MINISTRY OF ENVIRONMENT, SCIENCE AND TECHNOLOGY

DRAFT

NATIONAL SCIENCE, TECHNOLOGY AND INNOVATION POLICY

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Introduction

At the dawn of independence in 1957, Ghana nursed the dream of rapid social and economic development using knowledge and tools derived from Science and Technology (S & T). In spite of the post-independence push to create the current S & T capacity, there has been no remarkable progress in ensuring that Science, Technology and Innovation drive socio-economic activities. A major cause is the absence of a definitive and prescriptive National STI policy document which defined the vision, goals, objectives and priorities for investment in STI. A National Science and Technology Policy would commit government, the productive sector of the economy, science and technology sector institutions to targets for production, processing, research and development (R&D) and innovation.

The existing Science and Technology (S&T) policy was adopted as a national document in 2000. The policy was however not implemented. More importantly, advances in S&T with wide applications, such as innovations in ICT and Internet applications as well as emerging trends in Biotechnology and nanotechnology make it imperative for Ghana to review the S&T policy. It is in the context of the above that this *Draft National Science, Technology and Innovation Policy* was crafted for adoption. It has benefited from earlier documents and was reviewed by a cross section of the science and technology community including social scientists. Unlike previous documents the concept of *innovation* is strongly welded into this new framework of actions, policies and programmes to apply science and technology to achieve social and economic objectives. This has come from the realization worldwide that technologies are able to bring about desired changes only when they are fully integrated into local systems and practices which may not necessarily have emerged from R&D. In this sense, innovation is a critical driver for socio-economic and sustainable development.

Vision, Goals, Objectives

The vision for which Ghana applies STI remains that of becoming a middle–income economy in the shortest possible time. The goal of the STI policy which is fully integrated into a national development strategy would harness the nation's total science and technology capacity to achieve national objectives for poverty reduction, competitiveness of enterprises, sustainable environmental management and industrial growth. Specific objectives are among others to:

i.   facilitate mastering of scientific and technological capabilities;
ii.   provide the framework for inter-institutional efforts in developing STI and programmes in all sectors of the economy to provide the basic needs of the society;
iii. create the conditions for the improvement of scientific and technological infrastructure for research and development and innovation.

The policy will be driven on the principles of relevance, realism, cost-effectiveness, synergy and partnership.

Sector-Specific Policy Strategies
The principal thrust of the National Science, Technology and Innovation Policy is to ensure that science and technology pervades all sectors of the economy. In order to achieve these objectives, sectoral policies, programmes and strategies would be implemented on the basis of the overall National Science, Technology and Innovation Policy. Sectoral policies in Agriculture, Health, Education, Environment, Energy, Trade, Industry, Natural Resources, Human Settlements and Communications shall be driven by sector-specific science and technology programmes and activities. This policy document highlights some specific activities and programmes of individual sectors.

Management of Science, Technology and Innovation Policy
The draft STI policy sees the Ministry of Environment, Science and Technology as the sector ministry with responsibility for Science, Technology, and Innovation (STI) and which will manage and implement Government's STI policies. This mandate will be executed through the organizations operating under its auspices and where necessary through other relevant organizations. The cabinet minister and the political head of the ministry would provide the needed leadership to link with other ministries and organizations for STI application and development in the country. The Policy, Planning, Monitoring and Evaluation (PPME) Directorate of the Ministry would be its nerve centre. This is the Directorate responsible for Policy formulation and the development of appropriate strategies for the monitoring and evaluation of these policies. There would be an apex STI body established to ensure strong advocacy for STI in the country, to provide STI advice to the ministry and the President, and to ensure coordination and harmonization of the nation's STI policy and programs. This body would serve as a Think Tank with representation from the Ghana Academy of Arts and Science, the CSIR, the faculties of science and engineering and technology, professional science and technology-based associations to provide the STI oversight and advice for policy formulation.

Financing S&T

Government would take stock of the inadequacy of the funding which had handicapped the country's progress in the past and would accordingly boost public expenditure in STI to achieve the ends of the renewed vision to use science and technology as the major drivers for economic growth. Government would make appropriate arrangements for financing the science and technology development and delivery system. To ensure the availability of funds at all times to meet the demands of innovation, Government will among other things:

i. take stock of all existing funding lines established to support development in science and technology and industry with the aim of streamlining them to achieve economies in their operations;

ii. strengthen and modify the National Science and Technology Foundation to incorporate support for innovation in its sphere of operations;

iii. accelerate the allocation of a minimum of 1% of the Gross Domestic Product (GDP) to support the science and technology sector;

iv. institute an attractive tax incentive mechanism for contributors to the instituted funds or directly to R&D activities, but in such a way as not to erode the national tax base.

CHAPTER 1: INTRODUCTION

1.1   Background

Science and Technology are perceived the world over as major tools for rapid social and economic development. The more industrialized countries of the world applied science and technology to develop their economics. China, South Korea, India, Malaysia and Singapore, and a few other countries, followed their footsteps and have also successfully applied science and technology to transform their economies. The very rapid economic transformation that has taken place in the Republic of Korea, for example, in contrast to our country Ghana is generally attributed to their greater success in acquiring and using the knowledge and innovation based on science and technology. Yet at the dawn of independence in 1957, Ghana also nursed the dream of rapid social and economic development using knowledge and tools derived from S & T. In a speech which the founding Prime Minister of Ghana, Dr. Kwame Nkrumah delivered at the

last meeting of the old legislative assembly on the 5th of March, 1957 he spelt out clearly a vision of rapid development based on the application of S & T. He said:

"Our whole educational system must be geared to producing a scientifically-technically minded people. Because of the limitations placed on us, we have to produce, of necessity, a higher standard of technical education than is necessary in many of the most advanced countries of the Western world … I believe that one of the most important services which Ghana can perform for Africa is to devise a system of education based at its university level on concrete studies of the problems of the tropical world. The University will be the coordinating body for education research, and we hope that it will eventually be associated with Research Institutes dealing with agriculture, biology, and the physical and chemical sciences which we hope to establish …" (McWilliam & Kwamena-Poh, 1975:94) cited by Kwame Akyeampong (2007).

This vision drove the impressive institutional arrangements made within a few years after colonialism ended to apply research, science and technology to national development. A National Research Council was established in 1958 to operate full-time scientific research institutions to study and develop appropriate technologies to support the country's development. A Ghana Academy of Learning, a learned society, was established in 1959, which became the Ghana Academy of Sciences in 1961. In 1963 the National Research Council merged with the Academy which assumed responsibility for ten full time research institutes and projects whose programmes were directly related to the nation's economic and social development.

In 1966 following the overthrow of Dr. Nkrumah changes were made to the Academy which became the Ghana Academy of Arts and Sciences (GAAS), and the Council for Scientific and Industrial Research (CSIR) which in its present form was re-established in 1996 with 13 Research Institutes. Over the years more scientific and technological institutions were established. These include the Ghana Atomic Energy Commission, Environmental Protection Agency, Noguchi Memorial Institute for Medical Research, the Ghana Standards Board, etc.

 Alongside the research establishments and government agencies and central to their functioning, are the universities which perform the important task of training the high level human resource to run and manage them. The University of Ghana began in 1948, as the University College of the Gold Coast. The Kwame Nkrumah University of Science and Technology began as the Kumasi College of Science and Technology in 1951. The University of Cape Coast started in 1961. As of 2009, Ghana has seven public universities, and 25 small private universities. With that number of universities as well as ten polytechnics, and over 500 senior high schools, 23 technical institutes, and a large informal sector where most artisanal skills training take place, Ghana can be said to have a substantial education and training capacity for human resource development in S & T. Inadequate staffing, laboratory and workshop facilities have however limited the capacity of all these education and training institutions to produce the quantity and quality of high level scientists and technologists, the middle level technicians and artisans.

