NIGERIAN ELECTRICITY REGULATORY COMMISSION

MULTI-YEAR TARIFF ORDER

FOR THE DETERMINATION OF THE COST OF ELECTRICITY GENERATION

FOR THE PERIOD 1 JUNE 2012 TO 31 MAY 2017

Nigerian Electricity Regulatory Commission

1ST JUNE 2012

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Glossary of Terms

ARR	Annual Revenue Requirement
BPE	Bureau of Public Enterprises
Capex	Capital expenditure
CAPM	Capital Asset Pricing Model
CCGT	Combined Cycle Gas Turbine
CPI	Consumer Price Index
DISCO	Distribution company
DUOS	Distribution Use of Service
EPC	Engineering, Procurement and Construction
EPSRA	Electric Power Sector Reform Act
FGN	Federal Government of Nigeria
GENCO	Generation Company
IFC	International Finance Corporation
IMF	International Monetary Fund
IPP	Independent Power Producer
KWh	Kilo Watt hours of electrical energy
LRMC	Long Run Marginal Cost
MAR	Maximum Allowable Revenue
MDAs	Ministries, Departments and Agencies of the FGN
MLF	Marginal Loss Factor
MMBTU	Million Metric British Thermal Units
MO	Market Operator
MWh	Mega Watt hours of electrical energy
MYTO	Multi-Year Tariff Order
N/KWh	Naira per Kilo Watt Hour of electrical energy

NBET	Nigerian Bulk Electricity Trading Company
NELMCO	Nigerian Electricity Liability Management Company
NEPP	National Electric Power Policy
NERA	National Economic Research Associates
NERC	Nigerian Electricity Regulatory Commission
NESI	Nigerian Electricity Supply Industry
NTB	Nigerian Treasury Bonds
NUT	National Uniform Tariff
OCGT	Open Cycle Gas Turbine
ODRC	Optimised Depreciated Replacement Cost
O&M	Operations & Maintenance
Opex	Operating expenditure
PHCN	Power Holding Company Of Nigeria
PI	Price Index
PPA	Power Purchase Agreement
RAB	Regulatory Asset Base
ROE	Return on Equity
ROT	Rehabilitate, Operate, and Transfer
SO	System Operator
SPE	Special Purpose Entity
SPV	Special Purpose Vehicle
TSO	Transmission System Operation
TCN	Transmission Company Of Nigeria
TUOS	Transmission Use of System
WACC	Weighted Average Cost of Capital

ORDER NO: NERC/GL115

ORDER on the establishment of a Generation Tariff

PART ONE

The Nigerian Electricity Regulatory Commission (NERC) is Nigeria's independent regulatory agency for the NESI established by the Electric Power Sector Reform Act (EPSRA) 2005. NERC was officially inaugurated on 31st October 2005.

The Act provides the legal and regulatory framework for the electricity supply industry in Nigeria. It empowers NERC to regulate the Nigerian Electricity Supply Industry (NESI), comprising the Generation, Transmission, System Operations and Distribution/Retail sectors.

One of the primary functions of NERC as contained in Section 32(d) of the EPSRA is "to ensure that the prices charged by licensees are fair to consumers, and are sufficient to allow the licensees to finance their activities and to allow for reasonable earnings for efficient operation." Section 76 of the EPSRA further empowers NERC to establish one or more tariff methodologies for regulating electricity prices.

In its effort to provide a viable and robust tariff policy for the Nigerian Electricity Supply Industry (NESI), NERC in 2008 decided to introduce a Multi-Year Tariff Order (MYTO) as the framework for determining the industry pricing structure. The MYTO methodology established and lays out the process to be followed in meeting the statutory obligation in Section 76 of the EPSRA. It provides a fifteen (15)-year tariff path for the electricity industry with minor and major reviews bi-annually and every five years respectively.

In consultation with industry stakeholders and consumers, NERC adopted a holistic and scientific approach to balancing electricity tariffs to ensure a fair and cost-reflective tariff regime capable of sustaining the NESI while at the same time attract investment into the sector; all of which are non-negotiable enablers for driving socio-economic development across the country. The key principles of cost reflectivity and affordability were taken into consideration in evolving the new tariff regime. The MYTO further assumes a continuous reduction in transmission and

distribution/retail losses, which remain unacceptably high. Revenue earned by operators is made dependent on achieving these performance improvements.

The process for adoption of this methodology was transparent, as consultations took place with government, consumers, customer groups, other major stakeholders and industry practitioners. Their contributions to the proposed methodology were at various public fora and/or through written representations.

There are three separate Tariff Orders; one for each of the sectors in the NESI namely: generation, transmission and distribution/retail. This Generation Tariff Order is divided into two parts; this Part One, which is the proclamation of the Order; and Part Two, which presents the basis of the Order. Part Two is further divided into eight sections - the Introduction, Legal and Regulatory Framework, Pricing Principles, Technical Assumptions for the Determination of the LRMC for the 2012 Tariff Order, Economic and Financial Assumptions for the 2012 Tariff Order, Generation Tariffs for Various Fuel Sources, Bi-Annual Review, and the Effective Date.

Accordingly, by virtue of the powers conferred by S. 76 of the EPSRA, NERC hereby, makes the following **ORDER**:

1. The Tables for the Generation Tariff shown herein set out the wholesale electricity generation prices that shall come into effect as from midnight on 31st May, 2012 and continue in force until midnight on 31st May 2017 shall be as shown herein below, subject to the provisions of this Order.

2. Upon coming into effect, the said Charges shall continue in force subject to such minor and major reviews as NERC may hold from time to time.

3. This Order shall be called the Nigerian Electricity Generation Charges Multi-Year Tariff Order, 2012.

PART TWO

1 Introduction

By this Multi-Year Tariff Order 2 (MYTO 2), NERC establishes the regulated prices to be paid to licensed electricity generation companies (Gencos) in providing electricity to distribution and retailing companies (Discos) for the period 1st June, 2012 to 31st May, 2017, pursuant to the authority given under Section 76 of the Electric Power Sector Reform Act 2005 (the Act).

