ENERGY PLANNING IN NIGERIA:
COMBATING ENERGY POVERTY AND CLIMATE CHANGE

By

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1. Introduction

- I am conscious of the fact that the Nigerian Association of Energy Economics (NAEE) has a mix of membership with background not only from Economics, but also those with background from other Social Sciences, Natural Sciences, Engineering, Business, Law, etc, since energy development involves cross-cutting and multi-professional issues and subjects.

- I will therefore commence from the basic beginning by referring to the Oxford Dictionary for definitions of Energy, the keyword in my discourse.

1. Introduction

- Energy is defined by Oxford Dictionary as the strength and vitality required for sustained physical or mental activity.
- Energy is therefore essential for activity to occur.
- It went further to say that Energy is the power derived from utilization of physical or chemical resources, especially to provide light and heat or work.
- Therefore, energy is essential for provision of light, heat or work.

1. Introduction

- Similarly and technically, energy is defined as ability to do work.
- Therefore, for an activity to occur, work must be done physically or mentally and energy must be involved.
- The import of the preceding basic arguments is to show that energy is a desirable thing for human development.
- Energy is essential in food production and storage, health services, transportation, internet and modern communication and digitalization, defence, refrigeration and air-conditioning, education, and many other activities that improve on the socio-economic development of humanity.

1. Introduction

- This fact can be seen graphically on the plots of Gross Domestic Product (GDP) and Human Development Index (HDI) against Energy supply of nations, shown in Figs. 1 and 2. Energy here refers to final energies of fuels, electricity and heat.