With the creation of the Ministry of Environment, Science and Technology in the third republic, as the Ministry of Industry, Science and Technology, the promotion, management, coordination and harmonization of S & T policies and institutions were finally placed in the mainstream of Ghana's government machinery.

Currently, the status accorded science and technology in Ghana is low. Science and technology have a low priority rating in the eyes of policy makers and managers of the nation's resources. This has resulted in the inadequate allocation of the nation's budget to science, technology and innovation. Also without industries to use the talents and skills of bright young men and women who opt for science at school, their attraction is for medicine and related disciplines rather than the hard sciences of physics, mathematics, technological and engineering based professions. Inadequate support for S & T is manifest in the country's resource allocation to science and technology which has fluctuated between 0.3 and 0.5% of the Gross Domestic Product (GDP). This allocation is well below the target of 1% of the country's GDP prescribed at the Summit of African Heads of State of the Organization of African Unity (OAU) in 1980 under the Lagos Plan of action and adopted by the AU as a critical means of realizing the goals and objectives of the New Partnership for Africa's Development (NEPAD). Korea, Singapore and Taiwan spend as much as 2% of GDP on S & T.

In spite of the post-independence push to create the current S & T capability Ghana unlike many of the more successful economies transformed by S & T, there has been no definitive and prescriptive National STI policy document to define policies and prioritize investment. A National Science and Technology Policy to commit government, the productive sector of the economy and the science and technology sector workers, to set targets for production, processing, and also research and development. The existing Science and Technology (S&T) policy was adopted as a national document in 2000 providing a broad framework for defining goals and objectives for the application and development of S&T for socio-economic development. The policy was however not implemented. More importantly, advances in S&T with wide applications, such as innovations in ICT and Internet applications as well as emerging trends in biotechnology make it imperative for Ghana to review the S&T policy. Also other technologies with great potential such as nanotechnology among others underscore the need for Ghana to formulate a more comprehensive and vigorous approach to build a more modern scientific and technological capacity.

Meanwhile, competitive pressures on the national economy are enormous. The global trade environment which is dominated by rapidly emerging technologies and processes is gradually becoming threatening to local African enterprises. Climate change and its consequences in terms of food crises and threats to human welfare are affecting Ghana just as it is doing to the entire world ecosystem. However, the opening up of trade opportunities in the global markets in general and the mounting requirements of the World Trade Organization Treaty on Technical Barriers to Trade (Uruguay Rounds of Talks) pose both opportunities and risks to the developing economy of the country. Local enterprises can still be competitive in the global trade environment with enhanced innovation and scientific content in their operations in all areas. In this regard, Ghana as a matter of urgency has to make urgent policy decisions to harness STI in the development process.

It is in the context of the above that this *Draft National Science, Technology and Innovation Policy* was crafted for adoption. It has benefited from earlier documents and was reviewed by a cross section of the science and technology community including social scientists. The policy goals, objectives, approaches and mechanisms to achieve this, have taken account of among other things, investment in infrastructure, education and training, research and development and science acculturation.

Unlike previous documents the concept of *innovation* is strongly welded into this new framework of actions, policies and programmes to apply science and technology to achieve social and economic objectives. This has come from the realization worldwide that technologies that come from science and technology are able to bring about desired changes only when they are fully integrated into local systems and practices which may not necessarily have emerged from S & T. **Thus the sound application of scientific and technological know-how to effect positive changes have to take into consideration cultural norms and the total world view of the people who would be the users of the new technologies. Innovation therefore connotes these sometimes complex interactions of science, technology and the socio-cultural milieu whose definition and characterization require more than the skills of scientists and technologists and the advances which come from their insights.**

1.2   Existing Institutional Arrangements for Science, Technology and Innovation

Over the years, there have been re-structuring and re-organisation of the responsible ministry for STI with the aim of addressing specific developmental challenges. The consensus is strong that the Ministry of Environment, Science and Technology (MEST) which was re-established in January 2009 should be the sector ministry which should be responsible for the management and implementation of Ghana's science and technology policies under the Presidency. This will make the Ministry oversee and coordinate the activities and programmes of the Council for Scientific and Industrial Research (CSIR) with its thirteen research institutes, the Ghana Atomic Energy Commission (GAEC), the Environmental Protection Agency and Town and Country Planning Department, whose primary responsibilities are applied Research and Development (R&D) in Ghana.

As of now the MEST is not fully linked to sector-specific programmes in the other sector Ministries.

A major role for MEST which has so far not bene institutionalized is linkage between it and the Ministries of Education; Trade and Industry; Employment and Social Welfare; Communication; Lands and Forestry; etc and indeed all other Ministries to ensure that the educated, trained and skilled human resource in whom the national science, technology and innovation capability reside are available in adequate numbers to achieve national objectives in economic development. **An issue of concern and redress is inadequate commitment over the years to train a larger number of scientists and technologists to sustain the national scientific capability. Ghana also lost many of the trained persons to the brain drain. Unlike other countries use of the Diaspora has not been factored into a national assets utilization plan like other countries. One of the contributions towards that should be a national register of skilled Ghanaians abroad. The country needs more than their remittances which have become a major source of foreign exchange.**

While there is underproduction of science and technology sector workers at all levels, Ghana does not have a well thought of national policy to educate and train more Ghanaian scientists and technologists to the level of the PhD. While our universities may not have the capacity to train all the scientists and technologists that we require and across all the disciplines for an

effective S & T application in all sectors of the economy, it is the research and development that will build the national capacity and capability. A policy is required to link postgraduate training at the universities with the application of S & T in all sector ministries. A National Research and Technology Policy must encourage Ghana's scientists and technologists to link up with international research centers where world class basic research is being conducted so that Ghana is not isolated from such pursuits which eventually enlarge human knowledge and understanding. The excellence achieved by Ghanaian scientists and technologists at home and abroad is the evidence that that our educational system can unearth talent for further development at home and abroad. The polytechnics must be made to educate and train the high level technicians and technologists in larger numbers to provide high skilled support for national STI.

Major contributors to national science, technology and innovation capacity are the professional associations and bodies which meet annually to share results of their research and practice and pass resolutions which urge government to do this or that to advance STI. Unfortunately most of their annual gatherings receive little national coverage and many a time are not patronized by sector Ministers and the Presidency. The *National Forum on Harnessing Research, Science and Technology for Sustainable Development which was organized in 2004 was attended by the President, Chairman of the Council of* State, and major sector Ministries. It set a pattern of participation which must be repeated often to demonstrate commitment to STI by the President and his chief ministers. The new Science, Technology and Innovation Policy must recognize the value of professional bodies such as the Ghana Science Association (GSA). The communiqué that the Ghana Science Association issued at its 50th Anniversary Conference in Cape Coast is attached to show how professional science, technology and engineering associations can assist in setting national priorities and policy (Communiqué *at the end of the 26th Biennial Conference of the – Golden Jubilee – held at the University of Cape Coast, 4th to 9th August, 2009)*

1.3   What Constraints have limited STI Application?

Ghana has made much investment in science and technology infrastructure. These investments have not yielded the expected improvements in economic growth. This can be attributed to a number of constraints including the following:

a) The inadequate scientific expertise in the country
b) Lack of advocacy for S & T at high political and policy levels
c) Low science culture among the population
d) Weak mechanisms for the management of S & T
e) Ineffective coordination
f) Inadequate budget and resource allocation
g) Weak linkage between policy formulation and national development planning
h) Weak mechanisms for implementation, evaluation and review
i) Weak linkages between various agencies and organizations in S & T
j) Weak linkage between industry and S & T
k) Over reliance on the use of foreign expertise to the neglect of the use and development of local expertise.
l) Poor performance of majority of senior high school graduates in the WASSCE.

