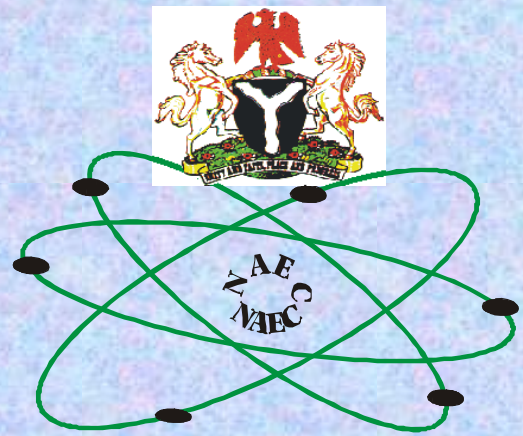
Nuclear Power Development in Nigeria: Catalyst for Sustainable Development



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Discussion Outline

i. Energy and Sustainable Development

ii. Diversification and Long-term Energy Security

iii. Why Consider Nuclear Power?

iv. Summing Up and Parting Thoughts

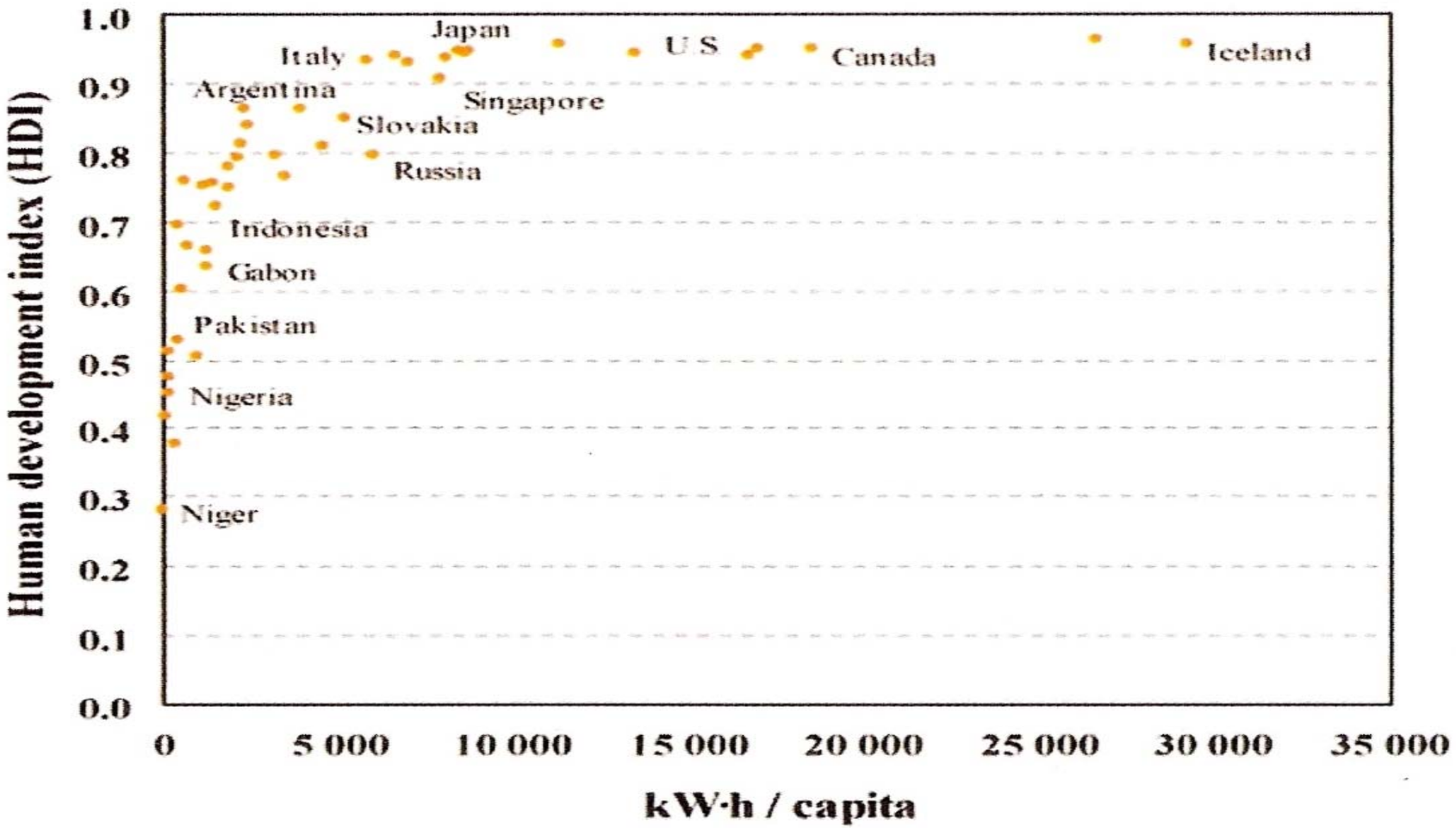
I
Energy and Sustainable Development

1 Energy and Sustainable Development

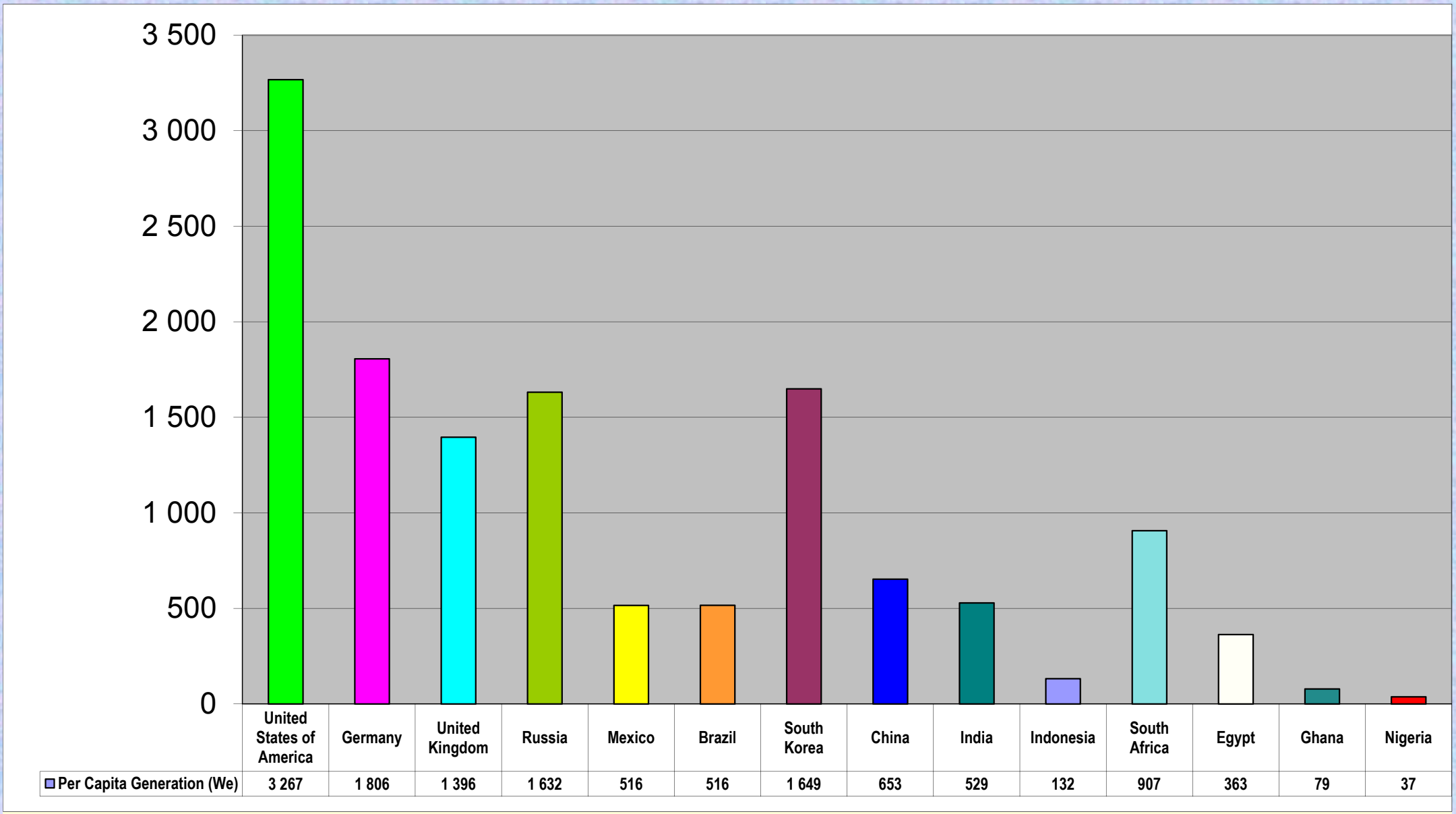
- Energy resources exploitation strategy and development should take into consideration the broader perspective of sustainable development.
- Sustainable development as defined by the World Commission on Environment and Development (WCED) in 1987 is "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs".
- Policy and strategy for economic development to meet human needs should be synergized with the importance of the sustenance of the natural environment as both a resource provider and waste absorber.