1. Introduction

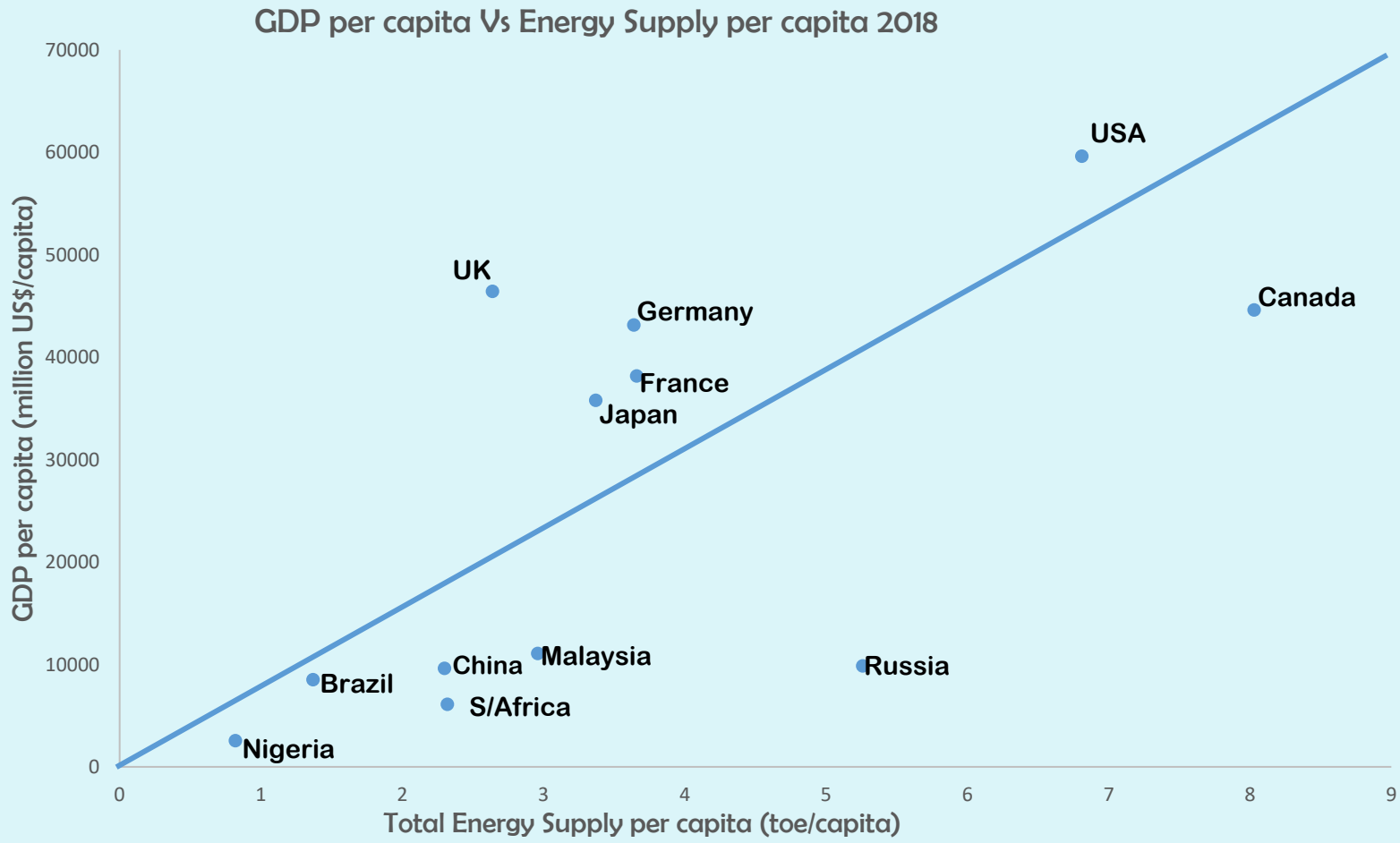

Figure 1

Source: IEA (2020). Key World Energy Statistics, 2018 Selected Indicators

1. Introduction

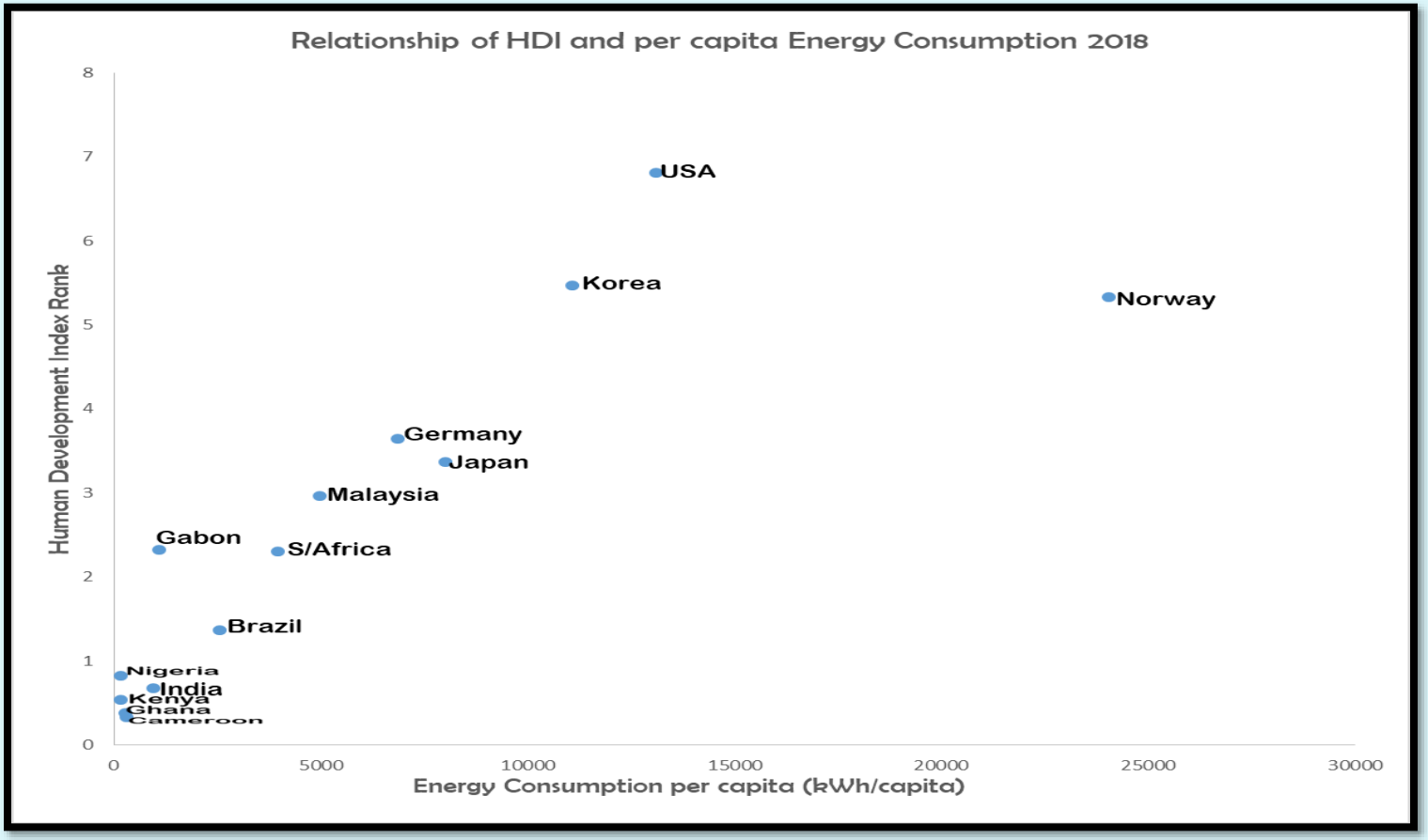

Figure 2

Source: IEA (2020). Key World Energy Statistics, 2020 Selected Indicators
UNDP (2020). 2019 Human Development Report

Source: IEA (2020). Key World Energy Statistics, 2018 Selected Indicators

1. Introduction

- Nations with high and adequate energy supply are shown to have higher GDP and HDI; which are indications of higher national wealth and standard of living of citizens (education, health, housing, security, etc.).

- Since the major objective of the State is the security and safety as well as welfare of its citizens, all affected by energy supply; provision of adequate, equitable (accessible and affordable) and environmentally sustainable energy becomes necessary in line with the Sustainable Development Goals (SDGs) and Climate Protocols.

1. Introduction

- The energy trilemna should therefore be our target.
- For the above to occur, proper planning for the energy systems in all its ramifications is also very imperative.
- Thus, the need for strategic energy planning to be entrenched into the national development planning in our country.
-

2. What is Strategic Energy Planning?

- Strategic energy planning is the development of a roadmap that brings the desired energy policy goals in both the present and future into clear focus.

- It considers current reality and leverages on local resources to map out efficient pathways to achieve the desired energy future, determined and set from stakeholder's inputs and buy-in, so as to ensure likelihood success of the plans over time.

2. What is Strategic Energy Planning?

Strategic energy planning therefore:

- Brings desired energy future into focus and builds consensus
- Considers current reality and local resources
- Considers hurdles/challenges before they are reached
- Maps out efficient paths to achieve the desired energy future
- Clarifies key performance indicators; and
- Documents the plan for short and long-term success

2. What is Strategic Energy Planning?

The following are steps required in strategic energy planning:

- Identify and convene stakeholders
- Form leadership team
- Develop Energy Vision
- Assess Energy needs and Resources
- Develop specific goals
- Prioritize projects and programmes
- Identify financing options
- Compile Energy Plans
- Measurement and verification and plan alterations

2. What is Strategic Energy Planning?

Strategic Energy Plans fail due to:

- Short-sighted predictions of situation, time line
- Unrealistic prediction of resources
- Uncoordinated implementation
- Narrow Ownership
- Failure to follow the plan
- Poor or Casual communication