Ghana STI would advance rapidly if these constraints are removed. Calls for their removal have come from annual and biennial resolutions from the professional bodies which represent the science and technology communities (see the 2009 GSA resolutions attached). Advocacy for STI should be greatly manifest if Ministers of State and the President himself are seen often interacting with scientists and technologists and working with them to address the limiting constraints.

1.4   Justification for Science, Technology and Innovation Policy

The priority themes underpinning Ghana's National Science, Technology and Innovation Policy and together form the agenda for the revived Ministry of Environment, Science and Technology provide ample justification for the STI policy. These are.

- Promoting competitiveness in productive sectors of the economy;
- Creating job opportunities and employment;
- Expanding industrialization;
- Enhancing the quality of life through innovation;
- Developing scientific human resources;
- Expanding infrastructure;
- Promoting an information society;
- Optimizing on the sustainable use of the natural and environmental resources;
- Commercializing research findings.

Ghana's development plans have made some elaboration of the STI components of the STI applications in national development. (See Box 1)

Box 1

In recent times the National Development Planning Commission (NDPC) articulated its vision for Ghana in 2015 thus: "a modern economy based on the development of science and technology."

To achieve this vision, Ghana will need a modern, efficient framework for promoting Science, Technology and Innovation (STI) and for managing the country's STI policies, programs, and institutions. Ghana's STI framework should reflect international best practice and lessons of experience, but these should be modified for implementation in Ghana.

Ghana's efforts to articulate the policy framework for STI application is also linked to the sub-regional commitments as defined by the ECOWAS Revised Treaty as well as NEPAD. The ECOWAS Revised Treaty urges member states to ensure proper application of science and technology to the development of agriculture, transport and communications, industry, health

and hygiene, energy, education, and manpower and the conservation of the environment. The NEPAD S&T Consolidated Plan of Action (2006-2010) outlines a series of "collective actions to develop and use science and technology for the socio-economic transformation of the continent and its integration into the world economy." These include such STI capacity building projects and programs as:[1]

(a) Improving infrastructure or facilities for R&D.
(b) Creating institutional and policy arrangements that enable African countries to mobilize and share their scarce resources to conduct science and generate technological innovations.
(c) Strengthening the continent's human skills base by increasing the number of scientists, technicians and engineers.
(d) Improving the quality and intensity of regional cooperation.
(e) Building a strong political and civil society constituency for science and technology in Africa.
(f) Improving the quality of science, technology and innovation policies of African countries.
(g) Strengthening the capacity of regional economic bodies to mainstream science and technology into their sectoral programs and projects.
(h) Promoting the application of science and technology to achieve specific MDGs.
(i) Promoting innovative ways and means of financing science and technology in Africa.

CHAPTER 2: VISION, GOALS, OBJECTIVES AND PRINCIPLES

2.1. Vision

The vision for which Ghana applies STI remains the broad national vision of middle–income status of an advanced human society with a better quality of life reflected in all aspects of socio-economic and environmental conditions. In practice Ghana must seek a future science, technology and innovation policy which enables maximum production and processing of the natural resources that she is blessed with, while also developing a national engineering and manufacturing capability consistent with the skills and talent that it is able to harness to be part of a competitive world community. To be specific Ghana in the 21st Century should not be exporting its Gold, Cocoa, Diamond, Bauxite, etc, unprocessed and unrefined. Ghana must produce high value added exports to not only produce jobs but high value jobs to provide employment for its thousands of school leavers and university graduates.

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[1] See AU / NEPAD S&T Consolidated Plan of Action, p. 10

2.2. Goal

Given the background of Ghana's efforts in STI application and development, the priorities outlined and the commitment to uphold the international aspirations for scientific and technological progress, the goal of the STI policy which is fully integrated into a national development strategy which fully harnesses the Nation's total high level and middle level human resource base to achieve national objectives for poverty reduction, competitiveness of enterprises, sustainable environmental management and industrial growth*".*

2.3. Objectives

The basic objectives of the STI Policy are:

iv.   facilitate mastering of scientific and technological capabilities;

v.   provide the framework for inter-institutional efforts in developing STI and programmes in all sectors of the economy to provide the basic needs of the society;

vi.   create the conditions for the improvement of scientific and technological infrastructure for research and development and innovation;

vii.   ensure that STI supports Ghana's trade and export drive for greater competitiveness; and

viii.   to promote a science and technology culture.

2.3.1   Long-term Objectives

In the long-term, the main objectives are to create endogenous science and technology capacities appropriate to national needs, priorities and resources, and to create a science and technology culture whereby solutions to socio-cultural and economic problems of the individual, the community and the nation are recognized and sought within the domain of science and technology.

2.3.2   Medium-Term Objectives

In the medium term within the first 10 years of implementation, the objective is to accelerate the promotion of innovation through the development and utilization of modern scientific and technological capabilities to provide the basic needs of the citizenry and to compete ably in the global market.

2.3.3 Short-Term Objectives

In the short term within first 5 years of implementation, the government will restructure the entire science and technology machinery, infrastructure and programmes in order to make them more responsive to national needs and priorities in all sectors of the economy. To that end, emphasis will be placed on:

i. restructuring of the National Science and Technology Advisory system.

ii. improving basic and applied research infrastructure;

iii. restructuring the teaching of science at the basic, secondary and tertiary levels of the education system;

iv. promoting the training of a critical mass of middle-level technical personnel to address the provision of basic needs of food, shelter, health, clothing, energy, etc;, and to enable the citizenry and the nation to participate in a competitive global economy;

v. acquisition of skills in high technology areas such as ICT, biotechnology and nanotechnology and their integration into known technologies; and

vi. initiation of mastery of known technologies and their application in industry.

2.4. Guiding Principles

The effective implementation of the Science and Technology Policy will be guided by these key principles:

i. *Relevance*: There is the need to critically examine areas and programmes of relevance to the country's development;

ii. *Cost-effectiveness*: There must be the use the most cost-effective means to achieve the desired results;

iii. *Realism*: Whereas Ghana desires to reach the frontiers of STI application and development, there is the need for realism in aspirations and efforts;

iv. *Synergy:* STI development and application must be holistic; there must be a multi-disciplinary and cross-sectoral approach to problem-solving for synergy; and

v. *Partnerships*: There must be conscious efforts for collaboration and interaction with all local and foreign stakeholders as partners.

CHAPTER 3: SECTOR-SPECIFIC POLICIES AND MEASURES TO APPLY SCIENCE, TECHNOLOGY AND INNOVATION

The principal thrust of the National Science, Technology and Innovation Policy is that it pervades all sectors of the economy. This will ensure the integration of science and technology into the national development process as envisaged in Ghana's development plan. STI should be the driver to the achievement of sectoral goals, objectives and programmes.

