International Journal of Engineering Science Invention (IJESI)
ISSN (Online): 2319-6734, ISSN (Print): 2319-6726
www.ijesi.org ||Volume 10 Issue 9 Series II || September 2021 || PP 13-17

Construction of a Liquefied Natural Gas Infrastructure in Akwa Ibom State, Nigeria (A Proposal)

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ABSTRACT: *NLNG is the most successful gas utilization infrastructure in Nigeria in term of income generation; generating over* ***$108 billion in total revenue, and paying*** *$8 billion for taxes, $17 billion in dividends, $13 billion as feed gas purchases to the federal government since it started production 20 years ago. Interestingly, this success has not been duplicated in other LNG companies; the Brass LNG and the Olokola LNG companies have been in the construction stage since their conception. This paper therefore proposes the construction of a 6MTPA LNG facility in Akwa Ibom state. The paper performed an economic analysis of the facility using a cash flow statement to determine its feasibility and profitability. The economic analysis forecasted at $1.6 billion initial capital investment gave a gross cash flow of $1.147 billion/year at peak performance, and a 6 years payback period. With a 28-year cash flow projection discounted at 10%, and 15%, the calculated NPV are $2.902 billion and $1.331billion respectively with an IRR of 26%. Additionally, a sensitivity analysis was carried out to determine the project performance under certain conditions and the analysis established that above the price of $5.5/MCF, the project will run at profit.*

KEYWORDS -*Natural Gas, LNG Economics, Economic analysis, LNG infrastructure, Gas, NPV, IRR, Cash Flow, Sensitivity analysis*

Date of Submission: 05-09-2021 Date of Acceptance: 15-09-2021

I. INTRODUCTION

The success story of Nigerian Liquefied Natural Gas (NLNG) has shown that LNG is the most successful gas utilization option in Nigeria. NLNG has within 21 years of operation moved from production capacity of 6.4MMTPA in 1999 to 22MTPA in 2007, it also takes in 3.5bcf/d of natural gas (www.nigerialng.com). Unfortunately, the effort put into making NLNG a success has not been replicated in other LNG companies/projects such as: the Brass LNG and the Olokola LNG companies have only been in the construction stage since their outset. Even with the worldwide evolution of the LNG industry, the Nigeria government are yet to invest in the infrastructure required to make Nigeria an LNG hub.

A privately owned mini-LNG plant (Greenville LNG) that produces 750 tons of LNG annually is the only other LNG company in Nigeria aside NLNG which is surprising that it is the only owned private LNG plat in Nigeria despite the huge potential and market the industry has. With the country's geographical location and gas reserves, Nigeria has the advantage over other players in the industry and should be consumers' first stop for reliable LNG. Leading global LNG producers like Cheniere Energy, Dominion Energy Inc., Woodside Energy, Novatek, Rosneft, etc. should have an operating license and plant in the Nigeria LNG industry.

II. CONSTRUCTION OF AN LNG FACILITY IN AKWA IBOM

Efforts should be geared towards LNG utilization as it is the most successful venture among the natural gas utilization options in Nigeria. Countries like Trinidad and Tobago, Qatar, and Canada etc have had all-out benefits (like employment, improved GDP, foreign earnings etc.) from the global LNG market; Nigeria should also partake in the benefits that comes with the LNG market to its full capacity if Nigeria invests in this sector as it should.

The construction of another LNG facility would enable Nigeria expand the LNG sector and boost LNG export. This paper recommends the construction of an LNG infrastructure in Akwa Ibom state in addition to the existing NLNG plant. This facility would comprise of an LNG processing facility containing two (2) LNG processing trains that produces 6MTPA of LNG, a product storage tank(s), condensate and LPG plant(s), a 100MW combined-cycle power plant and a product load-out jetty. Quality gas from existing pipelines from various gas gathering projects that already exists in Nigeria will supply gas to the proposed LNG facility. The volume of LNG produced from Nigeria will and would be then exported to the European market.

