Comparative Economic Analysis of Gas to Liquid and Liquefied Natural Gas Technologies

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Abstract —Nigeria has an estimate of 180 trillion cubic feet (TCF) of proved natural gas reserve which can be monetized to generate revenue for the country and proper function of various sectors. Lack of infrastructure is a constrain to monetize natural gas that is currently being flared. In this research work, Liquefied natural gas technology and Gas to liquid technology are of the utilization options. An economic comparative analysis was done, between the technologies to make better evaluation and prioritization of investment proposals and responds to world demand. The model for the study was developed using Microsoft Excel. The plant capacity of for the LNG and GTL plant is 1BCF of natural gas per day for 330 working days in a year for 25years. Both projects depended on the Capital expenditure, operating expenditure, natural gas Price, discount rate etc. Some economic indicators such as, net present value, internal rate of return, and profitability index were applied in the model for the comparison of the two technologies. These economic indicators gave results that were far different for an absolute choice to be made. From the results the GTL technology is better placed compared to LNG technology. This will enable the Nigerian government and the oil and gas companies recover maximum revenue possible from natural gas. Natural gas flared in Nigeria accounted for 10% of the total amount flared globally in 2011 although it has decreased in recent years, from 540 Bcf in 2010 to 428 Bcf in 2013.

Index Terms—LNG, GTL, FLARE, Utilization, Capex, NPV, IRR, Sensitivity analysis.

1 INTRODUCTION

ENERGY is the strength of Nigeria's economic growth and development. It plays a significant role in the nation's international diplomacy, and it serves as a tradable commodity for earning the national income, which is used to support government development programs. It also contributes to the production of goods and services in the nation's industrial, transportation, agricultural, health, and educational division, including the tools for politics, security and international relation [1]. Nigeria had an estimated 180 trillion cubic feet (Tcf) of proved natural gas reserves as of January 2015, according to the latest data from the department of petroleum resources, making Nigeria the ninth-largest natural gas reserve holder in the world and the largest in Africa. Out of this figure, some volumes are said to be stranded and not used. Despite holding a global top-10 position for proved natural gas reserves, Nigeria produced 1.35 Tcf of dry natural gas in 2013, ranking among the world's top 30 largest natural gas producers [2].Many researchers (such as [4], [5]) have worked on gas utilization based on the optimization and the economic opportunities. In this research work, an economic comparative analysis was done, between Liquefied natural gas and Gas to liquid technologies from the view point of Nigerian government and other oil and gas sector players, to make better evaluation and prioritization of investment proposals.The objective of this research work is, to review different options (GTL, LNG technologies) for using natural gas in Nigeria, taking into account the technology and costs of conversion (liquefaction and re-gasification), in the case of LNG; reaction and processing in the

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GTL) and respective transportation. An economic model was developed using Microsoft excel, which was used to perform an evaluation on the gas utilization options (LNG and GTL projects). A plant life of 25 years was incorporated, a construction period of 3 years, a 5-year straight line depreciation (SLD) schedule. Both projects have huge capital expenditure. Some economic indicators namely net present value (NPV), internal rate of return (IRR), profitability index (PI), days payable outstanding (DPO), break-even analysis (BE), Present value ratio (PVR) and discounted cash flow (DCF) techniques are applied in the model. For the purpose of this thesis, the NPV, IRR, PI and BE were used to compare the results of both projects.

2 WEIGHING OF PROJECTS

The economic indicators are weighed and used to evaluate the projects. These indicators will provide measures for evaluating the health of both projects. The projects are mutually exclusive when accepting one investment and rejecting even though the latter may pass muster as good investment. NPV and IRR are two of the most widely used investment analysis and capital budgeting decision tools.

2.1 NET PRESENT VALUE (NPV)

The NPV of a project or investment reflects the degree to which cash inflow, or revenue, equals or exceeds the amount of investment capital required to fund it. When assessing multiple projects, businesses use NPV as a way of comparing their relative profitability to ensure that only the most lucrative ventures are pursued. A higher NPV indicates that the project or investment is more profitable [6].

The following is the formula for calculating NPV:

$$NPV = \sum_{t=1}^{T} \frac{C_t}{(1+r)^t} - C_o \quad (1)$$

Where:

C_t = net cash inflow during the period t

C_o = total initial investment costs

r = discount rate, and

t = number of time periods

A positive net present value indicates that the projected earnings generated by a project or investment (in present dollars) exceed the anticipated costs (also in present dollars). Generally, an investment with a positive NPV will be a profitable one and one with a negative NPV will result in a net loss. This concept is the basis for the Net Present Value Rule, which dictates that the only investments that should be made are those with positive NPV values [7].

2.2 INTERNAL RATE OF RETURN (IRR)

Internal rate of return (IRR) is the discount rate at which the net present value of an investment becomes zero. In other words, IRR is the discount rate which equates the present value of the future cash flows of an investment with the initial investment. It is one of the several measures used for investment appraisal.

The acceptance criterion generally employed with the internal rate of return method is to compare the internal rate of return to a required rate of return, known as the cut-off, or hurdle rate. The discount rate assumed for the purpose of this research work shall be 10% [8]. An investment is acceptable if the IRR exceeds the required return, otherwise it should be rejected.

2.3 PROFITABILITY INDEX (PI)

Profitability index is a financial tool which tells us whether an investment should be accepted or rejected. It uses the time value concept of money and is calculated by the following formula. The conditions

for accepting or rejecting the decision are as follows; If PI is greater than 1, accept the investment.

If PI is less than 1, reject the investment and if PI = 1, then indifferent (may accept or reject the decision).

2.4 BREAK EVEN ANALYSIS (BE)

Breakeven analysis is used to determine when your business will be able to cover all its expenses and begin to make a profit. It is important to identify your start up costs, which will help you determine your sales revenue needed to pay ongoing business expenses.

To calculate your breakeven point, you will need to identify your fixed and variable costs. Fixed costs are expenses that do not vary with sales volume, such as rent and administrative salaries. These expenses must be paid regardless of sales, and are often referred to as overhead costs. Variable costs fluctuate directly with sales volume, such as purchasing inventory, shipping, and manufacturing a product. To determine your breakeven point, use the equation below:

Breakeven point = fixed costs/ (unit selling price – variable costs).

3 SOME ECONOMICAL TERMS APPLIED

A measure of changes in a company's cash account during an accounting period, specifically its cash income minus the cash payments it makes (Cash Flow). The budget highlights for cash flow are as follows:

a. Capital Expenditure
b. Sales/Revenue
c. Operating Expenditure
d. Production cost
e. Tax rate and others.

3.1 CAPITAL EXPENTITURE

A capital expenditure (CAPEX) is an amount spent to acquire or improve a long-term asset such as equipment or buildings. Usually the cost is recorded in an account classified as Property, Plant and Equipment. The cost (except for the cost of land) will then be charged to depreciation expense over the useful life of the asset. The CAPEX for the LNG project of is $3.7 billion for a plant to process 1.2MMBTU/D of feed gas while CAPEX for the GTL plant is 1MMBTU/D of feed gas for the purpose of this work.

