The Imperative Need for an Integrated Energy and Climate Policy for Africa

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***Abstract*—** Until recently, energy security and climate change were considered separate issues to be dealt with by policymakers. The two issues are now converging, challenging the security and climate communities to develop a better understanding of how to deal with both issues simultaneously. Africa is a continent of many contradictions: rich in natural resources, yet underdeveloped with large populations of poor people. Many African countries are generously endowed with productive land and valuable natural resources, including renewable and non-renewable resources. Although Africa is the continent least responsible for climate change, it is particularly vulnerable to its effects, including reduced agricultural production, worsening food security, the increased incidence of both flooding and drought, spreading disease and an increased risk of conflict over scarce land and water resources. Although historically least responsible for the problem, yet, according to all scientific prognoses, African countries will be hardest hit. Climate change is a major threat to sustainable growth and development in Africa, and the achievement of the Millennium Development Goals. Africa will be unable to cope with climate mitigation and adaptation demands without substantially increasing its use of its indigenous modern energy. Africa's capacity to respond to the challenges of climate instability will be expanded by improving overall resilience, integrating climate change goals into sustainable development strategies, increasing the use of modern energy systems with reduced carbon intensity, and strengthening international initiatives. This study seeks to establish a framework for considering the complex and evolving links between energy security and climate change, applicable to Africa.

***Keywords*—** Climate change, Climate policy, Energy policy, Energy security, Sustainable development.

I. Introduction

CLIMATE change is mainly caused by an accumulation of greenhouse gases (GHGs) in the atmosphere. Global atmospheric concentrations of carbon dioxide, methane and nitrous oxide have increased markedly as a result of human activities. The global increases in carbon dioxide concentration are due primarily to fossil fuel use and, to a lesser extent, land use change, while those of methane and nitrous oxide are primarily due to agriculture [1]. Stabilizing GHG concentrations at levels that will not dangerously interfere with the climate system requires an urgent and fundamental change in the way we produce and use energy. At the same time, concern over energy security grows deeper as global energy demand increases, prices continue to rise, and the ability to bring new supplies to market is called into question. Over the coming decades, the world will face a daunting challenge in meeting the energy needs of a growing and developing world population while mitigating the impacts of global climate change.

Global warming is fundamentally an issue of human rights and environmental justice. Those who will be most affected by global warming are those who are least responsible for, and benefit least from, the greenhouse gas emissions that cause the problem. Africa's marketed energy consumption in 2005 (14.4 Quadrillion Btu) constituted 3.12% of the total world energy consumption (462.2 Quadrillion Btu), and Africa's energy-related carbon dioxide emissions in 2005 (1 Billion Metric Tons) constituted 3.56% of the total world energy-related carbon dioxide emissions (28.1 Billion Metric Tons). Africa's population (922 Millions) constituted 14.16% of the total world population (6512 Millions) for the same year [2].

Africa has a low adaptive capacity to both climate variability and climate change exacerbated by existing developmental challenges including: low GDP per capita, widespread endemic poverty, weak institutions, low levels of education, low levels of primary health care, conflicts, complex disasters and limited access to capital, including markets, infrastructure and technology [3].

A workable strategy must be concerned not just with how to design a future in which climate change and energy security concerns are met, but also with the pathway to get there. The evolving and interconnected nature of energy security and climate change requires addressing the following categories on shaping the framework for an integrated energy and climate policy, applicable to Africa:

- Climate Change Challenges.
- Energy Security Challenges.
- Interrelation between Energy and Climate Change.

II. Climate Change Challenges

A. Global Climate Change

An overwhelming body of scientific evidence indicates that the Earth's climate is rapidly changing, predominantly as a result of increases in greenhouse gases. The causal link between greenhouse gases concentrations and global temperatures is well established, founded on principles

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established by scientists in the nineteenth century. Using climate models that follow basic physical laws, scientists can now assess the likely range of warming for a given level of greenhouse gases in the atmosphere [4]. This key conclusion has been supported in the Joint Statement of Science Academies in 2005 and a report from the US Climate Change Science Program in 2006 [5].

Scientific evidence indicates with increasing certainty that current changes in the earth's climate system are happening as a result of human agency, and that they are taking place at an accelerated pace. Carbon dioxide is the most important anthropogenic greenhouse gas. The global atmospheric concentration of carbon dioxide has increased from a pre-industrial value of about 280 ppm to about 380 ppm in 2005 and rising at around 2.3 ppm per year [1].

B. Africa Environmental Outlook

Africa contributes very little to climate change. During 2007, the energy-related CO_2 emissions from Africa constituted only 2.5% of the world emissions (Fig. 1) [6].

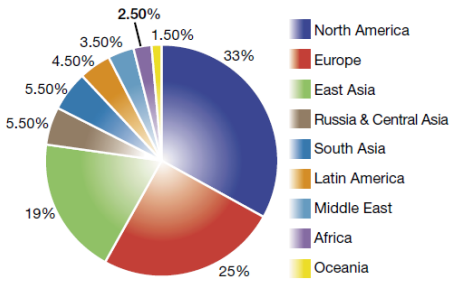

Fig. 1 Energy-related CO_2 emissions 2007 [6]

Carbon dioxide emission trends are commonly used as a tool to assess efforts to mitigate climate change [7]. Worldwide, the carbon dioxide emissions reached 2900 million metric tonnes in 2004 and continue to rise, as evidenced by increasing concentrations of CO_2 in the atmosphere. In northern Africa, emissions nearly doubled between 1990 and 2004, increasing from 1.9 to 3.2 metric tonnes of CO_2 per capita (Fig. 2). At an average of 0.9 metric tonnes of CO_2 per capita that did not change between 1990 and 2004, an individual in sub-Saharan Africa accounts for an amount of CO_2 too far below that produced by an average person in the developed world [8].

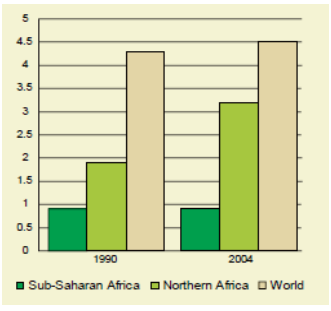

Fig. 2 Carbon dioxide emissions per capita [8]

An average African generates 13 times less GHGs than his counterpart in North America (Fig. 3) and the continent accounts for less than 4 percent of the world total GHG emissions [2].

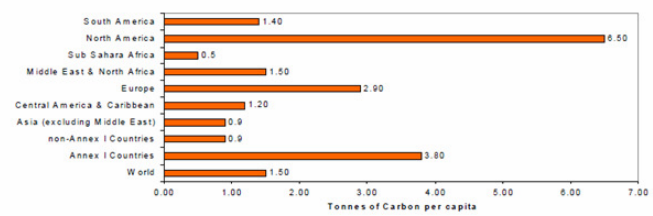

Fig. 3 Annual per capita GHG emissions 2007 [2]

The historical climate record for Africa shows warming of approximately 0.7°C over most of the continent during the 20th century, a decrease in rainfall over large portions of the Sahel, and an increase in rainfall in east central Africa. Climate change scenarios for Africa, based on results from several general circulation models using data collated by the Intergovernmental Panel on Climate Change (IPCC) Data Distribution Center (DDC), indicate future warming across Africa ranging from 0.2°C per decade (low scenario) to more than 0.5°C per decade (high scenario). This warming is greatest over the interior of semi-arid margins of the Sahara and central southern Africa [9], [10].