Proposed project size and structure:

1. **Field development**: the field development is beyond the scope of this paper and therefore the upstream section would not be discussed.
2. **Pipeline to the facility**: the pipeline facility would be based on the existing pipelines.
3. **The liquefaction facility**: the recommended facility would be made up of two-train liquefaction plant with other supporting infrastructure which would handle a capacity of 6MTPA.
4. **Tanker transportation**: In order to limit risk exposure and reduce the initial capital, most of the product would be sold on free on board (F.o.b) while those that cannot be sold on that term would be on charter agreement with notably shipping syndicates. Hence, the charter transport would be treated as operating cost instead of capital investment in the cash flow statement.
5. **Sales Agreement and Pricing**: Liquefied Natural Gas around the world is usually sold on the basis of a pricing formula which links the price of LNG to the price of crude oil. The exact pricing formulas are usually considered trade secrets and not available to be accessed by the public. However, the accessible information discloses that LNG price is typically calculated using either cost-insurance-freight (c.i.b) or free on board (f.o.b.). The facility would sell most of its products based on free on board pricing formula even though some would be on cost-insurance-freight using chartered vessels.

III. METHODOLOGY

To determine the feasibility of the project; various economic tools, steps and assumptions were made and used. This sector summaries the methodologies used to appraise the feasibility and profitability of the Liquefied Natural Gas infrastructure in Akwa Ibom. Spreadsheet model which was been used by noteworthy researchers (Ileadare, 2010, and Mian, 2002) for financial evaluation in the petroleum industry was implemented 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 CAPEX is made up of the cost of liquefaction plant, cost of loading jetty construction, and cost of storage tank construction. These costs were done by reviewing cost of LNG projects that were alike across the world (notably NLNG, Ichys LNG, Swinoujscie LNG) also including the inflation rate into the final cost. The Capex of the LNG project was projected to be $1.6 billion.

b. OPEX

The operating cost (OPEX) for the LNG plant contains cost of operating the plant and cost of feed gas; the operating cost of the plant was calculated as 11% of annual revenue while cost of feed gas was calculated at $4.5/MCF. The plant operating cost includes personnel costs, repairs and maintenance costs, and sundry expenses. This operating cost is in agreement with intentional LNG facility operating cost.

2) Investment Performance Indicators:

Economic profitability/feasibility of the project is measured using different standards; some of which are (Vivian *et al*, 2021):

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

Net Present Value (NPV)

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 account that analyses the amount of cash and cash equivalents that passes through a business. It is used to know the business cash position, if it is making profit or loss.

Certain calculation assumptions were made to calculate the cash flow for the recommended LNG facility. A period of 28 years was assumed for the cash flow statement for the facility running, this comprises of 3 years for construction. Total initial capital investment ($1.6 billion) and transport expenses were assumed to be known (LNG would be sold on f.o.b basis so transportation cost would not be the company business). Calculations were carried out in minimal terms; 3 years was assumed for construction of the project facility. Thus, invested capital ran during those 3 years while revenue income started from the 4th year up till the 28th year which is the project run-time period. The start-up stage of the project followed an output increase in steps of 50%, 70%, 85%, and 90%, of design volume on a yearly basis beginning from the first year of operation. Loans gotten starts running from the start of construction and attracts an interest of 5%. The interest is divided equally through the cash flow duration and payments will not commence until operation begins. Corporate taxes is calculated at 32%, OPEX is calculated at 11% of yearly revenue income. The NPV was discounted at the rates of 10% and 15% as stated above, assuming a 9% inflation rate in Nigeria during the life time of the facility. Additionally, for the income calculation, LNG was sold on an f.o.b basis at $8.50/MCF. Feed gas cost is calculated to be $4.45/MCF and 6MT of LNG requires 7.2TCF of gas was calculated.

Internal Rate of Return (IRR)

IRR measures the effective rate of return earned by an investment as though the money had been loaned at that rate. IRR is the rate that makes NPV to be Zero. IRR was also calculated for each sensitivity scenario.

Payback Period (PO)

Payback period tells the number of years required to recuperate initial capital invested by the investor and investors prefers a short payback period. It is the time on the cash flow statements that cumulative discounted cashflow is zero.