3. Energy Resources in Nigeria

- Nigeria is endowed with fossil primary energy resources of crude oil estimated at 37.0 billion barrels and with a reserve-to-production ratio of 50 years in 2019.
- It has natural gas reserve of about 203 TSCF reserve with a reserve-to-production ratio of about 70 years.
- Coal and Tar sand are available in reserves of 2.7 billion tonnes and 31 billion barrels of oil equivalent not being exploited.
- The country also has abundant renewable energy reserves of hydropower with potentials of about 28MW made up of 24GW large hydropower and 3.5GW of small hydropower.
- Solar energy intensity of between 4.0 kWh/m^2/day to 7.0kWh/m^2/day in the Southern and Northern parts of the country, respectively.
- Wind regimes are low at annual average of 2-4m/s at 10m height. There is also biomass resources of fuelwood and municipal animal and crop waste.

3. Energy Resources in Nigeria

(a) Table 1: Fossil and Nuclear Energy Resources

S/N	Resources	Reserves (2019)	Production (2019)	Domestic Utilization (2019)
1	Crude Oil	36.89billion barrels	0.735billion barrels	2.764million barrels ≈0.38% of production) Average refining capacity ≈2.53%
2	Natural Gas	203.45 Tscf	2.864Tscf	91.5% : Utilized 8.5% : flared
3	Coal	2.7 billion tonnes	0	Negligible
4	Tar Sands	31 billion barrels of oil equivalent	0	18.25 million barrels
5	Nuclear	Yet to be quantified	0	30kW experimental nuclear reactor in Zaria

(a) Table 2: Renewable Energy Resources

S/N	Resource		Reserve (2019)	Utilization Level (2019)
1	Large hydro power		24,000MW	• 1,900MW
2	Small Hydro power		3,500MW	• < 100 MW
3	Solar Energy		4.0 kWh/m²/day 6.5kWh/m²/day	• About 400 MW dispersed solar PV stand-alones • No solar thermal electricity • Yet to be quantified solar thermal use
4	Wind		2-4m/s at 10m height	• 2x2.5kW electricity generator in Sokoto; • 14x5kW wind electricity in Zamfara State • 10MW wind farm in Katsina
5	Biomass	Fuel wood	11 million hectares of forest and woodlands	• 73.4 million tonnes of firewood/yr @ ≈ kg/capita
		Municipal waste	- 18.3 million tonnes in 2005* & about 30 million tonnes/yr now	-
		Animal waste	- 243 million assorted animals in 2001	-
		Energy Crops and agric waste	- 72 million hectares of Agricultural land	28.2 million hectares of Arable land only 8.5% is cultivated

4. Energy Supply Situation in Nigeria

- The 2018 mix of primary energy supply in Nigeria is such that biomass, an organic matter of recent biological origin, constitutes the largest at about 81.0%, followed by natural gas at about 8.0%, petroleum products at about 5.0%, crude oil at about 5.0% and hydropower at about 1%.

- Table 3 shows Nigeria's energy supply situation over the past decade in comparison with the African and World averages.

- The energy consumption per capita, dominated by biomass, has over the past decade been comparable to African average, but grossly below, and at about 30%, the world's average

4. Energy Supply Situation in Nigeria

- The situation is even worst, when we look at grid electricity consumption per capita.

- Nigeria has had its grid electricity consumption per capita at less than 200 kWh and just at about 28% the African average, and about 6% only the world average over the past decade.

- These data empirically show the extent of energy poverty in the country, despite the enormous primary energy resource endowment shown in Tables 1 and 2.

- The challenge has been inadequate value addition, from primary to final energies, as exemplified by 2.5% capacity utilization of refineries in 2019 and the meagre average grid electricity supply of less than 30kWh/capita over the past decade.

