

**MAMBILLA HYDROPOWER PROJECT:  
THE ENGINEERING  
AND  
ECONOMIC IMPACT  
FOR  
OUR RECOVERING ECONOMY**

**ENGR. IMO EKPO, FNSE, FNICE  
Hon. Vice President, Int. Commission on Large Dams (ICOLD)  
Principal Partner, Micek Consult Ltd**

# 1.0 INTRODUCTION

## Where is Mambilla Hydropower Project (MHPP) located

- ❑ Mambilla Hydropower Project (MHPP) is located on the Donga River near Gembu in Sarduana Local Government Area of Taraba State, North East Nigeria.
- ❑ The river Donga begins from the Mambilla plateau and forms part of the boundary between Nigeria and Cameroon.
- ❑ The project lies between longitude  $10^{\circ} 50^{\circ}\text{E}$  and  $11^{\circ} 38'$  and latitude  $6^{\circ} 22'$  N and  $7^{\circ} 18'$  N.

# 1.0 INTRODUCTION

- The project was studied at feasibility stage since 1985 by Diyam Consultants and Binnie and Partners and by Damtech with Laymeyer in 2006. Fig.1, shows the location of the project and other Green Field hydropower sites.(Lokoja, Makurdi, Katsina Ala etc).

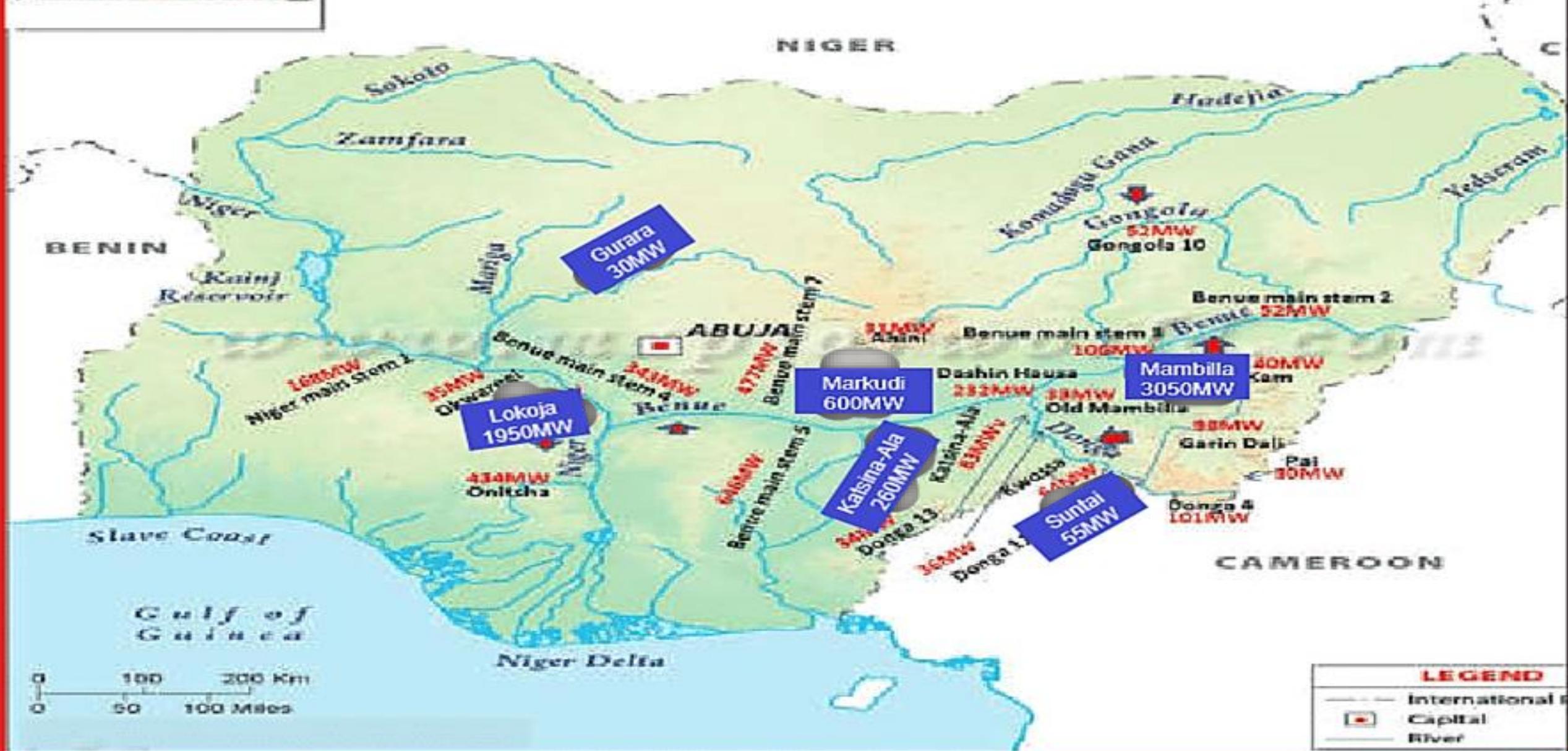


Fig 1. Map showing Mambilla Hydropower and other Large Green field Projects in Nigeria.

**Table 1:  
Identified Potential Hydropower sites for Investment  
(GREEN FIELDS)**



<b>S/NO</b>	<b>NAME OF PROJECT</b>	<b>NAME OF RIVER</b>	<b>STATE</b>	<b>PROJECTED POWER CAPACITY (MW)</b>
1	Mambilla	Donga	Taraba	3050
2	<i>Lokoja</i>	<i>Niger</i>	<i>Kogi</i>	<i>1950</i>
3	<i>Markurdi</i>	<i>Benue</i>	<i>Benue</i>	<i>600</i>
4	<i>Ikom</i>	<i>Cross River</i>	<i>Cross River</i>	<i>400</i>
5	Katsina-Ala	Katsina-Ala	Benue	260
6	Beli	Taraba	Taraba	240
7	Afikpo	Cross River	Ebonyi	180
8	Atan	Cross River	Cross River	180
9	Suntai	Donga	Taraba	55

