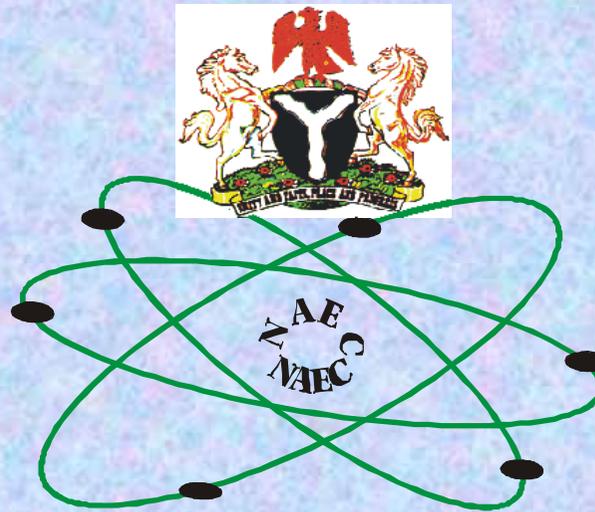


Nuclear Power Introduction in Nigeria : Organization and Way Forward



by

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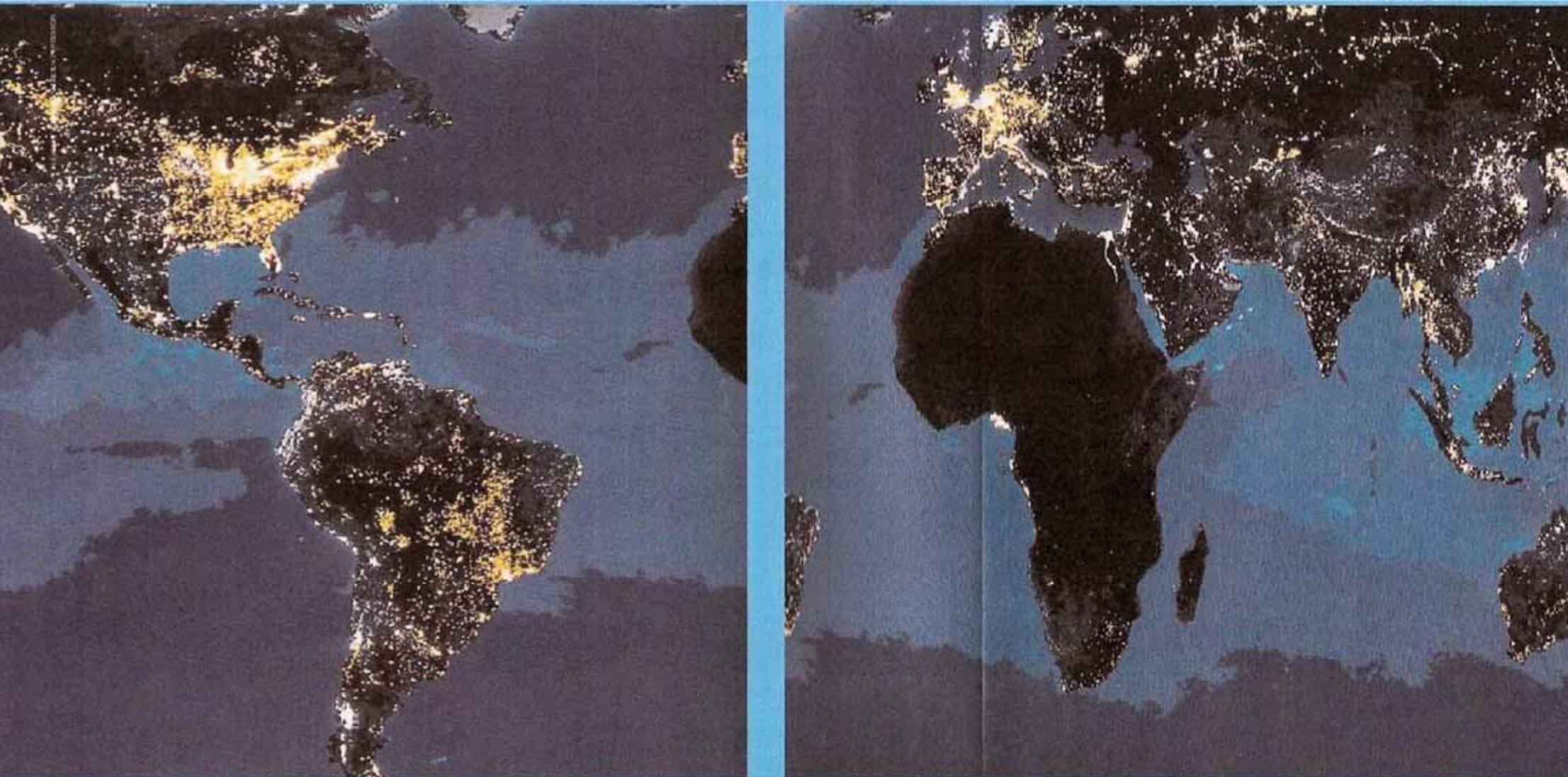
Discussion Outline

- i. Attainment of National Developmental Aspirations: The Energy Deficit
- ii. Prospects and the Decision Process for Considering Nuclear Power
- iii. The National Nuclear Power Roadmap
- iv. Progress Made So Far
- v. The Challenges We Face and Summing Up.

I Attainment of National Developmental Aspirations: The Energy Deficit

- ❖ Long-term energy security is a key promoter of sustainable development
- ❖ Achieving Long-term Energy self-sufficiency is imperative for the attainment of Nigeria's national and regional developmental aspirations in conformity with the key objectives of NEEDS, NEPAD, and MDGs.
- ❖ Empirically, there is a nexus between development and energy; both in terms of generation and consumption: GDP also dependent on energy generation/consumption.
- ❖ Current national power generation is low, thus the National Energy Policy is directed at increasing generation as well as diversifying the generation base beyond gas and hydro to include nuclear, coal and the renewable sources.
- ❖ Assurance of long-term energy security require detailed energy planning which would entail analysis of the supply side (available energy resources, exploitation strategies, and deployment schedules) as well as a realistic projection of the energy demand over time.

Figure 1.1: Electrical illumination on earth as seen from space



Compare Africa with the other continents!