4. Energy Supply Situation in Nigeria

S/N	Items	2005	2008	2011	2018	Average
1.	Grid Electricity generation (billion kWh)	24.22 (503)* (10,695)**	21.27 (562)* (18,603)**	27.7 (619)* (20,407)**	33.7 (870)* (26,730)**	26.7 638.5* 19,108.6**
2.	Energy Consumption per Capita (kgoe/Capita)	132.6 (680)* (1,780)**	808 (670)* (1,830)**	736 (670)* (1880)**	820 (660)** (1880)**	624.2 670.0* 1,842.5**
3.	Grid Electricity Consumption/capita (kWh/Capita)	181.4 (563)* (2596)**	142.9 (571)* (2782)**	165 (592)* (2933)**	157 (567)* (3260)**	169.6 573.3* 2,892.8**
4.	GDP/Capita (US$/Capita)	826.3 (2314)* (8,492)**	1286.3 (2540)* (9550)**	1470.6 (1281)* (7520)**	2552.3 (19851)* (11859.4)**	1,533.9 2,030.0* 9,355.4**
5.	Energy Intensity (kgoe/ US$)	0.161 (0.294)* (0.210)**	0.62 (0.264)* (0.192)**	0.50 (0.550)* (0.250)**	0.321 (0.332)* (0.159.)**	0.40 0.360* 0.203**
6.	GDP Growth Rate (%)	6.5	6.0	7.4	1.93	5.5

4. Energy Supply Situation in Nigeria

- The average GDP growth rate over the same period remained positive at about 5.5% per annum, indicating reasonable economic activities perhaps largely sustained by more expensive and fossil fuel driven electricity estimated at about three (3) times the supply from the cheaper but inadequate grid power.

5. Institutional Framework in the Energy Sector in Nigeria

- Figure 3 represents fairly the institutional arrangement in Nigeria's energy sector.
- The framework shown graphically suggests how each energy and energy-related Ministries operates with little reference or synergy with others for effective deliverance of national objective on energy.
- The government agency, which is the Energy Commission of Nigeria, mandated by law with the responsibility for strategic planning and coordination of national policies in the field of energy in all its ramifications has however not been strategically positioned to facilitate its carrying out this essential function.
- It is believed by some school of thought that this poor institutional arrangements has led to poor coordination of the energy sector; and consequently, and partially, responsible for energy poverty in the country.

