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Feasibility of a Trans Central and East African Pipeline (An Economic Perspective)

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ABSTRACT: *Inadequate infrastructure has been the major hindrance preventing the projected growth of the Nigeria gas industry. Gas infrastructures are capital intensive, and has long pay-back time, hence the involvement of international financial backbone or strong government participation is essential when planning for infrastructural development in the industry. However, the Nigerian government has shown to lack the political will and economic knowledge needed to achieve sustainable and profitable infrastructural development. This paper therefore performed an economic analysis of a Trans Central and East Africa gas Pipeline infrastructure proposal. It outlines the benefit of the pipeline to Nigeria and Africa at large and also perform an economic analysis forecast using a cash flow state to determine the pipeline profitability. The Economic analysis forecasted at $35 billion capital investment gave a net cash flow of $17.2108 billion/year at peak performance, and a 7 years payback period. With a 20-year cash flow forecasted, the project was discounted at 10%, and 15%, and the NPV derived was $62,804.48 million and $55,482.42 respectively with an IRR of 28%. Furthermore, a sensitivity analysis was carried out to ascertain the project performance under certain conditions of 50%, 75% and 100% production rate to emulate worst, medium and best-case scenarios, the project still showed profitable at worst case scenario of 50%, with an NPV of 10% and 15% the cash flow calculated was $63,804.48 million and $55,482.42 million respectively and an IRR of 28%.*
KEYWORDS *- Natural Gas, Gas Economics, Economic analysis, Gas infrastructure, Pipeline infrastructure, NPV, IRR, Cash Flow, Sensitivity analysis*

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I. INTRODUCTION

Nigeria has a peculiar problem of infrastructure inadequacy, almost all sectors of the economy lack vital infrastructures needed to survive. The fossil energy sector (particularly the natural gas sector) which is the main driver of Nigeria economy have suffered tremendously from this infrastructural neglect. Although other sectors might survive with little infrastructures, the gas sector cannot survive without vital infrastructures put in place.

Furthermore, because of the enormous capital required to develop the gas sector infrastructural needs and the extensive payback period, the government is best suited to develop these infrastructures. In recent years, the Nigerian government have shown to lack the political will to invest the much-needed capital needed in the gas sector, almost all the pipeline infrastructures were constructed more than 40 years ago. In the last 10 years there has been no major pipeline construction undertaken by the government, except for the recently inaugurated Ajaokuta-Kaduna-Kano (AKK) pipeline construction. Also note that AKK pipeline is part of the Trans-Sahara gas pipeline (itself a project of concern) which was reserved to enable Nigeria export natural gas to the European market.

Aside political will, the profitability of most of the pipeline construction being done by the government is a source of major concern. Take the West Africa Gas Pipeline (WAGP) project as an example, though the infrastructure belongs to four countries (Togo, Nigeria, Ghana, and Benin Republic), Nigeria basically funded the infrastructure. This did not prevent these countries from owing Nigeria for the gas supplied. In a publication by africaoilandgasreport.com on June, 10 2019, it was reported that Ghana National Petroleum Company owes NNPC around $160 million for gas supplied through WAGP. Exact amount owed by other countries cannot be determined at this moment although reports have suggested that they owe Nigeria for gas supplied. The issue of default in payment has made West Africa Pipeline Company (WAPco), the operator of the WAGP, to shut down gas supply to these countries severally in the last 5 years. These situation have shown that although the WAGP was a good initiative, its economic viability is subject to questioning. This could possibly be the same story with the Trans-Sahara gas pipeline although through a different perspective. Part of the pipeline route is through the unstable region of Niger where the safety of the pipeline cannot be guaranteed. Furthermore, since its conception in 2006, the first phase of the pipeline (AKK pipeline) was started only in 2020, this means it took 14 years after conception to begin the project. Owing to the fact that Europe is trying to deter from fossil energy, is it still economical to construct this pipeline? (Oxford Economics, 2014), (Hopkins P., 2015).

II. TRANS CENTRAL AND EAST AFRICA GAS PIPELINE

It is with great surprise that an effort has not been made to create a viable gas market in the continent even though there is an enormous gas reserve present in Nigeria and the populace of Africa that can feed on this commodity. No Trans-African gas pipeline infrastructure that would make the continent a major gas market exist. Rather, Africa commercial gas producers (Algeria, Nigeria, and Angola) spend a lot of resources to access the European gas market where they are in a huge competition with Russia, Qatar, Norway, and The Netherlands. Africa gas requires an African market and the construction of a Trans-African gas pipeline that would help attain that goal. The construction of a Trans-Africa gas pipeline infrastructure would open-up several opportunities for construction of gas to power (GTP) plants, cement industries, fertilizer and steel factories, cheap source of energy to the populace, etc to every part of Africa. Additionally, it would help fasten the path to industrialization of the entire continent (at least the paths which the pipelines will pass through). This paper therefore proposed the construction of a 4500km Trans Central and East Africa gas Pipeline which would go through Akwa Ibom-Calabar-Cameroun-Central African Republic-DRC-Sudan-Ethiopia. Gas will be supplied to the pipeline from various gas gathering projects that is already in existence in Nigeria and it will be transported to Central and Eastern African markets. The existing Eastern trunk line (Alakiri -Obigbo-Ikot Abasi) will be the back-bone of the pipeline.