## 1.1 *Recovering Economy*

### What do we mean by a Recovering Economy

- ❑ Before discussing the engineering and economic impact of Mambilla Hydropower Project, let us examine how suitable the project will be at a time like this when the Nigerian, or global economy is recovering.
- ❑ An economic recovery is described as the phase of the business cycle following a **recession**, during which an economy **regains** and exceeds peak employment and **output levels** prior to downturn

## 1.2 Global Economy

World bank did forecast that global economy will shrink by as much as 5.2% this year, 2020.

- ❑ This represent the deepest recession since the second World War
- ❑ The situation will tip millions of people into extreme poverty and lasting impacts on Human Capital Development.
- ❑ To ameliorate the situation, it is expected that various countries would examine areas of need but particularly address public health interventions, bolster economic activity, support businesses.
- ❑ In Nigeria, the projection is that the Covid-19 pandemic will also plunge the Nigerian economy into recession that would contract at about 3.2% in 2020. This will be the most severe downturn in Nigeria in four decades.

## 1.2 Global Economy

- ❑ Before the pandemic the economy in Nigeria was already showing reduction in growth by more than five percentage points.
- ❑ To recover from the Covid-19 Pandemic, Nigeria needs to stimulate economic activity, promote agribusiness for food security and job creation.
- ❑ This is where the construction of critical infrastructure like the Mambilla Hydropower Project is important.
- ❑ In the words of Dr. Prem Jagyasi, *“we still need to be inspired, despite the lockdown.”*

## **1.3 Primary Objectives of Mambilla Hydropower Project**

The primary objectives of the Mambilla Hydropower Project include the impact and importance of the project to the Nigerian economy, the objectives amongst others are: -