5. Institutional Framework in the Energy Sector in Nigeria

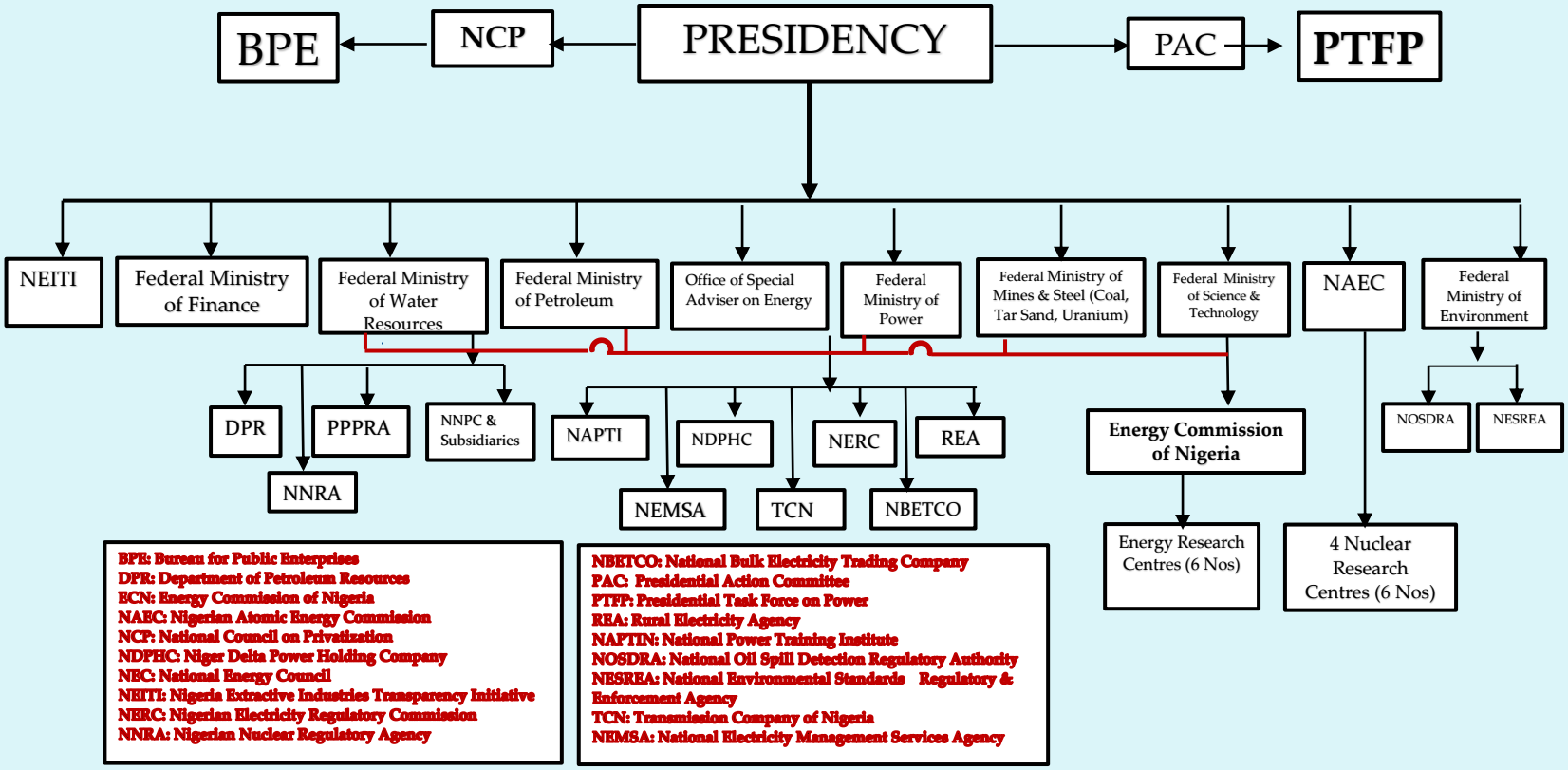

Figure 3

6. National Energy Planning in Nigeria

- National Energy Planning is a process put in place to facilitate the advancement of the national energy policy objectives.
- The National energy Policy was first approved in 2003 by the federal Executive Council after 10 years of draft consideration and inter-ministerial reviews.
- Before then, existing policies in the energy sector have been those of separate energy subsectors such as electricity, oil and gas, solid minerals and forestry.
- There had also been energy related policies developed in sub-sectors whose activities are strongly dependent on those in the energy sector.

6. National Energy Planning in Nigeria

- These include transportation, agriculture, science and technology, and environment, amongst others.
- The sub-sectorial policies, however, reflected the individual sub-sectorial perspectives.
- It therefore became necessary to have an integrated energy policy, which will guide future energy and energy-related sub-sectorial policy development, in order to avoid policy conflicts, which may otherwise arise.
- Draft National Energy Policy produced by stakeholders under the arrow head of Energy Commission of Nigeria, was presented to Federal Government in 1993, and was finally approved in 2003 by the Federal Executive Council

6. National Energy Planning in Nigeria

- The overall objective of the National Energy Policy is summarized as follows:
  - To ensure the development of the nation's energy resources, with diversified energy resources option, for the achievement of national energy security and an efficient energy delivery system with an optimal energy resource mix.
  - To guarantee increased contribution of energy productive activities to national income.
  - To guarantee adequate, reliable and sustainable supply of energy at appropriate costs and in an environmentally friendly manner, to the various sectors of the economy, for national development.

6. National Energy Planning in Nigeria

- To guarantee an efficient and cost effective consumption pattern of energy resources.
- To accelerate the process of acquisition and diffusion of technology and managerial expertise in the energy sector and indigenous participation in energy sector industries, for stability and self-reliance.
- To promote increased investments and development of the energy sector industries with substantial private sector participation.
- To ensure a comprehensive, integrated and well-informed energy sector plans and programmes for effective development.