Specific sectors of the Africa economy that will benefit directly from the project includes:

1. **Power Sector:** The project would encourage the construction of gas power plants across the countries that the pipeline would be passing through as a result of constant supply of natural gas to the Central and Eastern Africa. These would improve the power conditions in these regions due to low cost of electricity (Rud J.P. 2012).
2. **Cement Sector:** The project will boost the usage of gas by cement factories which are currently in the project area and even creation of new ones. As a result, the volume of cement produced would increase, causing a reduction in importation of cement and consequently reduce the cost of cement in those regions.
3. **Fertilizer Sector:** Nitrogen-based fertilizers accounts for about 63% of the roughly 4.3 million tons of fertilizer imported into Africa each year. The Eastern and Central Africa also accounts for the most nitrogen-based fertilizer imported into Africa with East African countries (especially Ethiopia, Kenya and Tanzania) accounting for most of the urea (produced from natural gas) imported into Africa (Petersen & Meessen, 2010). Ethiopia alone imports over 100,000 tons of urea yearly. These urea imports are largely from Russia, Middle East, USA and the Caribbean. With the conception of the project, construction of fertilizer plants would be encouraged in these countries, and unvaryingly reduce the importation of urea. Also, the accessibility of cheap fertilizer in this regions would invariably improve farming, and ultimately reduce their food stock imports.

Additionally, potential off-takers from the Trans Central and East African Pipeline are analyzed below:

- Trans Central and East African Pipeline would attract potential creation of power generation plants along its path. Its path in Nigeria would feed into some future power generation facilities in Akwa Ibom and Calabar, this would also serve as a support to further develop the North-west pipeline which would invariably be a source encouragement to build power generation plants in the North-West region. The availability and accessibility of cheap gas would attract potential investors to invest in the construction of power generation plants along the Central and East African pipeline routes, and the lower capital needed for this investment as compared to hydro-dam powered plants would facilitate their construction.
- Other planned gas off-takers, which includes but is not restricted to fertilizer, petrochemical and agro-allied companies. This will help facilitate the industrial development that is presently going on in East Africa (Medpro Technical Report, 2013).
- The pipeline construction will discourage deforestation in these regions by encouraging the use of LPG as source of fuel.
- The pipeline construction would open up discussions and be a reference for construction of other pipelines that would transport gas to the Southern African countries and the Far East.
- The pipeline construction will also encourage the development of manufacturing industries along the pipeline paths (HIS Economics, 2016).

III. METHODOLOGY

To determine the viability of the project; various financial tools, steps and assumptions were used. This sector outlines the methodologies employed to evaluate the viability of the proposed pipeline infrastructure. Spreadsheet model which has been employed by notable researchers (Iledare, 2010, and Mian, 2002) for economic evaluation in the petroleum industry was adopted for this study.

Deterministic Model Components

The various components of the used models and the various assumptions are outlined below:

1) Capital Requirements

a. CAPEX

The capital expenditure (CAPEX) comprises of the cost of compressor stations construction, cost of pipeline construction, and cost of constructing terminal gas stations. The cost of the CAPEX components was calculated by revising the cost of comparable projects worldwide. Nord stream pipeline and the AKK pipeline costs were used as reference points for the assumed cost in the proposed pipeline. The Capex of the pipeline was projected to be $35 billion.

b. OPEX

The operating expenditure (OPEX) for the pipeline was calculated as 30% of the price charged of the pipeline. These cost includes of the personnel, repairs and maintenance, power and electricity, and sundry expenses. This operating expenditure calculation was done in line with global best practices.

2) Investment Performance Indicators

- Net Present Value (NPV),
- Cash Flow (CF),
- Internal Rate of Return (IRR),
- Payback period (PO),
- Sensitivity Analysis

Net Present Value (NPV)

NPV also denoted to as the present value of cash surplus or present worth, it is gotten by deducting the present value of periodic cash outflow from the present value of periodic cash inflows.

$$\text{NPV} = \sum_{t=0}^{K} \text{NCFt}/(1+r)^t \qquad (1)$$

Where we have NCF as the cash flow and r = discount rate,

NPV= present value of periodic cash inflows - present value of periodic cash outflows

The NPV of infrastructure was estimated for two different scenarios (10%, and 15%).