The CAPEX for the Nigerian Liquefied Natural gas (NLNG) train 6 is $2.5 billion to process 800MMSCF/D of feed (NNPC, 2005) and the CAPEX for the Escravos Gas to Liquid (EGTL) plant is $1.7billion to process 340MMSCF/D of feed gas [9]. Both CAPEX and capacities is the base for this work.

TABLE 1 Estimated CAPEX for the LNG and GTL plant.

Project	LNG	GTL
Plant Capacity	7.67MMTPA	33MMBBL/YEAR
Feed gas	1BCF/D	1BCF/D

3.2 SALES REVENUE

Sales revenue usually refers to the sum of money owed or paid to the company for sales of goods and services [13]. The revenue generated by the sale of product from a plant is a key factor in analyzing the cash flow pattern for a given plant. The total annual revenue from the product sales is the sum of the unit price of each product multiplied by its rate of sales.

3.2 OPERATING EXPENDITURE (OPEX)

Operational expenditure (OPEX) is the money a company spends on an ongoing, day-to-day basis in order to run a business or system or expenditures that a business incurs to engage in any activities not directly associated with the production of goods or services.

The annual Operating Expenditure (OPEX) used in the research work includes cost for materials and supplies, labour, utilities and maintenance and feed gas cost. Al-Saadoon[10] gave an annual operating expenditure for large projects to be in the range of 5-7% of capital expenditure. For the purpose of this work the OPEX is 5% of the capital expenditure.

3.3 PRODUCTION COST

Peters reported in 2003, the total cost of production is a major factor of an economic analysis. It is the total of all cost of operating the plant, cost of selling the products including shipping, cost of feedstock and raw materials used for production as well as contributing to corporate functions such as management and research and development.

3.4 TAX RATE

Percentage of income paid in taxes, it can also be said to be levies on organisation by government. According to the Nigerian tax card data in 2014 company income tax rate is 30% while company royalty rate is between 5-7% for oil and gas sector.

In this research work, the company income tax rate is grouped as tax rate. A 30% Income tax rate and a Royalty tax rate of 5% was assumed in this research work**.**

3.5 FEEDGAS COST

Feedstock prices can vary greatly based on actual production costs and the financial structure of the project. The average cost of feed gas a for a chemical plant ranges from $0.00/MMBTU to $1.00/MMBTU [12].

For the purpose of this research work, gas prices of $0.25/MMBTU, S0.50/MMBTU, and $1.00/MMBTU shall be used in the analysis while the base case price shall be S0.50/MMBTU.

3.6 SHIPPING COST

For any gas project, the shipping cost varies depending on the type of gas project, the gas product and the distance between the seller and a buyer with is directly proportional to operating cost of the ship.

Chang [13] reported the shipping cost for the LNG as $0.2/MMBTU per 1000KM while GTL is $1.35/bbl per 1000KM. [14] also stated that the shipping cost for LNG ranges between $0.43/MMBTU and $0.71/MMBTU.

The shipping cost for GTL is $1.22/bbl while that of LNG is $0.72/MMBTU for the purpose of this work.

3.7 PRODUCT PRICING

Estimates that natural gas can be economically produced and delivered to the US and LNG in the price ranges of about $2.60-$4.80 per MMBTU depending largely on terms established by producing countries for E&P investment and shipping distance and cost [15]

GTL plant depends on the price of crude oil and the price of the refined products [16]. The price of diesel and Naphta as stated by [17] is $5/bbl and $3/bbl respectively.

The daily average oil price of West Texas Intermediate (WTI) in 2008 for the period from 1 January to 31 October 2008 was $110 per barrel. The average daily oil price in 2006 and 2007 was $66 and $72 per barrel respectively. The daily oil price peaked at $145 per barrel in July 2008, but has since dropped to under $60 per barrel (October 2015). This corresponds to a decline of more than 50%.

TABLE 2 GENERAL ASSUMPTIONS FOR THE LNG PLANT

PARAMETERS	VALUES
PLANT LIFE	25 YEARS
PLANT STARTUP YEAR	2014
PLANT CONSTRUCTION PERIOD	3 YEARS
PLANT STREAM DAYS PRODUCTION PROFILE	330 YEARS
PLANT CAPACITY	7.67MMTPA
LNG PRODUCT PER ANNUM	**7.5MMTPA**
CUMMULATIVE PROD.	**100%**
OWNER'S EQUITY	100%
COMPANY TAX RATE	30%
ROYALTY	5%
QUANTITY OF FEED GAS	**413793103.4**
FEED GAS COST	$ 0.50/MMBTU
DISCOUNT RATE (R)	10%
GENERAL INFLATION	NONE
LNG PRODUCT PRICE	$ 7.00/MMBTU
NUMBER OF TRIPS	12 PER ANNUM
LNG SHIPPING COST	$ 0.72/MMBTU
LNG GENERAL INVESTMENT COST	$ 3.7 BILLION
PLANT CONSTRUCTION CAPITAL SPENDING	25% FOR YR 1
	35% FOR YR 2
	40% FOR YR 3
DEPRECIAION	5 YEARS
CAPITALIZED INVESTMENT	70%

LNG PROCESS ASSUMPTIONS	
EFFICIENCY LOSSES IN THE LNG VALUE CHAIN	**COST**
LIQUIFACTION STAGE (9%)	6.41/MMBTU
TRANSPORTATION-SHIPPING (2%)	4.65/MMBTU
RE-GASIFICATION POINT (2%)	1.76/MMBTU
TOTAL EFFICIENCY LOSS	**13%**
PLANT STREAM CONSTUCTION CAPITAL SPENDING (YEAR)	**%**
1	**25%**
2	**35%**
3	**40%**

TABLE 3 GENERAL ASSUMPTIONS FOR THE GTL PLANT

PARAMETERS	VALUES
PLANT LIFE	25 YEARS
PLANT CONSTRUCTION PERIOD	3YEAR
GTL STARTUP YEAR	2014
PLANT STREAM DAYS PRODUCTION PROFILE	330
PLANT CAPACITY	100000 BBL/D
FEED GAS	1 BCF/D
TAX RATE: ROYALTY	5%
COMPANY TAX	30%
OWNER'S EQUITY	100%
CUMMULATIVE PRODUCTION	100%
GENERAL INFLUATION	NONE
FEED GAS COST	$ 0.50/MMBTU
GTL PRODUCT PRICE: DIESEL	$ 5.00/BBL
NAPTHA	$ 3.00/BBL
KEROSENE	$ 2.00/BBL
DISCOUNT RATE (R)	10%
PLANT CONSTRUCTION CAPITAL SPENDING	25% FOR YR 1
	35% FOR YR 2
	40% FOR YR 3
GTL SHIPING COST	$ 1.22/BBl
CRUDE OIL PRICE	$ 0.45
GENERAL INVESTMENT COST	$ 3.4 BILLION
CAPITALIZED INVESTMENT	70%
DEPRECIATION	5 YEARS

GTL PROCESS ASSUMPTIONS	
Syngas production	24%
FT synthesis	12%
product work up	8%
Utilities	12%
Offsites	16%
Other processing unit	8%
Gas plant	20%

GTL PRODUCT	BREAK DOWN
DIESEL	75%
NAPHTA	20%
KEROSENE	5%

4 RESULTS

The review on the viability of the LNG and the GTL projects were done in order to know which of the projects is more feasible to venture into. Both projects had same plant capacity of 1BCF of natural gas each.