Figure 1.2a: Interrelationship btw GDP and Energy usage

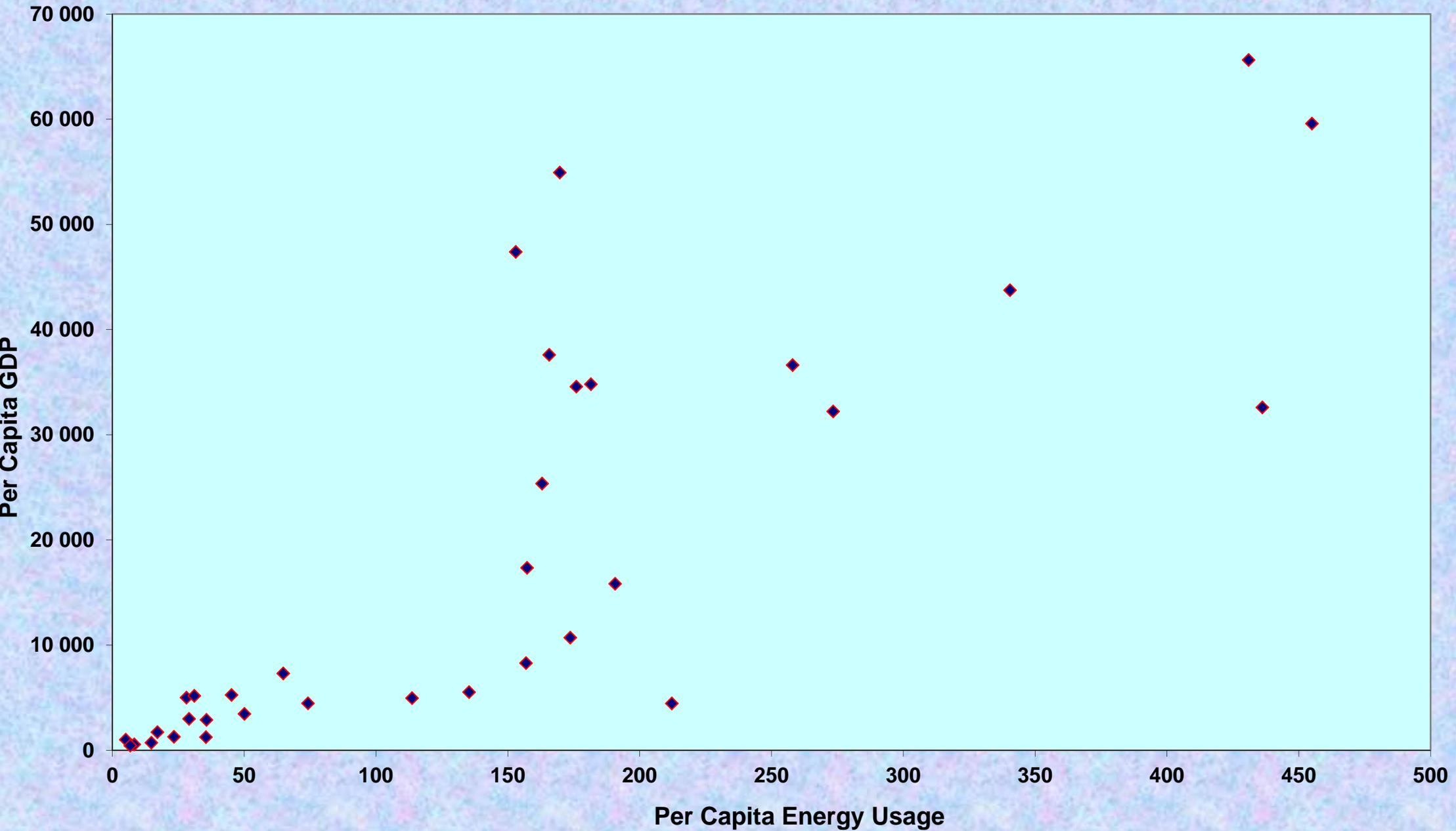


Figure 1.2b: Interrelationship