Nuclear Power in the WAPP

12th WAPP Financial & Technical Meeting and General Assembly

31 October, 2017
Swiss Spirit Hotel & Suites Alisa, Accra

Background

Quotes from Dr. Kwame Nkrumah at the launch of the Atomic Project on November 25th 1964

"We have been compelled to enter the field of Atomic energy, because this already promises to yield the greatest economic source of power since the beginning of man. Our success in this field would enable us to solve the many sided problems which face us in all the spheres of our development in Ghana and in Africa".

"We believe that the amount of energy which can be generated in Ghana, can play a decisive role in the development of our industry, agriculture, health and other services. Certainly, the foundations for the effective and rapid industralisation of our country must rest on the provision of cheap and abundant power".

Ghana's Nuclear Journey

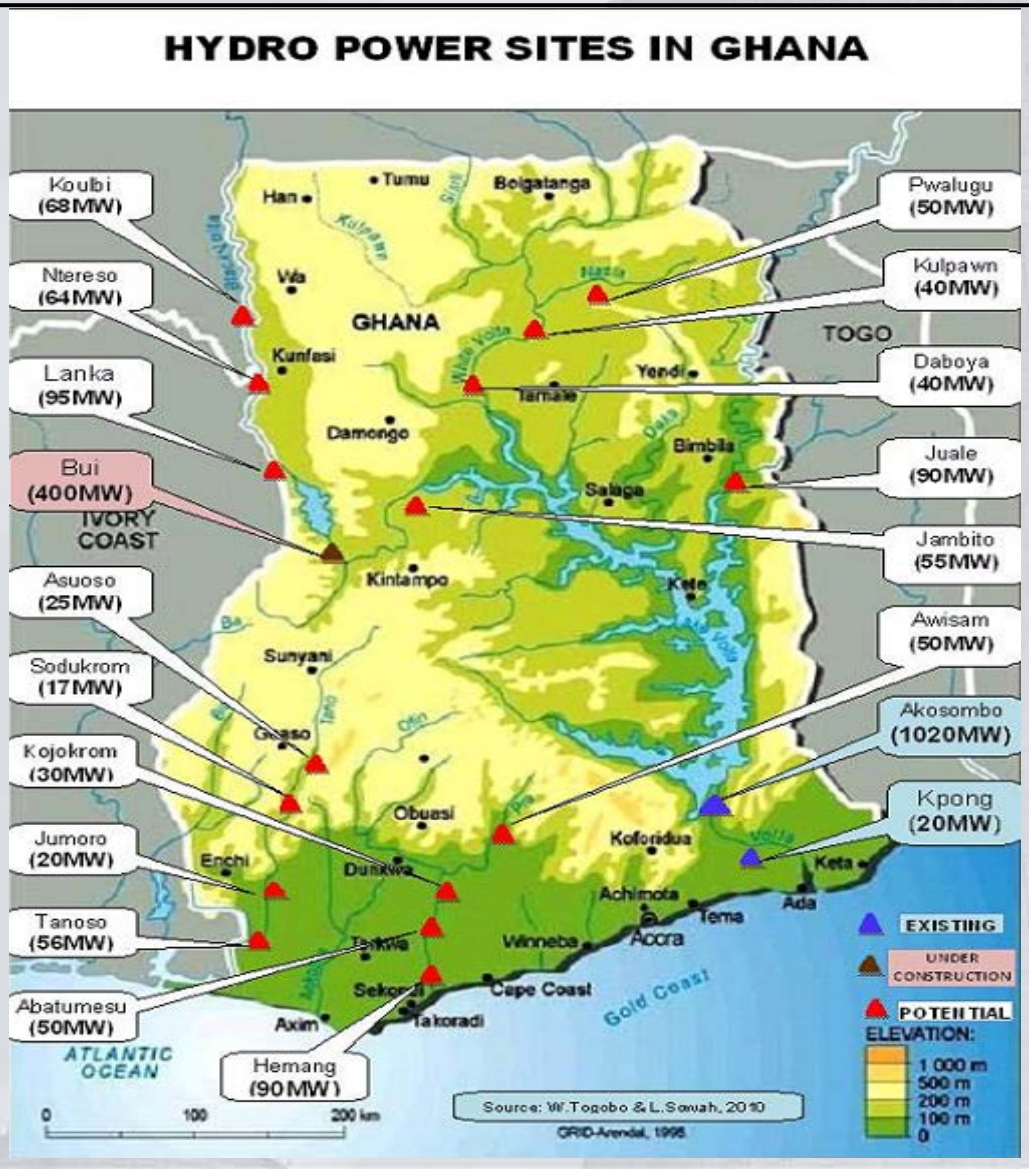
Date	Activity
Dec. 2007	Presidential Committee to report on a feasibility study of introducing nuclear into country's energy mix (Adjei-Bekoe Committee)
2008	Cabinet decision to include nuclear into energy mix based on the Committee's Report
2010	Nuclear Energy included in National Energy Policy and Strategy
Sept. 2012	Ghana Nuclear Power Programme Organization (GNPPO) established
Feb. 2014	Establishment of Nuclear Power Centre at GAEC as the technical driving force for GNPPO. Upgraded to an Institute in September 2016.
Jan. 2015	IAEA Experts visit Ghana to develop a better understanding of the for nuclear power infrastructure development