Risk Analysis

Sensitivity simulations were calculated for random inputs which was considered for three scenario (worst, normal, and best) using a different set of inputs. The result of each input and scenario was evaluated, and the final result of the model was taken as the possibility distribution of all likely outcomes. A sensitivity graph showing the three scenarios was done.

The assumptions and calculated inputs for the sensitivity simulation was calculated using variations in LNG price assuming production will not go below 90% of capacity once the 90% capacity has been achieved, the price variations used were $3.5/MCF, $5.5/MCF and $9.5/MCF. The NPV and IRR were calculated for each simulation scenario.

Deterministic Model Results

The estimated deterministic results for the LNG facility economic model developed in the previous section shows:

Cash flow Projection

The facility received a cash inflows of $800 million, $400 million, and $400 million for the 1st, 2nd and 3rd year of construction respectively. With the assumption that the facility attained 90% of volume capacity from the 4th year of facility operation, the projected gross cash flows (NCF) start at $63.75 billion and peaks at $114.75 billion (at 4th year of operation) and stays through the lifetime of the facility provided the price remains constant at $8.5/MCF and there is a smooth-running operation.

Fixed and Variable Operating Costs

OPEX which consists of plant operating cost and feed gas cost was valued at $86.325 million, $120.603 million, $146.447 million, and $155.061 million for 4th, 5th, 6th, and 7th year of operation. The subsequent years was calculated to be $172.29 million/year.

Profitability

In the 28 years period covered by the estimates, after the 3 years of construction, the 25 years projected financial statements shows a profitable and feasible project.

Payback period

The time required for the project to return the full investment amount of $1.6 billion loan and associated commitment is 6 years as calculated using the post-tax profits.

Net Present Value and Internal Rate of Return

The post-tax net cash flow of the project, discounted at 10%, and 15% were $2.903 billion, and $13.331 billion respectively. The determination of the cost of capital at which the project will break even (Internal Rate of Return) was determined to be 26%.

IV. FIGURES AND TABLES

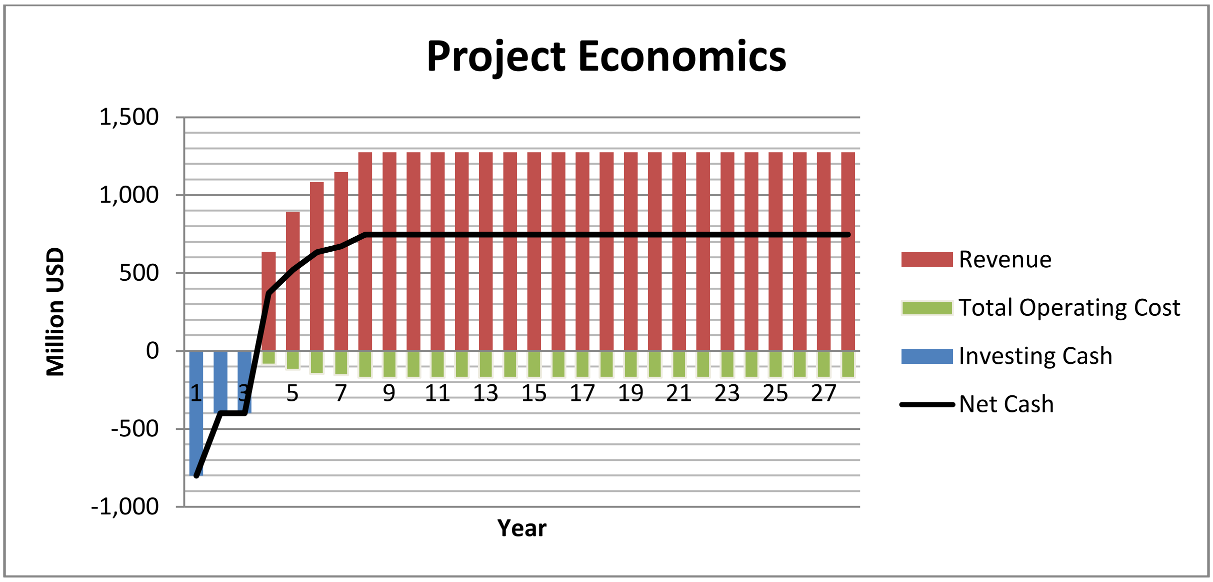

Figure 1: Calculated cash flow projections from the deterministic model.