In order to achieve these objectives, it is essential to facilitate the implementation of sectoral policies, programmes and strategies by the respective sectors on the basis of the overall National Science, Technology and Innovation Policy. Sectors such as Agriculture, Health, Education, Environment, Energy, Trade, Industry, Natural Resources, Human Settlements and Communications shall be particularly well-addressed in the formulation of the Science and Technology Policy guidelines. This section of the National Science, Technology and Innovation Policy highlights the objectives and strategies for STI facilitation of the sector-specific policies and programmes.

3.1   Agriculture

3.1.1   Objective

To strengthen the development, application and transfer of agro-based technologies for sustainable agriculture, food security, diversification of the economy, industrial growth through value addition.

3.2.1 Strategies

i.   Sustain and improve agriculture-related research competence of the National Agricultural Research System (NARS) to raise the productivity of crops, livestock, poultry, fish resources, production tools and implements with due regard to impact on the environment. Special preference will be given to agriculture in dry and arid regions of the country;

ii.   Promote the research and application of new technologies including safe biotechnology, which hold potential for increasing productivity;

iii.   Reduce pre-harvest and post-harvest losses in agricultural production in both cash and food crops;

iv.   Promote the development of food processing industries and enhance value addition for the local market and for exports;

v.   Strengthen the production of non-traditional export commodities to enhance the diversification of the economy;

vi.   In all these strategies ICT should play a crucial role;

vii.   Marketing of agricultural produce;

viii.   Promote research on orphan and medicinal crops

ix.   Promote soil and water resources management;

x.   Strengthen the linkage between research and agricultural extension.

3.2 Health

3.2.1   Objective

To support activities and programmes aimed at improving the quality of health of the citizenry; facilitate the sustainable exploitation of indigenous natural resources and knowledge for addressing health challenges; to educate, train and retain health professionals.

3.2.2   Strategies

i.   Promote preventive and regenerative healthcare;
ii.   Support biomedical research in prevalent diseases in the areas of prevention, diagnosis, therapy and management;
iii.   Improve access and services in the general health care delivery system;
iv.   Promote technologies in support of sanitation, environmental and occupational health;
v.   Promote research and development in the area of bio-medical engineering and instrumentation, as well as the potential of information technology application in the health delivery system;

vi.   Enhance the development of human resource for healthcare delivery;

vii.   Promote and support research into plant medicine to complement allopathic medicine including the commercialization of the research results.

viii.   Establish specialized health centres to promote health tourism.

3.3   Education

3.3.1   Objective

To orient all levels of the country's educational system to the teaching and learning of science and technology in order to produce a critical mass of the requisite scientific human resource for national development and accelerate the acculturation of science and technology in society.

3.3.2   Strategies

i.   Ensure that by the year 2020, 60% of all students in the public universities and 80% of those in the polytechnics and vocational institutions are registered in science and science-related disciplines;

ii.   Promote post-graduate education in scientific disciplines targeting 10% of the student population in tertiary educational institutions enrolling at the post-graduate level;

iii.   Create special incentives for students and graduates of science and technology;

iv.   Improve science education at all levels and in all aspects of the educational system, especially at the basic and secondary levels;

v.   Promote technical and vocational education and training to enhance middle level management in science and technology delivery to all sectors;

vi.   Promote science and technology innovativeness within the educational system;

vii.   Increase the country's capacity in the training of personnel in emerging technologies such as biotechnology, nanotechnology and material science.

viii.   Use the mass media to popularize STI.

ix.   Enhance collaboration between research institutions and universities to train high-level scientific manpower.

x.   Ensure that adult literacy classes include studies into cause and effect relations and how things work.

xi.   Identify skill gaps in STI new emerging technologies through regular review.

xii.   Emphasize on industrial attachments for students.

3.4   Energy

3.4.1   Objective

To ensure the supply of sustainable, affordable, safe and reliable energy for domestic and industrial use; provide an appropriate mix of energy sources;

3.4.1   Strategies

i.   Promote a research and development programme relating to alternate energy sources such as solar energy, biomass, wind and other renewable energy sources to supplement the current traditional energy sources;

ii.   Facilitate efforts to acquire and adapt sustainable safe and economical energy technologies for national development;

iii.   Support research aimed at upgrading hydropower energy production technology;

iv.   Promote research and development efforts aimed at popularization and dissemination of energy technology for rural development;

v.   Promote public support for energy conservation and encourage private investment in energy technologies;

vi.   Encourage community investment and ownership of energy systems e.g. solar farms, windmills and biomass plants;

vii.   Exploit the utilization of nuclear energy resources for domestic and industrial use.

viii.   Develop an integrated petrochemical industry to respond to the oil and gas industry.

3.5   Industry

3.5.1   Objective

To increase the national capacity for industrial production and innovation and promote science and technology to enhance industrial productivity and value-addition

3.5.2   Strategies

i.   Strengthen systems and mechanisms for acquisition, assessment, adaptation, adoption and application of essential technologies for industrial activities;

ii.   Encourage R&D activities that develop tools, equipment and machinery for industries;

iii.   Encourage quality assurance in manufacturing;

iv.   Promote S&T activities that would accelerate technology transfer and innovations;

v.   Create incentives to promote investment and support in research and development by the private sector;

vi.   Facilitate capacity building in engineering design and manufacturing technology to enhance national development;

vii.   Enhance industrial technology development infrastructure;

viii.   Promote and facilitate recyclable materials technologies, and application to minimize industrial waste in the environment;

ix.   Promote scientific knowledge acquisition and development of technologies in the new and emerging sciences of biotechnology, materials science, micro-electronics and laser technology;

x.   Create the national capacity to exploit opportunities for innovation addressing climate change;

xi.   Establish industrial parks, innovation centres and business incubators to foster linkages between the knowledge centres (i.e. research institutes and universities) and productive enterprises;

xii.   Institutionalise regular interaction between research institutions/ universities and the private sector

xiii.   Promote industrial attachments for S&T students.

3.6   Trade

3.6.1   Objective

To promote STI applications in commercial activities to ensure quality, reliability and efficiency in the delivery of goods and services in conformity with appropriate local and international standards.

3.6.2   Strategies

i.   Encourage the adoption of scientific and technological innovations to ensure effectiveness and efficiency of product output and high quality of products;

ii.   Utilise science and technology in improving national standardization and quality management programmes;

iii.   Utilise science and technology to improve packaging;

iv.   Promote the adoption of standards for the production of goods and services for the local and international markets.

3.7   Environment

3.7.1   Objective

To promote the use of STI to maintain and enhance the quality and sustainability of the environment and to integrate environmental concerns in all development policies.

3.7.2   Strategies

i.   Integrate environmental concerns in all development policies and ensure public understanding of the scientific basis of their actions on the environment;

ii.   Encourage and support science and technology interventions that promote sustainable environmental conservation and management;

iii.   Strengthen research and development activities that would promote sustainable development especially of ecosystems and ecological processes;

iv.   Develop the STI capacity to monitor, predict and mitigate the adverse effects of natural phenomena such as earthquakes, floods, droughts, desertification and bushfires;

v.   Develop an efficient integrated waste management system for using the principle of waste as a resource;

vi.   Promote the use of clean technologies in production systems.