These retail tariff schedules will be reviewed bi-annually and changes may be made thereto if any or all of the generation wholesale contract price, the Nigerian inflation rate, US$ exchange rate, daily generation capacity and accompanying capex, and opex requirements have varied materially from that used in the calculation of the tariff. A material variation for this purpose is defined as a price variation of plus or minus five per cent (+/- 5%) in any of these indices. A review of all inputs to the tariff calculation will commence in 2016 as the basis for a new Multi-Year Tariff Order (MYTO) to commence for 5 years from 1st June 2017.

1.1 Background

NERC is an independent regulatory agency established by the EPSRA, and was officially inaugurated on 31st October, 2005. The EPSRA provides the legal and regulatory framework for the entire NESI, and empowers the NERC to undertake technical and economic regulation.

The various challenges that the Industry must contend with may be summarised as follows:

- Acute shortage of generation capacity;
- Acute shortage of natural gas;
- Transmission constraints and inadequacies;
- Lack of private sector participation;
- Inadequate generation mix e.g. solar, wind, coal, etc;
- Unacceptable technical and non-technical loss levels; and
- Unacceptably high payment or credit risk in the distribution sector.

The establishment of NERC was the direct result of a genuine desire to transform the electricity supply industry into a market-based industry, in line with the Federal Government's reform agenda for the country's economic, industrial and social development. Thus, the NERC was established to facilitate the introduction and management of competitive, safe, reliable and fairly-priced electricity in the country. Pursuant to the above, the objectives of the NERC include:

- To create, promote, and preserve efficient industry and market structures, and to ensure the optimal utilisation of resources for the provision of electricity services;
- To maximize access to electricity services, by promoting and facilitating consumer connections to distribution systems in both rural and urban areas;
- To ensure that an adequate supply of electricity is available to consumers;
- To ensure that the prices charged by licensees are fair to consumers and are sufficient to allow the licensees to finance their activities and to allow for reasonable earnings for efficient operation;
- To ensure the safety, security, reliability and quality of service in the production and delivery of electricity to consumers;
- To ensure that Regulation is fair and balanced for licensees, consumers, investors and other stakeholders.

In its effort to provide a viable and robust tariff policy to support the long-term viability of the NESI, the NERC in 2008 decided to introduce a Multi Year Tariff Methodology as the framework for determining the industry's pricing structure. The MYTO Methodology establishes and lays out the process to be followed in meeting the statutory obligation in S.76, EPSRA. It provides a fifteen (15)-year tariff path for the electricity industry with bi-annual minor reviews and major review every five years.

This is the second Tariff Order issued by NERC and it is for the period 1 June 2012 to 31 May 2017. Two other Tariff Orders are being issued concurrently to cover generation prices in wholesale contracts and transmission tariff/institutional charges respectively. The MYTO regulatory model depends on data received from market participants. Institutions within the NESI have supplied estimates and forecasts upon which the industry costs and tariffs developed in the MYTO financial model are based. NERC is conscious that the NESI must evolve to meet the demands placed upon it. The data inputs and estimates underlying the MYTO will be reviewed periodically to ensure they remain current.

Following the procedures set out in Section 76, EPSRA, the NERC has published the MYTO Methodology upon which both MYTO 1 and 2 are based – see www.nercng.org. In describing its methodology the NERC noted that it had adopted three basic principles. These principles require that a regulatory methodology:

- produces outcomes that are fair;
- encourages outcomes that are efficient in that it involves the lowest possible costs and encourages investment in electricity generation; and
- is simple, transparent and devoid of excessive regulatory costs.

In establishing MYTO 2, the NERC has sought to apply these principles more precisely in order to produce tariffs that incentivise the NESI to attain standards of

performance set by NERC to produce the positive outcomes mandated in Section 32(1) of EPSRA.

NERC's recent major review highlighted the need for an amendment to the existing assumptions and so a "Notice of Proposed Change to the Multi-Year Tariff Methodology" was published, explaining the need to adjust the existing methodology. There were two (2) major changes expected to be made to the existing methodology and were brought about by:

- the need to be more flexible in wholesale generation pricing; and
- the need to consider a number of other essential variables during the minor reviews.

1.2 Insight into 2008 Multi Year Tariff Order

The 2008 MYTO was based on the new entrant cost profile for generation companies and the building block approach to electricity pricing of transmission and distribution services, all based upon a set of pricing principles and cost assumptions. The ultimate objective is to provide the industry with a stable and cost-reflective pricing structure that provides a modest return on investment to efficient industry operators. At the same time the tariff will protect consumers against excessive pricing, since the price is set at the entry level of the most efficient generation company.

The MYTO provided a fifteen (15) year tariff path and allowed for annual minor reviews and a major review no more than five years apart so as to keep the tariffs in line with current market prices. The minor reviews only take into consideration four variables, namely:

1. Rate of inflation,
2. Gas prices, and
3. Foreign exchange rates
4. Actual daily generation capacity

The major reviews involve a comprehensive review and overhaul of all the assumptions in the MYTO model. During the minor review of MYTO in May 2009, Successor Discos requested that the major review of MYTO scheduled for 2013 be brought forward in order to take care of the increasing cost of power, the rising cost of O&M expenses, and also because of their declining revenue due to the absence of the growth in generation capacity envisaged in the 2008 Tariff Order. The NERC after due consideration of this request, brought forward the major review of the MYTO.

This major review afforded stakeholders the opportunity to evaluate the methodology, make inputs to the existing model, incorporate Feed-In Tariffs (FITs) for renewable energy (wind, biomass, solar and small hydro) and also develop tariffs for generation using coal. Some of the assumptions reviewed include:

- Available generation capacity;
- Forecast of electricity demand;
- Expansion of the transmission and distribution networks;
- Capital expenditure (capex);
- Actual and projected sales;
- Operating costs (opex);
- Fuel costs;
- Interest rates;
- Weighted average cost of capital (WACC);
- Revenue collection efficiencies; and
- Subsidies.