C. Climate Change Impacts and Vulnerabilities

While any warming may have consequences, many scientists believe global warming must be limited to no more than two degrees Celsius above current levels to avoid the worst impacts of climate change. As indicated in Fig. 4, two degrees is not a guaranteed "safe" amount of warming; even at this level of change, serious impacts are predicted. However, it is often considered the maximum amount that the climate system can withstand before tipping points are reached that could rapidly accelerate the rate of warming and increase the risk of serious danger [11], [12]. At its meeting in March 2007 the European Council underlined the vital importance of achieving the strategic objective of limiting the global average temperature increase to not more than 2°C above pre-industrial levels [13].

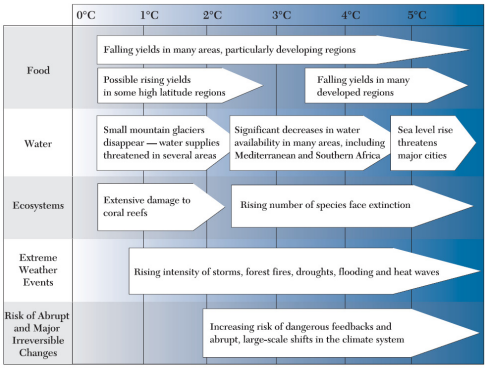

Fig. 4 Projected impacts of climate change [14]

Africa is highly vulnerable to the various manifestations of

climate change. Situations that are particularly important are:

• Water Resources: Warming is very likely to intensify the water cycle, reinforcing existing patterns of water scarcity and abundance and increasing the risk of droughts and floods [15], [16] ,[17]. By 2020, between 75 and 250 million people are projected to be exposed to an increase of water stress due to climate change [1], [18]. Africa will face increasing water scarcity and stress with a subsequent potential increase of water conflicts as almost all of the 50 river basins in Africa are transboundary [19]; international shared basins need regional coordination in water management. The problem of water scarcity is even more acute in North Africa in view of the very high population growth rates and already high rates of water resource use [20]. Water pressures may be intensified as rainfall becomes more erratic, glaciers retreat and rivers dry up. While there is much uncertainty about flow of the Nile, several models suggest a decrease in river flow, with nine climate scenario impacts ranging from no change to more than 75% reduction in flows by 2100 [21].

• Agriculture and food security: Agricultural production in many African countries and sub-regions is projected to be severely compromised by climate variability and change. The area suitable for agriculture, the length of growing seasons and yield potential, particularly along the margins of semi-arid and arid areas, are expected to decrease [6], [22]. General decline in most of the subsistence crops, e.g. sorghum in Sudan, Ethiopia, Eritrea and Zambia; maize in Ghana; Millet in Sudan; and groundnuts in Gambia [23]. Worsening of food insecurity and additional people at risk of hunger. During the mid-1980s drought's economic losses in Africa totaled several hundred million USD [24]. Exacerbation of desertification by changes in rainfall and intensified land use [25], [26] because over 95% of Africa's agriculture is rain-fed [9]. Some examples of the recent trends of Ethiopian rainfall indicate a decreasing tendency in the annual rainfall in some areas. The same trend has also been noted in seasonal rainfall. Easterling and co-authors (2000) noted a significant decrease in the number of days with precipitation exceeding 25.4mm over Ethiopia and Eritrea during the main rainfall season [27].

• Health: The health effects of a rapidly changing climate are likely to be overwhelmingly negative [28]. Vector- and water-borne diseases, especially in areas with inadequate health infrastructure, will likely spread [29], [30], [31]. The distribution and seasonal transmission of malaria is affected by climate, as both vector and parasite are sensitive to temperature [32]. Rising temperatures are changing the geographical distribution of disease vectors which are migrating to new areas and higher altitudes, for example, migration of the malaria mosquito to higher altitudes will expose large numbers of previously unexposed people to infection in the densely populated east African highlands [33]. Africa is vulnerable to a number of climate sensitive diseases including tuberculosis dengue fever, meningitis and cholera [34]. Future climate variability will also interact with other stresses and vulnerabilities such as HIV/AIDS (which is already reducing life expectancy in many African countries) [35].

• Terrestrial Ecosystems: Drying and desertification in many areas particularly the Sahel and Southern Africa, deforestation and forest fires, and degradation of grasslands. Up to 50 per cent of Africa's total biodiversity is at risk due to reduced habitat and other human-induced pressures [33].

• Coastal Zones: Coastal zones vulnerable to sea-level rise (SLR), particularly roads, bridges, buildings, and other infrastructure that is exposed to flooding and other extreme events could force major population movements. Sea level rise due to climate change is a serious global threat, particularly to countries with heavy concentrations of population and economic activity in coastal regions. Among regions, North Africa exhibits the greatest relative impacts. Threat of inundation due to sea-level rise in the continent's coastal areas also includes the Gulf of Guinea, Senegal, Gambia and the East-Southern African coast [17]. At the country level, results are extremely skewed, with severe impacts limited to a relatively small number of countries. For these countries (e.g. Egypt), however, the consequences of SLR are potentially catastrophic [36]. Egypt's population would be most severely impacted by SLR. With a 1m SLR, approximately 10% of Egypt's population would be impacted. Most of this impact takes place in the Nile Delta; it reaches 20% with a 5m SLR. The Egyptian GDP would also be significantly impacted due to severe disruption of the agricultural sector. Even with a 1m SLR, approximately 12.5% of the Egyptian agricultural sector would be impacted; this percentage reaches 35% with a 5m SLR [36]. Cost of adaptation to sea level rise could amount to at least 5–10% GDP [23]. Sierra Leone, which is in the Gulf of Guinea and one of the worst hit coastal areas in sub-Saharan Africa, is projected to suffer significantly from sea levels rise (up to 95 cm by the year 2010). Full protection of all its vulnerable shores will require USD 1.2 billion, equivalent to 17 percent of GDP [37].