3.8   Human Settlements

3.8.1 Objective

To promote the use of STI in planning and managing human settlements as well as all spatial developments;

3.8.2 Strategies

i.   Integrate planning technologies in the control of urban sprawl;

ii.   Promote the use of STI in the efficient and effective delivery of utilities and services;

iii. Facilitate the design of installation of technologies to address the special needs of the physically challenged in human settlements;

iv.   Encourage the use of STI to minimise the impact of natural disasters;

v.   Encourage, through constant education and legislation, the greening of human settlements;

vi.   Encourage the use of STI to establish standards, guidelines and codes for buildings to ensure durability and integration with the building materials fabrication industry;

vii. Encourage the use of science and technology for the management, preservation and maintenance of the country's public buildings, including historic buildings and sites;

viii. Emphasise sound environmental management in human settlement for sustainability of human societies.

3.9 Natural Resources (Land, Minerals, Water, Oil, Gas, Wildlife, Etc.)

3.9.1 Objectives

To promote the application of STI that would facilitate conservation and sustainable utilization and management of natural resources (land, water, minerals, oil, gas, wildlife etc.) in support of national development.

3.8.2 Strategies

i. Education and training of appropriate and adequate manpower to deal with the natural resource;

ii. Support research in the exploration and exploitation of additional mineral resources;

iii. development and utilization of natural resources;

iv. Strengthen the development and extension of technologies and innovations that form the basis for sustainable use of natural resources;

v. Promote research and measures to protect and conserve biological diversity of the country;

vi. Support research and development in identifying minerals of potential use;

vii. Enhance local participation in the STI associated with the exploration and exploitation of Ghana's oil and gas resources;

viii. Encourage investigations aimed at improving clean and potable water supply systems for both urban and rural areas;

ix. Facilitate research and studies to ensure prevention or control of pollution of surface and ground water;

x. Take measures to ensure that at least 40% of the land area is under permanent tree cover;

xi. Compile and constantly update the country's inventory of natural resources;

xii. Enhance the nation's forest product potential for sustainable use through:

- Afforestation programmes;

- Introducing through research and development fast growing timber species and lesser known species for plantation forestry;

- Encouraging research and development into savanna forestry to develop technologies for rapid re-afforestation and management;

- Developing of technologies for efficient wood processing;

- Promoting the development of technologies for sustainable exploitation of non-timber forest products and wildlife.

xiii. Educate and encourage local/community participation in the development, management and sustainable use of renewable natural resources.

3.10 Science Acculturation

3.10.1 Objective

To promote a culture of science, technology and innovation through public and private awareness campaigns and the development of an information system to enhance the scientific thinking of Ghanaians in their everyday lives;

3.10.2 Strategies

i. Promote and support efforts to sensitise the public on the importance and role of STI in society including career opportunities;

ii. Promote and support STI literacy programmes to facilitate the adoption and application of science and technology;

iii. Facilitate the packaging of research findings to be disseminated by the mass media;
iv. Facilitate the training of human resources in STI writing and communication;

v. Popularise STI through the establishment, investment and management of science museums, STI fairs, and in exhibitions to allow public participation in STI activities in all parts of the country.

vi. Institutionalise a yearly Presidential Address on STI;
vii. Review government programmes to ensure they reflect the changing nature of STI culture in the society.

3.11   Information and Communications Technologies

3.11.1 Objective

To promote the use of STI to ensure that modern information and communication technologies are available and utilized at all levels of society;

3.11.2 Strategies

i.   Educate citizens in the technical aspects of ICT;
ii.   Facilitate the development of the ICT sector through the use of local capabilities in STI;

iii.   Ensure that STI capabilities exist to integrate ICT into all sectors of the economy including education, industry, agriculture, health and e-governance;

iv.   Promote computer literacy at all levels of society;

v.   Develop a national competence for computer hardware and software engineering and information security;

vi.   Promote the development and application of technologies in micro-electronics;

vii.   Create special incentives for investing in electronic and general high-technology industries;

viii.   Promote research on the socio-economic impact of information technology use.

ix.   Facilitate the development of a modern ICT infrastructure to improve teaching, learning and research.

3.12   Building and Construction

3.12.1 Objectives

To develop the STI capacity to support the building and construction sector, including the development of local raw materials and equipment and to encourage their use;

3.12.2 Strategies

i. Support research and development of technologies for the development of the building and construction industry;

ii. Promote the commercialization of R&D outputs; (value chain concept; useable product; output of R&D as a public good versus private good);

iii. Develop the necessary capability in building and construction design, management, execution and production of building and construction material and equipment;

iv. Support the popularization of appropriate and local-specific building and construction and low-cost materials and technologies;

v. Ensure that government projects utilize local raw materials developed by local R&D;

vi. Ensure the incorporation of appropriate designs to cater for the physically challenged in the society.

vii. Ensure the standardization of building, design and construction materials for rationalizing their use and public safety especially in the informal sector;

viii. Promote the adoption and adaption of new appropriate technologies to improve efficiency in the building and construction industry.

ix. Promote the interaction between the researchers and private sector in the building and construction industry.

x. Encourage the training of artisans in the use of local materials and equipment.

3.13   Science, Technology and Innovation and National Security

3.13.1 Objectives

Develop STI capacity for the country's security services to enhance the efficiency and effectiveness in their operations.

3.13.2 Strategies

i. Promote STI in national security systems including national disaster and emergency management;

ii.   Support the development of STI to enhance the country's security infrastructure;

iii.   Enhance R&D capacity in the security services;

iv.   Promote the use of STI to combat sophisticated crimes,

v.   Enhance the teaching, research and application of science and technology in the security services.

3.14   Nuclear Science and Technology

3.14.1 Objective

To promote the peaceful use of nuclear science and technology in the national development process;

3.14.2 Strategies

i.   Develop the requisite infrastructure and human capacity for nuclear science and technology;

ii.   Promote the commercialization of research and development outputs in nuclear science and technology.

iii.   Accelerate the application of nuclear science and technology in all sectors including energy, health, agriculture and industry.

iv.   Create new avenues to optimize the use of nuclear science and technology;

v.   Establish a national regulatory framework for ioninzing and non-ionizing radiations to ensure public safety.

3.15   Basic Research

3.15.1 Objective

To promote and encourage basic research as the bedrock of scientific and technological innovation;

3.15.2 Strategies

i. Encourage and support basic research through the provision of adequate resources;

ii. Acquire the requisite state of the art infrastructure for the furtherance of basic research;

iii. Create incentives for the study of basic science at undergraduate and postgraduate levels;

iv. Educate, train and retain appropriate and adequate research and technical personnel for basic research.

3.16   Sports and Recreation

3.16.1 Objective

To promote scientific and technological methods which enhance the development of all sports;

3.16.2 Strategies

i. Promote research and development in sports medicine and nutrition, physical education and other disciplines to produce high caliber of sportsmen and sportswomen including the physically challenged;

ii. Facilitate the development of recreation as a health maintenance factor;

iii. Encourage STI courses related to sports at all levels of education.

3.17   Youth Innovation

3.17.1 Objective

To popularize science, technology and innovation among the youth.

3.17.2 Strategies

i. Promote innovation at all levels of the educational system;

ii. Encourage activities that bring the STI capabilities of the youth such as; hold regular Science and Mathematics clinics and computer programming clinics for both girls and boys to encourage science learning; promote STI competition among the youth;

iii. Establish awards schemes that reward innovation among the youth;
iv. Provide scholarships for promising science students.
v. Establish mechanisms for encouraging young people to move into the sciences;
vi. Initiate mechanisms to identify young scientists;
vii. Establish mentoring programmes in STI for the youth.