btw GDP and Electricity Generation

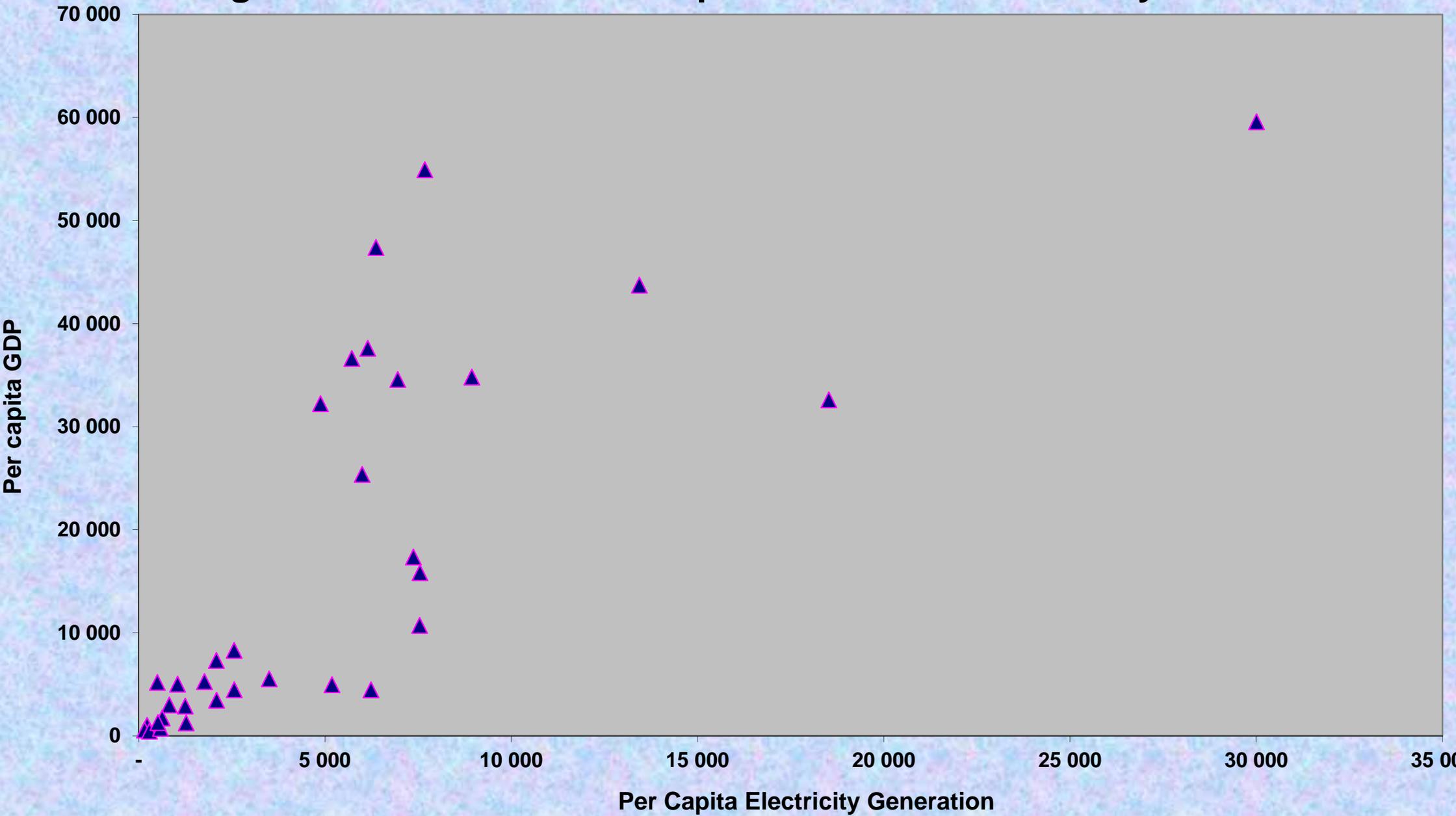
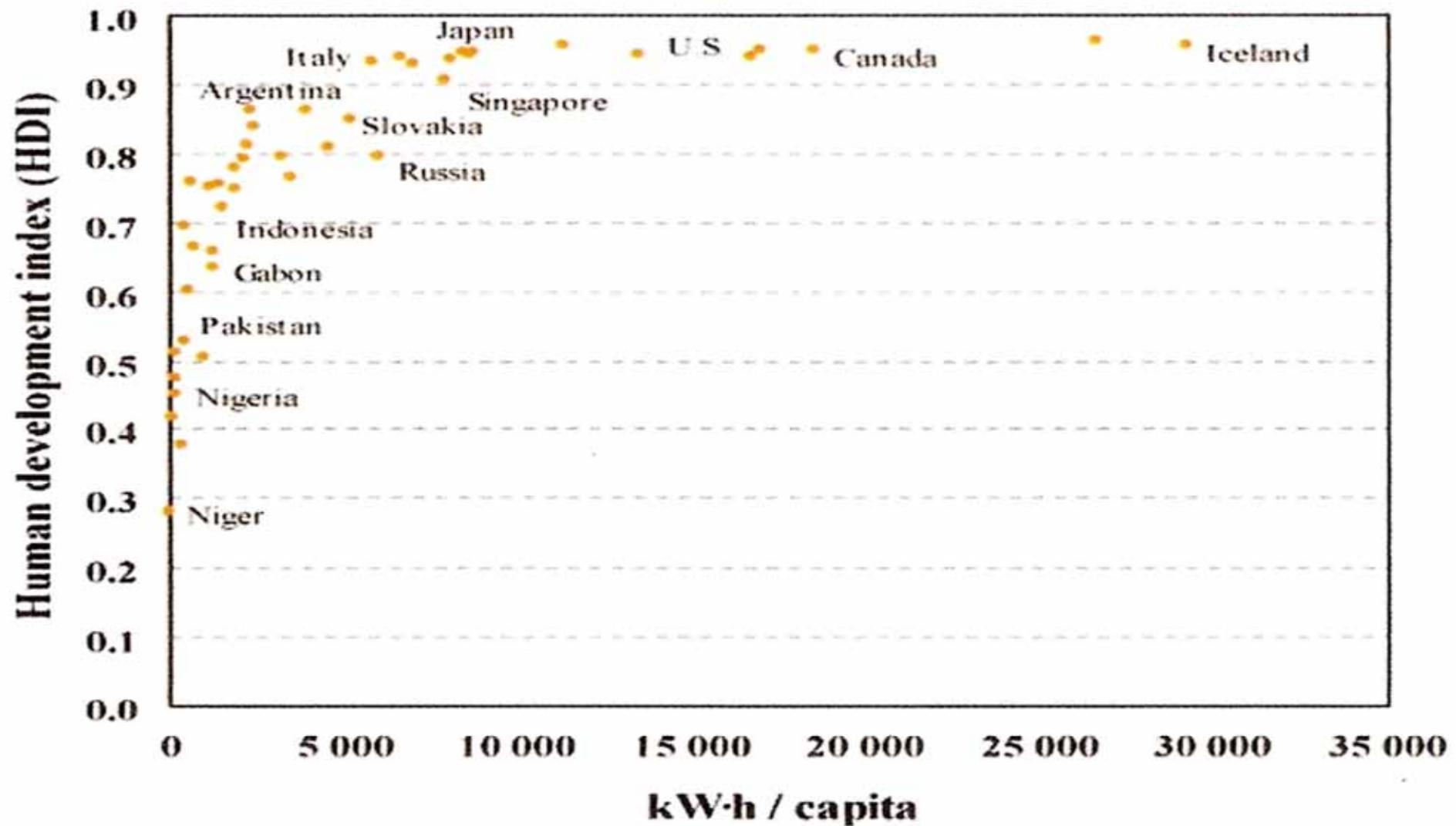


