 is expected to lower within 5-7 years to about $ 25/tCO_2	10
5.	Use of Fuel-cells for Transport Fleets	Introduce fuel-cells buses in Greater Cairo Region	MoT(3), MoEE, MoSfEA	N/A	10

(1) MoP = Ministry of Petroleum.
(2) MoSfEA = Ministry of State for Environmental Affairs.
(3) MoT= Ministry of Transport.

Following to Table (AI.2): ENERGY SECTOR Mitigation Priority Technology Options to Abate GHG Emissions and their Respective Cost Estimate

4. Support Capacity and Institutional Building

N0.	Program	Activities	Responsible Entities	Required Finance	Time Duration (Years)
1.	Instituting Customer- focused Educational and Informational Programs	Can be tailored to any situation or sector. Can include training, public information programs, creation of school, home, utility partnerships and more. Benefits lie in the avoided supply costs.	MoEE, MoP, MoM[(1)], MoSfEA, ESCOs[(2)] Private Sector	Lump Sum of US$ 50 Million	10
2.	Supporting GHG Mitigation Research in Energy Sector	Collaborative research and related implementing agreements will be initiated between Egypt and Annex I countries.	MoEE, MoP, MoSRT[(3)], MoSfEA Private Sector	US$ 100 Million	10

(1) MoM = Ministry of Media.
(2) ESCOs = Energy Services Companies.
(3) MoSRT = Ministry of Scientific Research and Technology.

N0.	Program	Activities	Responsible Entities	Required Finance	Time Duration (Years)
3.	Increasing Senior and Mid-level Management Performance and Efficiency	Applicable to all power plants, regardless of type or size. Requires both the tools (software and equipment) and the training to use the tools effectively. Relative small capital expenditures are required to obtain the tools and training; large expenditures are required for equipment replacement. However, overtime, these costs are more than offset by improved plant performance.	MoEE, EEHC	Initial cost US$ 10 Million	10
4.	Demand-side Management (DSM) Regulations and Incentives	DSM programs can be developed and implemented within a relatively short time period-a few years, at most. In the short-term, DSM is the only policy that can have a significant impact on reducing electricity consumption. DSM benefits end-users through cost savings as well as through improved environmental quality, economic competitiveness and energy security. May avoid or delay the need to construct additional capacity. These actions are dependent on the mix of fuels/technologies used to generate the electricity being displaced, a more precise estimate of carbon emissions reduced/avoided requires site-specific details.	MoEE, EEHC, MoSfEA, MoTI	Initial cost US$ 10 Million	10

N0.	Program	Activities	Responsible Entities	Required Finance	Time Duration (Years)
5.	Energy Efficiency Regulation and Incentives	May offer rebates, tax credits or involve setting standards. For example, could involve setting target level for emissions or fuel consumption, and charge consumers a variable fee when actual consumption is worse than the target level, and granting consumers variable (sliding-scale) rebates for those that do better than the target. Costs may be incurred; for instance, through foregone tax revenue for rebates. Some policies may be revenue-neutral-if fees are charged for non-compliance, these funds can be directed to pay for any rebates. As manufacturers or federal policies improve efficiency levels, targets can be adjusted to maintain a revenue-neutral program. Administrative changes can be made to make policies revenue-generating.	MoEE, EEHC, MoSfEA, MoTI	Initial cost US$ 10 Million	10

Annex II

TABLES FOR AGRICULTURE SECTOR NEEDS

Table (AII.1): Estimated total and periodic budget needed for adaptation to climate change impacts in Agriculture Sector (2011-2035)

No.	Program	Estimated total budget Million USD		Time table				
				10-15	15-20	20-25	25-30	30-35
1	observation and control of climate change in the agriculture	in	100	40	15	15	15	15
		n	50	30	5	5	5	5
		Total	**150**	70	20	20	20	20
2	Land and Agriculture production	in	565	140	125	100	100	100
		n	83	28.4	17.4	16.4	10.4	10.4
		Total	**648**	168.4	142.4	116.4	110.4	110.4
3	Farm Irrigation	in	1600	783	772	15	15	15
		n	506	250	250	2	2	2
		total	**2106**	1033	1022	17	17	17
4	Socio-economic studies	in	7	7	-----	-----	-----	-----
		n	15	7	2	2	2	2
		Total	**22**	14	2	2	2	2
5	Capacity building, enlightenment and training	in	14	6	2	2	2	2
		n	21	5	4	4	4	4
		total	**35**	11	6	6	6	6
-	**Total finance required**	in	2286	976	914	132	132	132
		n	675	320.4	278.4	29.4	23.4	23.4
		Total	**2961**	**1296.4**	**1192.4**	**161.4**	**155.4**	**155.4**

Table (AII.2): Program 1: Activities, stakeholders, budget and time life

<table>
<tr><th>Program</th><th>Activities</th><th>Stakeholders</th><th>Budget
Million dollar</th><th>Time life (Years)</th></tr>
<tr><td rowspan="2">Observe and control of climate change</td><td>• Construction of research and information centers that may strengthen climate networks in Egypt using satellites, radars, etc.</td><td rowspan="2">• Ministry of Agriculture