The Plant life of the projects was 25years respectively. The plant construction lasted for 3year and production started on the 4th year. The plant utilization capacity is assumed to be 50% for 5 years, 70% for the next 5years and 100% for the rest of the production years. The cost of feed gas increased at a rate of 4% for every 4years.

The economic parameters were evaluated with the aid of the developed model. The internal rate of return (IRR), Profitability Index (PI), Net Present value (NPV), Days payable outstanding (DPO) and other economic indicators for both projects where observed and compared.

The Initial Rate of Return for the LNG project 24% and 31% for the GTL project respectively at the discount rate 10%. The LNG will worthwhile when the price of gas is $6/MMBTU and GTL at oil price of $25/BBL.

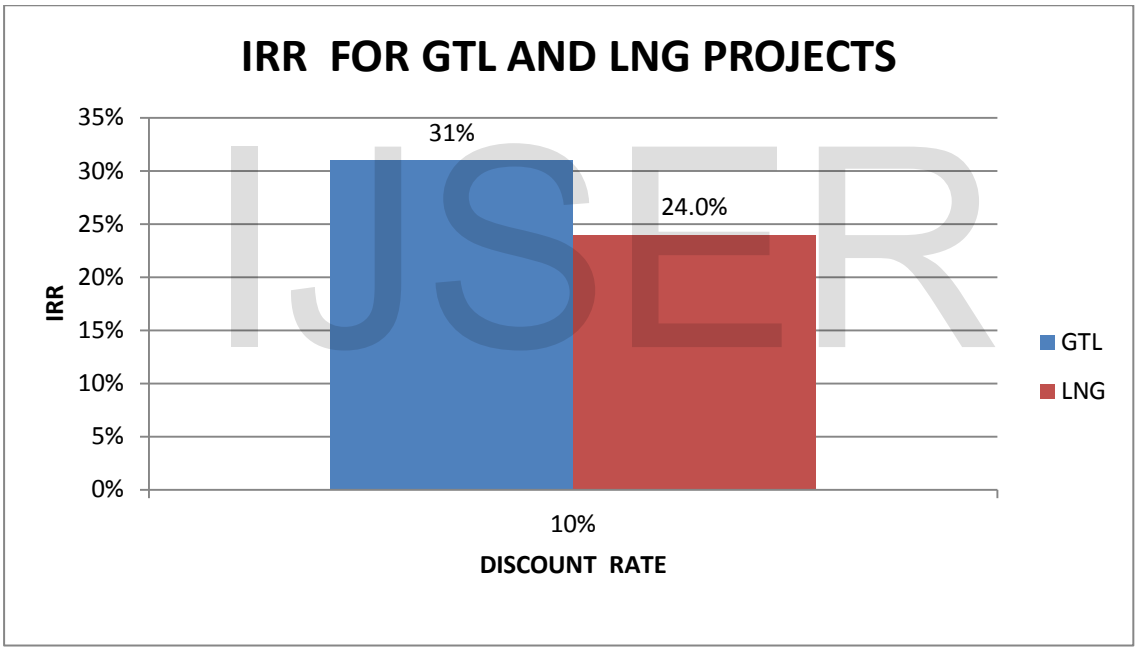

Fig 1: IRR for GTL and LNG projects.

The Monte Carlo simulation for the GTL IRR gave 33% from 0% IRR well above single estimate value which is very close the normal IRR (31%) at a mean value of 100% certainty.

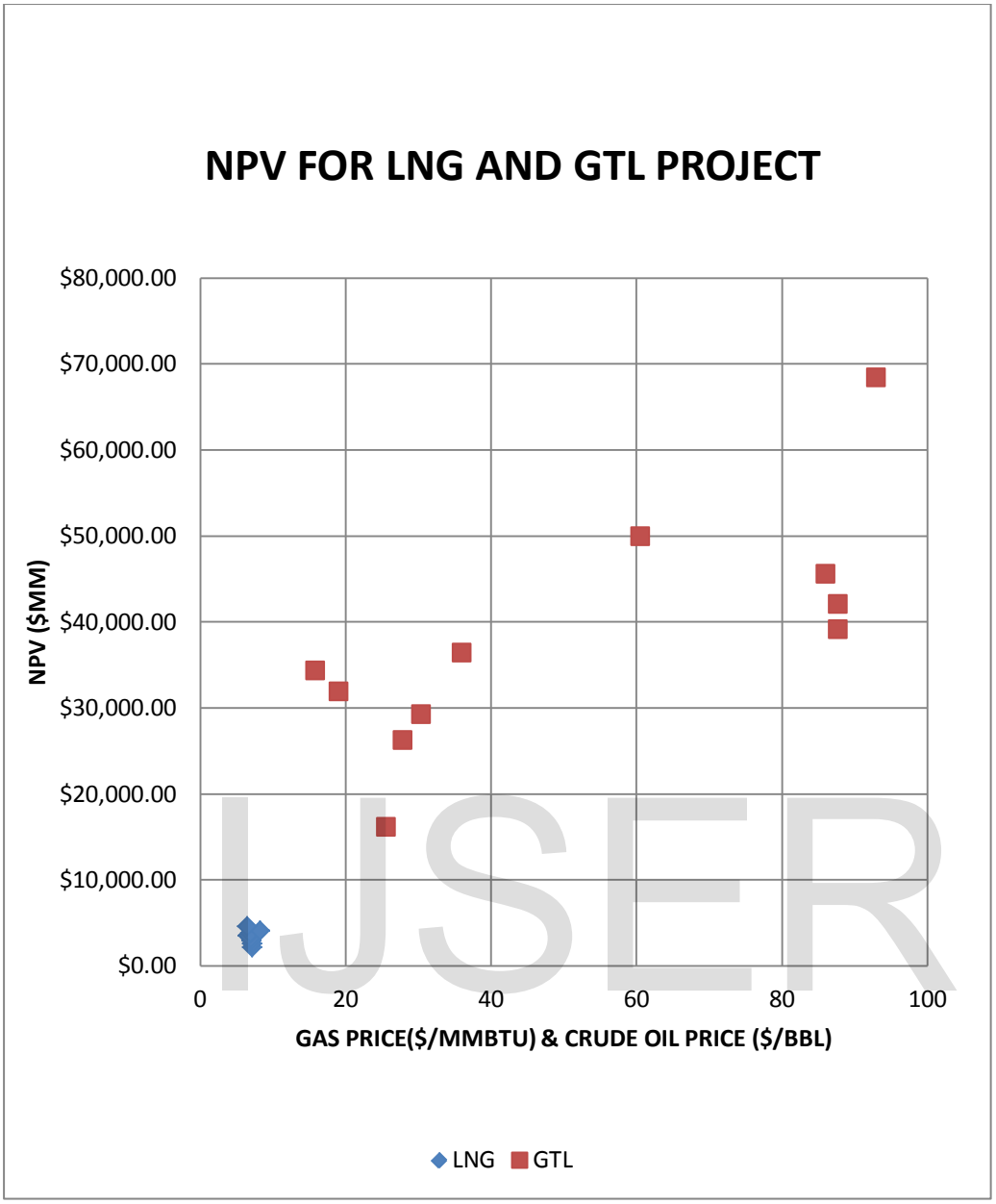

Fig 2: NPV for LNG and GTL projects

Fig 2.Shows the price of gas between $7/MMBTU and $9/MMBTU and crude oil price between $25/bbl to $85/bbl. The resultant net present value (NPV) for LNG is $5,164.40MM while the GTL is $3, 4040.43MM. However the GTL project offered better return to project compared the LNG project.