- Consequently, sustainable development entails optimal harnessing and utilization of human and material resources in the most efficient manner possible, for societal advancement in harmony with the environment.
- Energy self-sufficiency and long-term energy security are key promoters of sustainable development.
- Achieving Long-term Energy self-sufficiency is imperative for the attainment of national, regional and global developmental aspirations – NEEDS, NEPAD, MDGs.
- Require detailed energy planning - entails 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, using appropriate modeling tools.

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



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



	United States of America	Germany	United Kingdom	Russia	Mexico	Brazil	South Korea	China	India	Indonesia	South Africa	Egypt	Ghana	Nigeria
Per Capita Generation (We)	3 267	1 806	1 396	1 632	516	516	1 649	653	529	132	907	363	79	37

Figure 1.2d: Current Relative Per Capita Electricity in some Countries

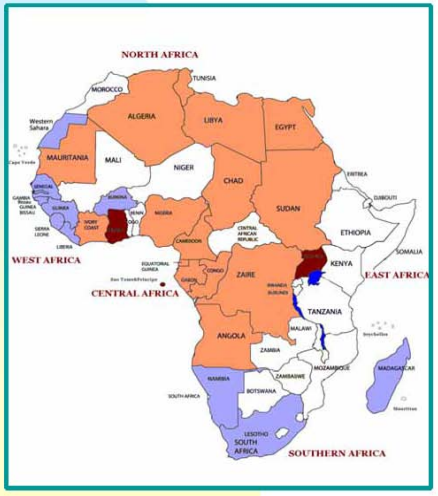
II
Diversification and Long-term Energy Security

2 Cursory Look at the African Energy Situation

- AFRECs report using the model of peaking and eventual depletion of any primary energy resource, fossil energy resources in Africa (oil, gas and coal) are limited.
- Petroleum: Only 2 African countries may remain net exporters by 2035; Except there are other finds. Nigeria would only be able to produce for domestic needs after 2035.

Oil

African oil situation as of 2010



- **Total Reserves:**
  118 B-bbl (9.5% of World)
- **Annual Production:**

2010	10.9 m-bbl
2009	10.7
2008	10.9
2007	10.8
2006	10.5

Oil

Projected African Oil Situation by 2035
(As of current proven reserves and daily production)

- Only 2 Countries will remain as oil exporters.
- Southern African block willincrease synthesis fuels (coal and gas to liquid).
- Many countries will increase biofuels production.

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- Natural gas: Only 3 African countries may remain as producers, but only 2 countries will continue to export by 2035; Nigeria will continue till about 2055. Projections may improve with possible finds, particularly from offshore drillings.

Natural Gas

African Gas Situation as of 2010

- **Total Reserves:**

  14.58 T- CM (8.0% of World)

- **Annual Production:**

2010	16.09 M-CM
2009	15.44
2008	15.03
2007	15.39
2006	15.50

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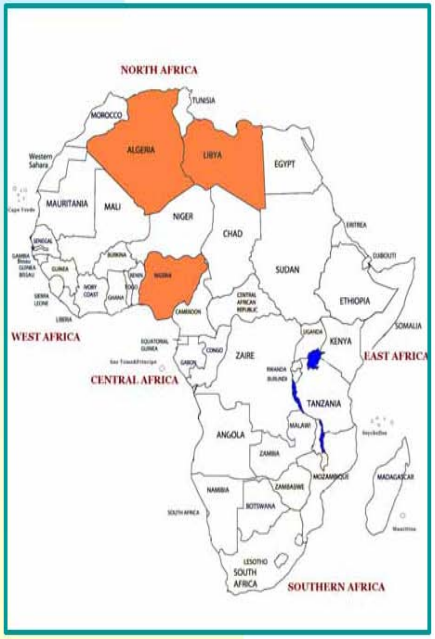
Natural Gas

Projected African Gas Situation by 2035

(As of current proven reserves and daily production)



- Only 3 countries will remain as producers but only 2 countries will continue to export
- Off-Shore drilliings may add more supplies but expensive

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- Coal, only the South African block will remain as producers by 2035; Nigeria's may have reserves which will not meet national need if relied upon. Projections may improve with possible finds.