• Conflict and Violence: Drought and other climate-related shocks may spark conflict and violence, as they have done already in many parts of Africa. Increased climate variability (such as periods of intense rain to prolonged dry periods) can result in adverse growth shocks and cause higher risks of conflict as work opportunities are reduced, making recruitment into rebel groups much easier [38]. Adverse climatic conditions already make societies more prone to violence and conflict across the developing world, both internally and cross-border. Long periods of drought in the 1970s and 1980s in Sudan's Northern Darfur State, for example, resulted in deep, widespread poverty and, along with many other factors such as a breakdown in methods of coping with drought, has been identified by some studies as a contributor to the current crisis there. The international community needs to help generate incentives to keep skilled labour in developing countries but also to allow developing countries to capitalize on the benefits that fluid labour markets can bring. The international regulation of labour migration, adaptation to climate change

and capacity building in vulnerable countries are inherently intertwined. Migration will be used by some households in vulnerable countries as a means of adapting to climate change. Clearly there has to be a balance of policies that promotes the incentives for workers to stay in their home countries whilst not closing the door of international labour mobility [39].

Climate change can be viewed as 'catastrophic', 'rapid', 'urgent', 'irreversible', 'chaotic', and 'worse than previously thought' [40]. Climate change is likely to impact more severely on the poorer people of the world, because they are more exposed to the weather, because they are closer to the biophysical and experience limits of climate, and because their adaptive capacity is lower. A Gini coefficient for climate change impacts, showed that the distribution of impacts is very skewed in the near future and will deteriorate for more than a century before becoming more egalitarian [41]. For Africa, changes in the climate will amplify the existing challenges posed by tropical geography, a heavy dependence on agriculture, rapid population growth, poverty, and a limited capacity that constrains African countries' ability to adapt [1], [42].

D. Climate Change Mitigation Measures

Climate change is global in its causes and consequences, and the response requires international collective action. There is still time to avoid the worst impacts of climate change, if we act now and act internationally [5]. The overarching goal for climate protection is "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system." The Millennium Development Goals and targets (MDG) come from the Millennium Declaration, signed by 189 countries, including 147 heads of State and Government, in September 2000 [8] and from further agreement by member states at the 2005 World Summit (Resolution adopted by the General Assembly [43]. The goals and targets are interrelated and should be seen as a whole. They represent a partnership between the developed countries and the developing countries "to create an environment-at the national and global levels alike -which is conductive to development and the elimination of poverty". The objective of the declaration is to promote "a comprehensive approach and a coordinated strategy, tackling many problems simultaneously across a broad front." Goal 7 of the Millennium Development Goals and targets (MDG) is to "ensure environmental sustainability" and Target 7.A is to "integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources" [8]. According to the UNFCCC, industrialized countries, or Annex I countries, have the main responsibility to mitigate climate change [44].

The three flexible mechanisms of the Kyoto Protocol: Joint Implementation (JI), the Clean Development Mechanism (CDM) and Emissions Trading (ET) are supposed to lead to an efficient compliance with the Kyoto commitments. The first two allow Parties with emission targets to conduct emission reduction or sink enhancement projects in other countries and use the resulting emission credits for compliance with their commitments. Emission trading creates an international market on which emission allowances and credits can be traded.

In addition to emission reduction (avoiding emissions at the source), removal and storage of greenhouse gases comprises another solution. Article 3.1 - in stating the goal of the Kyoto Protocol - uses the expression 'reducing the overall emissions'. However, national emission inventories include emission reduction as well as removal of greenhouse gases through carbon (dioxide) capture and sequestration activities [45]. Carbon sequestration activities have in common that they do not avoid the production of CO_2, but lock carbon (dioxide) away from the atmosphere for a certain period of time. This long-term storage of carbon can take place either in the terrestrial biosphere, underground or in the oceans. Carbon sequestration in the terrestrial biosphere refers to activities leading to an increase in carbon stocks in the terrestrial biomass as for example through afforestation. Such carbon sequestration activities have entered the Kyoto Protocol as the 'Land use, Land-use change and Forestry (LULUCF)' issue. Often LULUCF has simply been referred to as the 'sinks issue'. A sequestration option, which has only recently entered the climate policy arena, is the one of carbon dioxide capture and storage (CCS). This refers to activities which capture carbon dioxide at large point sources like power plants and store it subsequently in reservoirs [45].

The CDM is a project-based mechanism through which a developed country partner and a developing country partner jointly develop a project that reduces greenhouse gas emissions. In essence a CDM project would involve either reducing currently occurring emissions from a particular activity or ensuring the emissions from a future activity are less in the presence of the project than they would have been without the CDM project. It is also required that the CDM project shall assist the developing country in achieving sustainable development. This will require some form of criteria and approval confirming that the project does contribute to sustainable development in the country in which the project will occur. The greenhouse gas reductions are termed "certified emission reductions" (CERs) in the case of the CDM because they will need to be audited and certified by an independent third party. The CERs are the 'currency' of the mechanism and they have value to the developed country because they are less costly to produce than greenhouse gas reductions would be in the developed country. The CERs are valuable to developing country because they are the commodity which they sell to the developed country in return for technology, capital investment in projects, or direct financial returns.

The regional distribution of CDM projects is also rather uneven with three countries China, India and Brazil accounting for 75-85 percent of the projects (Fig. 5). China completely dominated the CDM sell side in 2006, miles ahead of India and Brazil. China continued to be bigger than all the rest, although it has inched down from 70 percent in 2006 to 62

percent of transaction volume in 2007. Africa is almost bypassed in the CDM investments flows. Africa holds 1% of the confirmed and probable projects and 3% of the estimated CERs until 2012 [46].

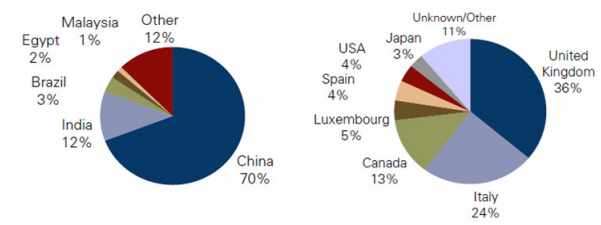

Fig. 5a The relative share of CDM country sellers (left) and buyers (right) in 2006 [47]

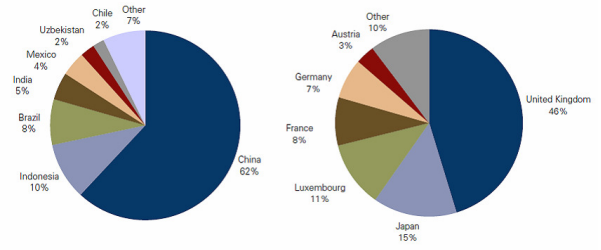

Fig. 5b The relative share of CDM country sellers (left) and buyers (right) in 2007 [48]

Although they account for a much smaller share of the primary CDM market, some countries in Africa (Kenya, Uganda, Nigeria), reported sharp increases in transaction volumes. Projects in Africa have contracted to supply about 50MtCO2e to the market so far, with more than 20MtCO2e transacted in 2007 alone [49].