Figure 1.2c: Interrelationship btw Per Capita Electricity Consumption and the Wellbeing



Human development index and per capita electricity consumption (UNDP (2005)).

- ❖ Thus, the resultant national policy on energy would ordinarily take due cognizance of physical and technical limitations to the harnessing of the respective energy resources.
- ❖ Policy should ensure sustainability in the context of the Brundtland Commission (World Commission on Environment and Development (WCED)), defined in 1987 as "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs".
- ❖ Detailed Studies on modeling the national energy needs and planning were carried out using various analytical tools such as MESSAGE, MEAD, WASP etc, with the assistance of the IAEA.
- ❖ Recent studies by the Energy Commission of Nigeria using various scenarios have estimated the national energy demand based on current energy usage, with some projected industrial growth rates and the national population growth rate as primary bases.
- ❖ Results of the studies which clearly show a wide difference between the projected energy demand, and expected generation, have been used as the conservative basis for planning. These are depicted in the figures.

Electricity Demand (Peak) Projections, MW

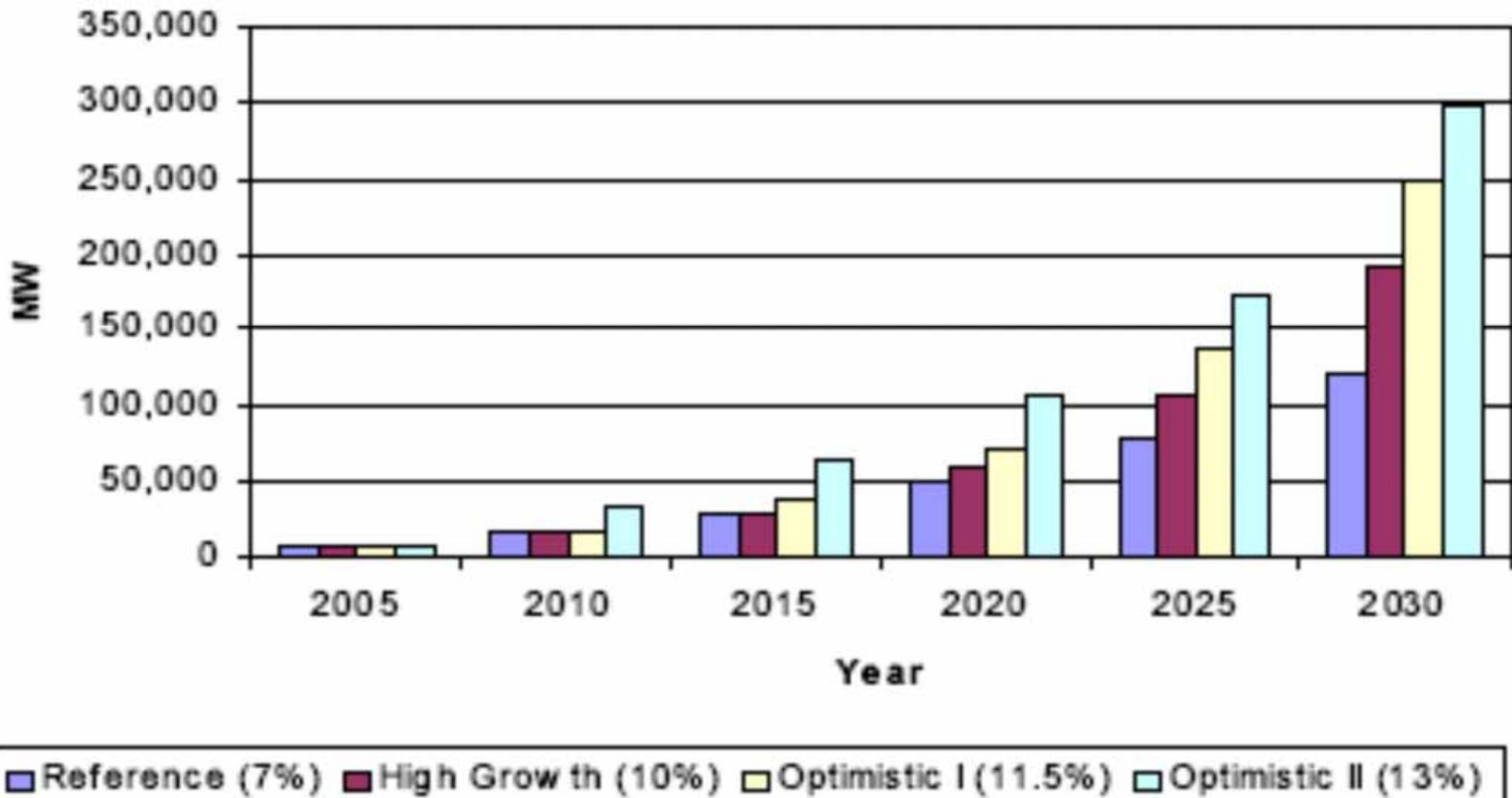


Figure 1.3a: Electricity Demand Projections from 2000 to 2030 (Sambo, 2008)