Ghana's Nuclear Journey

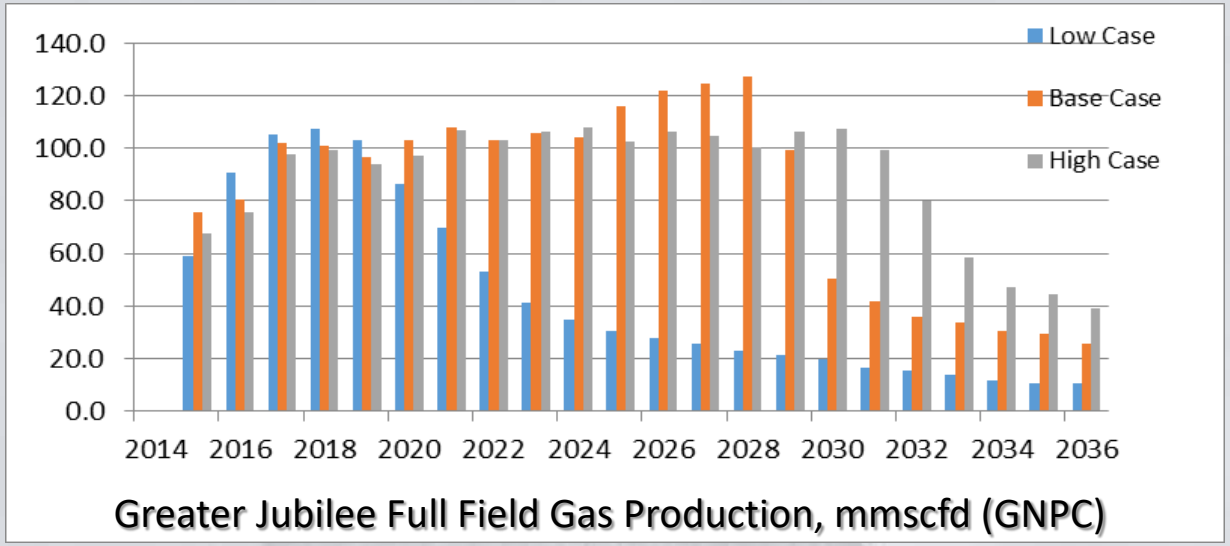
Date	Activity
March 2015	Draft of Roadmap for NPP development in Ghana. Document reviewed by IAEA in Nov 2015, and subsequently approved by GNPPO
Aug. 2015	Nuclear Regulatory Authority Act 2015 (Act 895) for the establishment of an effectively independent Nuclear Regulatory Body passed. NRA established in January 2016.
Dec. 2015	Ghana applied for IAEA Integrated Nuclear Infrastructure Review Mission for Phase 1 of the Programme development
Apr.– Dec 2016	Ghana develops Phase 1 INIR Mission Self Evaluation Report
Jan 2017	Phase 1 INIR Mission conducted by IAEA
May 2018	Submission of INIR Report to Government of Ghana