Having concluded that establishing a cost-reflective tariff would ordinarily lead to a general increase in tariffs across all classes; and in order to avoid the effects of a rate shock on more vulnerable consumers, the tariffs paid by certain classes consumers will be less than cost-reflective values over the first two years, up to June 2014, following the introduction of MYTO 2. In this vein, FGN support will be provided in the form of a subsidy to make up the shortfall between actual and cost-reflective tariffs over this period, while the tariff moves gradually towards viable levels.

Unlike before, this will be enjoyed only by the tariff classes that genuinely need support. The removal of the subsidy over a period of time is expected to lessen the burden on consumers while allowing them to adjust to the new price level. The Federal Government subsidy is intended to exit when power availability increases enough to enable a further rebalancing of tariffs. This rebalancing will be such that the NESI is left with only a cross-subsidy scheme established within the framework of the Power Consumer Assistance Fund (PCAF), as mandated by Part VIII (Sections 83 – 87) of the EPSRA.

1.3 Electricity Pricing in Nigeria

In Nigeria, the true cost of electricity production is not reflected in the consumer tariff. MYTO 2 is intended to be cost-reflective and provide financial incentives for urgently-needed increased investments in the industry. These investments, in turn, lead to a significant and continuous improvement in the quantity of energy and quality of service enjoyed by the consumer.

NERC has since September 2010 carried out wide consultations with the industry operators, consumer advocacy groups, the legislature and relevant MDAs on both the MYTO methodology and tariff. (See Appendix 1 for the list of stakeholders consulted).

1.4 Rationale for Tariff Review

Electricity is similar to any other manufactured product. Its cost of production is made up of the cost of inputs such as fuel (e.g. natural gas), and capital items such as turbines, cables, switchyards and switching equipment, communication and data acquisition equipment, transformers, and meters. The industry is highly capital intensive and electrical plant and equipment usually have a long technical and economic life, and to complete a project takes a considerable amount of planning, time and effort. Electricity differs from other products in that it cannot be economically stored as it is produced. The implication of instantaneous supply and consumption is that price has to be sufficient to cover the cost of production, otherwise supply will be jeopardised.

If electricity is under-priced then supply will not meet demand. At the moment in Nigeria there is a very high level of unsatisfied demand for electricity due, in part, to the historical under-pricing of electricity. One indicator of this is the extensive use of diesel generators which typically produce electricity at price levels that are much higher than the price of grid electricity.

It is imperative that electricity should be priced properly such that it covers its supply costs, in order for adequate and reliable electricity is to be produced to meet demand. As with any other product, its price must, at the minimum, cover the operating and capital costs. If the price is at a sufficient level to ensure a reasonable return on investment, it will keep the current producers, and also attract new producers. At present the revenue from electricity tariffs covers about half of the revenue required to achieve a viable and growing electricity sector. In other words, the tariffs currently set for the industry can barely fund routine activities and certainly cannot provide for investment in new generation, transmission and distribution infrastructure.

MYTO 2 is intended purely to facilitate the Industry's successful passage through this period of significant reform, performance improvement and growth. It will:

- Allow for the recovery of appropriate reasonable return on capital invested, depreciation (and replacement) of capital and recovery of fuel, operation, maintenance and overhead costs;
- Provide an incentive for new investment in capital equipment;
- Provide incentives for reducing technical, and commercial losses;

- Provide viable and transparent tariff methodology that will allow NESI's progress towards a reformed and market-oriented system in which generation and retail activities are not subject to price regulation while the monopoly activities of transmission and distribution continue to be under price regulation; and
- Finally, ensure that the benefits of a reformed NESI are passed through to consumers in the form of reliable electricity supply at the lowest possible price consistent with the above objectives.

The NESI will, as it grows and evolves during the coming years, move to a market-based system whereby generators and electricity retailers will be free to contract with each other for the supply of electricity. Transmission and distribution will remain regulated.

2 Legal and Regulatory Framework

The establishment of NERC was the direct result of a genuine desire to transform the NESI into a market-based industry. Thus, NERC was established to facilitate the introduction and management of competition in the country's electricity supply industry.

Pursuant to the above, the objects of NERC include:

I. To create, promote, and preserve efficient **industry and market structures**, and to ensure the optimal utilization of resources for the provision of electricity services;
II. To maximize **access** to electricity services, by promoting and facilitating consumer connections to distribution systems in both rural and urban areas;
III. To ensure that an **adequate supply of electricity** is available to consumers;
IV. To ensure that the **prices** charged by licensees **are fair** to consumers and are sufficient to allow the licensees to finance their activities and to allow for **reasonable earnings** for efficient operation.

Section 76(1) of the Act subjects the following activities to tariff regulation:

(a) Generation and trading, in respect of which licences are required pursuant to this Act, and where the NERC considers regulation of prices necessary to prevent abuse of market power; and

(b) Transmission, distribution and system operation, in respect of which licences are required under this Act.

Section 76(2) provides for the NERC to adopt appropriate tariff methodology within the general principles established in the Act, which:

- Allows recovery of efficient cost including a reasonable rate of return;
- Gives incentives to improve efficiency and quality;
- Sends efficient signals to customers on costs they impose on the system; and
- Phases out or reduces cross subsidies.

This Tariff Order (MYTO 2) is based on a set of principles designed to provide tariffs for each of the generation, transmission, and distribution (including retail) sectors (reference Section 1.4 above):

- **Cost recovery/financial viability** – regulated entities should be permitted to recover their "efficient" costs, including a reasonable rate of return on capital.

- **Signals for investment** – prices should encourage an efficient level and nature of investment (e.g., location) in the industry.
- **Certainty and stability** – Confidence in a pricing framework is also important for private sector investment.
- **Efficient use of the network** – Generally, this requires "efficient" prices that reflect the marginal costs that users impose on the system and the reduction of cross-subsidies.
- **Allocation of risk** – pricing arrangements should allocate risks efficiently (generally to those who are best placed to manage them).
- **Simplicity and cost-effectiveness** – the tariff structure and regulatory system should be easy to understand, and not excessively costly to implement (e.g., facilitate metering and billing).
- **Incentives for improving performance** – the way in which prices are regulated should give appropriate incentives for operators to reduce costs and increase quality of service.
- **Transparency/fairness** – prices should be non-discriminatory and transparent, as non-discriminatory access to monopoly networks is also a key pre-requisite for effective competition in the contestable sectors.
- **Flexibility/robustness** – the pricing framework needs to be able to cater for unforeseen changes in circumstances.
- **Social and political objectives** – the pricing framework needs to provide for the achievement of social policy goals such as universal access, demand-side management, and user affordability.