Tropical developing countries preserve for the earth as a whole a vast public resource in the form of conserved rainforest which acts as a powerful carbon sink. According to the UNFCC, if this rainforest is cleared (which is happening now at a rate of 1-2 percent per year) then it releases carbon emissions (from loss of carbon sink as well as release of carbon through burning) amounting to 25 percent of total planetary carbon emissions [50]. Six of the ten largest forest losses (Congo Democratic Republic, Nigeria, Sudan, Tanzania, Zambia, and Zimbabwe) are in sub-Saharan Africa. Yet there are currently no mechanisms in place to offer tropical developing countries any incentive for preserving these important carbon sinks. The Kyoto Protocol excludes deforestation issues, even from the Clean Development Mechanism, whereas reafforestation after clearing is rewarded in the form of carbon credits. The integrative and participatory approach for holistic and adaptive management of the carbon cycle is a challenging but not impossible learning process [51].

E. Adapting to Unavoidable Climate Change

All countries, rich and poor, need to adapt to climate change and this will be costly. Developing countries, already the hardest hit by climate change, have little capacity (both in human capacity and financial resources) to adapt. Spending to adapt to climate change will undermine funding for sustainable development, putting strong pressure on developing country budgets and overseas development assistance. It is therefore vital that ways and means are found to enable developing countries to enhance their efforts to adapt in the context of sustainable development and sustainable development must incorporate adaptation plans.

Adaptation to climate change in African countries is vital and should have a high or urgent priority. However, African countries have limitations, both in their human capacities and financial resources, which represent a major barrier for adaptation. Many factors contribute and compound the impacts of current climate variability in Africa and will have negative effects on the continent's ability to cope with climate change. These include poverty, illiteracy and lack of skills, weak institutions, limited infrastructure, lack of technology and information, low levels of primary education and health care, poor access to resources, low management capabilities and armed conflicts [1], [6].

Africa's challenge is to develop a framework and policies that ensure that resources are used efficiently and equitably, to maintain economic and developmental aspirations, and to protect the weak in responding to changes in the climate. Africa's capacity adequately to respond to the challenges of climate instability will be expanded by improving overall resilience, integrating climate change goals into sustainable development strategies, increasing the use of modern energy systems with reduced carbon intensity, and strengthening international initiatives.

Adapting to climate change will entail adjustments and changes at every level – from community to national and international. To enable workable and effective adaptation measures, ministries and governments, as well as institutions and non-government organizations, must consider integrating climate change in their planning and budgeting in all levels of decision making.

A number of current collaborations are discussed which are helping to pave the way for cooperation on climate change adaptation:

- African countries should fully exploit the current growing international attention to climate change and development in Africa despite declining aid to the continent.
- Governments need to take a greater role in addressing this: the private sector involvement advocated by donor and international agencies can assist but only in an adequately regulated and competitive environment.

A comprehensive approach is required in order to help the understanding of climate change impacts and vulnerabilities and to facilitate better policy decisions and management. An effective way to address the impacts of climate change is by integrating adaptation measures into sustainable development strategies so as to reduce the pressure on natural resources, improve environmental risk management, and increase the social well-being of the poor; looks at adaptation in the light of

sustainable development, the integration of adaptation into policy and development planning, and the need for further capacity-building and training. Sustainable development and the Millennium Development Goals (MDG) constitute a necessary backdrop to integrating adaptation into development policy. Capacity-building, for example to integrate climate change and socio-economic assessments into vulnerability and adaptation assessments, helps to better identify effective adaptation options and their associated costs.

Effective adaptation strategies that are more likely to succeed need to link with coordinated efforts aimed at poverty alleviation, enhancing food security and water availability, combating land degradation and reducing loss of biological diversity and ecosystem services, as well as improving adaptive capacity.

Examples of good practice:

In Africa rural farmers have been practicing a range of agricultural techniques as coping strategies and tactics to enable sustainable food production and deal with extreme events. These include intercropping and crop diversification; use of home gardens, diversification of herds and incomes, such as the introduction of sheep in place of goats in the Bara province in Western Sudan, pruning and fertilizing to double tree densities and prevent soil erosion in semi-arid areas, e.g. Senegal, Burkina Faso, Madagascar and Zimbabwe; manipulation of land use leading to land use conversion, e.g. a shift from livestock farming to game farming in Southern Africa; water conservation techniques to cope with arid conditions such as the Zaï technique in Burkina Faso: farmers dig pits in the soil to collect organic material carried by the wind during the dry season, at the start of the rainy season farmers add organic matter from animals which attracts termite activity resulting in termite tunnels that can collect rain deep enough that it doesn't evaporate, and thus increasing soil fertility. In many locations tribal and individual movements and migration are also identified as adaptation options [23].

Recommended adaptation measures in key vulnerable sectors highlighted in national communications of African countries

Water Resources:

- Protection of groundwater resources
- Improved management and maintenance of existing water supply systems
- Protection of water catchment areas
- Groundwater and rainwater harvesting and desalination
- Water policy reform including pricing and irrigation policies
- Development of flood controls and drought monitoring
- Better use of recycled water

Agriculture and food security:

- Erosion control
- Dam construction for irrigation
- Changes in fertilizer use and application
- Introduction of new crops
- Soil fertility maintenance
- Changes in planting and harvesting times
- Switch to different cultivars
- Educational and outreach programmes on conservation and management of soil and water
- Development of tolerant/resistant crops (to drought, salt, insect/pests)
- Diversification and intensification of food and plantation crops
- Policy measures, tax incentives/subsidies, free market
- Development of early warning system

Health:

- Public health management reform
- Improved housing and living conditions
- Improved emergency response
- Development of early warning system
- Better and/or improved disease/vector surveillance and monitoring
- Improvement of environmental quality
- Changes in urban and housing design

Terrestrial Ecosystems:

- Improvement of management systems including control of deforestation, reforestation and afforestation
- Promoting agroforestry to improve forest goods and services
- Development/improvement of national forest fire management plans
- Improvement of carbon storage in forests
- Identification/development of species resistant to climate change
- Monitoring of species

Coastal Zones:

- Protection of economic infrastructure
- Integrated coastal zone management
- Building sea walls and beach reinforcement
- Better coastal planning and zoning
- Development of legislation for coastal protection

III. Energy Security Challenges

A. *Africa Energy Outlook*

According to the IEA's (International Energy Agency) World Energy Outlook (WEO 2008), and supposing that there is no major energy policy shift in the coming decades, world energy consumption is expected to expand by 50 percent from 2005 to 2030, with an average annual increase of 1.6 percent [2]. Energy consumption in Africa only is expected to expand by 67 percent over the same period, with an average annual increase of 2 percent (Table I).