Sensitivity Analysis

A sensitivity analysis of the impact of LNG prices on the project's NPV and IRR in order to know its performance gave the following results:

- At the price of $3.5/MCF, with an NPV of 10% and 15% the cash flow is $310.18 million and -$246.24 million respectively with an IRR of 12%.
- At the price of $5.5/MCF, with an NPV of 10% and 15% the cash flow is $1.347 billion and $384.77 million respectively with an IRR of 19%.
- At the price of $8.5/MCF, with an NPV of 10% and 15% the cash flow is $2.902 billion and $1.331 billion respectively with an IRR of 26%.
- At the price of $9.5/MCF, with an NPV of 10% and 15% the cash flow is $3.421 billion and $1.646 billion respectively with an IRR of 29%.

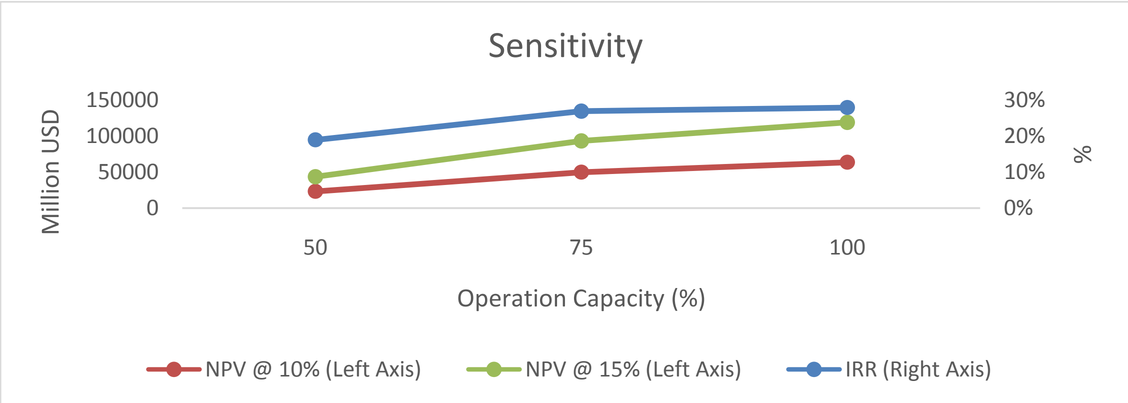

Figure 2: NPV (10% and 15%) and IRR sensitivity to varying pipeline capacity

V. CONCLUSION

The paper recommended the construction of a 6MTPA two train LNG facility in Akwa Ibom State. An economic analysis of the LNG infrastructure projected a $1.6 billion initial capital investment; a gross cash flow of $1.147 billion/year at peak performance, and a 6 years payback period. Using 28-year cash flow projection discounted at 10%, and 15%, the calculated net present values are $2.902 billion and $1.331billion respectively with an internal rate of return of 26%. Furthermore, the project performance was evaluated under different scenarios of different LNG prices, and a sensitivity analysis done; it performance showed that at $5.5/MCF, the facility will still run at profit. Nevertheless, a price below $5.5/MCF will return a non-profitable venture.

Like any other economic project, the construction of an LNG facility and would impact the economy of Nigeria through job creation, increased income and tax revenue as already determined by (Gabe, Rubin, Morris,

& Bragg, 2005).

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Vivian Ihejirika, et. al. "Construction of a Liquefied Natural Gas Infrastructure in Akwa Ibom State, Nigeria (A Proposal)." *International Journal of Engineering Science Invention (IJESI)*, Vol. 10(09), 2021, PP 13-17. Journal DOI- 10.35629/6734