3.18 Roads and Transport

3.18.1 Objective

To use STI to improve the road and transportation system and promote more efficient and safe movement of people, goods and services;

3.18.2 Strategies

i. Promote R&D in the road and transportation system;

ii. Facilitate the adoption and use of R&D outputs and local innovations for road design and construction;

iii. Encourage investment in local innovation in the transport sector;

iv. Create information management systems for transport companies to improve on service delivery;

v. Develop appropriate scientific human resource for the transportation system.

3.19 Tourism

3.19.1 Objective

To use STI to improve the tourism industry for better service delivery;

3.19.2 Strategies

i. Promote STI in marketing Ghana's tourist resources;
ii. Adopt relevant technologies in the operations of tourist industries;
iii. Design and implement training schemes to enhance the competence of the technical staff of the tourism industry.

CHAPTER 4: MANAGING SCIENCE, TECHNOLOGY AND INNOVATION POLICY

A sector ministry in charge of Science, Technology, and Innovation will manage and implement Government's STI policies. This mandate will be executed through the organizations operating under its auspices and where necessary through other relevant organizations. The Minister being a cabinet member will provide the needed leadership to link with other ministries and organizations for STI application and development in the country.

The Ministry will be structured with a head of policy planning who has the appropriate experience to interact with the country's scientific and technical experts as well as with government policymakers. The Ministry will have representatives assigned to interact with each of the relevant sector Ministries in order to ensure the implementation of the sector STI strategies stated in chapter 3.

There will be an apex STI body established to ensure strong advocacy for STI in the country, to provide STI advice to the Ministry and the Presidency, and to ensure coordination and harmonization of the nation's STI policy and programs. This body would serve as a Think Tank institution and it is meant to provide the brain power for national strategic STI policy formulation. The body, rather than diminish the MEST, would provide the Ministry huge space to influence STI policies in all sectors by creating a think tank capacity for STI that can advise the highest offices of the land.

The apex STI body will be established as either:
i. An Office of a Presidential Advisor on Science, Technology and Innovation (PASTI).[2] The holder of that office would be appointed in

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[2] A similar position to the Presidential Advisor on Science, Technology, and Innovation exists in countries such as the United Kingdom and the United States.

consultation with the Ghana Academy of Arts and Science and other STI related bodies so the office would be accorded the national stature it requires for non-partisanship in STI policy formulation and implementation. The Presidential Advisor must be a distinguished Ghanaian scientist or technologist.

Or

ii.   An STI Commission (or Council)[3] composed of representatives of Ghana's STI institutions including government, research institutes, universities, the private sector, and other relevant institutions. The Commission will be chaired by a distinguished Ghanaian scientist or technologist to be appointed by the Minister. The Commission will be limited to not more than 12 members to ensure its ability to operate efficiently. The Commission will be supported by a small cadre of technical staff with expertise in STI policy matters.

The apex STI body will liaise with MEST to ensure that the following STI management functions are performed:

- Provide advice to the President and Ministries on STI policy formulation and program design, so that they will best serve the specific needs of the country.
- Provide STI advocacy, so that the voice of the country's STI community will be represented in the country's programs and policies at all levels.
- Ensure coordination and harmonization of the country's STI policies, so that STI activities are comprehensive, complementary, and reinforcing across all sectors and Ministries.
- Provide monitoring and evaluation of the implementation of this STI policy, to ensure that the activities initiated to this end are for the benefit of the Ghanaian society. In this wise, a body (or bodies) of experts will be set up under the STI apex body to perform the role of reviewers of the implementation strategies of all STI activities.

4.1   The Policy, Planning, Monitoring and Evaluation Directorate

The Policy, Planning, Monitoring and Evaluation (PPME) Directorate of a Ministry may be described as its nerve centre.   This is the Directorate responsible for Policy formulation and the development of appropriate strategies for the monitoring and evaluation of these policies. The Directorate is also responsible for managing the process for the preparation of the Ministry's Budget.

With a Ministry responsible for Policy formulation and its associated implementation arrangements, the role of the PPME Directorate cannot be over-emphasized. These

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[3] A STI Commission could operate in a manner similar to Ghana's Energy Commission, but of course for the STI sector. STI commissions or councils are used in countries such as Japan and India.

functions of the Directorate are not limited to the Ministry alone but also to Departments and Agencies under it.

It is important that the Directorate has adequate resources – especially the right quality and quantity of personnel for it to be able to function effectively and efficiently. For the Directorate to gain the respect it needs to function, it is important for personnel of the Directorate to have the types of qualifications which will make it easy for them to work not only with bodies such as the National Development Planning Commission and the Ministry of Finance but also the Departments and Agencies under it.

The Ministry of Environment, Science and Technology has the following Department and Agencies under it:

- Town and Country Planning Department;
- Council for Scientific and Industrial Research;
- Ghana Atomic Energy Commission;
- Environmental Protection Agency.

The following is proposed as the structure of the PPME Directorate of the Ministry of Environment, Science and Technology.

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                        │   Director   │
                        └──────┬───────┘
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        ┌──────────────┐       │
        │  Executive   │───────┤
        │  Assistant   │       │
        └──────────────┘       │
                               │
        ┌──────────┬───────────┼────────────┬──────────┐
   ┌────┴─────┐          ┌─────┴──────┐         ┌───┴──────┐
   │ Deputy   │          │Deputy      │         │ Deputy   │
   │ Director │          │Director    │         │ Director │
   │ (Science │          │(Environment)│        │ (Human   │
   │ and Tech.)│         │            │         │ Settlements)│
   └──────────┘          └────────────┘         └──────────┘
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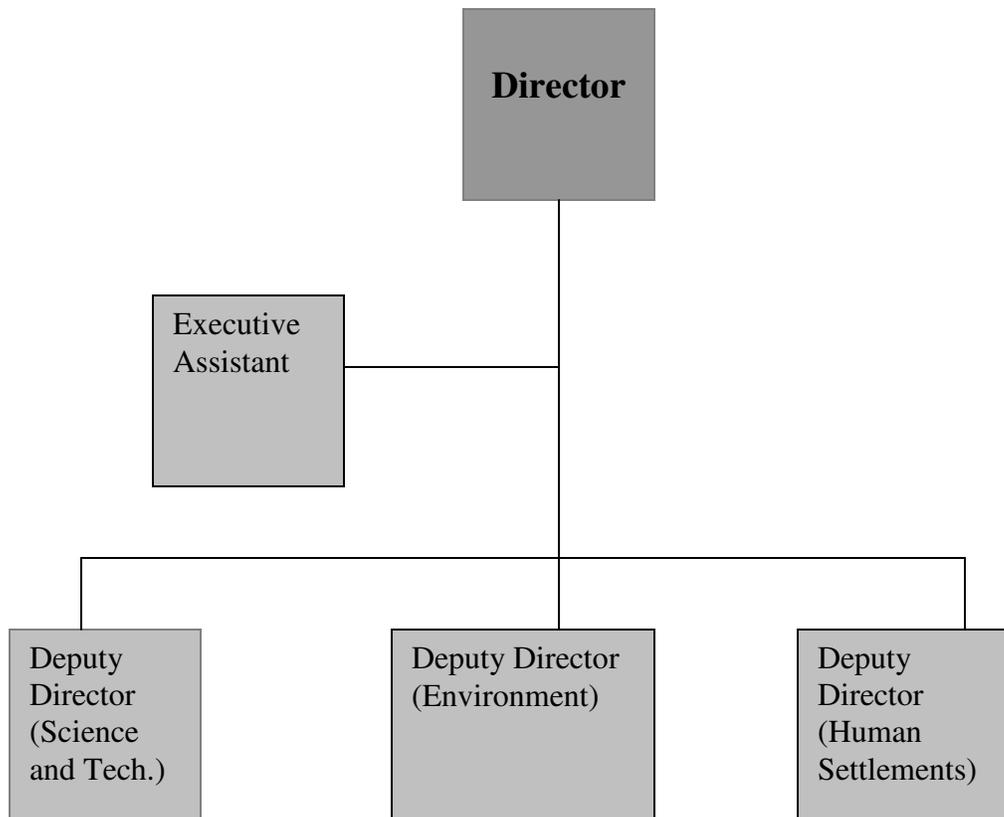
There will be officers (Assistant Directors) under the Deputy Directors.