China and India, the fastest growing non-OECD economies, will be key contributors to world energy consumption in the future. Over the past decades, their energy consumption as a share of total world energy use has increased significantly. In 1980, China and India together accounted for less than 8 percent of the world's total energy consumption; in 2005 their

TABLE I
AFRICA ENERGY OUTLOOK 1990-2030

No.	Variable	Region	History		Projections					Annual Change *
			1990	2005	2010	2015	2020	2025	2030	
1	Energy Consumption (Quadrillion Btu)	Africa		14.40	16.50	18.90	20.90	22.50	23.90	2.0
		Total World		462.20	512.50	563.00	608.40	651.80	694.70	1.6
		Africa/World%		3.12	3.22	3.36	3.44	3.45	3.44	
2	Gross Domestic Product (GDP) (Billion 2000 Dollars)	Africa	1,450	2,295	2,971	3,656	4,390	5,219	6,171	4.0
		Total World	33,989	56,793	71,680	85,713	100,552	116,413	133,802	3.5
		Africa/World%	4.27	4.04	4.14	4.27	4.37	4.48	4.61	
3	Natural Gas Production (Trillion Cubic Feet)	Africa		6.1	7.9	10.7	13.5	14.8	15.8	3.9
		Total World		101.9	116.2	129.5	141.2	149.9	158.6	1.8
		Africa/World%		5.99	6.80	8.26	9.56	9.87	9.96	
4	Coal Production (Quadrillion Btu)	Africa		5.9	6.7	7.4	7.8	8.1	8.2	1.3
		Total World		122.2	140.2	158	172.1	187.1	202.7	2
		Africa/World%		4.83	4.78	4.68	4.53	4.33	4.05	
5	Liquids Consumption (Million Barrels Oil Equivalent per Day)	Africa	2.1	2.9	3.4	3.5	3.7	3.8	3.8	1.1
		Total World	66.6	83.6	88.6	92.3	95.6	98.3	101.3	0.8
		Africa/World%	3.15	3.47	3.84	3.79	3.87	3.87	3.75	
6	Energy-Related Carbon Dioxide Emissions (Billion Metric Tons)	Africa	0.6	1.0	1.1	1.2	1.4	1.4	1.5	1.8
		Total World	21.2	28.1	31.1	34.3	37	39.6	42.3	1.7
		Africa/World%	2.83	3.56	3.54	3.50	3.78	3.54	3.55	

*Average Annual Percent Change, 2005-2030
Modified from: Energy Information Administration (2008) [2].

share had grown to 18 percent. Even stronger growth is projected over the next 25 years, with their combined energy use more than doubling and their share increasing to one-quarter of world energy consumption in 2030.

Demand for electricity in Africa grows at an average annual rate of 3.1 percent. Thermal generation accounted for most of the region's total electricity supply in 2005 and is expected to be in the same position through 2030. Coal-fired power plants, which were the region's largest source of electricity in 2005, accounting for 47 percent of total generation, are projected to provide a 32-percent share in 2030, as natural-gas-fired generation expands strongly from 22 percent of the total in 2005 to 50 percent in 2030 (Fig. 6) [2].

South Africa is Africa's largest electricity generator, producing nearly 43 percent of the region's total electric power in 2005. The country has been an important regional supplier, exporting electricity to neighbors, including Zimbabwe and Swaziland.

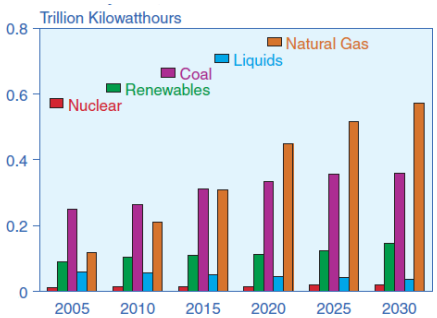

Fig. 6 Net Electricity Generation in Africa by Fuel, 2005-2030[2]

The International Energy Agency (IEA) highlighted the important link between energy and poverty in its WEO 2008. The IEA's outlook to 2030 of global energy supply and demand trends estimates that 1.6 billion people – one quarter of the world population – have no access to electricity, and that in the absence of vigorous new policies, 1.4 billion people will continue to lack electricity in 2030. There are some African countries that have very low accessibility to electricity especially Mozambique (6%) and Togo (17%) that accounted for 18.6 and 5.1 million populations without electricity, respectively [52].

Economic growth in Africa has maintained a healthy pace of more than 4 percent per year since 2000, based on increased earnings from fossil fuel exports, strong global demand and favorable international prices for some other export commodities, vigorous domestic demand, and significant foreign direct investment and foreign aid [53]. Africa's combined economy is projected to grow at an average annual rate of 4.5 percent from 2005 to 2030 - a projection that is optimistic by historical standards but is supported by the region's strong economic activity over the past 5 years, resulting from expansion of primary exports and robust domestic demand in many of Africa's national economies. Nevertheless, both economic and political factors - such as low savings and investment rates, lack of strong economic and political institutions, limited quantity and quality of infrastructure and human capital, negative perceptions on the part of international investors, protracted civil unrest and political disturbances, and especially the impact of HIV/AIDS on population growth - present formidable obstacles to growth in a number of African countries.

B. Africa Energy Security

Under the strictest terms, energy security is defined as the availability of reliable and affordable energy supplies in adequate quantities to satisfy demand and maintain economic growth. More comprehensively, it also includes notions of geopolitics, sustainability, and social acceptability. Energy security is closely linked with economic development and environment – the "three Es". Policymakers often think of energy security in terms of oil supply disruptions and energy price volatility, which can wreak havoc on economic growth and create significant international tension. However, policymakers must consider the links between fuel choices, energy demand, infrastructure needs (both existing and future), investment requirements, and the environmental impacts of energy use [54].

In Africa, energy security concerns are also very real – without access to ample, reliable and affordable energy, economies cannot develop. Energy security concerns vary by country depending on resource endowment, population distribution, economic makeup, and a number of other factors. Africa is a continent of many contradictions: rich in natural resources, yet underdeveloped with large populations of poor people. Many African countries are generously endowed with productive land and valuable natural resources, including renewable and non-renewable resources.

Developing energy, industrializing agriculture and mining sustainably are three promising areas for wealth creation. Africa's vulnerability to climate change will only worsen, unless there is a significant increase in the use of fertilizers, irrigation and agricultural mechanization. Regional networks are even more significant for Africa, given the relatively small national markets and the need for regional cooperation to ensure energy security and to attract needed investment. Moreover, the fact that there are more than 12 land-locked countries in Africa strengthens the necessity for co-operation and integration of energy projects with neighboring countries and/or for access to nearby ports, in order to develop better energy transport networks and to guarantee security of energy supply [55].

In July 2001, African Heads of State met in Lusaka, Zambia to address the energy challenges facing them. They recognized that only with greater access to modern energy could they achieve the poverty reduction goals of the UN Millennium Declaration. With modern energy, fewer women and children will die prematurely of indoor smoke inhalation, water and air will be cleaner, African youth will be able to learn at night and productivity will increase. Recognizing this reality, African Heads of State agreed to create the African Energy Commission (AFREC). The mandate and architecture of AFREC seek to integrate African energy efforts, strengthen regional co-operation and provide policy-makers with the tools to accelerate the penetration of modern energy services across the continent.