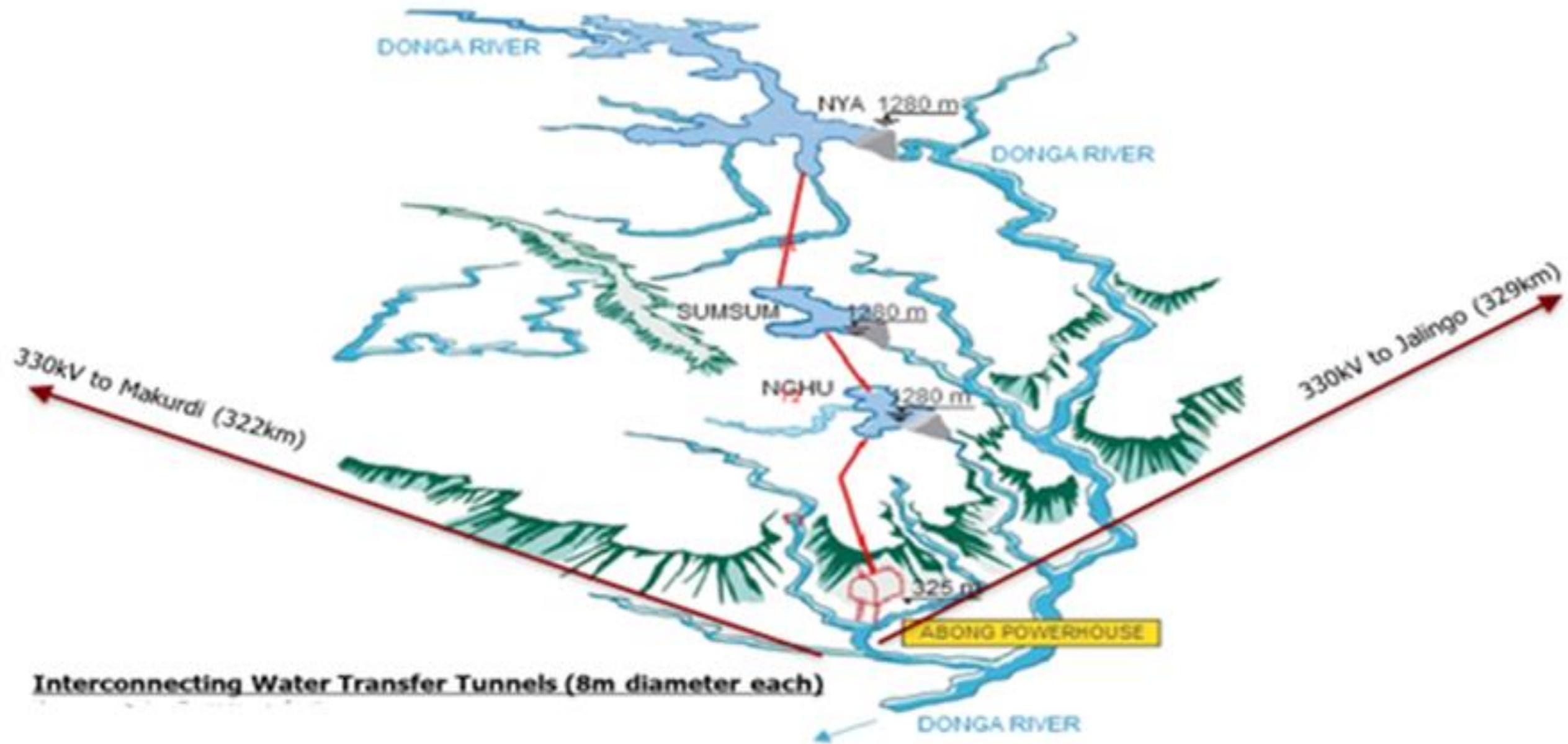
- ❑ Improvement of the socio-economic status of the nation and the project's immediate vicinity.
- ❑ Generation of employment opportunities.
- ❑ Harnessing tourism potentials of the area and development of industry.
- ❑ Development and enhancement of irrigation farming in the area especially tea cultivation.
- ❑ Generating 3050MW of power which adds to the national grid and boost the economy.
- ❑ Implementation of the Paris Agreement in mitigating Green House Gas (GHG) emissions through an increase in renewable source of energy (hydro) to boost economic activity.

## 1.4 Scope of Works

- ❑ Constitute the construction of four (4) large dams namely: Nya, Sumsum, Nghu & Api Weir.
- ❑ Underground water ways.
- ❑ Underground water transfer tunnels.
- ❑ Underground Power Complex

### Other Components

- ❑ Two (2) units of 330kv of 700km transmission lines, *Fig 2.*, to Makurdi and Jalingo.
- ❑ 120km of access roads connecting the project site and nearby communities and the resettlement of an estimated 100,000 impacted persons.



**Fig 2. 3,050mw Mambilla Project-Transmission Network**

## 1.5 Why the Renewed and Global Investments in Hydropower

- ❑ The global renewed focus now is on clean energy. Environmentally friendly, conducive to social harmony complies with the Sustainable Developmental Goals (SDGs).
- ❑ Among various types of energies, hydropower has **the highest Energy Pay back Ratio (EPR)**. The EPR of a power plant is defined as the total energy produced over the lifetime of the plant divided by the energy needed to build, operate, fuel and decommission it.
- ❑ Hydro storage provides back-up energy to intermittent energy sources such as wind power.
- ❑ The versatility of hydropower places it at the nexus of water and energy issues. It can play a key role in energy and water security.
- ❑ Generally, for countries with untapped resources, hydro offers to be the least-cost option for energy production.
- ❑ Investigations have found out that on purely economic terms, hydro continues to be of top priority against other renewable energies

## 1.6 Nigeria's Renewable Energy Plans

- ❑ Nigeria's renewable energy plan is captured in Nigeria's sustainable energy vision.
- ❑ The electricity supply situation in Nigeria and the energy mix is projected in 2030 as 30GW, a contribution of 30%.