Coal

African Coal Situation as of 2010 (million tonne)

- **Total Reserves:**
  54.7 B-T (6% of World)
- **Annual Production:**

2010	278.9 M-Ton
2009	283.3
2008	278.4
2007	275.6

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Coal

Projected African Coal Situation by 2035
(As of current proven reserves and daily production)

- Only southern Africa block will remain coal producers.
- Environmental concerns may discourage wide usages.
- Clean coal technology might develop faster.

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Table 2: Estimated Reserves of some Energy Resources in Nigeria

Resources Type	Estimated Reserves
Crude Oil	36.5 billion barrels
Natural Gas	187.4 trillion SCF
Coal & lignite	Over 4 billion tonnes
Tar Sand	31 billion barrel of oil equivalent
Hydropower (Large)	11,250MW
Hydropower (Small)	3,500MW
Fuelwood	13 million Hectares
Animal Waste	61 million tonnes/yr
Crop residual	83 million tonnes/yr
Solar Radiation	3.5-7.0 kWh/m2 -day
Wind	2-4 m/s (annual average)

- Quite a number of countries, particularly African countries, depend primarily on fossil fuels and hydropower for their national energy needs with concomitant environmental degradation.
- These resources are finite and will be depleted over time; also physical and technical limitations to the harnessing of hydropower, it is imperative to think of diversification.
- Consequently:
  - Conservation of natural energy resources
  - Diversification of energy options to achieve optimal mix
  - Mitigation of environmental degradation and global warming
- Sustainable socioeconomic development:- access to a diversified basket of energy options, taking into consideration natural availability, economic competitiveness, technology infrastructure and strategic considerations, as well as preservation of the environment.

III
Why Consider Nuclear Power?

- With a population of over 170 million and annual growth rate of about 3%, the energy situation in Nigeria is quite dire.
- The currently installed capacity, (including the recently completed NIPPs)) is just about 8GWe
- Out of which only about 6GWe is available. Hydropower contributes about 1850MWe, while the balance is supplied by gas-fired plants.
- Most of the on-going new power projects are gas-fired plants, and would provide the additional capacity in the coming years.
- Hydro potential is limited; only14GWe can be harnessed from all available hydropower sources
- Currently, no coal-fired plants are under development.
- Renewables of solar and wind are under consideration, but would not be able to contribute significantly to base-load grid electricity supply in the foreseeable future.
- This is the kernel of the problem. NP progamme launched in 2007; aimed at diversifying generation base and to gradually reduce the stress on the national fossil fuel resources.

Table 3: Features of Nuclear Power

Advantages	Drawbacks	Inherent /Attainable
■ Low maintenance and Operating cost ■ Stable and predictable generating costs ■ Long life time (50-60yrs)	■ High upfront capital costs can be difficult to finance ■ Sensitive to interest rates ■ Long lead times (planning, construction, etc)	◆ Need for technical and human resource underpinning ◆ High safety standards ◆ Security and safeguarding of nuclear materials
■ Supply security (insurance premium) ■ Low external costs (so far no credit applied) ■ Least potential for contributing to climate change ■ Higher availability and capacity factors	■ Long payback periods ■ Regulatory uncertainties /policy risks ■ Market risks; Predisposed to cost overruns and construction delays ■ Long term government commitment and public support (requires political and policy stability)	◆ Commitment to an international regime of oversight ◆ Accession to international treaties and conventions

Table 3.2: Compilation of Potential Environmental Impacts

Fossil Fuels	Hydroelectric	Renewables *(solar, wind, geothermal, biomass)*	Nuclear *(full energy chain)*
• Global climate change • Air quality degradation (coal, oil) • Lake acidification and forest damage (coal, oil) • Toxic waste contamination (coal ash and slag, abatement residues) • Groundwater contamination • Marine and coastal pollution (oil) • Land disturbance • Large fuel and transport requirements • Resource depletion	• Population displacement • Land loss and change in use • Ecosystem changes and health effects • Loss of biodiversity • Dam failure • Decommissioning	• Air quality degradation (geothermal, biomass) • Extensive land use • Ecosystem changes • Fabrication impact (solar photovoltaic cells) • Noise pollution (wind)	• Severe reactor accident release • Waste repository release

3.1 . Elements of Nigeria's NP Programme

- The national Nuclear Power Roadmap referred, tagged "Technical Framework" has since been developed andFederal Government in February 7, 2007;
- The Technical Framework is three-phase plan which is aimed at positioning Nigeria to generate electricity from NPPs in about 12 years with considerable national participation. The National Strategy for its implementation was finalized in December 2009.
- The various phases are:
  - Manpower training and infrastructure development;
  - Design certification, regulatory and licensing approvals; and
  - Construction and start-up.
- The roadmap, if meticulously implemented, is expected to generate at least 1,000 mega watts of electricity in by the end of the decade and gradually increase this capacity to 4,000 mega watts in another ten years.