The International Energy Agency (IEA) jointly with the World Energy Council (WEC) and nine other international organizations have been working together to support AFREC in the creation of an Africa-wide energy information system – the African Energy Information Forum (AEIF). Regional energy networks around the world are contributing to integration of gas and electricity, harmonization of pricing and regulatory regimes and invigoration of investment regimes to attract foreign capital. These networks are underpinned by functioning and effective energy information systems to allow for sound analysis and planning to sustain development. Reliable information based on comparable, detailed and timely data, is necessary for such sound analysis and planning [56], [57], [58].

At its meeting in March 2007 the European Council pointed out to the importance of building a special dialogue with African countries on energy and using Community instruments to enhance in particular decentralized renewable energies and generally energy accessibility and sustainability in this region, as well as energy infrastructure of common interest [13].

Persistent high oil prices represent the second important economic issue to Africa. Increased energy cost is constraining investment and growth in many oil-importing African countries that are also confronted with other threats to macroeconomic stability, including intensifying inflationary pressures, and increasing fiscal and current account deficits. In

addition to good macroeconomic management, oil-importing countries will need increased external support to maintain growth and reduce growth volatility in the foreseeable future. On the other hand, oil-exporting countries need to manage oil revenues to ensure diversification of sources of growth and exports and avoid excessive currency appreciation and build up of reserves [57].

C. Africa Renewable Energy Options

At present, the majority of the poor in Africa spends a significant proportion of their income on energy and relies mainly on biomass. Reliance on traditional biomass, as the main source of energy, is particularly high in sub-Saharan Africa, where biomass accounts in some countries for 70-90% of primary energy supply and up to 95% of total consumption [58]. Since most of Africa's poor live in remote rural communities, there are no clear economic incentives for grid-extensions or for supplying modern hydrocarbon fuels, such as kerosene and liquefied petroleum gas (LPG).

There is an enormous potential for hydropower development in Africa, and yet to date only 7.0% of that potential has been harnessed. Traditionally, hydro-based electricity generation was the basis for the expansion of electricity networks in many African countries [58].

In these conditions, the deployment of other renewable energy technologies should play an important complementary role. The new process technologies developed during the last years made it possible to produce biodiesel from recycled frying oils comparable in quality to that of virgin vegetable oil biodiesel with an added attractive advantage of being lower in price [59].

While in absolute terms, Africa's energy resources are adequate; the geographical distribution of the different resources across the continent is uneven. North Africa is rich in oil and gas; South Africa has huge coal reserves and the sub-Saharan Africa is largely reliant on biomass [58].

IV. Interrelation between Energy and Climate Change

Energy security and climate change interests sometimes conveniently align. There are many options having both positive climate and energy security characteristics. Like other efficiency options, improvements in energy efficiency have a unique combination of positive security and climate traits. Improvements in energy efficiency and reductions in energy demand provide a "double win". Increased efficiency has the potential to reduce GHG emissions throughout the economy by decreasing the amount of energy needed for society to function. Lower-carbon energy sources such as wind, solar, biomass, and hydropower provide domestically produced energy and can substantially reduce emissions compared to fossil fuels. Depending on domestic resource endowment and disposal facilities, nuclear power can also improve energy security while reducing emissions; however this is not always the case. Research and development to increase commercialization of current technologies and to create new clean energy technologies is an essential component of meeting energy security and climate goals. Biodiesel and other biofuels can play an important role in this aspect. Assisting Africa's development of its largely unexploited hydropower potential would help to meet its objective of increasing energy access while limiting GHG emissions. Less than 4% of Africa's hydropower potential is currently utilized [60].

There are also some measures which present conflicts between energy security and climate goals. There are some options which have energy security but negative climate traits. A good example is utilizing the coal-to-liquids (CTL) technology. Using coal-to-liquids (CTL) technology will allow reduced oil imports. Pursuing this option will result in additional CO2 emissions resulting from the conversion of coal to liquid fuel compared to traditional petroleum. This will impose significant negative impacts on global warming, even with carbon dioxide capture and sequestration (CCS). Domestic fuel options (e.g., oil shale, oil sands, and extra-heavy oil deposits) result in higher carbon emissions than traditional resources. Greater use of these fuels (without the ability to capture and sequester the carbon emissions at a large scale) would dramatically increase GHG emissions.

There are also some options having positive climate but negative energy security characteristics. Expanding imports of liquefied natural gas (LNG) may expose a country to greater risks of potential imported fuel supply disruption, but this fuel is less carbon-intensive. Climate change strategies that replace high-carbon fuels with lower-emitting energy sources can increase energy insecurity. For example, switching from coal combustion to natural gas in the power sector is an effective means to reduce GHG emissions. However, many regions rely on imported natural gas. Expanded reliance on imported oil is an option having both negative energy security and climate implications.

V. Recommendations for an Integrated Energy and Climate Policy

A. Strong Commitments to Reduce Global Carbon Emissions

The world's most developed countries are the leading producers of greenhouse gasses. Ambitious and binding commitments on reducing emissions by the developed countries should be a constant, justified call. Although there are still no commitments on reducing emissions by developing countries, including African countries, yet measures have to be taken to cut emissions. By recognizing Africa's legitimate development needs, incentives from developed countries should be expected. It is thus urgent for all countries to agree on a long-term global stabilization goal on GHG emissions and ways of allocating the effort equitably.

International community and African governments themselves need to respond, within the UN Framework Convention for Climate Change (UNFCCC) of current commitments and future negotiations. This response needs to take into account not only Africa's acute vulnerability but also

its legitimate development needs, and the broader principles of equity and fairness in a global framework to reduce global GHG emissions.

Development partners and African countries must review carbon finance mechanisms to make them more easily accessible to Africa for climate adaptation and to help Africa meet its energy requirements while moving to cleaner energy. This must be accompanied by efforts to raise awareness about the potential benefits of CDM in helping African countries develop new sectors such as renewable energy, and support by external partners for capacity development to elaborate and certify CDM projects.

B. The Need for Regional Cooperation and Integration

Regional energy cooperation and integration is one of the most promising and cost-effective options for Africa, to further the development of its energy sector, in order to gain the environmental, social and economic benefits accruing from a more efficient use of resources. It is imperative to widen the region's economic space so as to generate economies of scale for production and trade and to maximize the welfare functions. !is is basically why the numerous regional economic communities (RECs) have been created, and why African political leaders have held at heart the goals of both the Abuja Treaty establishing the African Economic Community and the Constitutive Act of the African Union [55].

Integration remains a key strategy for Africa to transform itself from a continent of mainly least developed and developing countries to a strong united bloc of developed nations and a global force. Regional cooperation and integration is necessary to improve Africa's competitiveness and position it to maximize the benefits of globalization [58].

C. Carbon Capture, Storage and Sequestration

A large body of literature suggests that terrestrial sequestration of carbon through land management changes is an option for mitigating climate change [45, 61]. Assessing the contribution of terrestrial carbon sequestration to climate change mitigation requires integration across scientific and disciplinary boundaries.