6. National Energy Planning in Nigeria

- To foster international co-operation in energy trade and projects development in both the African region and the world at large.
- To successfully use the nation's abundant energy resources to promote international co-operation.

- In order to meet these objectives, it was required that an energy masterplan be developed that will, amongst other things, bring out medium and long-term energy demand and supply projections that will guide development in the energy and energy-related sub-sectors; and the methodology must be in line with international best practices.

6. National Energy Planning in Nigeria

- The department of Energy Planning of the International Atomic Energy Agency (IAEA), Vienna was contacted under its programme on Sustainable Energy Development in Sub-Saharan Africa, to build capacity.
- To guide Energy Commission of Nigeria on behalf of the country, in the use of its energy planning tools. The Model for Analysis of Energy Demand (MAED) and Model for Energy Supply Systems Alternatives and their General Environmental Impact (MESSAGE) are in view.
- MAED is a Scenario based model that relates energy demand to the set of social, economic and technological factors;
- MESSAGE is a supply optimization model with input from MAED.
- Bearing in mind other development planning documents such as NEEDS, and MDGs, Vision 20:2020 etc., the following scenarios and assumptions were adopted

6. National Energy Planning in Nigeria

- **Reference Growth Scenario:**
  - Population growth of 2.8% per annum
  - GDP grows by an average of 7% per annum.
  - The main driver of growth is the manufacturing sector
  - Manufacturing to account for 15% of GDP by 2020 from 4% in 2010
  - Poverty to be reduced by half by 2015 in line with MDG objectives.

- **High Growth Scenario**
  - Population growth of 2.8% per annum
  - GDP grows by an average of 10% p.a.
  - Manufacturing to contribute 22% to GDP by 2030 from 4% in 2010
  - Nigeria transits from an agrarian to an industrializing economy

6. National Energy Planning in Nigeria

- **Optimistic Growth Scenario I**
  - Population growth of 2.8% per annum
  - GDP grows by an average of 11.5% p.a.
  - Manufacturing to contribute 22% to GDP by 2030 from 4% in 2010
  - Nigeria transits from an agrarian to an industrializing economy
- **Optimistic Growth Scenario II**
  - Population growth of 2.8% per annum
  - GDP grows by an average of 13% p.a.
  - Manufacturing to contribute 22% to GDP by 2030 from 4% in 2010
  - Nigeria transits from an agrarian to an industrialized economy
- Based on the preceding Scenarios and assumptions, the following energy demand and supply projections were made from MAED and MESSAGE.

6. National Energy Planning in Nigeria

- Table 4 shows that for our economy to grow by about 7%, Nigeria needed grid electricity capacity of not less than 24GW by 2015 and will need 100GW by 2030; while for a double digit growth, capacity of not less than 40GW by 2015 and 300 GW by 2030 would be imperative.

- The energy supply mix and their technologies to meet these demands are shown in Tables 6 and 7, respectively.

- The supply projections indicate possibility of power input by 2030.

- The additional capital investment implication between 2015 and 2030 is estimated at about $248 billion for the reference Scenario and about $445 billion for the double digit growth.

- The demand for fuel petroleum products of PMS, AGO, DPK, FO and LPG projected is shown in Table 5. For example, the demand for PMS at reference Scenario was projected at about 40 million litres/day by 2015 and about 155 million litres/day in 2030.

6. National Energy Planning in Nigeria

- In addition to planning for energy security, climate considerations as dictated by Climate Protocols is also very imperative.

- Commission was also supported by the British High Commission and the then UK Department of Energy and Climate Change (UK-DEC), now known as the UK Department of Business, Energy and Investment Strategies, to adapt its UK 2050 Calculator, a web-driven planning tool, which reveals interactively the various electricity demand and supply pathways over long-term periods and their consequent emissions.