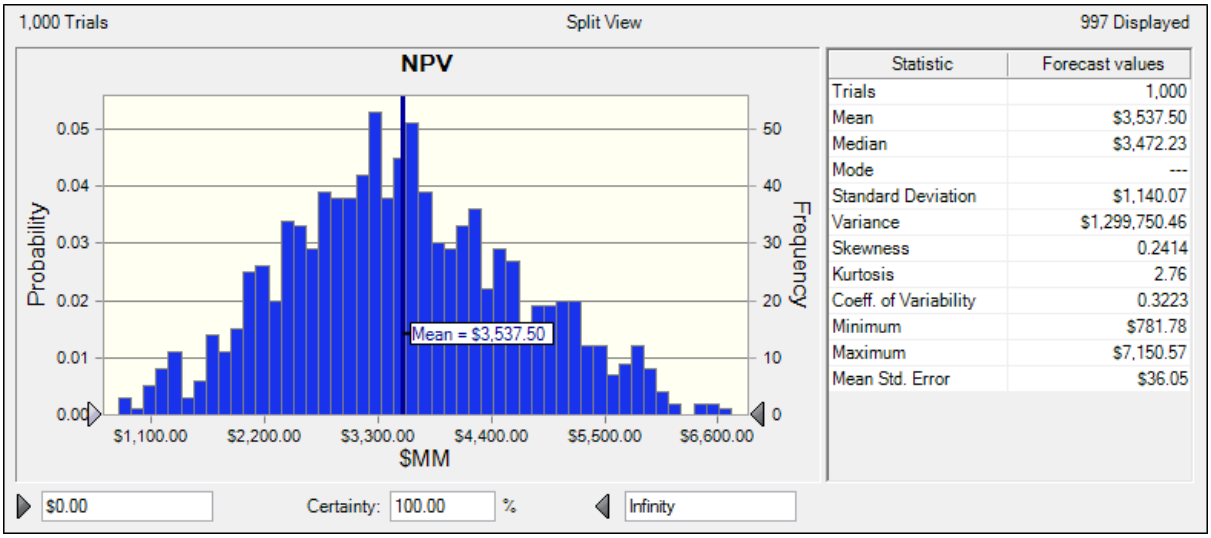

Fig 3: LNG NPV (MONTE CARLO Simulation)

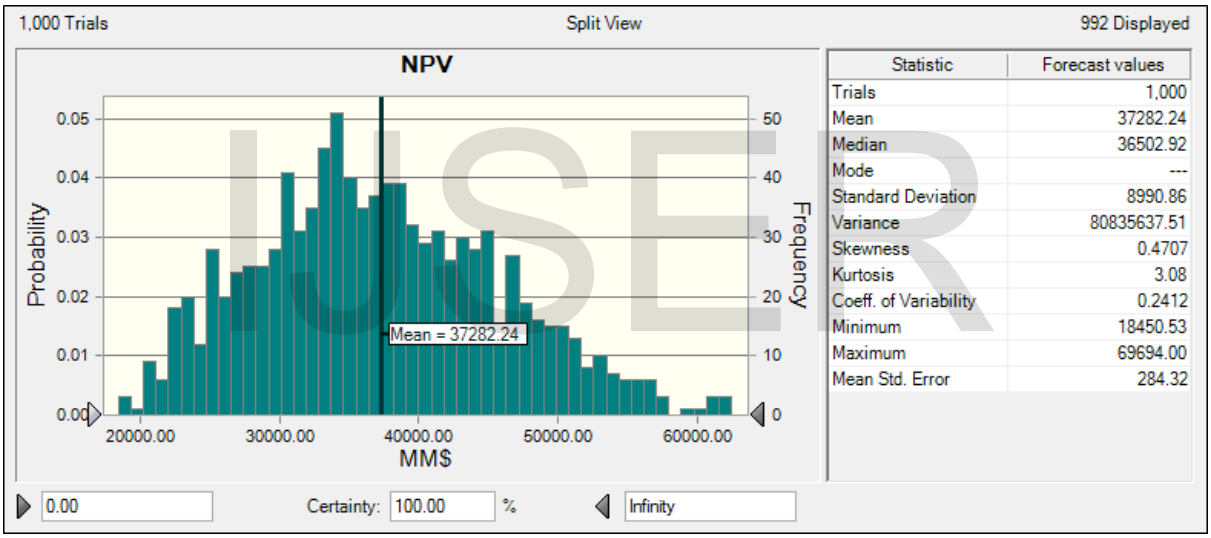

Fig 4: GTL NPV (MONTE CARLO Simulation)

From 0 to NPV well above single point estimate value which corresponds to the NPV (Net NPV of $3,537.50MM for the LNG project and $3, 4040.43MM for the GTL project respectively) there is a 100% certainty of having a minimum NPV of 0 which is the Break Even point and an NPV well above single point estimate value.

From the statistical analysis the percentile shows that from (0%-100%). For the LNG project, there is an increase in NPV values from $781.78MM - $7150.57MM with a mean NPV of $45740.65MM for a frequency distribution of 1000 trials.

From the statistical analysis the percentile shows that from (0%-100%). For the GTL project, there is an increase in NPV values from $18450.35MM - $69694MM with a mean NPV of $37282.24MM for a frequency distribution of 1000 trials.

At a bit above 50% of the total 1000trials, an NPV of zero (Break Even point) and above single point estimate value respectively.