D. Adapting to the Massive challenge of Climate Change

Adaptation to climate change should be understood as a continuous process which addresses current climate variability and future climate risks. Africa's challenge is to develop a framework and policies that ensure that resources are used efficiently and equitably, to maintain economic and developmental aspirations, and to be alert in responding to changes in the climate.

African countries should enhance their efforts to adapt in the context of sustainable development and sustainable development must incorporate adaptation plans. Urwin and Jordan (2008) [62] suggested that governments are undoubtedly right to raise the profile of adaptation by identifying and resolving the most obvious antagonisms between existing policies, while building flexibility and adaptability into policy systems to facilitate, rather than inhibit, robust adaptive planning.

Development partners must deliver on their commitments to support African countries to adapt to the unavoidable effects of climate change. That includes scaling up efforts to improve and increase access to climate data; investment and transfer of technologies for adaptation in key sectors; developing and implementing best practice guidelines for screening and assessing climate change risk in their development projects and programs in climate sensitive sectors; mainstreaming climate factors into development planning and implementation; and providing significant additional investment in disaster prevention.

E. Legitimate Need to Increase Africa's Energy Supply

It should be in the wider global interest that Africa should be able to develop clean energy sources. Full implementation of the Clean Energy and Development Investment Framework being developed by the World Bank and the African Development Bank is a vital step. Renewable energies and energy efficiency programs should take priority [63].

F. Stressing on Appropriate Energy Options

Energy options that are compatible with existing infrastructure (e.g., pipelines, vehicles, power generation facilities, etc.) have a natural advantage over those energy sources that require new or altered infrastructure. This economic advantage can drive businesses and policymakers to choose energy sources that can be used in the existing infrastructure despite the trade-offs or undesirable consequences.

Lower-carbon energy sources such as wind, solar, biomass, and hydropower provide domestically produced energy and can substantially reduce emissions compared to fossil fuels. Encouraging the increased use of hydropower and non-hydropower renewables for electricity generation and the increased use of renewable fuels for transportation. Assisting Africa's development of its largely unexploited hydropower potential would help to meet its objective of increasing energy access while limiting GHG emissions.

G. Improving Energy Efficiency

In 2050, it is estimated that energy efficiency improvements could reduce the primary energy demand by approximately 300 EJ, resulting in an annual emission reduction of approximately 20-25 Gtons CO2 (compared to a business-as-usual scenario) [64]. It makes more economic sense to invest in energy efficiency now rather than bearing the costs of the impacts of climate change later. Apart from climate change, increasing energy prices and energy security concerns are important incentives to stimulate energy efficiency.

Applying consistent and comprehensive policies for achieving energy efficiency that use pricing (including consideration of externalities), taxation, regulation and other forms of support to effectively achieve long term efficiency objectives is recommended.

H. Compromises in Energy Policy

To find compromises between often contradictory targets (e.g. economic, environmentally friendly and secure energy supply), it has been necessary to develop cornerstones for a new integrated energy and climate policy. As a result, at its meeting in March 2007 the European Council laid the foundations for an integrated European climate and energy policy [13]. Also, despite opposition from some countries, the G8 Summit at Heiligendamm in June 2007 made reference to the global challenge of climate change and the related topics of energy efficiency and security [65,66]. Africa is in need for a similar response.

With regard to energy security policy, a distinction can be made between government actions to mitigate the short-term risks of physical unavailability occurring in case of a supply disruption and efforts to improve energy security in the long-term [62]. In the first case, actions include establishing strategic reserves, dialogue with producers, and determining contingency plans to curtail consumption in times of important supply disruptions. In the second case, policies tend to focus on tackling the root causes of energy insecurity [54,62].

Analysis of the energy policy options in the context of conflicting sub-sector objectives, peculiar constraints of the geo-politics, socio-economic and technological limitations and environmental implications has made integrated planning approach inevitable. The fast growing computational capabilities of the personal computers and the web based communication tools has made it possible to develop and use energy system models as decision tools [67].

I. Governance

A major obstacle to mitigation measures is the increasing fragmentation of global climate governance. First, climate governance is marked by a mosaic of policies, such as the emissions trading system of the European Union (EU), the target-and-timetables approach of the Kyoto Protocol, the voluntary Asia-Pacific Partnership on Clean Development and Climate (AP6), and independent initiatives taken by U.S.A. This explains why so little has been achieved in terms of reform with positive practical consequences and why there is scant potential for raising the effectiveness of the UN in global environmental governance [68]. Second, climate governance is marked by a mosaic of actors, including governments, civil society, science and business, and their interlinked political activities in this field. This actor fragmentation extends to governments, where we can distinguish at least three different groups: industrialized countries that have ratified the Kyoto Protocol and committed to limit their greenhouse gas emissions by an average of five percent by 2012; industrialized countries that reject Kyoto, but intend to develop alternative regulatory approaches and architectures of international cooperation; and developing countries that support Kyoto in principle, and have ratified it, but do not need to limit or reduce their emissions within the first commitment period [69, 70]. African countries belong to the third group. Different types of fragmentations have degrees of performance. Integrative fragmentation might be a realistic second-best option in a world of diversity and difference in which purely universal governance architectures are more a theoretical postulate than a real-life possibility [71].

After the adoption of New Partnership for Africa's Development (NEPAD) in 2001, African countries are increasingly placing emphasis on creating new institutions and strengthening the existing ones to facilitate the implementation of NEPAD programmes and projects. In 2002, African governments established the African Ministers' Council on Water. In 2003 the Summit of the African Union adopted the "Action Plan for the Environment Initiative of NEPAD," with the objective of complementing relevant African processes, with a view to improving environmental conditions in Africa in order to contribute to the achievement of economic growth and poverty eradication. It also seeks to build Africa's capacity to implement regional and international environmental agreements and to effectively address African environmental challenges in the overall context of implementing NEPAD [72]. In 2005, African energy Ministers created the Forum of Energy Ministers. Africa's regional and sub-regional institutions, such as the Economic Commission for Africa, and the African Development Bank are also involved in sustainable development cooperation and joint programming throughout the continent.

The defining governance challenges in Africa are: visionary leadership, effective institutions, and indigenous capacity development. Improving governance and tackling corruption are difficult tasks, but empowered Africans are at the forefront of demanding better governance. African leaders are committed to strengthening governance and combating corruption [73]. It is important that Africa should speak with a strong unified voice in future international negotiations, and that this voice should be heard.

J. Capacity Building

Augmenting human capital through education and health care should be recognized as a critical process for enhancing resilience and adaptive capacity. Governance, in the form of institutional capacity, is a key issue and efforts are needed to build more robust functioning institutions. In spite of the many efforts to address capacity building deficits, the problem has continued to persist. The major challenges include: capacity-building efforts that have been poorly coordinated and not highly valued; poor attitudes and mindsets driving development; limited institutional focus towards advisory development; poor coordination and inadequate integration of efforts in capacity building; ineffective mobilization and utilization of African Capacity; wide gap between commitments and implementation; inadequate committed and accountable leadership; high dependency on external capacity; poor mobilization; and inadequate diagnosis of the real issues in capacity development [3].