Limited Hydro Potential

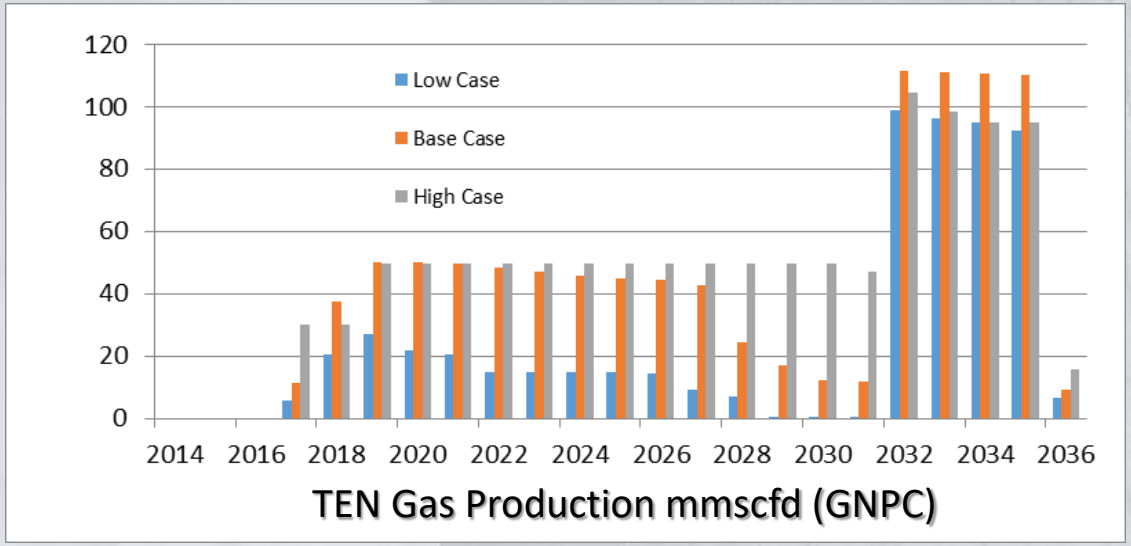
- Potential exploitable resource is about 2,420 MW
- 1,580 MW already developed at Akosombo, Kpong and Bui.
- Resulting in a total of 65.3% of exploitable resource
- Remaining 840 MW can be obtained from 21 sites mainly from medium and small Hydro power plants with capacities below 95 MW.