• Agricultural Research Center, institutes and laboratories affiliated</td><td rowspan="2">150</td><td rowspan="2">25</td></tr>
<tr><td>• Construction database and information system on climate change related to adaptation and mitigation.</td></tr>
</table>

Program 1: Budget distribution

Item	years	Total cost (million USD)
Incentives of the research team	**25**	35
Incentives of salaries and employment	**25**	15
Transport	**25**	4
Travel allowance	**25**	5
Machinery	**25**	60
Publications	**25**	5
Training	**25**	16
Tools and tasks	**25**	7
Reports and print	**25**	3
Total		**150**

Table (AII.3): Program 2: Activities, stakeholders, budget and life time

Program	Activities	Stakeholders	Total budget (Million USD)	Life Time (years)
The complete resource management of land and agriculture production	Project #1: [8] Produce new strains of crops with high yield, high efficiency in water use, dry and temperature resistance	- Ministry of Agriculture - Agricultural Research Center, institutes and laboratories affiliated	50	25
	Project #2: [9] Support farm management programs for animal husbandry improvement and to reduce emissions		5	7
	Project #3: [10] Preparation of climate maps of an agriculture regions that may help in agriculture policy		23	15
	Project #4: [11] Preparation of cropping patterns that may help to nationalize the use of irrigation water and agriculture rotations		5	5
	Project #5: [12] Project the new communities that may be established to absorb population that may have to leave their homes as result to the adverse effects of climate change		563	25
	Project #6: [13] Conduct a study on pests, insect diseases that may result from the effect of climate change		2	5
Total finance required			**648**	**--------**

[8] Details are in table: project #1
[9] Details are in table: project #2
[10] Details are in table: project #3
[11] Details are in table: project #4
[12] Details are in table: project #5
[13] Details are in table: project #6

Program 2 Budget distribution:

Program	Total finance required (million USD)		Time table				
			2010-15	15-20	20-25	25-30	30-35
Land and Agriculture production	in*	565	140	125	100	100	100
	n**	83	28.4	17.4	16.4	10.4	10.4
	total	**648**	168.4	142.4	116.4	110.4	110.4

*in = international **n= national

Detailed Description of the proposed project for the Land and Agriculture production

<u>Project #1</u>: Production of new strains of crops with high yield, high tolerance to heat, drought and salinity

Stage	Cost (per character per variety)	Total cost (5 crops, 3 varieties, 3 characters)
Obtaining genes for heat, salinity and drought tolerance	1.000.000	45,0
Preparation of genes	500.000	22,0
Tissue culture preparation	1.100.000	49.5
Selection of proper plan for gene insertion	900.000	40.5
Evaluating consistency of gene expression	1.500.000	67.5
Crop development after engineering	650.000	29.25
Field evaluation	200.000	9.0
Use of crop after registry	150.000	6.75
Total cost (Million LE)	6.000.000	270
Total cost (Million US$)		**50,0**

- Cost of one character per one of three cultivars in five crops = 6 million LE
- Total cost = 6 Million x 5 crops x 3 cultivars x 3 characters = 270 Mill LE (50 million US$)
- Rate of change: one US$ = 5.4 LE

<u>Project #2:</u> Support farm management programs for animal husbandry improvement and to reduce emissions

Item	Annual cost	years	Total
Salaries and incentives	25 x 12.000	7	2.10
Training programs	24 x 10.000 240.000	7	1.20
Training materials	24 x 50.000 1.200.000	7	8.40
Materials and supplies	2.000.000	7	14.00
Miscellaneous (communication, printing, etc)	80.000	6	0,48
Total cost (Million LE)			**27.0**
Total cost (Million US$)*			**5,0**

* Rate of change: one US$ = 5.4 LE

<u>Project #3</u>: Preparation of climate maps of an agriculture regions that may help in agriculture policy

Item	Annual cost	years	Total
Salaries and incentives	150.000	15	2.25
Casual labour	310.000	15	4.65
Preparation of GIS system	750.000	15	11.25
Materials and supplies	250.000	15	3.75
Software and tools	500.000	15	7.50
Travel	200.000	15	3.00
Field check	600.000	15	9.00
Total cost (Million LE) of one geographic zone			**41.40**
Total cost (Million LE) of three geographic zones			**124.20**
Total cost (Million US$)*			**23.00**

*Rate of change: one US$ = 5.4 LE

<u>Project #4:</u> Preparation of cropping patterns that may help to nationalize the use of irrigation water and agriculture rotations:

Item	Annual cost	years	Total
Salaries and incentives	0,4	5	2.0
Casual labour	0,5	5	2.5
On farm training	1.5	5	7.5
Field studies	2.0	5	10.0
Travel and transport	0,6	5	3.0
Materials and supplies	0,3	5	1.5
Miscellaneous	0,1	5	0,5
Total cost (Million LE)			**27.0**
Total cost (Million US$)*			**5.0**

*Rate of change: one US$ = 5.4 LE

<u>Project #5:</u> Project the new communities that may be established to absorb population that may have to leave their homes as result to the adverse effects of climate change (30 000 families, of average 5 persons per family, Average 5 Feddans per family).