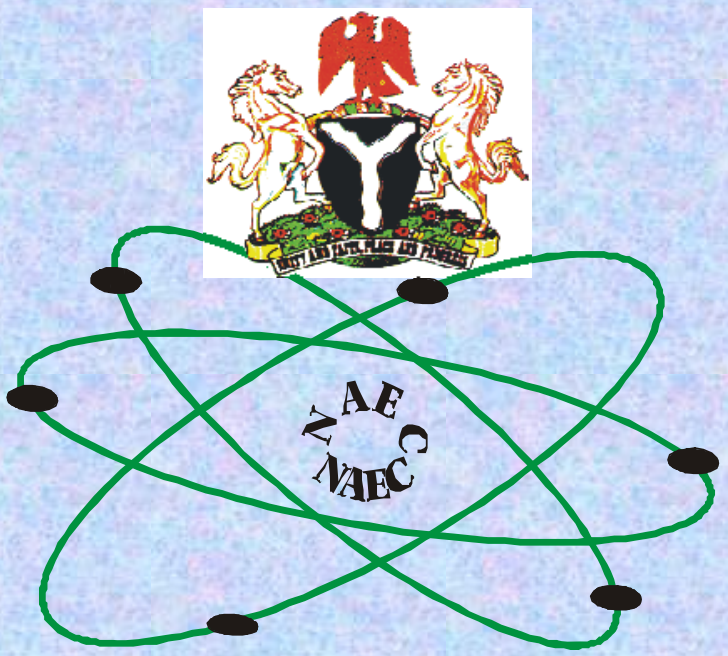
- The Strategic Plan developed to streamline the implementation of the TF was approved in December of 2009.
- Currently implementing Milestone 2 activities:
  - Building the requisite nuclear power infrastructure.
  - Has undertaken some preliminary site selection and characterization activies;
  - Two preferred sites located in Geregu/Ajaokuta in Kogi State in the North-Central zone, and Itu in Akwa Ibom State in the South-South zone of the country would undergo further detailed evaluation and assessment studies;
  - Emplacement of facilities and development of partnerships for Human Resources Development.

- The human resource development strategy is designed to:
  - produce indigenous professionals who would acquired an in-depth understanding of nuclear technology for effective project planning, technical coordination and management; and
  - train specialized corps of scientists, engineers, technologists and technicians to create a sustainable pool of human capital for the design, operation and maintenance of the nuclear power plants.
- Requisite training and research infrastructure for HRD are being developed in national nuclear energy research and training centres and partnering universities, for domestic training in the fundamentals.
- Other specialized aspects of the HRD programmes are being implemented in partnership with offshore institutions, development partners and the IAEA.

IV
Summing Up

- In spite of divergent views on the economics of NP vis-à-vis other sources of electricity, expansion in the use of nuclear power would contribute significantly towards the effective management and conservation of finite natural assets of fossil fuels
- There is a strong desire to conserve such fossil fuels which do have uses of high utility values in other sectors of the economy. This will further engender and deepen sustainable development.
- In light of the gradual recovery from the Fukushima Daiichi accident and the apparent nuclear power renaissance, international effort should be further galvanized to ensure that it is sustained successfully over time, particularly in the newcomer developing countries
- The success and sustainability of the various new programmes in newly embarking countries will derive from:

- creation of a stable network of national institutions which supports the successful development of the requisite national nuclear power infrastructure and capacity building;
- strengthening of the network of national physical and industrial infrastructure covering a wide range of activities and capabilities such as transportation, electricity grid and heavy industries;
- putting in place a strategy for the development of a virile and professional human resource base with in-built mechanisms for effective workforce development, succession planning and nuclear knowledge management; and
- the development of a creative and pragmatic financing plan with significant private sector participation, backed-up by appropriate Inter Governmental Agreements and long-term commitment of national resources.



Thank you for your attention.