Electricity Supply Projection in Nigeria

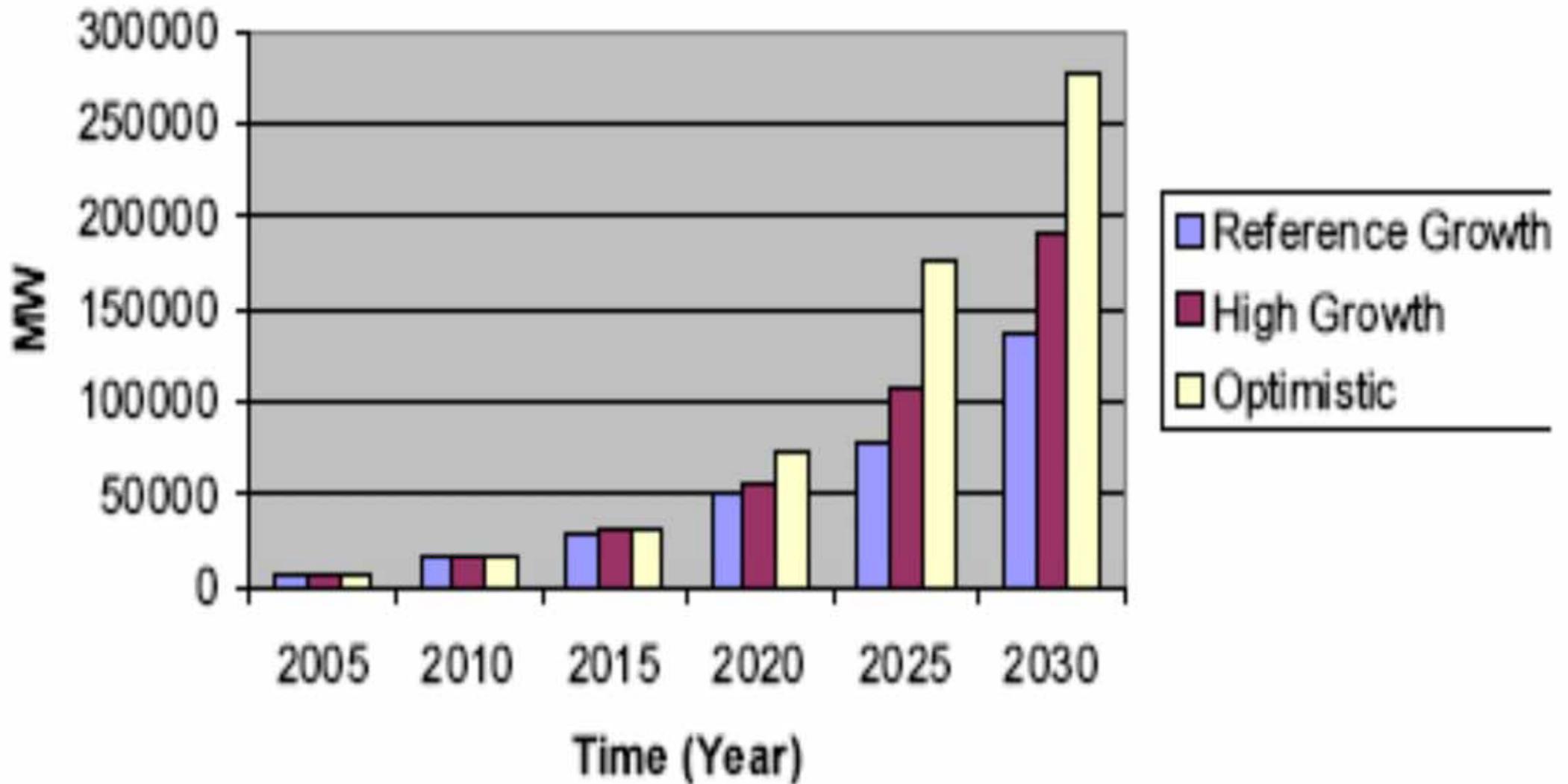


Figure 1.3b: Gross Electricity Supply Projection from 2000 to 2030 (Sambo, 2008)

II Prospects and Decision Process for Considering Nuclear Power

2.1: The Key Features of a Nuclear Power Programme

- ❖ High initial capital cost
- ❖ Long construction period compared to other technologies
- ❖ Delayed investment returns (government vs private sector financing?)
- ❖ Predisposed to cost overruns and construction delays in an environment of regulatory uncertainties.
- ❖ Long term government commitment and public support (requires political and policy stability)
- ❖ Low maintenance and Operating cost
- ❖ Higher availability and capacity factors
- ❖ Longer lifetime (50-60 years)
- ❖ Least potential for contributing to climate change
- ❖ Need for technical and human resource underpinning
- ❖ Need to secure nuclear material and thus, need for high safety standards, insurance and physical security.
- ❖ Must be committed to an international regime of oversight governed by one standard of safety, security and safeguards and international treaties and conventions.

2.2 The national Decision Process:

- ❖ An assessment of energy resources in the country was performed in April 2004 by an Inter-Ministerial Committee which was set up to quantify all the major energy resources in the country.
- ❖ Study documented the various resources; nature, availability, estimated derivable electricity, level of exploitation and business opportunities.
- ❖ Nuclear was identified as a major potential source for consideration in Nigeria;
- ❖ Reasoned that revenues from the oil gas sector can be invested now to develop and harness other energy resources for sustainable development.
- ❖ Inter-Ministerial Committee on NPP was inaugurated and a Technical Committee on NPP mandated to evaluate the feasibility of deploying NPP in June 2005.
- ❖ NAEC was activated in April 2006; and 10-member Governing Board headed by Mr. President inaugurated in July 2006
- ❖ National Nuclear Power Roadmap and Strategy for its implementation were approved and adopted by the Federal Government for implementation in February, 2007.

2.3 National Institutional Framework for NP Development

- ❖ The Nigeria Atomic Energy Commission has the institutional mandate for the development and application of nuclear energy in Nigeria.
- ❖ Five nuclear energy research centres operate under the supervision of NAEC; involved in manpower training and capacity building;
- ❖ The Nigerian Nuclear Regulatory Authority (NNRA) is national regulator and licensing authority; established by Act 19 of 1995, became operational in 2001. Empowered to develop and enforce all regulations that would govern the operations of the nuclear power industry;
- ❖ The Energy Commission of Nigeria (ECN) responsible for energy policy and planning;
- ❖ Others are the National Electricity Regulatory Commission (NERC) - electricity pricing; National Environmental Standards and Regulations Enforcement Agency (NESRA); and the National Emergency Management Agency (NEMA); all have roles to play in the NNPP
- ❖ Harmonization of the input of the many relevant stakeholder institutions is coordinated through the Nuclear Energy Programme Implementation Committee (NEPIC);
- ❖ Programme is also implemented with the requisite international endorsement, particularly the support of the IAEA and other partners, ensuring safety and security.