A) Infrastructure cost

Item	Quantity	Unit price LE	Total cost Million LE
Roads	1200 km (6 m wide)	500.000	600
Electricity	132 transformers	250.000	33
Transport and communications	100 buses 100 central points	300.000 3.500.000	30 3.5
Infrastructure and housing	30000 houses	25.000	750
Potable water	One unit to serve 150 inhabitants	3.500.000	9
Internal services*	30000	1000	30
Total costs			1455.5
Marginal reserve for rate change			62.2
Grand Total			**1517.7**[A]

*Internal services mean security, hospitals, schools, markets, bakeries, etc.

B) Total land reclamation cost

Item	Quantity Feddans	Unit price LE	Total cost Million LE
Land reclamation	150,000	10150 [C]	**1522.5**[B]

C) Breakdown cost of reclamation of one feddan

Item	Per feddan cost
• **Price of land** • **Cost leveling** • **Per feddan of well cost** • **Per feddan of irrigation network** • **Cost of cultivation**	250 1500 3750 2500 2200
Total costs (million LE)	10150

Total cost of the project (A+B) = 1517.7 +1522.5 = 3040.2 Million LE, =

<u>563 Mill. US$*</u>

*One US$ =5.4 LE

<u>Project #6:</u> Conduct a study on pests, insect disease that may result from the effect of climate change

Item	Annual cost	years	Total
Salaries and incentives	300.000	5	1.50
Casual labour	200.000	5	1.00
On farm training	500.000	5	2.50
Materials and supplies	600.000	5	3.00
Travel and transport	250.000	5	1.25
Materials and supplies	300.000	5	1.50
Miscellaneous (communication, printing, etc)	10.000	5	0,05
Total cost (Million LE)			10.80
Total cost (Million US$)			**2.00**

Table (AII.4): Program 3: Activities, stakeholders, budget and time life

Program	Activities	Stakeholders	Budget Million USD	Time life (years)
Integrated water management	1- Improvement of irrigation water in the field in delta and valley in an area of five million Fadden through change from flood irrigation to developed irrigation of the rate of 500 Fadden per year using drip irrigation, buried pipes and the formation of water uses association.	• Ministry of Agriculture • Agricultural Research Center, institutes and laboratories affiliated	2050	10
	2- Evaluation of available water resources under the effect of climate change in order to predict rivers Nile water and possible cooperation with the rivers Nile basin countries		56	25
Total finance required			**2106**	**-------**

Table (AII.4.1): Costs of project's investment per acres

No	Item	Unit Price
1	Costs canal	5000
2	The development of canals socket	800
3	The cost of electricity	1800
4	Other costs (farmer)	4000
5	**Total (LE/feddan)**	**11600**
	Total (US$/feddan)	**2110**

Farm irrigation development in an area of 988 thousand acres in the Delta
Total cost = 998 * 2110 = 2106 million USD

Table (AII.5): Program 4: Activities, stakeholders, budget and time life

Program	Activities/ Projects	Stakeholders	Budget Million dollar	Time life (years)
Socio-economic studies	Project#1: Conduct studies on losses of communities, firms that may be caused as a result of climate change. Suitable regions for new settlements are determined.	• Ministry of Agriculture • Agricultural Research Center, institutes and laboratories affiliated	12	5
	Project #2: Environmental, economical and social studies on the effects of climate change on population and slandered of living		10	25
Total finance required			**22**	**-------**

Project #1:

Item	Number of years	Total estimate kUSD
Incentives for the research team	5	4000
Salaries and employment	5	1000
Travel allowance and transport	5	1000
Means of transport	1	1500
Tools and equipments	5	1000
Publications	5	1000
Field studies	2	1000
Data Analysis	2	500
Progress reports	1	500
Final report	1	500
Total		**12000**

Project #2

Item	Number of years	Total estimate kUSD
Incentives for the research team	10	2000
Salaries and employment	10	1000
Travel allowance and transport	10	1000
Means of transport	1	1000
Tools and equipments	1	500
Publications	4	1500
Field studies	1	1500
Data Analysis	2	500
Progress reports	1	500
Final report	1	500
Total		**10000**

Table (AII.6): Program 5: Activities, stakeholders, budget and time life

Program	Activities/ Projects	Stakeholders	Budget (Million USD)	Time life (years)
Capacity building	1-Strengthen the role of Institute of Meteorology with youth and equipments that enable it to provide new technology suitable for needs and requirements	• Ministry of Agriculture • Agricultural Research Center, institutes and laboratories affiliated • Universities and its affiliated bodies	20	25
	2-Development of human skills in the region dealing with climate change in water and land sectors and extensions		5	25
	3-Increase the awareness of institutional and legislative level to combat the effect if climate change		10	25
Total finance required (Million USD)			**35**	**-------**