Cash Flow

It is a financial report that puts together the total amount of cash and cash equivalents that passes through a company. It helps to measure a proper management of a company cash position, i.e., how it generates cash to pay its debt responsibilities and fund its operating expenditures.

Certain assumptions were made for the cash flow calculations for the pipeline infrastructure. The project assumed that initial capital investment was treated as a loan so as to enable proper analysis. 50000mmscfd throughput volume for gas was projected for the pipeline at maximum capacity. The pumping phase of the project follows an output increase from 50%, 75%, 90%, to 100% of design capacity annually. Operation days was assumed to be 365 days per year. Gas price is projected to be stable at $2/mscf for the period of the breakdown. Corporate tax of 32% Earnings Before Interest and Taxes (EBIT) and starts from the 4^{th} year of operation while interest on loan at 15% reimbursement begins from the first year of operation and is covered through the remaining 16 years of forecast. Construction was projected to be done in the 4^{th} year then full-on operation begins on the 5^{th} year. The cash flow forecast covered a 20 years' timeframe (NDRC, 2013).

Internal Rate of Return (IRR)

IRR is used to measure the actual rate of return made by an investment as though the money had been loaned at that rate. It describes the discount rate that makes the NPV exactly equals to zero.

$$\text{NPV} = \sum_{t=1}^{K} \frac{\text{NCFt}}{(1+\text{IRR})\text{t}} = 0 \qquad (2)$$

IRR was also calculated for each sensitivity scenario.

Payback Period (PO)

Payback period tells the projected number of years required to recuperate initial project capital investment. It is calculated based on the time required for the cumulative discounted net cash flow to be precisely zero. Usually, investors prefer investment with a shorter payback time.

Risk Analysis

Sensitivity simulations was done to calculate results for random input variables were considered for three scenario (worst, middle, and best-case scenario) using a set of different input values for each case. The result outcome from each input was noted, and the final results of the model was taken as the likelihood distribution of all possible outcomes. A sensitivity graph was then built to show the scenario cases.

The assumed and calculated variables for the sensitivity analysis was done using production rate. The rate assumed was 50%, and 75% of the capacity and then NPV and IRR was done for each case scenario.

Deterministic Model Results

The estimated deterministic results for the Trans-Central and East Africa gas Pipeline economic model developed in the preceding section are outlined as follows:

Cash flow Projection

The facility is expected to receive inflows of $15 billion, $10 billion, $5 billion and $5 billion for the 1st, 2nd, 3rd and 4th year of construction respectively. With the assumption that operation starts on the 4th year of facility operation, the projected net cash flows (NCF) begins at $12.535 billion, peaks at $17.2108 billion (4th year of operation) and continues throughout the life of the facility on condition that there is a smooth operation running.

Fixed and Variable Operating Costs

Variable operating cost was projected to be at $0.60/MCF (30% of price) of gas, it includes personnel, repairs and maintenance, power and electricity, and sundry expenses and thus it was estimated to be $5.475 billion, $8.1212 billion, $9.855 billion for the 1st, 2nd, and 3rd year when operation begins respectively. The subsequent years are $10.950 billion/year.

Profitability

In the 20 years' period covered by the forecast, after the preliminary construction period of 4 years, the 16 years forecasted financial report calculations shows a profitable profile.

Payback period

The time needed for the project to make the total sum of $35 billion contractor financing and associated responsibilities is 7 years calculated using profit after tax.

Net Present Value and Internal Rate of Return

The net cash flow post-tax net cash flow discounted at 10%, and 15% was calculated to be $62.804 billion, and $55.482 billion respectively. The Internal rate of return which determines the cost of capital at which the project will break even was gotten to be 28%.