Figure 2.1: National Institutional Framework for NP Development

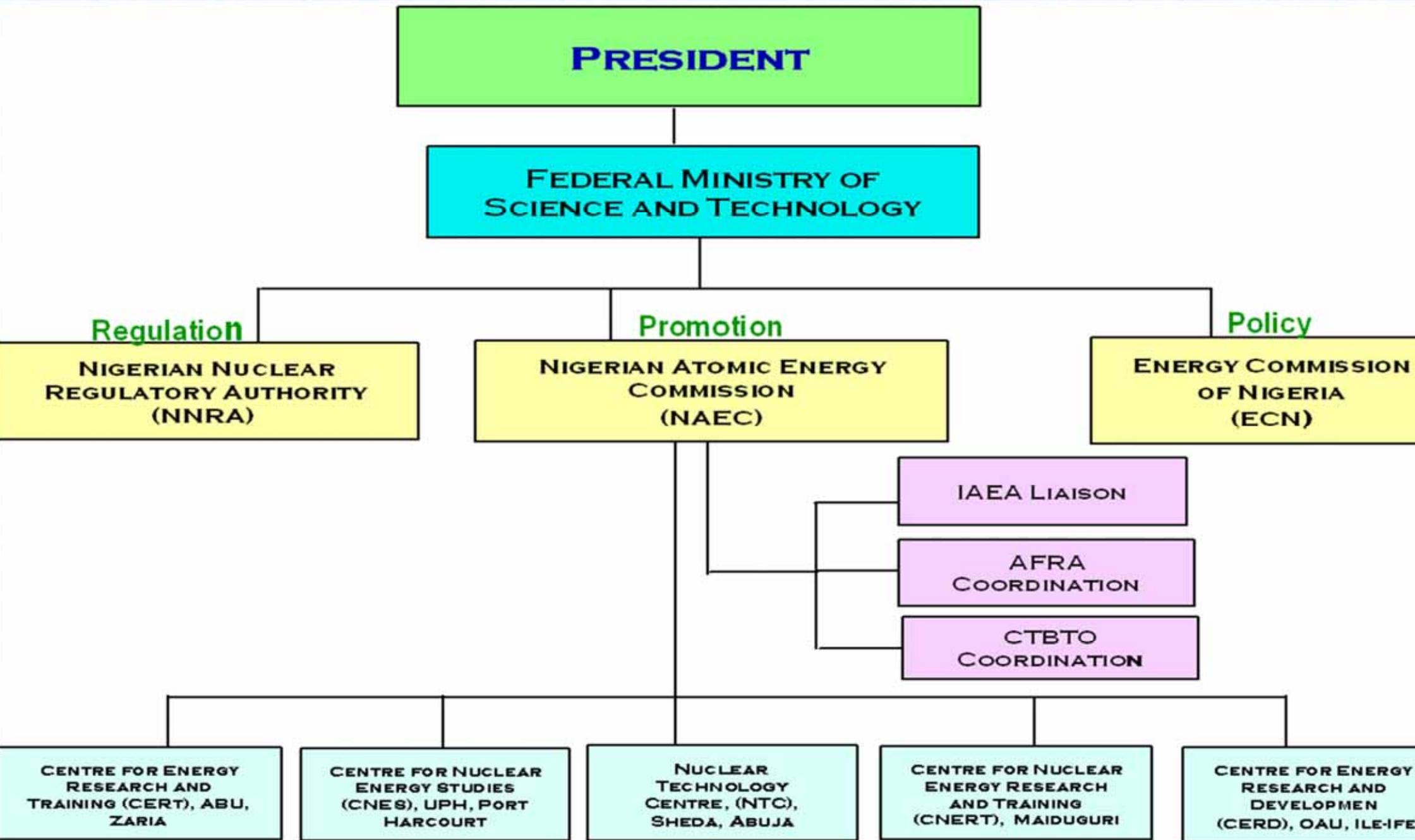
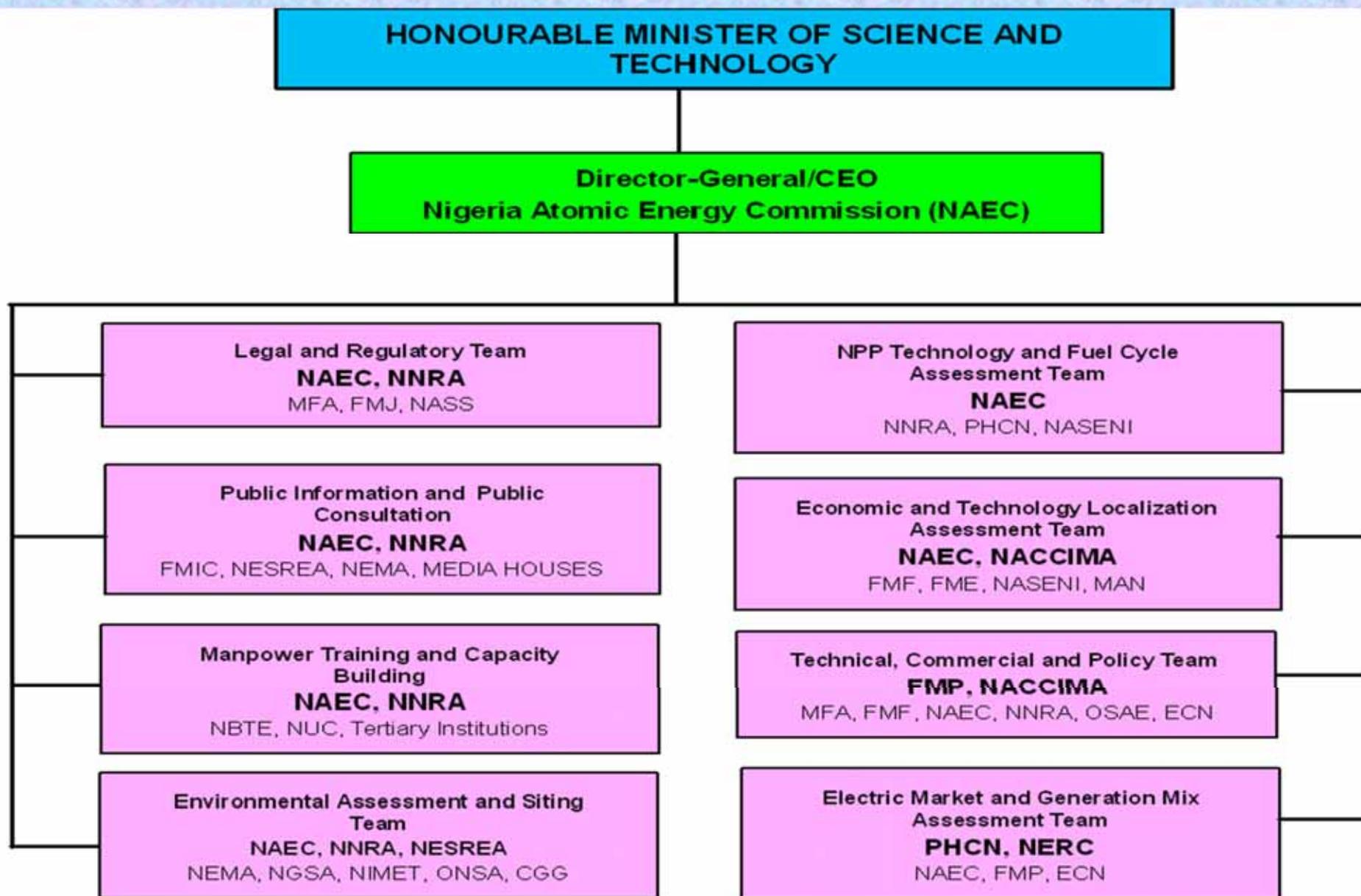
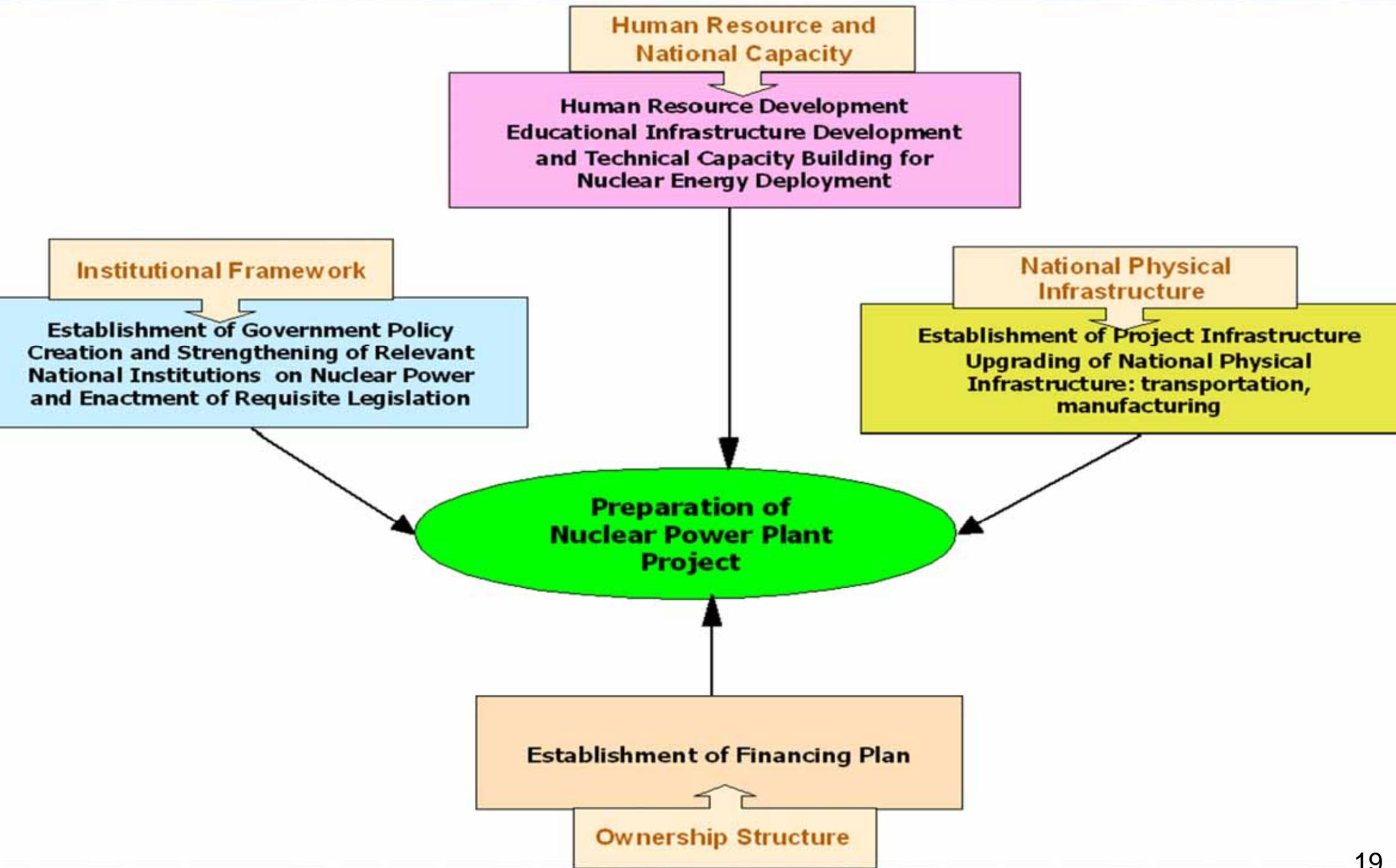