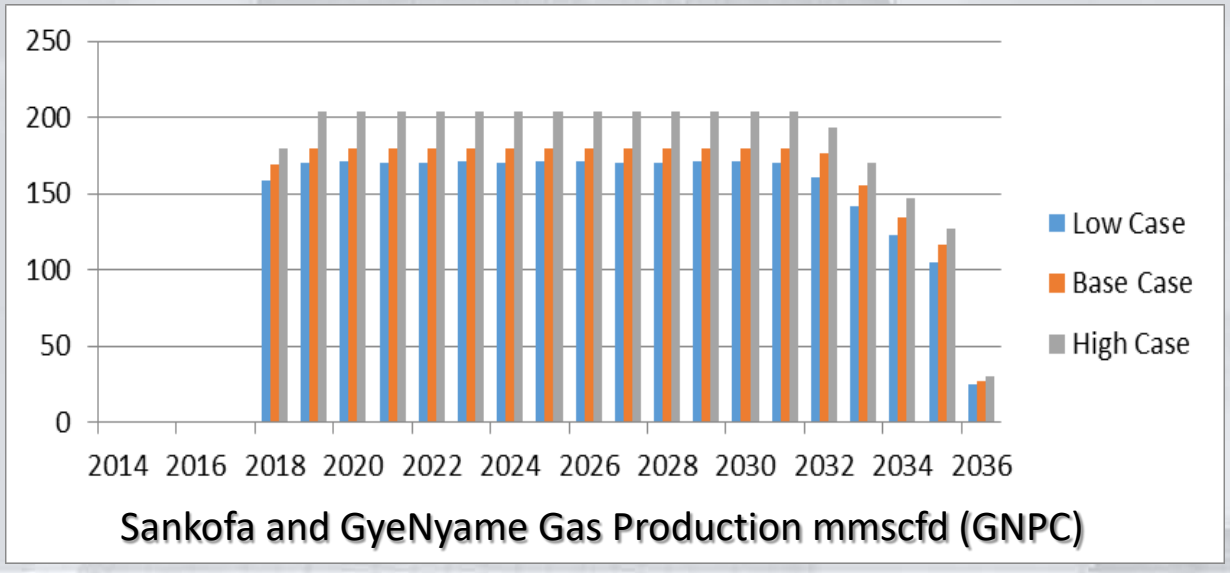
Gas depletion



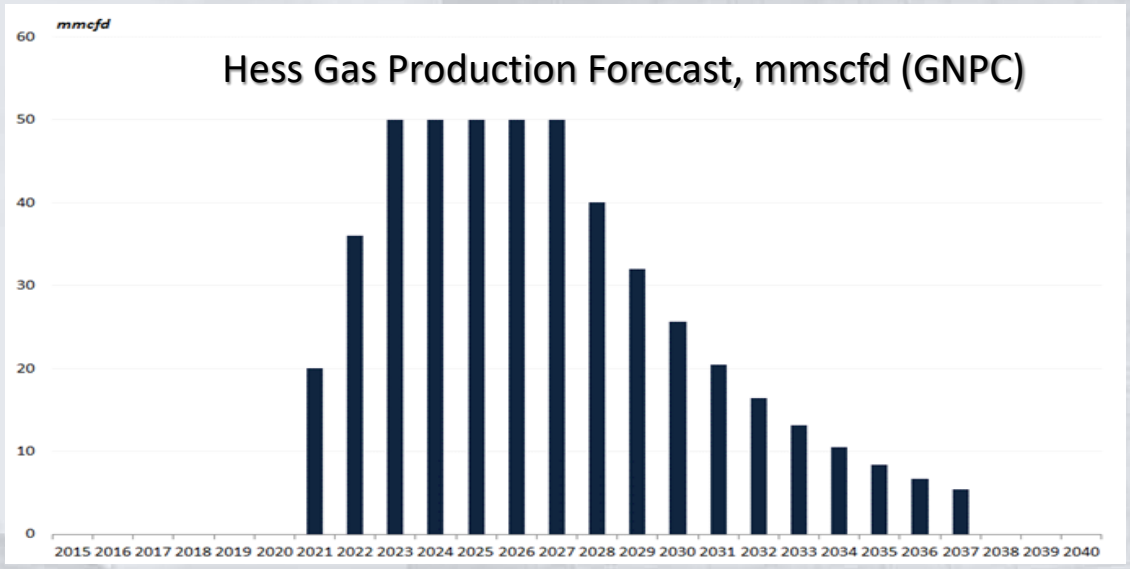
Greater Jubilee Full Field Gas Production, mmscfd (GNPC)



TEN Gas Production mmscfd (GNPC)

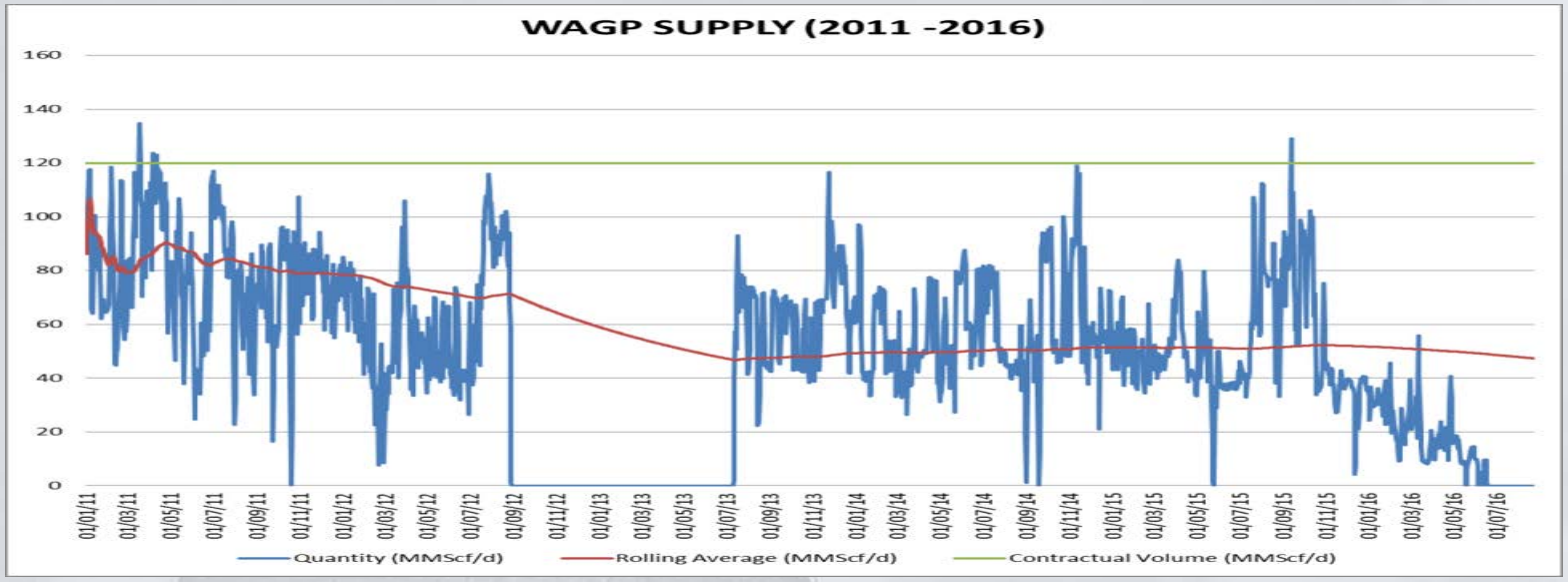


Sankofa and GyeNyame Gas Production mmscfd (GNPC)