## 2.0 THE ENGINEERING CONCEPT - PRELIMINARY DESIGN

- ❑ Mambilla Hydropower Project has a total installed capacity of 3,050mw from three reservoirs, Nya, Sumsum, and Nghu, which are under joint control and have a storage capacity of 1837 million m<sup>3</sup>, 168 million m<sup>3</sup>, and 156million m<sup>3</sup> respectively and 2161 million m<sup>3</sup>, in total.
- ❑ The three reservoirs are connected by tunnels, *Fig 3*.
- ❑ In the design, Mambilla Hydropower Project has an intake near the Nghu dam, where the powerhouse is linked by the penstock headrace system.
- ❑ The power flow passes through the turbines and is released into the tailrace channel and finally into the tributaries and branch channels via the Api regulating reservoir downstream.

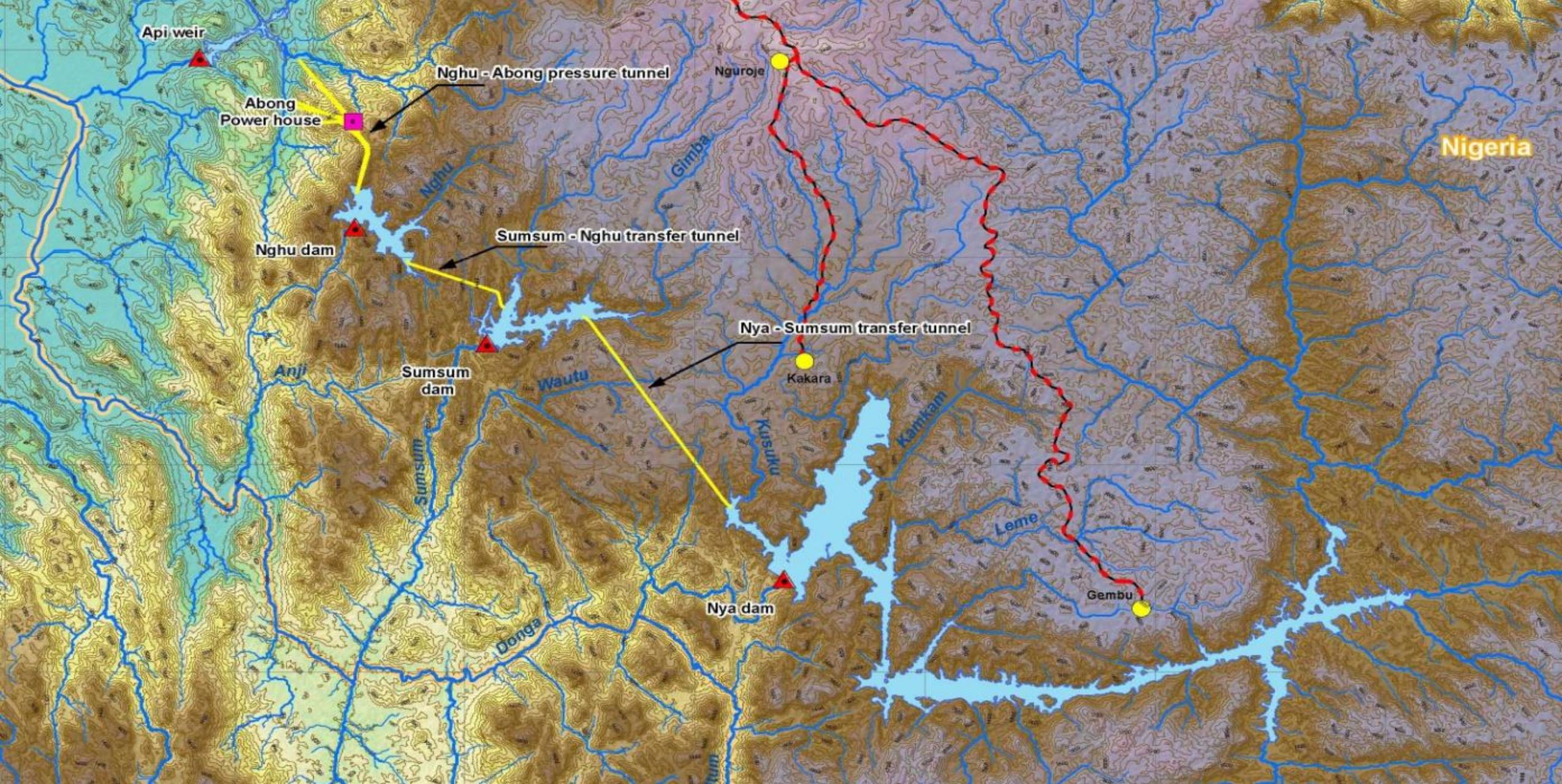
## 2.1 Main Tunnel Structures of MHPP Area