IV. FIGURES AND TABLES

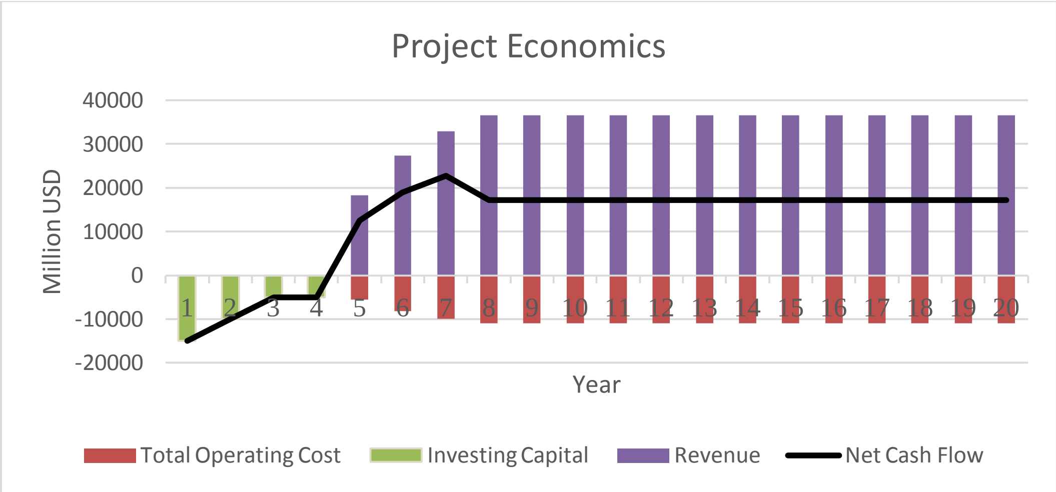

Figure 1: Calculated cash flow projections from the deterministic model.

Sensitivity Analysis

A sensitivity analysis of the effect of capacity reduction or increment on the project's NPV and IRR in order to assess its performance showed that:

- at 50% production capacity, with NPV at 10% and 15% the cash flow gives $23,289.38 million and $20,251.64 million respectively with a 19% IRR.
- at 75% production capacity, with NPV at 10% and 15% the cash flow was $49,971.58 million and $43,453.55 million respectively with a 27% IRR.

- at 100% production rate, with NPV at 10% and 15% are the cash flow gives $63,804.48 million and $55,482.42 million respectively with a 28% IRR.

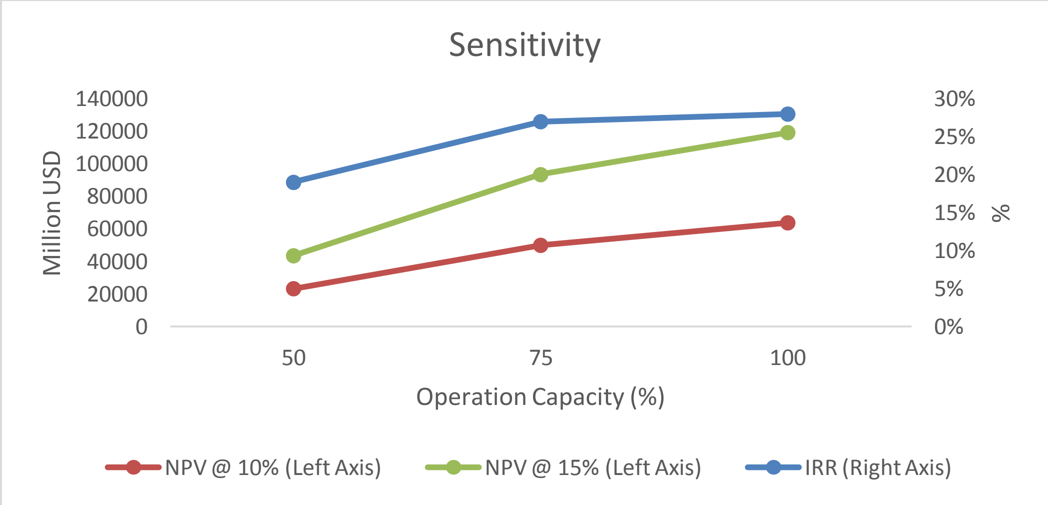

Figure 2: NPV (10% and 15%) and IRR sensitivity to varying pipeline capacity

V. CONCLUSION

The paper proposed a construction of a 4500km Trans Central and East Africa gas pipeline; the pipeline would originate from Akwa Ibom, Nigeria pass through Cameroun, Central Africa Republic, DRC, Sudan, and terminates in Ethiopia. A financial analysis of the pipeline infrastructure projected a $35 billion capital investment; a net cash flow of $17210.8 million/year at peak performance, and a 7 years payback period. Using 20-year cash flow projection discounted at 10%, and 15%, the calculated net present values are $62,804.48 million and $55,482.42 respectively with an internal rate of return of 28%. Furthermore, the project performance was accessed under various scenarios, a sensitivity analysis of the impact of different throughput; it revealed that even at 50% production rate, the project is still profitable with an internal rate of return of 19%. At 100% capacity, the project returned an impressive IRR of 28%. A feasibility study shows that the project would help facilitate development in the countries along the pipeline route. Some of the identified sectors that would benefit from the infrastructure are power sector, cement sector, fertilizer sector, etc. The risk analysis of the project was projected to be high; this is due to the volatile nature (politically) of the countries along the route of the pipeline.

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