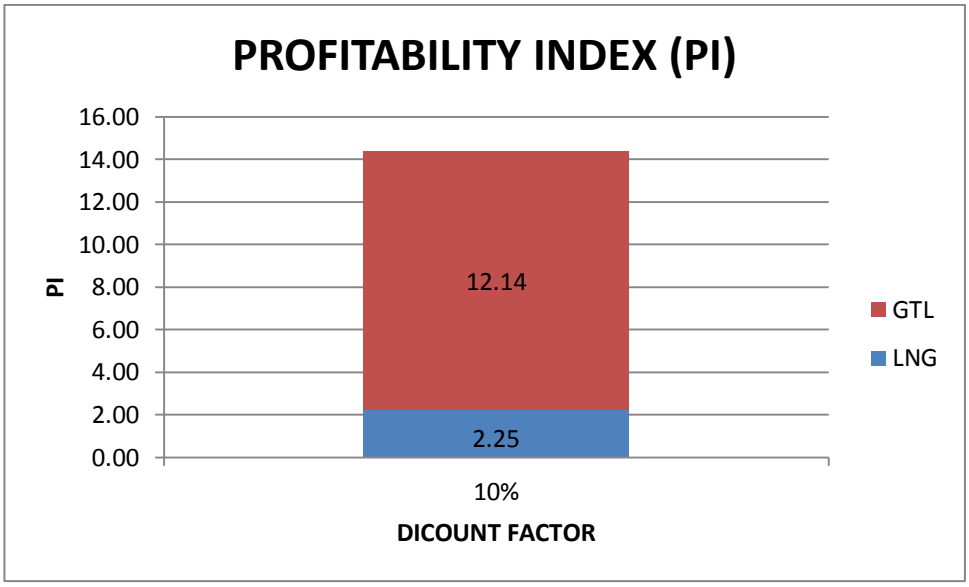

Fig 5: PI of GTL and LNG

The profitability index (PI) which gave the present worth of every dollar invested in each of the projects. The LNG Project generated a PI of 2.67 while the GTL project gave a PI of 12.14. Each $1 invested in the GTL project gave a profit of $10.3at crude oil price of $75/bbl and the LNG project delivers $3.1 at gas price $7/MMBTU respectively.

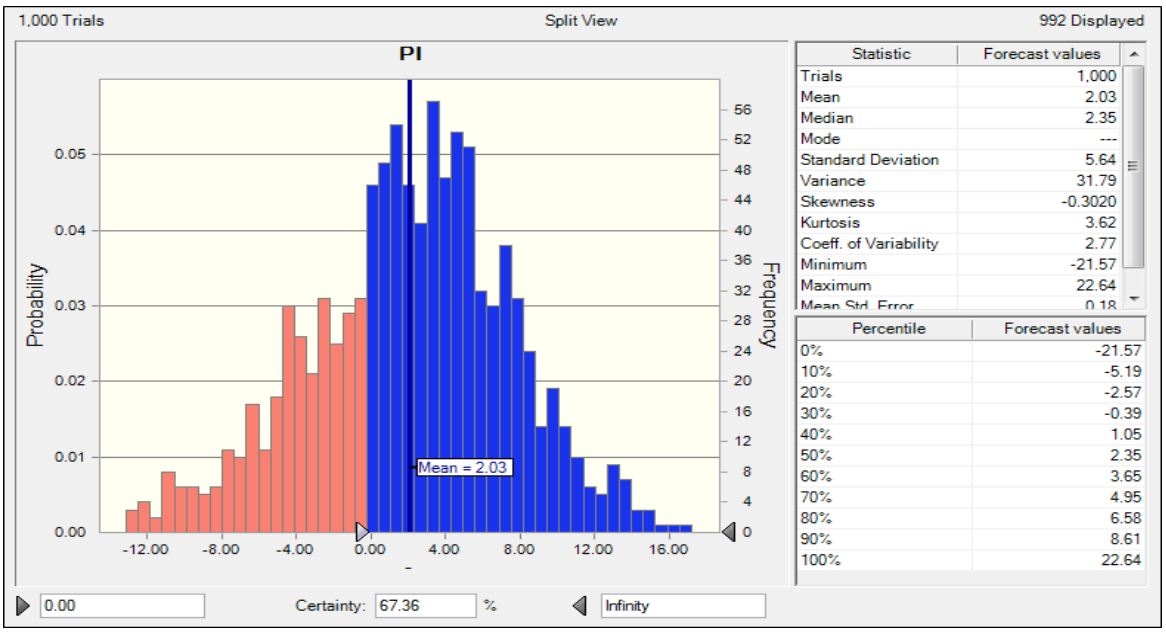

Fig 6: Monte Carlo simulation for the LNG project PI

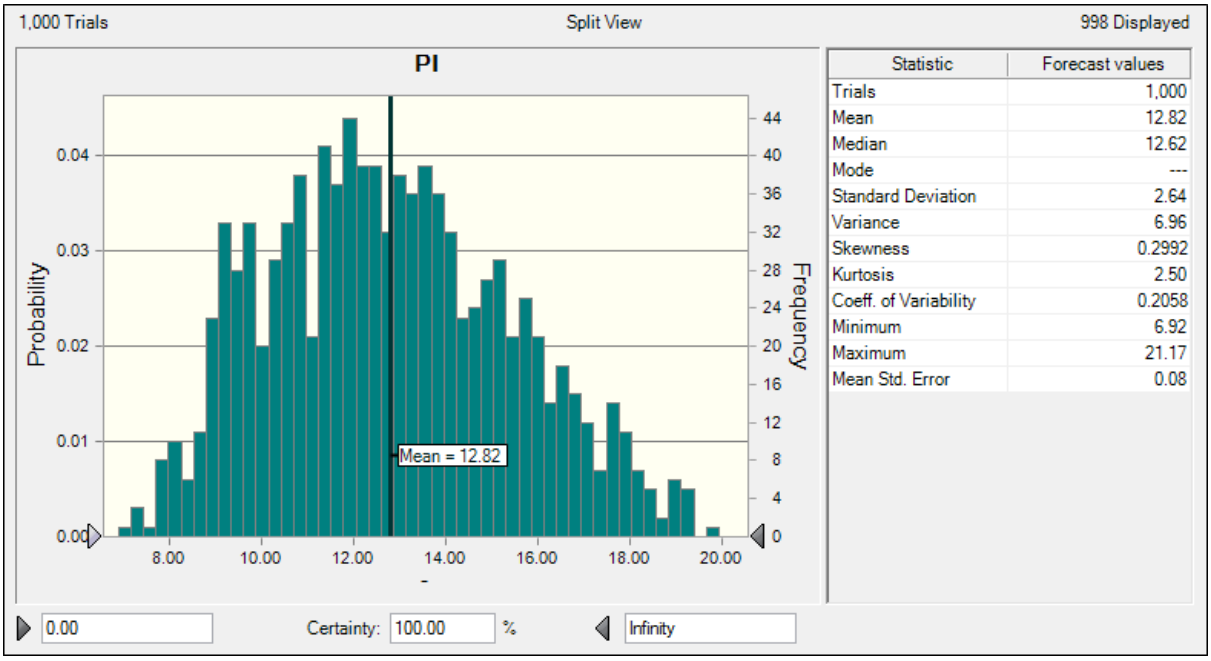

Fig 7: Monte Carlo simulation for the GTL project PI

4.1 SENSITIVITY ANALYSIS

Sensitivity analysis is very useful when attempting to determine the impact of a particular variable will have if it differs from what was previously assumed under a given set of assumptions. Tornado chats were done using expected input values and a set of maximum and minimum values from it. Other sensitivity analysis can be run from a developed model. Our focus on this research work is limited to the plant capacity of both projects.