- ❑ Power house tunnel – length -197m, width – 25m.
- ❑ Main transformer - length – 178m, width -15.6m
- ❑ Bus tunnel, 6 no, approx. length – 40m. Arranged between the power house and main transformer tunnel.
- ❑ Power house access tunnel (2,86m) both outlet & air exhaust tunnel & air inlet tunnel (2419m)

***Fig 3.***

***Map showing Mambilla Hydropower location and tunnels***





## 2.2 Mambilla dam, an International Milestone Project in the Making

- ❑ Looking at the future, this century is likely to be characterized by rapid urbanization as well as increasing concerns about impacts of climate change. Accordingly, the role of dams and reservoirs will be fundamental.
- ❑ At a time like this, Mambilla project is coming up with new technology. Mambilla dam is to be Roller Compacted Concrete (RCC) dam, and an international milestone project, competing with dams like Three Gorges Dam (TGD) China, Hoover Dam (USA), or the Grand Ethiopian Renaissance Dam (GERD) on the Blue Nile (Ethiopia) with installed capacity of 6.45GW.

## 2.3 Update on Grand Renaissance Dam, Ethiopia in Africa

- ❑ Let's recall that the construction and recent filling of this dam by Ethiopia has created tension between Egypt and Sudan. Egypt is insisting on legally binding agreement over equitable allocation of the Nile waters.
- ❑ The on-going discussion center on economic growth, Hydropower development, irrigated agriculture and poverty alleviation.
- ❑ The construction of Mambilla Hydropower Project is virtually hitch free.

Below in *Table 2* are some of the economic impacts that the construction of Mambilla Hydropower Project will have on the economy of Nigeria, as compared to the Three Gorges Dam and the Hoover Dam.

## 2.4 Economic Impact of Mambilla Hydropower Project

### Table 2:

Comparison of Economic Impact of Mambilla Hydropower Project Vs Hoover Dam, USA and Three Gorges Dam, China



S/N	FEATURES	MAMBILLA DAM NIGERIA	HOOVER DAM USA	THREE GORGES DAM (TGD), CHINA
1	Location	Donga River on Sarduana LGA in Taraba State	Black Canyon on Colorado River at the border between Arizona and Nevada, USA	Xiling Gorge on the Yangtze River in Yiling district, Hubei province, China
2	Date/Duration	2020? (5 years Duration)	Started (1931)- Completed (1936) 5 years	17 years Phase 1 = 1993 -1997 Phase 2 = 1998 -2003 Phase 3 = 2004 - 2009
3	Generation Capacity (MW)	3,050 MW	15, 000 MW (Stimulate economy attract investment)	22,500MW from 32 turbine generator units
4	Tunnels	3 major tunnels and 2 minors.	4 major tunnels (about 16000 feet) 2 on the Nevada side and 2 on the Arizona side	The Shanghai river tunnel (8,950m) Nanjing Yangtze river tunnel (7,014m)



5	Irrigation	The highland is home to Nigeria and West Africa's only highland tea plantations located at kakara town. Promotion of economic growth and industrial development. Job creation.	Farmers received dependable source of water to Nevada, Arizona, California, Los Angeles, San Diego and Phoenix	Dam provides more than 11km <sup>3</sup> of fresh water to downstream cities and farms during dry season
6	Flood Control	To reduce sedimentation	Reduction of the sediments from 125m tons of suspended sediment to the delta.	Protected flood in major cities of Wuhan, Nanjing and Shanghai. Total reservoir flood capacity is 22 cubic kilometers