3 Pricing Principles

Section 3 of the MYTO Methodology states that "The main objective in setting bulk electricity prices in vesting contracts are to cover the costs of existing plant and allow for their efficient maintenance and on-going investment programs while ensuring that an appropriate price for bulk electricity supplied by generators under vesting contracts is the unit price an efficient new plant would require in the Nigerian Electricity Supply Industry (NESI)." The strategy for managing the transition to a competitive wholesale market includes the use of vesting contracts for generators.

Wholesale contract prices offer the prospect of some certainty about cash flows during the transition towards a competitive market. The method to be used here is the Long Run Marginal Cost (LRMC) method. LRMC involves calculating the full life cycle cost of the lowest-efficient-cost new entrant generator, taking into account current costs of plant and equipment, return on capital, operation and maintenance, fuel costs, etc. In this Order, LRMC is applied in two ways:

- Benchmark costing: Creates a proxy for the market price which an efficient generator is expected to operate below.

- Individual long run marginal cost for each generator: This sets prices for each generator according to its plant and site specific costs.

NERC has determined that the price of electricity to be paid to generators will be at the level required by an efficient new entrant to cover its life cycle costs (including its short run fuel and operating costs and its long run return on capital invested). In a market such as the NESI, where demand is in excess of supply, the price of electricity should be at the price required to encourage operators who have already invested into the market, and also attract new entrant investors.

The two methods above will be utilised by the NERC. The classic LRMC applies to the successor Gencos, as set out in the 2008 Tariff Order, in which the long-run marginal cost of an OCGT plant will be calculated for the successor Gencos by the NERC. The individual (site-specific) LRMC model requires each new entrant IPP that requires a tariff beyond the MYTO benchmark to apply to the NERC for approval. In such case, the IPP will open its plans, accounts and financial model to scrutiny by the NERC, which will then apply prudence and relevance tests to determine whether such plant- and site-specific costs should be allowed in the tariff. It is pertinent to note that feed-in tariffs have been developed for investors wishing to invest in generation capacity that utilises other sources of energy including solar, wind, biomass and small hydro.

For the time being, the NERC has determined that the lowest cost new entrant generator is an open-cycle gas turbine (OCGT) using natural gas. Most new power

stations completed or under construction are currently open cycle gas turbines. Given the current price of gas used for electricity generation in Nigeria, this form of generation technology produces electricity at a lower life cycle cost than combined-cycle gas turbines, and at a lower cost than coal-fired generation. However, it is anticipated that the gas price will become market-based in the near future, and CCGT is likely to emerge as the benchmark for a lowest-cost new entrant generator. Then, the NERC will review the generation pricing methodology accordingly.

It is to be noted that when the Nigerian electricity market evolves to a point where bilateral contracts are signed between generators and distributors, this LRMC will determine the price set in wholesale contracts. Such bilateral contracts will be executed via the procurement framework now being developed by the NERC. At this point, the wholesale price for each site procured by a Disco or by the Bulk Trader will be the lowest price bid for that site. That lowest price will be the price set in the PPA awarded by the procuring entity.

The selection of OCGT as the lowest price new entrant is in recognition of the fact that natural gas is the most abundant and environmentally-appropriate fuel in Nigeria, and therefore that which gives Nigerian generators the greatest competitive advantage. New entrants, particularly in a number of locations where natural gas is not most efficient fuel available, are entitled to submit bids for generating plant using the most efficient fuel for that particular site.

The estimation of the generation costs of an open cycle gas turbine power station in Nigeria is based on the estimation of the price required, over the life of such a generation project to pay all of its component costs, including fuel, operation and maintenance, tax and a return on capital. These costs are brought together in a financial model which finds the average price per unit of output that needs to be achieved in order for all of the component costs to be met over the project's life. The component costs are:

- Fuel;
- Capital;
- Fixed and variable operation and maintenance;
- Company tax; and
- Transmission costs.

Other factors that must be determined in calculating the LRMC in this way include conversion efficiency (heat rate) and internal energy use. The capacity factor assumed is important because it determines the output over which fixed costs can be spread. Having determined the values to be assigned to these inputs, they are brought together in a financial model that determines the life cycle price (the LRMC) by calculating a price that makes the net present value of the power station equal to zero.

The methodology is different from the building blocks approach that NERC uses for the calculation of regulated prices for transmission, distribution and retail. In setting the wholesale contract price in this way the NERC is determining a proxy for a market price of generation, not a regulated price, in a way that estimates the price needed to attract the next unit of energy (and the next power station) on to the system. The financial model used to estimate life cycle cost attempts to broadly simulate the financial approach taken by a new entrant when making their investment decision. It includes tax payments, a weighted average cost of capital that reflects generator risks and the effects of other costs, such as an allowance for transmission losses.

At the beginning of the transition stage of the industry, generation output pricing will still be determined by the NERC to ensure that only prudently incurred costs are recoverable. However, it is envisaged that with the imminent introduction of a bulk procurement framework, the market will evolve to having wholesale generation prices set via the bid process albeit benchmarked against the LRMC prices established by the relevant MYTO.

3.1 Existing Power Purchase Agreements

The pricing of electricity provided by generators to distribution and retail companies through the Nigerian Bulk Electricity Trading Company (Bulk Trader) will be regulated by the NERC. With the establishment and the operationalisation of the Bulk Trader in 2011 and the privatisation of PHCN successor companies now approaching successful conclusion, the Bulk Trader is expected to enter into PPAs with the successor Gencos. The electricity thus purchased will, in turn, be sold to the Discos through a Vesting Contract. This arrangement, while being of utmost importance to the immediate viability of the NESI, is temporary. It will continue for each Disco only until such a time when the NERC, in consultation with relevant stakeholders, determines that the Disco has become financially viable and is able to contract for new capacity on its own account and also to take over (novate) these existing PPAs with the Gencos.