4.1.1 LNG SENSITIVITTIES.

The parameters used to examine the LNG project are a total of ten. Table 4.1 shows the input parameters used; the most likely value, minimum expected value and maximum expected value.

Table 4 APPLIED PARAMETERS FOR LNG SENSITIVITY

MONTE CARLO SIMULATION ASSUMPTIONS FOR LNG				
PARAMETERS	MINIMUM EXPECTED VALUE	MOST LIKELY EXPECTED VALUE	MAXIMUM EXPECTED VALUE	DISTRIBUTION
PLANT LIFE	20	30		Uniform
COMPANY TAX RATE	25%	35%		Uniform
ROYALTY	5%	8%		Uniform
FEED GAS COST	0.5	0.6		Normal
DISCOUNT RATE (R)	8%	10%		Uniform
LNG PRODUCT PRICE	6	9		Normal

FEED GAS	350,000,000	413,793,103.45	550,000,000	Triangular
LNG PRODUCTION	300,000,000	360,000,000	400,000,000	Triangular
LNG SHIPPING COST	0.5	0.8		Normal
CAPEX	3,500,000,000	4,000,000,000		Uniform

Table 4. shows the effect of the input parameters on NPV OF THE LNG project. Usually, in a tornado chart, the longest bar has the greatest influence on the NPV of a project, while the parameter with the shortest bar has the least influence on the project. It's usually placed at the bottom of the chart.

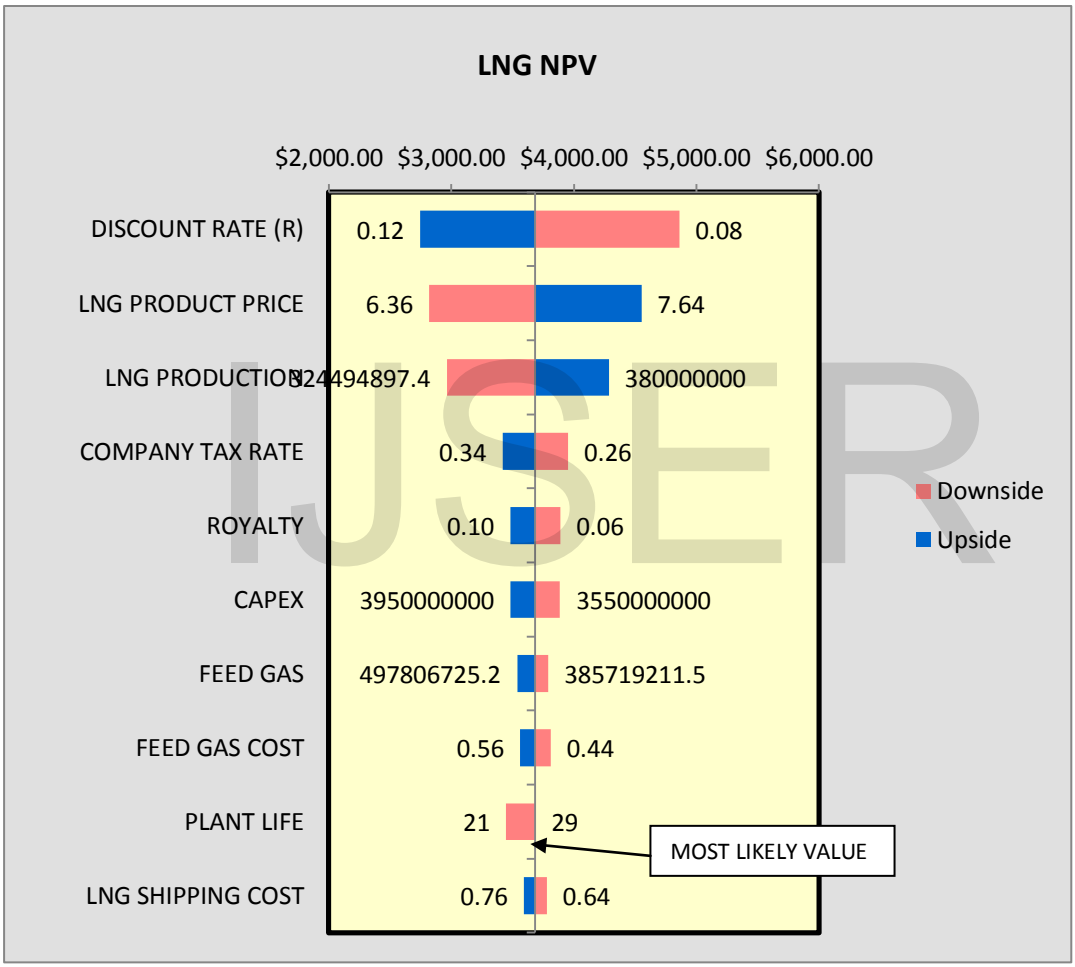

Fig 8: TORNADO CHART FOR LNG NPV

The values on both horizontal ends of the bar indicate the range of the variables while the vertical line is the most likely value. From the chart, the discount rate has the most sensitive impact compared to other parameters. A shift in discount rate between 8% and 12% will cause a change in NPV $6billion from $2billion. Other parameters would have an appreciable impact on the viability of the LNG project.

The company tax rate affects viability of the LNG project. An increase in tax rate from 30% to 34% will

reduce the investor's interest. While a decrease in decrease rate from 30% to 26% will encourage the investor. The availability of gas as low as increases NPV by $0.44/MMBTU will increase NPV by $5billion

Also, a 10% decrease in Capex from $3.7billion to $3.3billion will increase NPV by $50billion

4.1.2 GTL SENSITIVIY ANALYSIS

Fifteen input parameters were used to investigate the sensitivities the GTL project, as seen in table 4.2; the minimum value, most likely value and minimum value.

Table 5: Applied parameters for GTL sensitivity analysis

MONTE CARLO SIMULATION ASSUMPTIONS FOR GTL				
PARAMETERS	MINIMUM EXPECTED VALUE	MOST LIKELY EXPECTED VALUE	MAXIMUM EXPECTED VALUE	DISTRIBUTION
PLANNT LIFE (YEARS)	20	30		UNIFORM
ROYALTY (%)	0.05	0.07		UNIFORM
COMPANY TAX (%)	0.25	0.35		UNIFORM
FEED GAS COST($/MMBTU)	0.5	0.07		NORMAL
DIESEL PRICE($/BBL))	4.45	5.5		UNIFORM
NAPHTA PRICE($/BBL)	2.7	3.3		UNIFORM
KEROSENE PRICE($/BBL)	1.8	2.2		UNIFORM
DISCOUNT RATE(%)	0.1	0.08		NORMAL
GTL SHIPPING COST($/BBL)	1.22	1		NORMAL
CRUDE OIL PRICE($/BBL)	30	40.00		NORMAL
FEED GAS (MMBTU)	350000000	413713103.5	550000000	TRIANGULAR
GTL DIESEL PRODUCTION(BBL)	100,000,000	124,137,931	150,000,000	TRIANGULAR
CAPEX	3200000000	3700000000		UNIFORM
GTL NAPHTHA PRODUCTION(BBL)	30,000,000	33103448.24	35000000	TRIANGULAR
GTL KEROSENE PRODUCTION (BBL)	7000000	8275862.06	9000000	TRIANGULAR

The GTL NPV tornado chart shows that price of the GTL kerosene has the highest impact on the project viability. A kerosene price of $1.72/bbl gives an NPV of $60billion from $20billion for most likely values when the price of kerosene is $1.08/bbl.