The Executive Assistant will be working in the Office of the Director to monitor activities and assignments in the Directorate and ensure that these are all being done within time frames envisaged.

4.2   Measuring the Performance of Science and Technology

To ensure that the implementation of science and technology is led on course for the benefit of the Ghanaian society, Government will put in place mechanism for monitoring and evaluating the performance of activities initiated.

In this wise, a separate body (or bodies) of experts will be set up to perform the role of reviewers of the implementation strategies of all science and technology activities.

Incentive schemes will be developed for individuals and institutions identified as contributing positively to the development and promotion of science and technology in the country.

4.3   Promoting the Development and Utilisation of STI Capabilities

In line with the vision for science and technology-led economic growth and enhancement in the quality of life, government will take necessary measures to develop fully, national science and technology capabilities to enable it achieve greater productivity and efficiency, and to attain self-reliance in terms of trained skills and technical know-how.

In this wise various actions will be carried out in broad terms to create the required capabilities. A comprehensive training programme will be designed and implemented, with special emphasis on indigenous capabilities with respect to adaptation, absorption and mastery of imported technologies, skills and know-how for basic research, research and development, and information management. New and emerging technologies, commercialization and dissemination of research results will be strengthened and expanded.

National education policies will be periodically reviewed by collaborating with the Ministry of Education and other relevant bodies with a view to enabling them to respond to national needs. These reviews will target science education, teacher training, curriculum development, teaching/learning methods, engineering and entrepreneurial skills development, among others;

4.4   Promoting Science and Technology Capacity Building

In view of the fact that Ghana intends to promote and nurture innovative development as its goal, a system will be developed to attract, retrain, motivate and retain indigenous scientific, technical and technological skills and know-how. Deserving scientists, engineers and technologists will be given special recognition through awards. Remuneration for practitioners of science and technology would be packaged to minimize the brain drain.

New approaches to education and training shall be developed to equip researchers to work more effectively in an innovative manner. This will require new curricula and training programmes that are comprehensive, holistic and flexible rather than being narrowly discipline-based. Education and training in an innovative and competitive society should not rap people within constraining specializations, but enable them to participate and adopt a problem-solving approach to social and economic issues within and across disciplinary boundaries.

4.5   Strengthening National Engineering Design Capacity

The acceleration of the mastery of known technologies is of prime importance in the industrialization programme. Government will facilitate the establishment of centre(s) for engineering and manufacturing, and pilot and demonstration plants in selected institutes and departments to promote the development of indigenous capacity and capability in these and other fields. An all-embracing capacity for industrial design will be established in support of quality presentation at all levels of product development and manufacture.

4.6   Strengthening the Protection of Intellectual and Innovative Property Rights

One of the forward movers of science and technology development is the official recognition of innovation and the need to protect the rights of such innovation for the benefit of society.

In this respect, government will encourage and promote science and technology development through the protection and use of intellectual and industrial property rights. This will be achieved through strengthening the system for the protection of intellectual property rights, facilitating the use of industrial and other property rights for the development of science and technology; and establishing and strengthening intellectual and industrial property rights as well as information management systems.

4.7   Promoting participation of Women in Science and Technology

Traditionally women have not been encouraged to embrace the learning of science at all levels of the educational system. This has created a lopsided proportion of women involved in the learning, teaching and practice of science, engineering, technology and related fields as compared to their male counterparts.

In order to improve the ratio towards equilibrium, Government will take appropriate measures to institute programmes which encourage girls to specialize in science, mathematics and engineering at the secondary and higher echelons of the education system. MEST will design special incentive packages for female science students as instruments of motivation; and encourage rural women engaged in micro and small-scale production to adopt new and appropriate technologies conducive to their fields of operation.

4.8   Promoting International and Local Co-operation and Linkages

The international scene is linked in such a way that exchanges, partnerships, networking and co-operation have become the norm for keeping abreast with the pace of innovation in all sectors of the economy. Given the scope for international co-operation in science and technology at the regional and sub-regional levels, the Government will adopt all necessary measures to consolidate and widen bilateral and multilateral programmes to the benefit of its science and technology plans, especially the flow of scientific and technological information.

4.9   Promoting a Science and Technology Culture

Science and technology culture may be loosely defined as the sum total of society's concept and attitude to science and technology as expressed in its beliefs, traditional customs and daily occupations. In this respect, the Ghanaian society as a whole has not embraced science and technology and its benefits to any appreciable extent, especially in the conduct of their lives. This is evidenced in the prevalence of the use of primitive tools in agriculture, fishing, black smithing, construction and other technology intensive occupations. At the social level, explanation of natural phenomena is often sought in superstition.

In order to reverse this trend and the slow acceptance of science and technology, Government will harness all available resources to create public awareness of the benefits of science and technology and to seek solutions to socio-cultural and economic problems within the domain of science and technology. In health, agriculture, industry, trade, recreation, etc., the citizenry will be made to recognize the indispensability of science and technology as tools to better their lives.

CHAPTER 5: MECHANISMS FOR FINANCING, MANAGEMENT AND EVALUATION OF THE PERFORMANCE OF SCIENCE AND TECHNOLOGY

The success of a programme for integrating science and technology into the country's development agenda depends on the establishment of appropriate arrangements for managing the science and technology development and delivery system. It is important that all sectors of the economy, especially the private sector, realize the importance of science and technology and provide adequate resources to support science and technology activities. The necessary systems should also be put in place to ensure that

such resources are utilized optimally and that duplication of activities is avoided, as much as possible.

5.1   Financing Science and Technology

To ensure the availability of funds at all times to meet the demands of innovation for the benefit of society, Government will:

v.   take stock of all existing funding lines established to support development in science and technology and industry with the aim of streamlining them to achieve economies in their operations;

vi.   strengthen and modify the National Science and Technology Foundation to incorporate support for innovation in its sphere of operations;

vii.   encourage the private sector to support the funding for R&D activities, especially to cater for the needs of the small, micro, and medium enterprises (SMMEs) which can be nurtured to become the cutting edge for the commercialization of novel products or processes (that is, products of innovation). Typically, the SMMEs have limited resources both for financing internal R&D and for transferring technology to or from national and international technology vendors;

viii. accelerate the allocation of a minimum of 1% of the Gross Domestic Product (GDP) to support the science and technology sector;

ix.   institute an attractive tax incentive mechanism for contributors to the instituted funds or directly to R&D activities, but in such a way as not to erode the national tax base;

x.   encourage the formation of a venture capital (high risk) fund administering authority for the commercialization of new technologies from scientific and technological institutions; and

xi.   encourage public procurement of products and services from S&T institutions as a means of facilitating their promotion.

In all these funding mechanisms, Government will solicit the effective participation and contribution of the private sector as an indispensable partner in the management of science and technology for the socio-economic development of the country.