The Bulk Trader's PPAs with successor Gencos provide the NESI with a commercially sensible way to provide payment security, reassign payment risks, provide a guarantee of supply to the Discos and, above all, incentivise the legacy Gencos to immediately commence recovering their licensed capacities that have remained stranded for decades (estimated at about 3,000 MW) because of their inability to earn enough income to justify necessary capital expenditure.

4 Technical Assumptions for the Determination of the LRMC for the 2012 Tariff Order

4.1 Introduction

The 2012 Tariff Order determined that the generation price is to be based on efficient new entrant life cycle costs and this price is to be paid to all generators who sell to the grid. Further to this, it was determined that this new entrant will be an Open Cycle Gas Turbine Plant (OCGT). To further open the market and encourage other sources of fuel, the NERC has allowed for coal-fired plants, renewable energy plants, and has also developed a separate LRMC for large hydro plants.

The OCGT plant, chosen due to the abundance of gas in Nigeria at a relatively low price, is regarded as one of the most efficient plants, and all new entrants are to use this efficient technology benchmark for project evaluation and analysis.

4.2 Gas-to-Power Plants

The price of electricity to be paid to generators is at the level required by an efficient new entrant to cover its life cycle costs which includes their short run fuel and operating costs and their long run return on capital invested. The NERC has gathered inputs from a number of industry sources in order to bring together estimates of plant's costs and technical characteristics. The assumptions to calculate the long run marginal costs (LRMC) for wholesale contract prices using or benchmarked with OCGT plant are as follows:

- *Capacity factor:* New plants will have a high level of availability and should be running at maximum output for a high proportion of the time in order to meet demand. The 2008 Tariff Order set 70% as the available capacity for a new plant. In fact, new plants have the capacity to generate at over 90%. However, taking their present poor condition into account, Successor Gencos will have a lower capacity factor of 65% (63% after allowing for normal plant degradation).
- *Marginal Loss Factor:* Generators are required to inject enough electricity to cover their contract plus transmission losses. Electricity delivered by a generation company to a distributor/retailer is calculated by multiplying the output injected at a particular point in the network by the MLF at that point. The MLF being adopted for use in the sector is 8.05%.
- *Sent out efficiency/heat rate:* refers to the efficiency in converting gas thermal energy into electrical energy. The figure from the 2008 Tariff Order of 34% has been reviewed downwards to 32%.

- *Auxiliary requirement:* This is the internal energy use in the power station and it has been reviewed upwards to 2% from 1% that was in the 2008 Tariff Order.
- *Construction period:* The time it takes to complete and commission the plant has been reviewed to 3 years from the 2 years that was in the 2008 Tariff Order.
- *Plant life:* This is the life over which costs are recovered and for the purpose of calculating the long run marginal cost of a new plant. A project life of twenty (20) years has been set.
- *Plant availability:* The percentage (%) of time the plant is available to generate has been set at 95% of the available capacity.
- *Capital cost:* The capital cost includes the following components:
    - Engineering, Procurement and Construction (EPC);
    - Planning and approval;
    - Professional services;
    - Land acquisition;
    - Infrastructure costs (including water);
    - Spares and workshop, etc; and
    - Connection to the electricity transmission network
    - Fuel connection, handling and storage
- *Fuel: This* is what drives the turbines to produce electrical energy. The price of natural gas is a pass through cost.
- *Fixed and variable operation and maintenance:* These are the expenses that the generator incurs in providing service to its customers. They include the cost of labour, materials, rent, etc. Fixed costs are not a function of energy produced. These remain unchanged from the 2008 Tariff Order, but are escalated by the exchange rate and rate of inflation.

Table 1: Technical Characteristics of New Entrant Plants -2012

S/N	Description	Units	Assumptions			
			OCGT (Successor Gencos)	OCGT (New Entrant)	LARGE HYDRO	COAL
1	Installed capacity	MW	250	250	300	250
2	Capital cost	US$/KWh	950	1,200	1,800	2,730
3	O&M Cost (Fixed)	NGN/MW/Yr	2,496,000	2,496,000	2,217,000	899,000
4	O&M Cost(Variable)	NGN/MWh	904	920	**140**	1674
5	Capacity Factor	%	65	80	65	70
6	Auxiliary Requirement	%	2	2	1	7.5
7	Economic life	Year	20	20	40	40
8	Construction period	Year	3	3	4	4
9	Sent-out efficiency	%	32	34	-	42
10	Availability	%	95	95	40	86
11	Fuel costs	$	1.8	1.8	-	4..30

4.3 Coal-Fired Power Plants

The NERC has developed the methodology for deriving the Long Run Marginal Cost (LRMC) or the life cycle cost of a coal-fired generating plant in Nigeria. This is aimed at taking advantage of the abundant coal resources in the country, and also opening up the market to give investors in power generation more choices.

For coal-fired generation in Nigeria, two possible sources of coal are considered, namely; domestic and imported coal. The consideration for an imported coal source

may be a short-term measure pending when coal mines become fully operational in Nigeria. However, the price is benchmarked to imported coal (landing cost) to encourage local mining, while discouraging importation.

The explanations of the assumptions considered in the LRMC for coal are as follows:

- *Installed capacity per generating unit:* The actual effective plant capacity which would be achievable in Nigeria is assumed to be 250MW. The plant in question would be a Subcritical Water-cooled Plant
- *Thermal efficiency:* The estimates of heat rate have been based on sent out and generated output published by existing black coal generators in Australia and Asia. NERC considers forty-two percent (42%) as appropriate, as it takes into account the average plant heat rate, ageing, load frequency of starts and lifetime extension.
- *Plant Availability:* Availability is the proportion of time in any operational year that a plant is available to generate. The outage times that reduce availability consists of planned outages for scheduled maintenance and forced outages when plants are forced to stop or operate at reduced output for technical reasons. Data on new plants and technologies indicate that outage rates can be high and so availability for a new coal fired plant in Nigeria is estimated at 86%.
- *Construction period:* The construction period or build time assumed for subcritical black coal technology is four (4) years.
- *Fixed O&M cost:* Fixed O&M costs include maintenance, operating, and overhead costs that are not dependent on hour-by-hour level of generation from the station but on available capacity. The estimated fixed O&M costs is $32,000 per MW.
- *Economic life of the plant:* For the purpose of calculating the long run marginal cost of a new plant a project life of forty (40) years has been assumed.
- *Capacity factor:* NERC has continued to adopt the approach of setting the plant factor based on the actual performance of the most efficient subcritical black coal generator. The capacity factor has been set at 70%. New plants will have a high level of availability and so should be running at maximum output for a high proportion of the time in order to meet demand.
- *Auxiliary/Internal usage:* The subcritical black coal plant will require a water cooling system, therefore the auxiliary is estimated at 7.5%
- *Capital Cost:* The estimate of project capital cost for a new coal-fired power station includes the following components:
    - Engineering, Procurement and Construction (EPC)
    - Planning and approval
    - Professional services
    - Land acquisition

- Infrastructure costs (including water)
- Spares and workshop etc and
- Connection to the electricity transmission network
- Fuel connection, handling and storage

The estimate of the project capital cost excludes Interest During Construction (IDC), capital costs, and site works for a coal mine. IDC is excluded, as a return on investment is required in this model from year zero (i.e., at the commencement of the project before construction has begun) and interest charges are a component of the WACC.

- *Variable cost:* The estimates of variable O&M cost is presented as cost per MWh sent-out. This is estimated at **$0.96**MWh.

4.4 Renewable Power Plants

The NERC has considered the use of different renewable energy sources in order to:

- Encourage embedded generation, thereby reducing the load on the transmission network and reducing distribution losses associated with the network;
- Encourage uptake of and stimulating innovation in, renewable energy technology (either generally, or a specific type of technology); and
- Reduce greenhouse gas emissions by lessening reliance on fossil fuels.

Electricity generation costs vary according to the renewable energy source and technology used. Therefore, the FIT levels will be technology-specific and will depend on:

- The investment costs for the plant;
- The O&M Costs;
- Fuel costs (where applicable);
- Financing costs and return on the invested capital;
- Estimated lifetime of the power plant; and
- Capacity of the plant.

In view of the high cost of renewable energy power plants, NERC has, for the next five years, set a cap on energy from renewable sources at 10% of total energy sent out. The cap shall be reviewed whenever the Federal Government's policy on energy mix is established.

In this Order, NERC has set Feed-In-Tariffs (FITs) for four major sources of renewable energy, Wind, Solar, Small Hydro and Biomass/Biodiesel.

4.4.1 Qualifying Renewable Energy Sources

- As used in this Order, biomass includes diverse fuels ranging from lumber, lumber waste, agriculture and industrial food processing waste, municipal solid waste, methane from land fill, bio-fuels from crops that are specifically grown or reserved for electricity generation.
- Wind power here refers to onshore wind power
- The Solar Tariff is for ground-mounted solar PV with no tracking
- Small Hydro refers to those producing less than 30MW

4.4.2 Electricity generation for a power station using a mixture of sources

For the purpose of computing the amount received by a power station with a mixture of sources, the amount of renewable electricity generated by an accredited power station is worked out in accordance with equation:

$$\text{NetREGeneration} = \text{TEG} - (\text{FSL} + \text{AUX} + (\text{DLEG} * (1 - \text{MLF}))) \quad (1)$$

Where:

NetREGeneration	is the amount of renewable electricity generated by an accredited power station in a year
TEG	is the total amount of electricity, in MWh, generated by the power station in the year, as measured at all generator terminals of the power station.
FSL	is the amount, if any, of electricity, in MWh, generated by the power station in the year using non-eligible energy sources
AUX	is the auxiliary loss, in MWh, for the power station for the year
DLEG	is the amount of electricity, in MWh, transmitted or distributed by the power station in the year. MLF is the marginal loss factor, to allow for the amount of electricity losses in transmission networks

4.4.3 General Assumptions

The following assumptions are proposed for the determination of Feed-in Tariffs:

- *Installed Capacity:* This is the total available capacity of the plant and the assumption here differs for each of the technologies. It ranges between 5MW to 10MW
- *Capital Cost:* This refers to the one-time set cost of the plants including connection cost to the grid
- *Fixed O&M Cost:* These are the expenses that the generator incurs in operating and maintaining their facilities, in N/MW/Yr.
- *Variable O&M Cost:* These are indicated in N/MWh
- *Capacity Factor:* The plant capacity factors are relatively low due to the fact that natural fuels, i.e., wind, sun and water are intermittent and not always optimally available.
- *Auxiliary Requirement:* This is the internal use of electricity with the premises of the generating station, which is assumed at a rate of 1% for all the sources, except Biomass which is set at ten percent (10%)
- *Economic Life:* A project life of twenty (20) years is assumed for all the sources and it is used to derive the period over which the costs are recovered.
- *Construction period:* This is the assumed length of time it will take to design, import and construct the plant to get it up and running. It is assumed to be three (3) years.

Table 2: Technical Assumptions for Feed-in tariffs (2012)

S/N	Description	Units	Assumptions			
			Wind	Solar	Small Hydro	Biomass
1	Installed capacity	*MW*	10	5	10	5
2	Capital cost	*US$/kW*	2,525	5,545	3,500	4,000
3	O&M Cost (Fixed)	*NGN/MW/Yr*	2,900,000	9,570,000	5,655,000	8,370,000
4	O&M Cost (Var.)	*NGN/MWh*	232	87	87	775
5	Capacity Factor	*%*	38	33	60	68
6	Auxiliary Requirement	*%*	1	1	1	10
7	Economic life	*Years*	25	25	25	25
8	Construction period	*Years*	3	3	3	3

4.5 Gas Price

Gas prices have been regulated since the adoption of the MYTO in 2008 and the regulated prices as applied in the 2012- 2016 tariff are as follows:

Table 3: Gas and Gas Transmission Cost (2012-2016)

	2012	2013	2014	2015	2016
Price (US $/mmbtu)	1.80	1.80	2.30	2.37	2.44

Gas prices are pass-through costs for the electricity producer. Where there is a material change in the price, the NERC will effect a commensurate change to the wholesale contract price.