More so, an increase in discount rate from 10% to 21%will reduce the interest rate anticipated by the investors of the GTL project while a decrease from 21% to 5% will buoy up the investors to develop the GTL project.

The company tax rate is another factor that affects viability of the GTL project. An increase in tax rate from 30% to 34% will reduce the investor's interest. While a decrease in decrease rate from 30% to 26% will embolden the investor.

Also, a decrease in Capex from $3.7billion to $3.4billion will increase NPV by $4billion

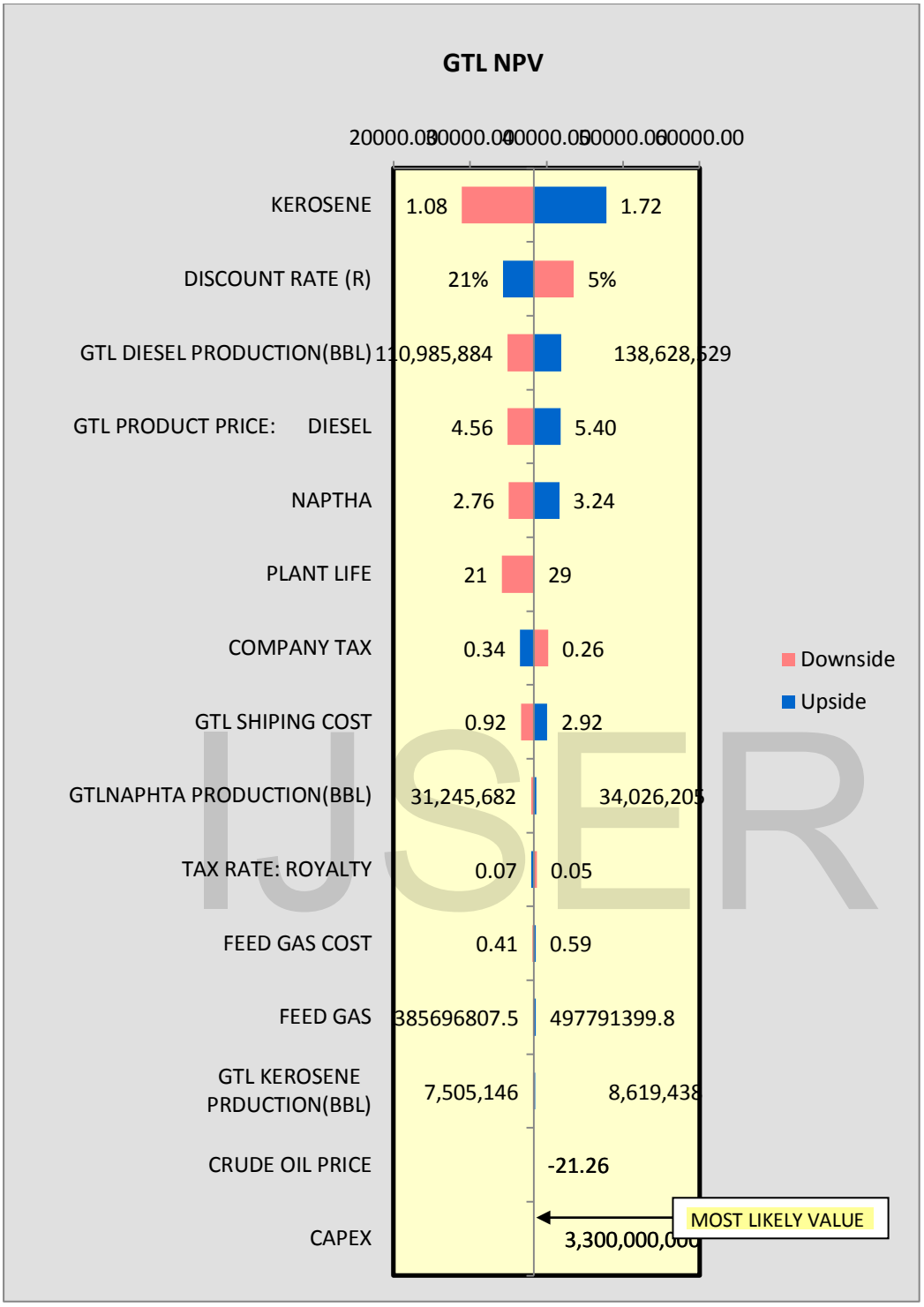

Fig.9 TORNADO CHAT FOR GTL NPV

Finally, the result of the simulation of both projects shows that the LNG and GTL projects gave distinctive economic returns at a kerosene price$1.5/bbl and a discount rate of 10%.

4. CONFIRMATION OF RESULTS

The results obtained from this research work were affirmed from authors and organizations in the oil and gas industry. Such are stated bellow.

In a GTL report by [18]), Capex was a significant factor which is greatly affected by crude oil price. In 2007, he stated that GTL economics is driven by four variables (crude oil price, capital cost, gas price and other fiscal terms).The crude oil price was the biggest driver of the GTL economics.

In 2006 [19], estimated that the capital cost for GTL project ranges between $50,000/BPD and $60,000/BPD. The capital cost in this research work for the GTL plant is between $33,000/BPD for a 100,000BPD plant. Also, [20] estimated a range of $2.4billion and $6.0billion for an LNG capital cost. The LNG capital cost used in this research work was 3.7billion for a plant capacity of 1Bcf/d.

5. CONCLUSION

The Results from the developed model shows that both the LNG and the GTL projects are economically viable. The LNG project will be profitable at a 9% discount rate and a liquefied natural gas price of $7/mmbtu while the crude oil price will be more profitable at a GTL kerosene price of $1.5/bbl and a decrease in discount rate as low as 6%.

The model that was applied to generate the tornado sensitivity chat is quite vigorous such that it automatically generates results for any changed parameter. It creates output values for all inputted values. It can also scrutinize various scenarios. The results from the model were applied in the tornado chart in other to get the tornado chat for the LNG and GTL project.

It is significant to note that, the GTL technology is peak of its commercialization and technological advances. Although its technology is less mature compared to the fully commercialized technology.

The results from the NPV, IRR and PI of the LNG and GTL project were far different for an absolute adoption to be made. The break even process also gave the GTL project an edge over the LNG project. It broke even at a lower cost compared to LNG.

Improved optimization process for GTL plant will reduce the running cost of the plant. The next generation catalysts will lower the GTL operating cost by improving catalysts productivity and allowing higher reactor intensities.

[18] in 2010, stated that Increase in carbon and thermal efficiencies are important measures of technology improvement; the co-based sasol SBCR process has a carbon efficiency of about 75% minimizing CO2 losses in syngas production combined with other potential improvements in gas separations could increase carbon efficiencyto85%. GTL carbon efficiency is 60%-66%.