Figure 2.2: Nuclear Energy Programme Implementation Committee (NEPIC)



III National Nuclear Power Roadmap

Figure 3.1: Fundamentals of Starting an NPP Programme

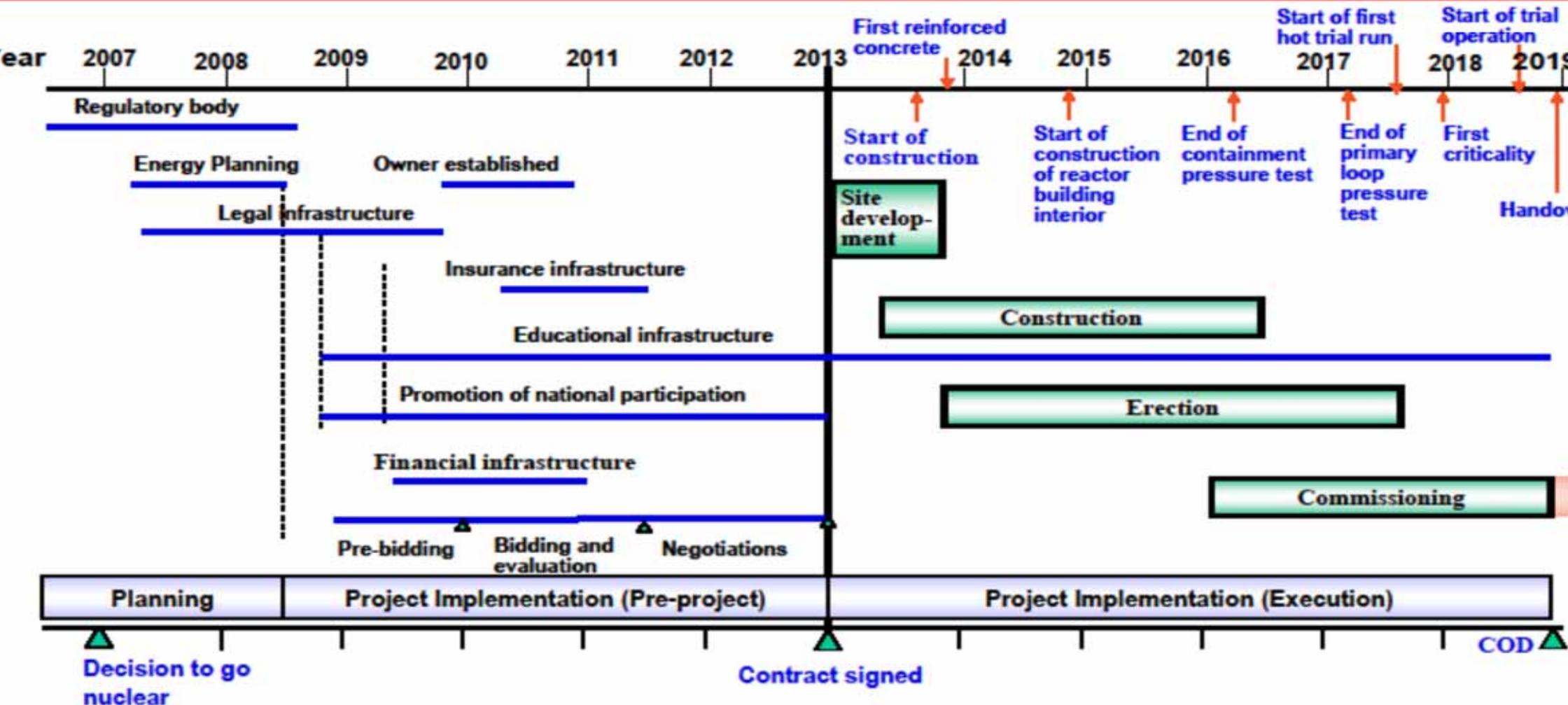


3.1: Nuclear Power Roadmap and Deployment Timeline

- ❖ At the inauguration of the Commission on July 31, 2006, NAEC was charged with the responsibility to develop a National Nuclear Power Roadmap which would position the country to generate electricity from NPPs in 10 to 12 years;
- ❖ The Roadmap has since been developed based on the fundamentals of starting an NPP Programme as shown in Figure 6.1 and formal FEC approval was given in February of 2007;
- ❖ The technical framework is three-phase plan which is aimed at positioning Nigeria to generate electricity from NPPs in 10 to 12 years with considerable national participation.
- ❖ The various phases are:
 - Manpower training and infrastructure development;
 - Design certification, regulatory and licensing approvals; and
 - Construction and start-up.

Figure 3.2: NPP Deployment Timeline

Nuclear Power Project Key Milestones



3.2: Programme Elements being Implemented

A draft law for the implementation of the national nuclear power programme has been developed, and has been subjected to detailed scrutiny by all major stakeholders with technical input of the IAEA. It has been finalized and expected to be submitted to the National Assembly by the second quarter of 2011.

- ❖ The NNRA law is being revised and modified to adequately equip the regulator to effectively deal with regulation and licensing of nuclear power plants. Currently under consideration in the National Assembly.
- ❖ A draft regulation on the *Safety and Regulatory Requirements for Licensing of Sites for Nuclear Power Plants* is being developed by the NNRA.
- ❖ A National Policy on Radioactive Waste Management has been finalized by NAEC in consultation with the NNRA and other stakeholder institutions.
- ❖ The framework for the establishment of a national nuclear insurance policy and scheme to adequately address the civil liability component of the nuclear power industry is to be developed in conjunction with Federal Ministries of Finance, Commerce & Industry, and Justice.
- ❖ Government is being positively sensitized to ratify and domesticate all other relevant international statutes, treaties and convention.

- By the IAEA Evaluation Methodology, Nigeria achieved Milestone 1 in the implementation its NPP programmes in December 2009;
- Development of the requisite educational and training infrastructure, and the finalizing of the regulatory infrastructure are the current preoccupation for development with partners (IAEA, bilateral, etc).
- Interaction with the various professionals through IAEA expert missions, conferences, workshops, scientific visits, etc, has significant contributed to an in-depth appreciation of the respective tasks, and the fine-tuning of the various elements of the national NPI development plans.
- Enabled us to develop an appropriate human resources development strategy in line with the workforce requirements of the national NPP programme.
- The human resource development strategy is designed to:
 - produce indigenous scientists and engineers who would acquired an in-depth fundamental understanding of nuclear acquired an

in-depth fundamental understanding of nuclear technology for effective project planning and management, technical coordination and sustainable implementation of the national nuclear power programme; and

- train specialized corps of scientists, engineers, technologists and technicians, imbued with a high level of fundamental knowledge and practical expertise, so as to create a sustainable pool of human capital for the design, operation and maintenance of the nuclear power plants.
- ❖ In this regard, educational development programmes of the requisite training and research infrastructure for the NPP project are being implemented in the nation's five nuclear energy research and training centres and partnering universities.
- ❖ A post-graduate bridging programme and masters' degree programmes have been developed, approved and being implemented in partnership with four participating universities.

3.3 Requisite Project Tasks to Build National Capacity

- ❖ **The infrastructure development would entail:**
 - strengthening and updating of training and capacity-building facilities;
 - gradual development of pertinent industrial competencies, engaging the local heavy industry, such as the iron and steel industry, the cement and allied industry as partners, to become active participants in the NP programme;
 - gradual development of professional skills for local participation in the NP industry; and
 - Sensitizing government to upgrade the requisite transportation capabilities to facilitate the movement of heavy equipment needed for an NP programme, among others.

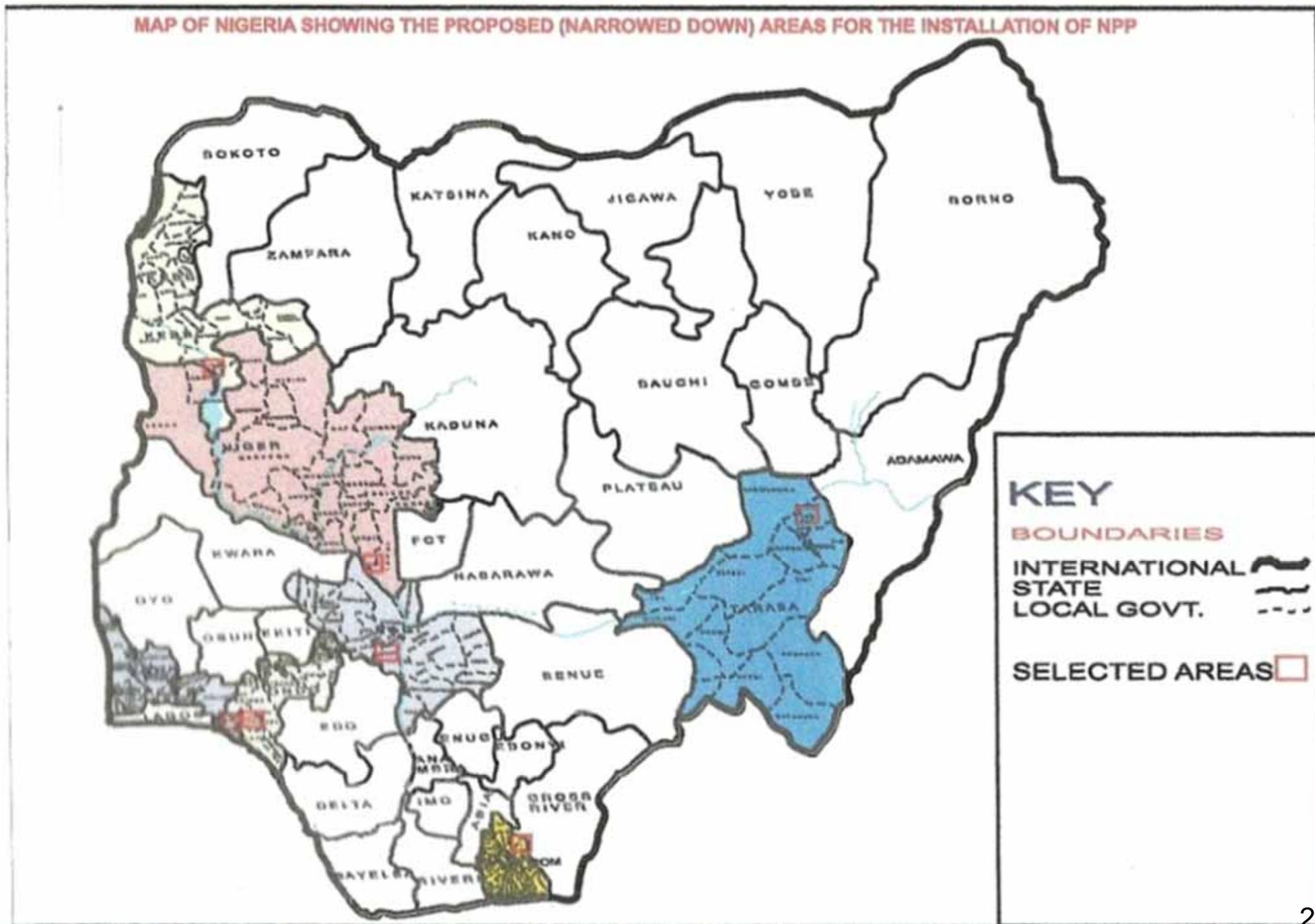
- ❖ **Industrial capacity upgrading through:**
 - Survey and determination available industrial capacity in the country, identifying possible developmental needs and recommend strategies to achieve this within a given time frame;
 - Gradually achieving competencies in local industrial capacity and enhancing local content in the execution of nuclear power projects.