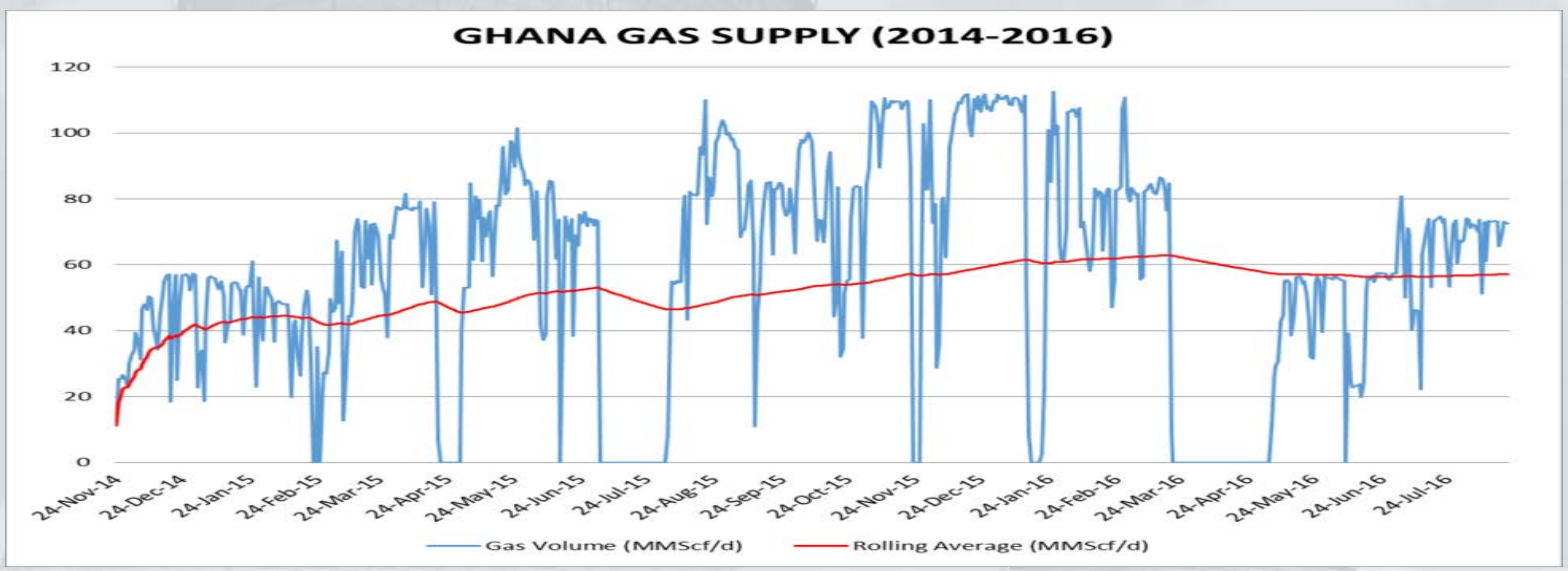


Hess Gas Production Forecast, mmscfd (GNPC)

Variability of Fuel Supply



VARIABILITY OF FUEL SUPPLY (Water & Gas) has been the biggest issue in VRA and the Ghana Power Sector