The economy of scale which has been instrumental in the reduction of cost for the LNG process will also help reduce the capital cost for the GTL process when a larger single train capacity plant is built. Adding more trains to an existing GTL plant will also help better the economics of the plant. GTL has a very big market that cannot be inhibited unlike LNG which must have a secured market before the project is processed.

The growing realisation that cleaner fuels are vital for the future of the planet will enable natural gas to become an increasingly important source of fuel for power generation worldwide.

An investigation on a power generating plant close do a GTL facility to utilize excess steam/power which could create significant capital saving should be investigated in order to improve the GTL process.

More so, a collaborative investigation of the LNG and GTL projects should be done since both projects have almost same utilities such as the flare system, the nitrogen purge system and the liquefied petroleum gas storage facilities.

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8. APPENDIX

CASH FLOW FOR GTL PLANT

TIME	YEAR	CAPEX(MM$)	OPEX	DEPRECIATION	FEEDGAS (MMBTU)	LIQUID VOLUME(BBL)	REVENUE(MM$)	TAX(MM$)	CASH FLOW(MM$)	DISCOUNTED CASH FLOW (MM$)
0	2014	850	-	119	-	-	-	-	- 850.00	- 850.00
1	2015	1,190	-	286	-	-	-	-	- 1,190.00	- 1,081.82
2	2016	1,360	-	476	-	-	-	-	- 1,360.00	- 1,123.97
3	2017	-	170	476	206,896,551.5	82,758,621	1,552	623.72	1,117.02	839.23
4	2018	-	170	476	206,896,551.5	82,758,621	1,552	619.59	1,118.26	763.79
5	2019	-	170	357	206,896,551.5	82,758,621	1,552	738.59	1,082.56	672.19
6	2020	-	170	190	289,655,172.1	115,862,069	2,172	1,411.42	1,470.37	829.98
7	2021	-	170	-	289,655,172.1	115,862,069	2,172	1,601.82	1,413.25	725.22
8	2022	-	170	-	289,655,172.1	115,862,069	2,172	1,596.03	1,414.98	660.10
9	2023	-	170	-	413,793,103.0	165,517,241	3,103	2,352.90	2,072.41	878.90
10	2024	-	170	-	413,793,103.0	165,517,241	3,103	2,352.90	2,072.41	799.00
11	2025	-	170	-	413,793,103.0	165,517,241	3,103	2,352.90	2,072.41	726.37
12	2026	-	170	-	413,793,103.0	165,517,241	3,103	2,344.62	2,074.89	661.12
13	2027	-	170	-	413,793,103.0	165,517,241	3,103	2,344.62	2,074.89	601.02
14	2028	-	170	-	413,793,103.0	165,517,241	3,103	2,344.62	2,074.89	546.38
15	2029	-	170	-	413,793,103.0	165,517,241	3,103	2,344.62	2,074.89	496.71
16	2030	-	170	-	413,793,103.0	165,517,241	3,103	2,336.34	2,077.37	452.10
17	2031	-	170	-	413,793,103.0	165,517,241	3,103	2,336.34	2,077.37	411.00
18	2032	-	170	-	413,793,103.0	165,517,241	3,103	2,336.34	2,077.37	373.63
19	2033	-	170	-	413,793,103.0	165,517,241	3,103	2,336.34	2,077.37	339.67
20	2034	-	170	-	413,793,103.0	165,517,241	3,103	2,328.07	2,079.86	309.16
21	2035	-	170	-	413,793,103.0	165,517,241	3,103	2,328.07	2,079.86	281.05
22	2036	-	170	-	413,793,103.0	165,517,241	3,103	2,328.07	2,079.86	255.50
23	2037	-	170	-	413,793,103.0	165,517,241	3,103	2,328.07	2,079.86	232.27
24	2038	-	170	-	413,793,103.0	165,517,241	3,103	2,319.79	2,082.34	211.41
		3,400	**3,740**	-			-	**44,005.79**	**37444**	**9010**

CASH FLOW FOR LNG PLANT

TIME	YEAR	CAPEX (MM$)	OPEX (MM$)	DEPRECIATION	FEED GAS (MMBTU)	LIQUID VOLUME (MMBTU)	REVENUE (MM$)	TAX(MM$)	CASH FLOW (MM$)	DISCOUNTED CASH FLOW (MM$)
0	2014	925		129.50				-	-925	-925
1	2015	1,295		310.80				-	-1295	-1177.272727
2	2016	1,480		518.00				-	-1480	-1223.140496
3	2017	-	185	518.00	180,000,000	206,896,552	1448	429.76	818.831034	615.1998756
4	2018	-	185	518.00	180,000,000	206,896,552	1448	429.76	818.831034	559.2726142
5	2019	-	185	388.50	180,000,000	206,896,552	1448	559.26	779.981034	484.3068559
6	2020	-	185	207.20	252,000,000	289,655,172	2028	1,196.97	1045.08069	589.9208041
7	2021	-	185	-	252,000,000	289,655,172	2028	1,395.90	977.127586	501.4209534
8	2022	-	185	-	252,000,000	289,655,172	2028	1,395.90	977.127586	455.8372304
9	2023	-	185	-	360,000,000	413,793,103	2897	2,080.52	1456.36207	617.6396849
10	2024	-	185	-	360,000,000	413,793,103	2897	2,080.52	1456.36207	561.4906227
11	2025	-	185	-	360,000,000	413,793,103	2897	2,072.24	1450.56897	508.4155732
12	2026	-	185	-	360,000,000	413,793,103	2897	2,072.24	1450.56897	462.1959756
13	2027	-	185	-	360,000,000	413,793,103	2897	2,072.24	1450.56897	420.1781597
14	2028	-	185	-	360,000,000	413,793,103	2897	2,072.24	1450.56897	381.9801451
15	2029	-	185	-	360,000,000	413,793,103	2897	2,063.97	1444.77586	345.8678545
16	2030	-	185	-	360,000,000	413,793,103	2897	2,063.97	1444.77586	314.4253223
17	2031	-	185	-	360,000,000	413,793,103	2897	2,063.97	1444.77586	285.8412021
18	2032	-	185	-	360,000,000	413,793,103	2897	2,063.97	1444.77586	259.8556382
19	2033	-	185	-	360,000,000	413,793,103	2897	2,055.69	1438.98276	235.2851797
20	2034	-	185	-	360,000,000	413,793,103	2897	2,055.69	1438.98276	213.8956179
21	2035	-	185	-	360,000,000	413,793,103	2897	2,055.69	1438.98276	194.4505617
22	2036	-	185	-	360,000,000	413,793,103	2897	2,055.69	1438.98276	176.7732379
23	2037	-	185	-	360,000,000	413,793,103	2897	2,047.41	1433.18966	160.0559805
24	2038	-	185	-	360,000,000	413,793,103	2897	2,047.41	1433.18966	145.5054368
		3,700	**4,070**	**310.80**				**38,430.99**	**24833.3928**	**5164.401303**