7	Water Supply	Supply water to numerous towns ranging from over 2,000 to 20,000 people in Leme, Kabri, Vakude, etc.	Supply water to California and Las Vegas. Revenue to be used in funding more water projects	Since filling the dam in 2003, Three Gorges Dam has supplied an extra 11km <sup>3</sup> of fresh water to downstream cities and farms during the dry season
8	Tourism	Promotion of the Gashaka/Gumti Game Reserve. Boat ride, Hotel tourism. Leisure stimulated by temperate weather.	\$ 12-15/person for 30mins of power plant tour, while \$30/person for 1 hour Hoover dam tour	Statistics shows that the Yangtze river of three Gorges dam project received about 330millions yearly since 2016 and generating 274.8 billion Yuan in tourism revenue. In 2015, revenue in tourism was about 23 billion Yuan (about 3.5 billion USD)
9	Concrete	31,240,000 bags of cement, 18,981,000 tonnes of aggregate gravels, granite and 42,000 tonnes of steel	4,360,000 cubic yards of concrete in the dam, power plant and appurtenant works	Total concrete placement in the TGP construction is 28 X 10 <sup>6</sup> m <sup>3</sup> of strict quality requirement and 463,000 tonnes of steel (enough to build 63 no. Eiffel tower in France).

## **Note:**

We cannot over emphasize the role of professionals especially various cadre of engineers in the project.

## 3.0 WAY FORWARD

- ❑ This is the time to encourage hydropower development, both large and small.
- ❑ Plants with installed capacity of 10MW or less, preferable to be considered.
- ❑ Use of low head and run-of-the river technologies.
- ❑ Over dependence on subsidized oil and gas as primary energy sources has over the years slowed down the development of renewable energy.
- ❑ Diversification to achieve a wider energy supply mix that will ensure greater energy security for the nation.
- ❑ Public Private Partnership in the sector recommended.
- ❑ Promotion of homegrown technology in planning, design construction, turbine manufacturing and management as in Norway is recommended in these days of global recession.

# CONCLUSION

- ❑ Reviewing the past and looking ahead to the future, the stage is set for government to evolve greater political will and commitment to invest in the power sector in general and hydropower in particular.
- ❑ At this time when government is making effort to recover the economy, the construction of Mambilla dam is imperative.
- ❑ Capital expenditure in hydropower sector will help to strengthen macro-economic resilience while building and accelerating economic growth.

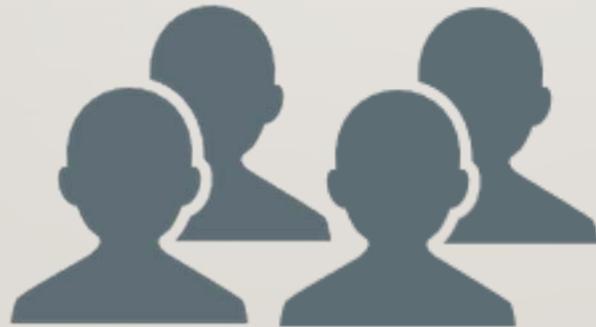


My parting statement is quotation by ***Dr. Prem Jagyasi***

***“Today’s crises are tomorrow’s stories, and its your story. Decide what acts you wish to portray.”***



**THANK YOU**



# REFERENCES

- I. Overview of Activities in Dams and Hydropower Development in Nigeria: Engr. Imo Ekpo: African Union Congress Centre, Ethiopia 16-18 April, 2013.
- II. National Renewable Energy and Energy Efficiency Policy (NREEEP). Approved by Federal Executive Council for Electricity Sector, 20<sup>th</sup> April, 2015.
- III. Detailed engineering design and project management of the proposed Mambilla Hydro-electric Power Project by; Tractebal Engineering, Decrown (W.A) Co Ltd, Coyne et Bellier and Water & Dam Services Company, 22<sup>nd</sup> August December 2012.
- IV. World Bank Africa Overview, 2020, [www.worldbank.org](http://www.worldbank.org)
- V. Impact of the Mambilla 3050 Hydropower Project on the Nigerian Economy, Engr. Imo Ekpo. Technical Paper to Bwari Branch, NSE. November 2018.
- VI. Government's Policies and Plans for Renewable Energy in Nigeria by Faruk Yabo. The Consulting Engineer, ACEN, Renewable Engr., 2018
- VII. Nigeria SE for All, Action Agenda, NACOP/ICREE, 2016: <http://power.gov.ng/s>