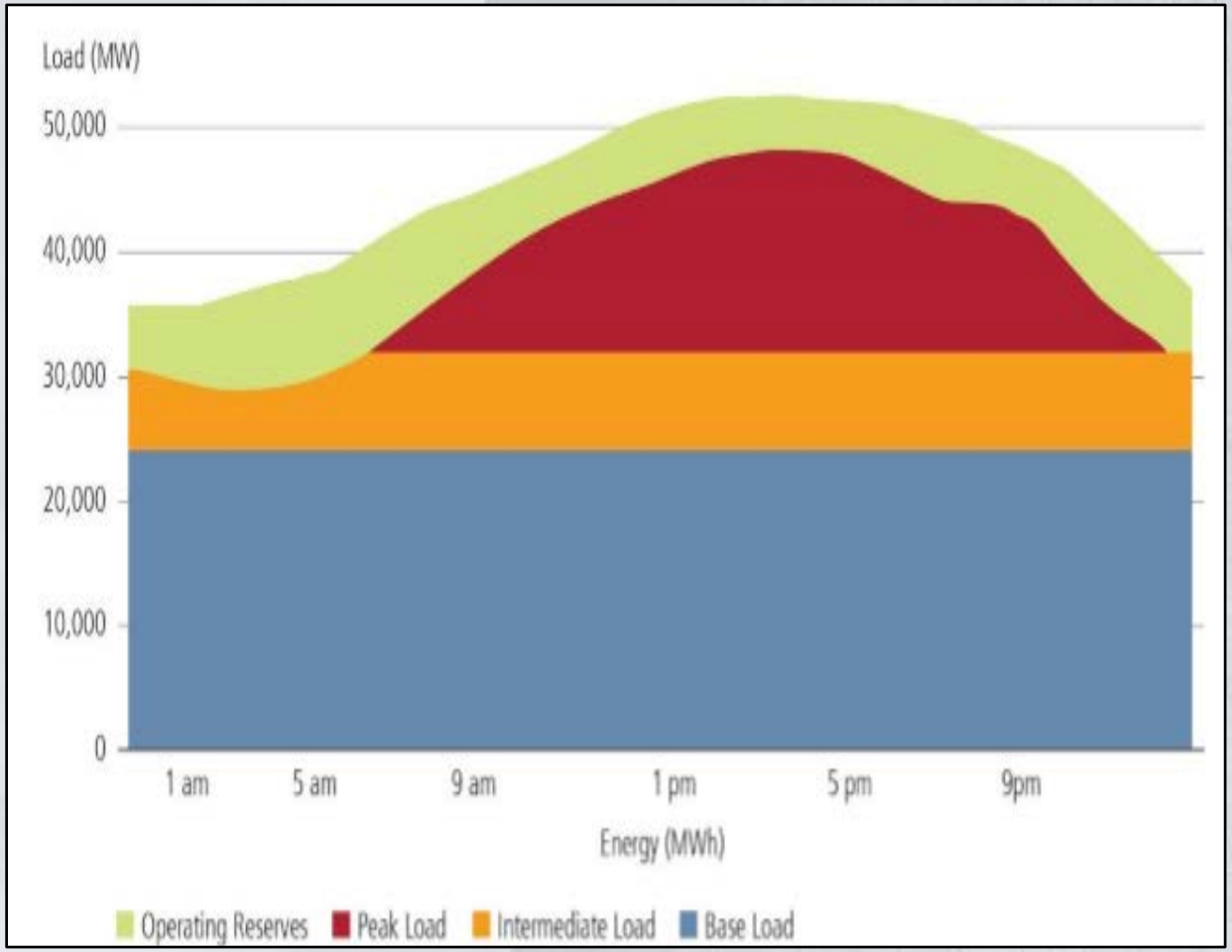


Long Term National Development Plan

- Energy Infrastructure Plan
- Objectives of the electricity infrastructure plan are:
  - Expand, modernise and maintain an electricity supply infrastructure, which ensures enhanced generation, transmission and distribution of electricity for domestic use and export;
  - Develop an optimal electricity generation mix, which can ensure security of electricity supply;
  - Exploit all fuels and develop an optimal fuel mix for electricity generation to ensure least-cost energy service delivery;
  - Promote efficiency along the electricity supply chain.
- Nuclear and Clean coal considered as the backbone to provide baseload power

Need of Base Load for Resilience & Reliability

- Baseload generation generally refers generation that provides for the minimum level of electricity that customers demand around the clock.
- Generally, in multi-source generation markets, coal, nuclear and to some extent gas powered plants fit into this category.
- Recent penetration of variable renewables into the US and European energy markets have resulted in the displacement and retirement of some base load plants.



Need of Base Load for Resilience & Reliability

- The recent August 2017 US Dept. of Energy Report on Electricity Market Reliability**, the US DOE has *stamped its feet* on the need to support traditional base load generation since it provides resilience and reliability in electricity supply.

- US electricity markets are now being asked to take up the challenge and see how to get this policy implemented in the US electricity market system.

- In developing the WAPP electricity market, a cue must be taken from this study to ensure that future long term planned generation gives enough room for traditional base load.

***Staff Report to the Secretary on Electricity Markets and Reliability, US Department of Energy, August 2017*

Sub-Regional Cooperation on NPP

- West African Integrated Nuclear Power Ministerial Conference and Technical Meeting held in Niamey from 20 - 24 July, 2015.
- Participating countries: Benin, Burkina Faso, Ghana, Mali, Nigeria, Senegal and Niger
- The Niamey Ministerial conference followed the recommendations of the Third African Conference on Energy and Nuclear Power held in Mombasa, Kenya from 13 - 15 April 2015, under the auspices of the IAEA.
- The objectives of the Niamey Conference were to:
  - inform and sensitize policy-makers on the requirements of a nuclear power programme.
  - define a possible strategic framework for sub-regional cooperation;
  - adopt an MOU and possible roadmap for a sub-regional programme;

Sub-Regional Cooperation on NPP

- Among others, the meeting concluded with the following:
  - A sub-regional programme should be autonomous with its own resources (financial, human and logistic) and should be implemented after the IAEA Milestone approach for the introduction of nuclear power.
  - A draft roadmap was prepared and adopted at the meeting and was to be submitted for review, approval by Member States.
- Although not much action has resulted from the meeting, countries such as Ghana and Nigeria are moving forward with their respective nuclear programmes.
- Although the efforts in Ghana and Nigeria are not regionally developed, it is expected that these efforts would support the entire sub-region through the WAPP backbone.
- The IAEA is therefore in talks with GNPPO to support Ghana host a possible sub-regional conference on an NPP – WAPP Grid Interconnectivity Conference in either 2018 or 2019.