Capacity development is an ongoing process, requiring the unleashing of a continuous supply of the appropriate legal, institutional, human and material resources and a conducive

operational environment. The ingredients of capacity and capacity building come from a wide range of sources in society, including the private sector, civil society organizations, schools, universities, think tanks and research institutes. These resources need to be mobilized and efficiently managed to build institutional capacities. In essence capacity building is about people who have to be trained, adequately equipped, sufficiently remunerated and appropriately disciplined in the efficient use and management of resources [74].

The environment in which capacity building takes place is very important. It requires peace and stability and an open and free political atmosphere. Only in this environment would people be free and willing to use their talents, skills and capital for productive and creative activities and in the process create wealth and employment, personal incomes and tax revenue, thereby establishing the basis for the continuous supply of the ingredients for capacity building. Thus, the government must continue to strengthen the democratization process while building the capacity of institutions responsible for supplying essential public goods and services to the people such as education, healthcare and security [74]. These roles of government demand capacity that might take different forms, all of which need building. Governments must embrace a broad perspective of capacity building in order to ensure appropriate capacity to fulfill their many different roles [3].

K. Encouraging Private Sector Investment

African governments should continue to improve the environment for investment to encourage private sector investment in carbon finance. Effective adaptation planning may only be feasible when a centralized and well-resourced decision-making system is in place, which is unlikely to be the case in many African countries. Thus, adaptation processes may be stimulated through the private sector and market innovation, as occurred in the process of adoption of new crop varieties in African rural economies.

African governments have the responsibility to build institutions that suit the African reality, including those that are capable of supporting African democracy and nation building and creating circumstances in which people feel secure to carry out daily activities. Governments are responsible for creating policy environments, as well as the actual policies that give effect to their national programmes for economic and social development. Governments are also responsible for creating economic and investment environments in which business can thrive and economies can grow. Governments need to create a dispensation to protect precious natural and cultural heritages for generations to come. Increasingly, governments are also responsible for building alliances and partnerships across national borders since policy constraints will not be effectively addressed if attention is only paid to nation-state boundaries [3].

L. Bridging Science and Policy

There will remain always a need for more research to inform the policymaking process. For scientific data to be successfully exchanged and used in policy formulation and decision making, it must meet a number of key criteria, namely: relevance, timeliness, clarity, integrity and visualization. African countries need to adapt and apply science and technology to attract efficient investment, improve competitiveness, and stimulate productivity.

1) Promoting Research Programs

Research and development to increase commercialization of current technologies and to create new clean energy technologies is an essential component of meeting energy security and climate goals. Africa has poorly funded research and government institutions, which makes it difficult to build and retain capacity for climate modeling and adaptation. Regional centers of excellence should be created and expertise within research and government institutions needs to be strengthened beyond a few individuals to form effective teams.

Research programs often suffer from the loss of key individuals, who move to better paid sectors of African economies as research funding runs out. It is thus critical to invest in individuals, as well as in institutions. It is important that African individuals and institutions take a leadership role in research programs and networks and that the latter and their implementation projects become sustained in the long-run.

Other problems plaguing the continent's science, technology and innovation system include weak or no links between industry and science and technology institutions, a mismatch between research and development activities and national industrial development strategies and goals. As a result, research findings from public research institutions do not get accessed and used by local industries and particularly small and medium-sized enterprises [3].

Investing in new technologies will require specific investments in public and private scientific and technological research infrastructures. This implies that important policy choices and trade-offs - from the infrastructure requirements for supporting new technologies to the ethical considerations relating to biotechnology - need to be made [75].

2) Facilitating Access to Technology Transfer

Access to existing technologies and technological innovations is commonly seen as a prerequisite for the reduction of emissions in developing countries [76]. Broad diffusion of current technologies and transition to new ones, for example, are expected to improve efficiency in energy use, introduce less carbon-intensive sources of energy, and further develop renewable energy sources [77]. Consequently, transfer of technology will be a key pillar in any agreement on a future regime to combat climate change [78]. While views on how to resolve this issue differ broadly, the private sector will play an important role, as it is the main source for the worldwide diffusion of technology [79]. Channels for the transfer of technology can be market-based (including trade, foreign direct investment and technology licensing) or informal (such as imitation and the mobility of technical and managerial personnel). The role of the public sector, however, is no less critical [77].

An important barrier to technology-transfer deals is the potential lack of commercial viability. In general, technology imported from industrialized countries is more efficient but also more expensive than technology manufactured locally, and it therefore requires higher initial investment costs [80]. Increasing technology transfer within the Clean Development Mechanism (CDM) could serve the dual purposes of both reducing the emissions of developing countries and changing their course of development. Given that the transfer of technology is not an automatic or costless process, legal and policy incentives are generally required to achieve the most effective rate and approach for transfer of technology in relation to national and international needs and objectives [77].

In the complex process of transfer of technology, the role of IP protection - despite being only one of many influential factors - has proven particularly contentious. As a legal and policy measure, intellectual property is potentially both an incentive and an obstacle to the transfer of technology. IP rights, as private rights, have been established and conceived as instruments to promote innovation and the dissemination of knowledge. Yet an excessive scope or level of protection of IP rights might stifle innovation or make access to knowledge more difficult or costly. In any policy context, including climate change, a balance between the protection of IP rights and the promotion of public objectives, such as the transfer of technology, is necessary [77]. Whilst access to Intellectual Property Rights (IPRs) may sometimes be a necessary part of facilitating technology transfer, it is not likely to be sufficient in itself. Other factors such as absorptive capacity and risks associated with new technologies must also be addressed [81].

M. Public Acceptance

Besides technical, legal and economic questions, however, broad public acceptance and a corresponding transfer of consciousness into every-day life are essential for reaching policy goals. Planning proceedings should always take perceived justice by the public into account. If people feel left out of the planning process and decision making, they will be more likely to oppose these processes [82].

Public participation is an important normative goal in formulating response to climate change risks [83]. It is important for decision-makers to recognize the range of different pressures and forces shaping the policy environment within which they must craft the pathway toward a stable climate and more energy-secure future. Environmentally sensitive local administrations and environmentally sensitive community that has environmental consciousness are essential components of good governance [84].

VI. Conclusion

Africa's challenge is to develop a framework and policies that ensure that resources are used efficiently and equitably, to maintain economic and developmental aspirations, and to be alert in responding to changes in the climate. Africa's capacity to respond to these challenges will be expanded by improving overall resilience, integrating climate change goals into sustainable development strategies, increasing the use of modern energy systems with reduced carbon intensity, and strengthening international initiatives. To find compromises between often contradictory targets (e.g. economic, environmentally friendly and secure energy supply), it is necessary to develop cornerstones for a new integrated energy and climate policy.

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