3.4 Preliminary Site Selection Activities

Following site survey and site evaluation exercises embarked upon by the Commission, four sites have been designated for further detailed characterization, investigation, evaluation and recommendation to government. The sites are located in the areas around:

- ✓ Geregu/Ajaokuta Local Government Area of Kogi State in the North Central Zone of the country.
- ✓ Itu Local Government Area of Akwa Ibom State in the South-South Zone.
- Agbaje, Okitipupa Local Government Area of Ondo State in the South West Zone.
- Lau Local Government Area of Taraba State in the North-East Zone.
- ❖ In the preliminary site survey and evaluation project, a number of technical, environmental, security, social and economic issues were investigated.
- ❖ It is expected that NAEC will apply for the licensing of the approved site(s) by the end of year 2012.

Fig. 3.2: Sites being considered for NPP



IV Progress Made So Far

4.1: Milestones Achieved

- ❖ National Nuclear Power Roadmap has been developed and approved by the Federal Government for implementation. The roadmap envisages NPP operation by 2020.
- ❖ The National Strategic Plan for the implementation of the NP programme has been developed and finalized with input from all relevant national stakeholder institutions, as well as technical guidance from the IAEA.
- ❖ The NPP project implementation, by IAEA assessment methodology, has attained milestone one, and programme has been endorsed by the IAEA.
- ❖ The management framework for the implementation of the National Nuclear Energy Programme has been streamlined to achieve better synergy; all relevant nuclear energy training and research institutions have been placed under one umbrella.

- ❖ Manpower development activities are fully on course; institutions have been designated and various curricula developed for the commencement of undergraduate and graduate training programmes in nuclear science and engineering.
- ❖ Successful design and implementation of a three-months bridging programme in nuclear science and engineering for forty young engineers and physical scientists.
- ❖ Two additional nuclear energy research centres, namely: Centre for Nuclear Energy Research and Training, Unimaid, Maiduguri and the Centre for Nuclear Energy Studies, Uniport, Port Harcourt have been created, bring the total to five.
- ❖ Site selection activities are progressing in a structured manner; and
- ❖ A finalized draft Legal Framework developed in partnership with all relevant national stakeholder institutions and with technical input from the IAEA is ready for presentation to the National Assembly for enactment.

4.2: Major Facilities for Training and Research

- ❖ A number of relevant infrastructural and research facilities are being built in the respective nuclear energy centres across the country to enhance our national capacity for manpower training. These include:
 - A 30kw Miniature Neutron Source Reactor (MNSR) became critical in September 2004 at the Centre for Energy Research and Training, (CERT), Zaria.
 - A state-of-the-art Mechanical and Electrical Workshop is also fully equipped and operational at the NTC for implementation of the national nuclear power programme.
 - A 2-5MW multipurpose research nuclear reactor (NIRR-7) is also planned for the NTC, Sheda-Abuja; yet to take off due to budgetary limitations.
 - A 1.7MeV Tandem Accelerator was commissioned and became operational at the Centre for Energy Research and Development, (CERD), Ile-Ife in September 2008.

- A 340kCi Co-60 Gamma Irradiation Facility (GIF) was commissioned at Nuclear Technology Centre (NTC), Sheda-Abuja, in July 2006, and a products warehouse is being constructed.
- Currently:
 - A researchers' hostel and national resource centre for training of nuclear energy professionals is under construction at the NTC, Sheda-Abuja.
 - A central national facility for the management of low and intermediate radioactive wastes is under construction at the NTC, Sheda-Abuja.
 - Two Nuclear Science and Engineering Laboratories are under construction at CNERT, Maiduguri and CNES, Port Harcourt, respectively.
 - Two Nuclear Thermal Hydraulics Laboratories are under construction at CERD, Ile-Ife and CNES, Port Harcourt, respectively.
 - Arrangements are underway for the design and construction of a 2-5MW Multipurpose Nuclear Research Reactor at the NTC, Sheda-Abuja.

V

The Challenges We Face
And Summing Up

5.1 The Challenges We face

Long term national (political) commitment to, and sustainability of programme over gestation period of at least 20 years;

Availability of requisite specialized and restrictive manpower and long time required to build critical mass;

Development of appropriate infrastructure needed to support the implementation of the programme;

Development of requisite industrial capacity to gradually domesticate nuclear technology;

Development of the requisite financing plan, catalyzed by government, with the private sector as a partner;

Identifying and sustaining the interest of the Nigerian Public and developing a positive attitude in the country, while maintaining the confidence of our partners;

5.2: Concluding Remarks

Long-term national energy security can only be achieved through the development and harnessing of a diversified basket of energy sources, taking into consideration the needs of future generations.

In this respect, the Federal Government of Nigeria has activated a nuclear power programme, and had approved the roadmap for its implementation;

A National Strategy for the implementation of the approved Nuclear Power Programme has been finalized with the assistance of the IAEA and it is expected that its meticulous implementation will achieve NPP commercial operation by year 2020;

The requisite structure for the prosecution of the national nuclear power programme are being put in place by the Nigeria Atomic Energy Commission, in partnership with other relevant stakeholder institutions and international development partners;

The Government has shown commitment by taking on the responsibility for infrastructure and manpower development to create the requisite enabling

Effective human resources development programme has been put in place to cater to the short-term needs, as well as the long-term sustainability of the national NP programme;

Industrial and other relevant sectors of the economy are being constructively engaged and challenged to participate in the programme;

Enabling environment is being created to sensitize the financial investing community on the business opportunities in the national programme to nuclear power development;

Infrastructure sustainability and upgrade depends strongly on the development of a road map for technology acquisition, and a technology acquisition strategy is a long-term priority that must be planned for; and

The sustainability of nuclear power development is centred on broad-based national acceptance of the programme, and all facets of the programme have an important role to play to stimulate long-term national commitment to the project for the development of the programme.



Thank you for your attention.