APPENDIX 1 – THE STI ORGANISATIONAL FRAMEWORK IN GHANA

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                    ┌──────────┐   ┌──────────┐   ┌─────────────────┐
                    │   MEST   │───│ Apex STI │───│ Other ministries│
                    │          │   │   Body   │   │ e.g. MoE,       │
                    └────┬─────┘   └──────────┘   │ MoFA, MoTI      │
                         │                        └────────┬────────┘
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   │CSIR (13 ││ GAEC ││ EPA ││ Town &   │ │Universities││ Industries/ │
   │research ││      ││     ││ Country  │ │e.g. KNUST, ││ enterprises │
   │institutes)│     ││     ││ Planning │ │University of│            │
   │         ││      ││     ││ Dept.    │ │Ghana       ││             │
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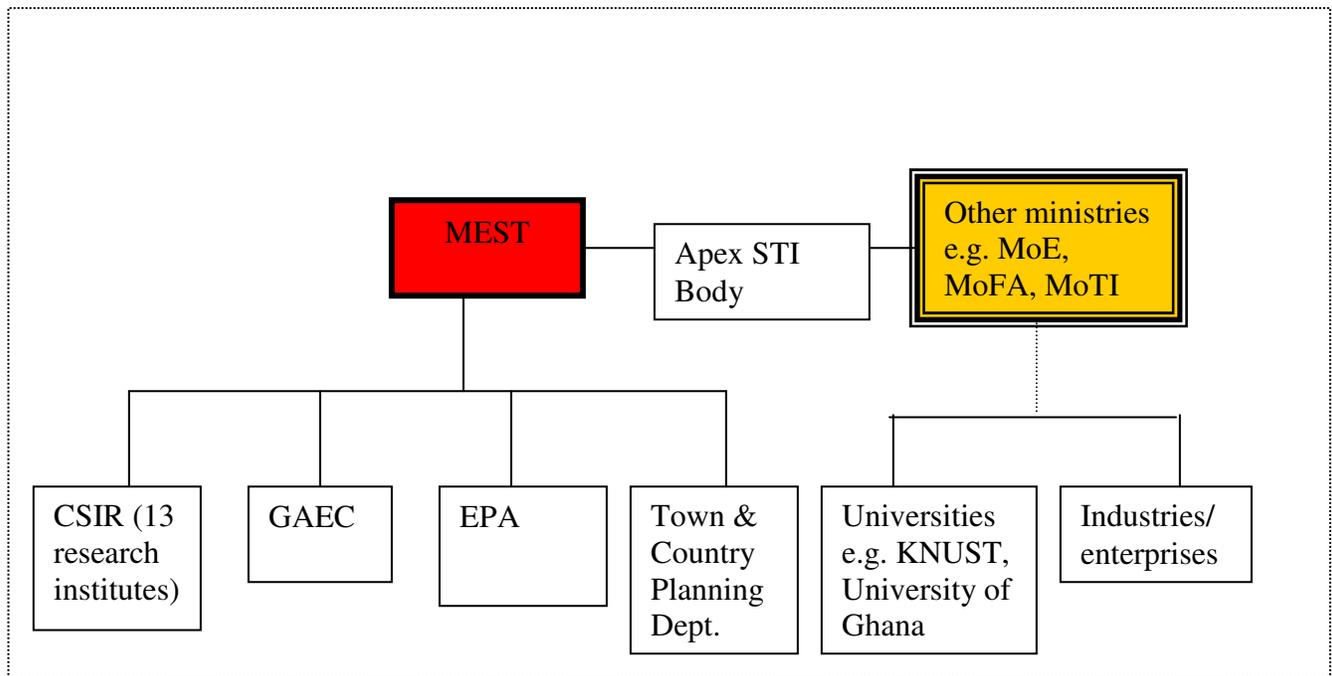
APPENDIX II - SCIENCE AND TECHNOLOGY SUPPORT AND PROMOTION INSTITUTIONS

The understated Government Ministries, Agencies, private sector institutions and Non-Governmental Organisations perform policy formulation, planning, programming, co-ordination, monitoring, evaluation and implementation functions relating principally to their areas of competence in the area of science and technology. The Ministry of Science, Environment and Technology will seek to open science desks in the major ministries.

MAJOR MINISTRIES

National Development Planning Commission
Ministry of Environment, Science and Technology
Ministry of Finance
Ministry of Food and Agriculture
Ministry of Foreign Affairs
Ministry of Employment and Social Welfare
Ministry of Mines and Energy
Ministry of Works and Housing

Ministry of Health
Ministry of Education
Ministry of Roads and Transport
Ministry of Lands and Forestry
Ministry of Trade and Industry
Ministry of Communications
Ministry of Local Government and Rural development
Ministry of Justice
Ministry of Defence
Ministry of Parliamentary Affairs/Parliamentary Committee on Environment, Science and Technology

MAJOR GOVERNMENT AGENCIES

Architectural and Engineering Services Ltd.
Centre for Scientific Research into Plant Medicine (CSRPM)
Cocoa Research Institute of Ghana (CRIG)
Council for Scientific and Industrial Research (CSIR)
Customs, Excise and Preventive Service (CEPS)
Department of rural Housing and Cottage Industries
Development and Application of Intermediate Technology (DAPIT)
Electricity Company of Ghana (ECG)
Environmental Protection Agency (EPA)
Fisheries Commission
Food and Drugs Board
Forestry Commission
Geological Survey Department
Ghana Atomic Energy Commission (GAEC)
Ghana Broadcasting Corporation (GBC)
Ghana Export Promotion Council (GEPC)
Ghana Highway Authority (GHA)
Ghana Institute of Management and Public Administration (GIMPA)
Ghana Investment Promotion Centre (GIPC)
Ghana Regional appropriate Technology Industrial Service (GRATIS)
Ghana Standards Board (GSB)
Ghana Statistical Service (GSS)
Meteorological Service Department
Minerals Commission
National Board for Small Scale Industries (NBSSI)
Pharmacy Council
Polytechnics of Ghana

- Accra Polytechnic
- Kumasi Polytechnic
- Takoradi Polytechnic
- Cape Coast Polytechnic

- Ho Polytechnic
- Tamale Polytechnic
- Sunyani Polytechnic
- Koforidua Polytechnic

Public works Department (PWD)
Rural Enterprises Project
State Enterprises Commission (SEC)
Technical Institutes of Ghana
Town and Country Planning Department (TCPD)
Universities of Ghana
- University of Ghana
- Kwame Nkrumah University of Science and Technology
- University of Cape Coast
- University for Development Studies
- University of Education, Winneba

Volta River Authority (VRA)
Water Resources Commission

NON-GOVERNMENTAL AGENCIES AND INSTITUTION

Association of Ghana Industries
Association of Small Scale Industries
Centre for Policy Analysis
Ghana Academy of Arts and Sciences
Ghana Association of Science Teachers
Ghana Biochemical Society
Ghana Chamber of Mines
Ghana Chemical Society
Ghana Geological Society
Ghana Institution of Biology
Ghana Institute of Planners
Ghana Institution of Engineers
Ghana Institution of Physics
Ghana Institution of Surveyors
Ghana Journalist Association
Ghana Medical Association
Ghana National association of Garages
Ghana National Chamber of Commerce
Ghana Registered Nurses Association
Ghana Science Association
Institute of Economic Affairs
Mathematical Association of Ghana
National Union of environmental Non-Governmental Organisations

Pharmaceutical Society of Ghana
Private Enterprise Foundation
Trades Union Congress
Women in Science and Technology