- The adopted tool is referred to as Nigeria Energy Calculator 2050. The Calculator will help re-evaluate our Nationally Determined Contributions (NDCs) towards meeting our climate commitment.

6. National Energy Planning in Nigeria

a) Electricity Demand Projections

	2009	2010	2015	2020	2025	2030
Ref (7%)	4,052	7440	24380	45490	79798	115674
High Growth (10%)	4,052	8420	30236	63363	103859	196875
Opt I (11.5%)	4,052	9400	36124	76124	145113	251224
Opt II (13%)	4,052	10230	41133	88282	170901	315113

6. National Energy Planning in Nigeria

(b) Petroleum Products Demand Projections

Year	PMS (Million litres)		DPK (Million litres)		AGO (Million litres)		Fuel Oil (Million litres)		LPG (Thousand tonnes)	
	7%	13%	7%	13%	7%	13%	7%	13%	7%	13%
2009	5096.9	5096.9	356.1	356.1	565.6	565.6	120.0	120.0	74.2	74.2
2010	6180.0	8890.0	464.0	902.0	791.7	1177.9	160.0	270.0	93.2	132.9
2015	14460.0	19510.0	3788.0	7039.0	2301.9	3651.0	1800.0	3380.0	1107.0	1871.2
2020	28170.4	35587.1	9038.7	22704.5	4176.8	6270.8	4632.1	9277.9	2862.5	5733.5
2025	39769.4	55459.4	15084.9	44285.4	6231.8	11408.4	7806.1	20797.4	4824.0	12852.3
2030	56457.2	88369.2	22064.9	77255.7	8902.4	21349.7	11374.6	45443.4	7029.2	22903.7

6. National Energy Planning in Nigeria

(c) Electricity supply Projections: Reference Scenario (7%) Growth

Fuel Type	2009	2010	2015	2020	2025	2030
Coal	0	609	1805	6527	7545	10984
Electricity import	0	0	0	0	0	31948
Gas	3803	4572	18679	33711	61891	80560
Hydro	1930	1930	3043	6533	6533	6533
Nuclear	0	0	1000	1500	2500	3500
Small hydro	20	60	172	409	894	1886
Solar	0	260	1369	3455	7000	25917
Wind	0	10	19	22	25	29
Biomass	0	0	3	16	35	54
Total	5753	7440	26092	52174	86422	161411

6. National Energy Planning in Nigeria

(d) Electricity Supply Projection: Optimistic II Scenario (13% Growth)

Fuel Type	2009	2010	2015	2020	2025	2030
Coal	0	3353	3353	12122	14011	20399
Electricity import	0	0	0	0	0	59333
Gas	3803	13110	26426	49996	120512	164307
Hydro	1930	4157	11207	12132	12132	12132
Nuclear	0	0	3600	7200	7200	7200
Small hydro	20	105	320	760	1660	3502
Solar	0	490	2543	6417	15970	48132
Wind	0	23	36	41	47	54
Biomass	0	0	5	30	65	100
Total (supply)	5753	21238	47490	88698	171598	315158

7. Conclusion

- Energy planning is very necessary for the balanced and coordinated development of energy in any nation. Nigeria is no exception.
- The implementation of an integrated national energy planning needs to be earnestly pursued, if energy poverty is to be averted in the medium to long terms.
- Also our national commitment to climate protocols can only be achieved, if the energy sector is strategically planned to support sustainable development.

7. Conclusion ……. Cont'd

- The Energy Commission of Nigeria saddled with the responsibility for the strategic planning and coordination of national policies in the field of energy in all its ramifications provides this platform.

- Commission needs to be supported by all stakeholders in the Energy Sector in order to achieve a balanced and coordinated development of the Nigeria energy sector.

- Scientific energy planning models/tools of MAED, MESSAGE and the Nigerian Energy Calculator 2050 are being employed to assist in the delivery of strategic energy plans for the country.

8. References

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Thank you
and
God Bless