Impact of NPP Integration into Grid Power System

- **Impacts & Safety Issues**
  - Regulation, Grid Planning, Business Case, Energy Market, Power Reserve.

- **Grid Development**
  - Transmission Capacity, Reinforcements, Interconnection Impacts, load dispatch ..

- **Compliance between Plant and Grid**
  - Minimizing plant adaptation costs versus considering grid code changes.

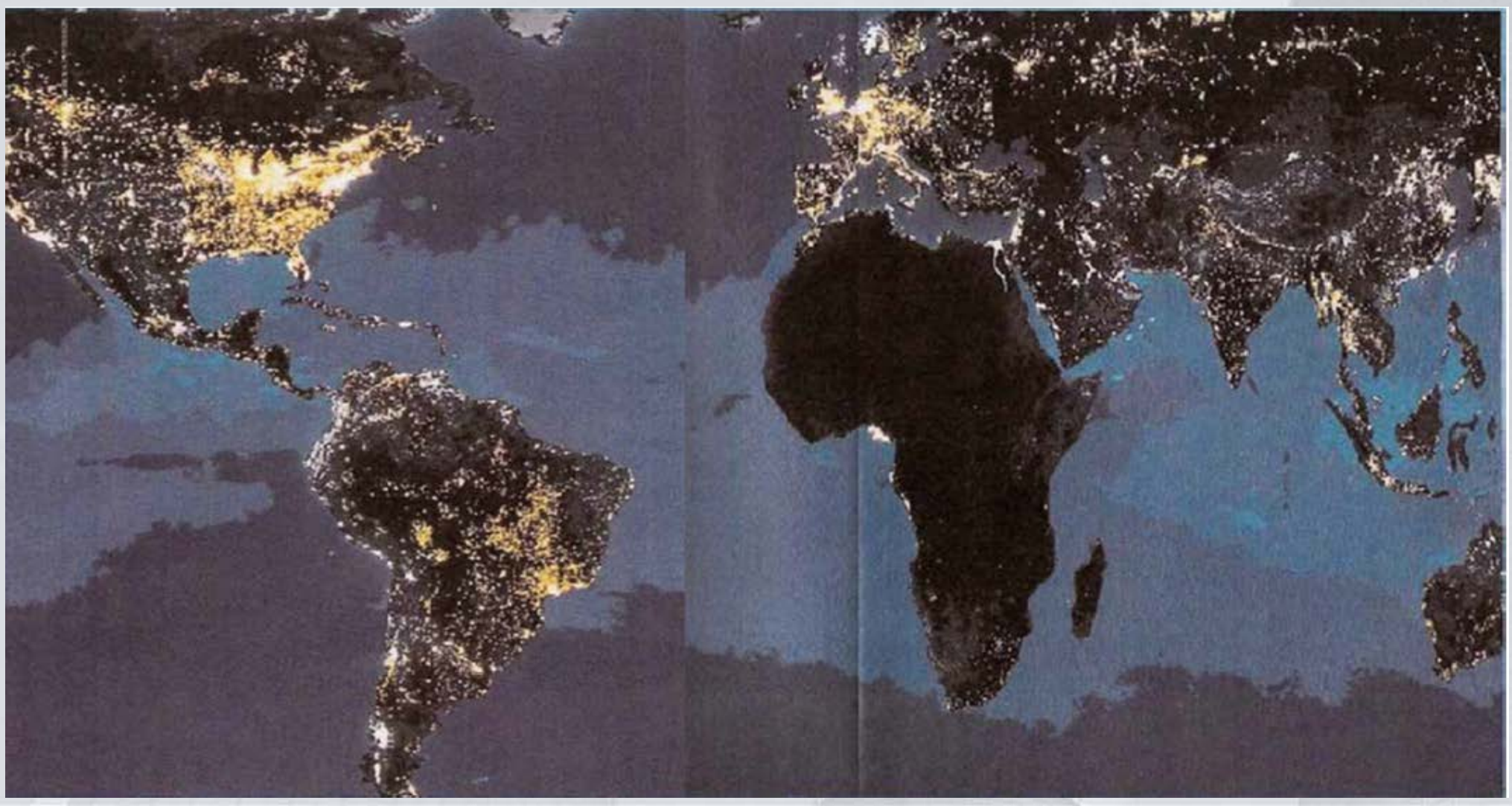
- **Site Connection**
  - Connection Conditions, Grid Operation Rules, Maintenance Scheduling.