4.6 Generation/ Load projection

This is a significant variable in tariff determination. Under MYTO 1, projected generation capacity was put at 4000 MW for 2008; 6000 MW for 2009; 10,000 MW for 2010; and 16,000 MW for 2011. However, none of the projections were ever achieved causing additional major disequilibrium in the market and contributing very significantly to the suboptimal performance of MYTO. Therefore, having consulted with key generation stakeholders, the new MYTO will be based on the following conservative but realistic daily generation capacities:

Table 4: Projected Generation Capacity to National Grid- (2012-2016)

Year	Gross Generation Capacity - Sent Out to Grid (Gwh)
2012	30,715
2013	41,884
2014	50,601
2015	56,242
2016	59,034

This projection assumes that improvements in the generation capacity are solely from the successor Gencos and based on realistic expectations for improvements in efficiency and the refurbishment and expansion of facilities and the completion of ongoing NIPP projects. These figures will be reviewed bi-annually.

5 Economic and Financial Assumptions for the 2012 Tariff Order

5.1 Introduction

To develop the tariffs, a considerable mass of economic and financial assumptions were made by the regulator as the basis of the Tariff Order. These include the following variables.

5.2 Inflation

An inflation rate of thirteen percent (13%) was adopted. This however, is subject to minor review bi- annually. In an event of any material change in inflation rate, this would be reflected and the tariff adjusted accordingly.

In the MYTO, the rate of inflation is used to ensure that investors are well compensated against rising cost of doing business and workers in the industry are paid living wages. To achieve this, the NERC has escalateed the following variables:

- WACC;
- Fixed labour cost;
- Fixed admin cost;
- Variable O&M cost;
- Other Fixed O&M cost; and
- Capital Investment.

Table 5: Assumed Inflation Rate in Nigeria (2012-2016)

	2012	2013	2014	2015	2016
Inflation	13	13	13	13	13

5.3 Exchange Rate

Being an importer of electricity generation equipment components opens Nigeria to foreign exchange risk. This foreign exchange risk is taken care of in the MYTO model, and adjusted bi-annually during the minor reviews.

Though this is regularly adjusted during the minor reviews to bring it to current realities, investors have informed the NERC that the official CBN rates are not always accessible to them, and that they are often charged a commission. NERC therefore recommends a 1% premium above CBN rates. The exchange rate adopted is assumed to increase steadily over the years, and is also subject to review bi-annually.

Table 6: Assumed Naira/US Dollar Exchange Rate (2012-2016)

	2012	2013	2014	2015	2016
Exchange Rate	161	169	178	189	198

5.4 The Weighted Average Cost of Capital (WACC)

The cost of capital included in the MYTO is intended to provide a return on existing assets and appropriate incentives for future investment. The cost of capital is an important component of the tariff and is included in the annual revenue requirement calculation as a return on the value of capital invested. The regulated asset value at the start of a given year is calculated by taking the depreciated replacement cost of capital assets at the start of the immediate proceeding twelve (12) months, and adding the investments in new capital assets acquired during the same period.

The Capital Asset Pricing Model (CAPM) is used to estimate a WACC for the NESI. While this approach gives a method for estimating the average cost of capital in a sector and is widely used by regulators, it requires consideration of volatility of returns in the sector, as well as the domestic cost of debt. Even in developed economies, the calculation of a WACC frequently requires estimation of a number of the inputs. This is the case in Nigeria, and most of the inputs to the WACC calculation are, the NERC estimates. The WACC is set at the level that attracts investment funds to the industry, but is not sufficient to produce super profits.

The CAPM provides estimates of the appropriate return on equity and the returns to equity are measured in relation to the risk premium on the equity market as a whole. Thus:

$$Re = Rf + ße\,(Rm - Rf) \qquad (2)$$

Where:

R_e is the return on equity

R_f is the risk free rate observed in the market

$ß_e$ is the correlation between the equity risk and overall market risk

R_m is the return on the market portfolio

$R_m - R_f$ is the market risk premium

The WACC lies between the cost of equity and the cost of debt. The WACC is calculated as:

$$WACC = Rd \times D/(D + E) + Re \times E/(D + E) \quad (3)$$

Where:

D is the total market value of debt

E is the total market value of equity

R_d is the nominal cost of debt; and

R_e is the nominal cost of equity.

This formulation does not include the effects of tax. The formulation of the WACC that allows for the effects of taxation – specifically the corporation tax rate (T_c) – and used extensively by regulators is as follows:

$$\text{Nominal post tax } WACC\,(w) = Re \times E/V + Rd\,(1 - Tc) \times D/V \quad (4)$$

Where:

T_C is the company tax rate,

V is the total market value of the business, i.e. debt plus equity

A transformation is applied to derive an estimate of the real pre-tax WACC, as follows:

$$\text{Real pre tax } WACC\,(RW) = [(1 + w/(1 - Tc)) / (1 + i)\,] - 1 \quad (5)$$

Where:

W is the nominal post tax WACC, as given by equation (4)

I is the inflation rate

The company tax rate used is the statutory corporation rate of thirty-two percent (32%).

5.4.1 Estimating the WACC Components

This section provides the NERC's estimates of the various components required to calculate a WACC for the NESI. These estimates are then drawn together in a description of the process used for the first WACC calculation.

The risk free rate

The yield on government bonds is regarded here as the risk free rate. The NERC has had regard to relevant yields on Nigerian Treasury bonds, and has selected a risk-free rate of eighteen percent (18%)

Many regulators use 10-year bond rates or 10-year (indexed linked) bonds or their local equivalent. The longer term also ensures consistency with the risk free rate used to estimate the market risk premium - that is also based on 10-year bonds.