Ghana NPP GRID Interaction Study

- The GNPPO has taken steps to initiate a detailed NPP grid interaction study as part of the work tasks required to meet the requirements of the IAEA Phase 1 Milestone.
- The objectives of the study are:
  - Preparations to be done by countries with small grids (such as Ghana) in expanding their electric grid by the addition of nuclear power plant;
  - Understand the special requirements of the NPP with regard to its grid connection;
  - Optimise grid impact on siting and size selection of Nuclear Power Plant unit capacity (including technical, economic and financial power systems expansion study).
- The GNPPO will later expand the Ghana study to the sub-regional grid (WAPP).
- We believe that among others, the WAPP secretariat should consider the integration of nuclear power into the WAPP as one of its priority projects.

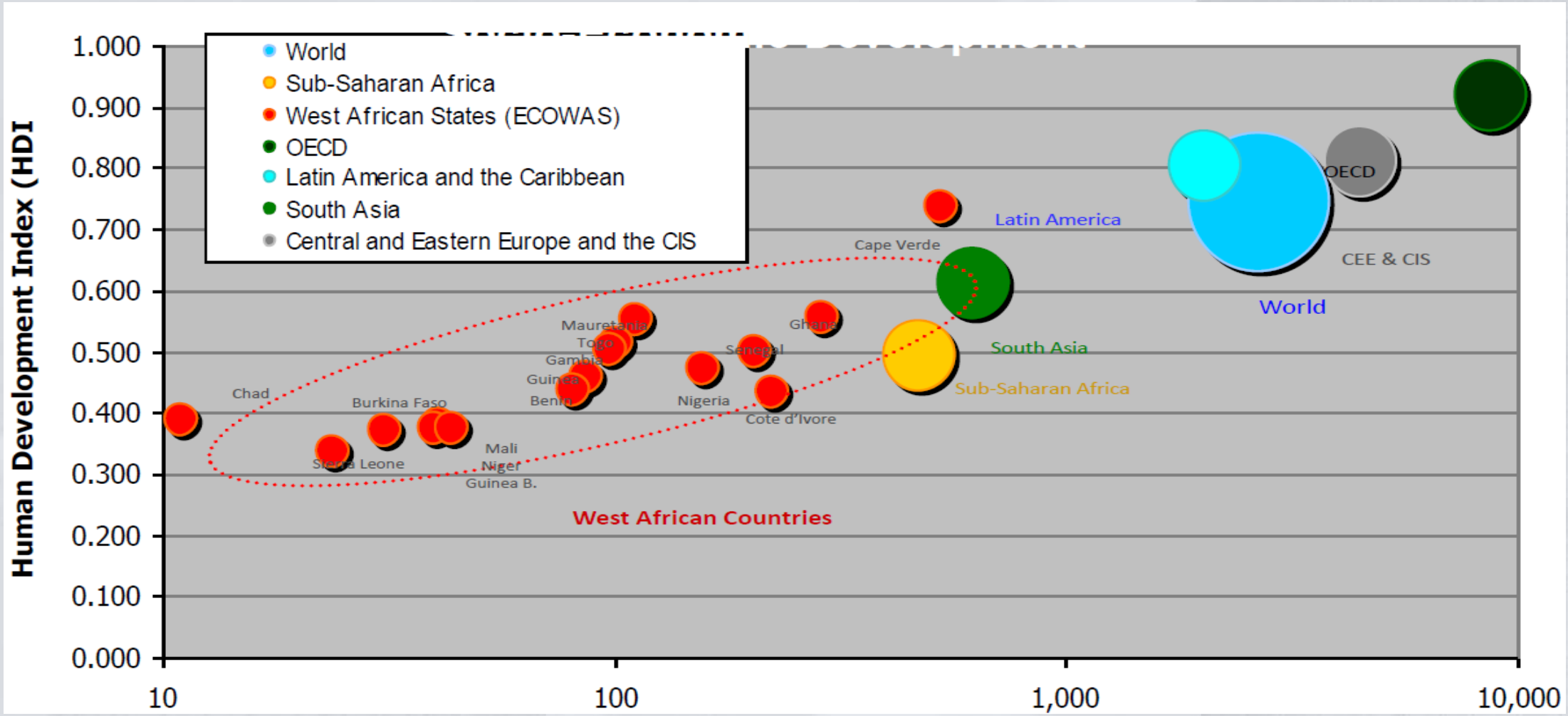
Concluding Remarks

Electrical illumination on Earth as seen from space.



Africa: the dark Continent - **WHY ??**

Concluding Remarks



Electricity Consumption per Capita (kWh) (log scale)

Source:- http://hdr.undp.org/en/

Concluding Remarks

"Electricity is the energy commodity that separates the developed countries from the rest. Countries that can provide cheap and reliable electric power to their citizens can grow their economies and create wealth. Those who can't, can't."

Robert Bryce (Power Hungry, 2010)

Thank you