The cost of debt

The NERC adopted a nominal cost of debt of twenty-four percent (24%) for generation reflecting current debt levels for business and project. The cost of debt is generally determined by adding a debt premium, and sometimes a transaction cost, to the risk free rate.

$$\mathrm{Rd} = \mathrm{Rf} + \mathrm{DRP} + \mathrm{DIC} \qquad (6)$$

Where:

DRP is the debt risk premium

DIC is the debt issuance cost lending in Nigeria

Betas

Beta reflects the riskiness of an asset relative to the market as a whole (usually represented by the stock market). Equity betas will reflect the financial risk carried

by shareholders, which is in turn influenced by the level of gearing since high levels of debt increase the risk to shareholders.

Electricity supply is not an area with any history of investment from which to draw information on the relative risk and it is not considered possible to derive at statistically significant betas. The NERC has decided not to apply any value for the 2012 Tariff Order, but appropriate estimates will be made against next tariff review when enough data exists for estimates to be made.

Gearing

The ratio of equity and debt is used to weight the equity and debt returns in the WACC calculation.

In the past, independent power producers in developing countries were financed with high gearing ratios – commonly 80:20 debt to equity. However, the World Bank considers that in future, greater caution by lenders will result in project sponsors being expected to assume a greater degree of the project risk, by accepting lower debt-equity ratios. The Bank has suggested that future ratios would be closer to 60:40. This level would also apply to regulated assets, such as transmission and distribution.

The NERC has selected a gearing ratio of 70:30 in the development of the WACC for the NESI.

WACC estimate

The following are the main assumptions used in the WACC calculations:

risk free rate	18%
nominal return on equity	29%
nominal cost of debt	24%
gearing level (debt/equity)	70%/30%
corporate tax rate	32%

These assumptions provide the following WACC estimates:

Nominal before tax WACC	25%
Nominal after tax WACC	17%
Real pre-tax WACC	11%
Real after tax WACC	7%

6 Generation Tariffs for Various Fuel Sources

Tables 7-14 below show the wholesale prices calculated through the LRMC of thermal power plants, coal-fired power plants, large hydro plants, small hydro plants, land-mounted wind power plants, PV solar power plants and biomass power plants for each year of the coming tariff period. As the NESI evolves, more credible and detailed data on industry performance will become available, and the renewables sub-sector becomes more viable with the emergence of cheaper technologies and a settled Government policy, NERC will review its assumptions particularly as regards renewable.

The total wholesale contract price has been calculated for each year as a capacity and an energy charge. The capacity charge comprises fixed operation and maintenance cost, capital cost and two-third of tax (2/3) cost. While the energy charge comprises fuel cost, variable operation and maintenance cost, the transmission loss cost and a third (1/3) of tax cost. The capacity and energy charge will be included in the wholesale contract and will be the basis for payments to the eligible generators.

However renewable energy generators are not entitled to capacity payment but will be paid full wholesale price based on power sent out from their plants.

Table 7: Wholesale Generation Prices for the Successor Gas Power Plants

	2012	2013	2014	2015	2016
Wholesale contract prices (N/MWh)	9,563	10,257	12,140	13,172	14,296
Capacity charge (N'000/MW/month)	3,515	3,789	4,084	4,403	4,747
Energy charge (N/MWh)	5,389	5,758	7,290	7,944	8,658

Table 8: Wholesale Generation Prices for New Entrants Gas Power Plants

	2012	2013	2014	2015	2016
Wholesale contract prices (N/MWh)	10,743	11,534	13,520	14,665	15,910
Capacity charge (N'000/MW/month)	4,359	4,701	5,071	5,470	5,902
Energy charge (N/MWh)	5,568	5,951	7,499	8,169	8,902

Table 9: Wholesale Generation Prices for the New Entrant Coal Plants

	2012	2013	2014	2015	2016
Wholesale contract prices (N/MWh)	25,106	27,024	29,097	31,559	34,232
Capacity charge (N'000/MW/month)	13,971	15,103	16,328	17,651	19,083
Energy charge (N/MWh)	11,135	11,921	12,769	13,907	15,150

Table 10: Wholesale Generation Prices for the Successor Large Hydro Plants

	2012	2013	2014	2015	2016
Wholesale contract prices (N/MWh)	4,898	5,290	5,715	6,174	6,671
Wholesale price including HYPADEC charges	6,368	6,877	7,429	8,026	8,672
HYPADEC Charges	1,470	1,587	1,714	1,852	2,001
Capacity charge (N'000/MW/month)	4,928	5,317	5,737	6,191	6,681
Energy charge (N/MWh)	1,439	1,560	1,692	1,835	1,991

Table 11: Wholesale Feed-in Tariff for Small Hydro Plant

	2012	2013	2014	2015	2016
Wholesale contract prices (N/MWh)	**23,561**	**25,433**	**27,456**	**29,643**	**32,006**

Table 12: Wholesale Feed-in-Tariff for Land Mounted Wind Power Plant

	2012	2013	2014	2015	2016
Wholesale contract prices (N/MWh)	24,543	26,512	28,641	30,943	33,433

Table 13: Wholesale Feed-in-Tariff Solar Power Plant

	2012	2013	2014	2015	2016
Wholesale contract prices (N/MWh)	67,917	73,300	79,116	85,401	92,192

Table 14: Wholesale Feed-in-Tariff for Biomass Power Plant

	2012	2013	2014	2015	2016
Wholesale contract prices (N/MWh)	27,426	29,623	32,000	34,572	37,357

7 Bi-Annual Review

The NERC has noted that its determination of wholesale contract prices is based on current estimates of the cost of generating electricity with all the energy sources identified in this Order. The NERC also notes that the NESI is likely to change over the coming years and that the commercial conditions applying to generators may change.

The NERC will consider reviewing the wholesale contract price of generation if there is a material change in the inflation rate, gas price, exchange rate and generation capacity. The NERC considers that a material change would be plus or minus 5% in these inputs to the price. The NERC will consider the combined effects of these parameters only, while other parameters will be considered as part of the detailed major review process.

8 Effective Date

This Order shall come into effect as from midnight on Thursday, 31st May 2012.

DATED AT ABUJA THIS_____ DAY OF _____ , 2012.

DR. SAM AMADI
CHAIRMAN

DR. STEVEN ANDZENGE
COMMISSIONER (LEGAL, LICENSING AND ENFORCEMENT)