Journal of Engineering Research and Reports

22(3): 45-57, 2022; Article no.JERR.84725
ISSN: 2582-2926

Model Application That Monitors and Evaluates the Economic Viability and Cost-effectiveness of Modular Gas Processing Plants for Gas Utilization in Field-X

Osadebe A. U. [a*], Nmegbu C. G. J. [a] and Dagde K. K. [b]

[a] Department of Petroleum Engineering, Rivers State University, Nigeria.
[b] Department of Petrochemical Engineering, Rivers State University, Nigeria.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JERR/2022/v22i317529

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/84725

Original Research Article

Received 12 January 2022
Accepted 19 March 2022
Published 24 March 2022

ABSTRACT

This paper express model application that monitors and evaluates the economic viability and cost effectiveness of modular gas processing plant for the utilization of gas in Field-x. Critical evaluation has shown that these oil companies waste (flare) this precious resource primarily due to lack of processing infrastructures and remoteness of the field. Discounted cash flow analysis was used to evaluate the developed model for the utilization of associate gas for the marginal field. The profitability of the project was evaluated at discount rates of 5%, 10%, 15%, 20% and 25% for a project life cycle of 10 years. The payback period for each scenario was approximately 2 years. Net Present Value (NPV) observed an increase almost linearly with time until later periods (about 5 years) which the relationship with non-linearity was visible. This suggests that the project was approaching its peak production, and there was a progressive decrease in the amount of gas flared. The Net Present Value (NPV) and Return on Investment (ROI) which is a fair indication of the profitability index of the project increased with reducing discount rate. All values of NPV were positive, and the Profitability Index (PI) of the project was greater than one. The regression model was also compared with the observed data from the field and the percentage error in prediction was less than 5% for all scenario of discount rate.

**Corresponding author: Email: osadebest1@gmail.com;*

Keywords: Model; evaluation; economic; modular gas; Field X.

1. INTRODUCTION

Associated petroleum gas (APG) is gas dissolved in oil produced in the process of oil production, so it is a derivative. But APG itself is also a valuable raw material for further processing (Roland, 2010). Associated petroleum gas is a form of natural gas which is found with deposits of petroleum, either dissolved in the oil or as a free "gas cap" above the oil in the reservoir. Historically, this type of gas was released as a waste product from the petroleum extraction industry. It may be a stranded gas reserve due to the remote location of the oil field, either at sea or on land, this gas is simply burnt off in gas flares [1]. When this occurs the gas is referred to as flare gas. The gas can be utilized in a number of ways after processing: sold and included in the natural gas distribution networks, used for on- site electricity generation with engines or turbines, re-injected for enhanced oil recovery, converted from gas to liquids producing synthetic fuels or used as feedstock for the petrochemical industry [2]. Associated gas is gas produced as a by-product of the production of crude oil. Associated gas reserves are typically developed to produce crude oil, which pays for the field development costs. The reserves typically produce at peak levels for a few years and then decline [1]. According to the estimation of the International Energy Agency (IEA), the natural gas will overtake rival role of oil and coal by 2035 and will cover 25% of the total globally energy demands [3]. Flaring and venting of associated gas are problematic from environmental point of view because both processes involve releasing Greenhouse Gases (GHGs). Venting release a huge amount of methane (CH_4) and flaring release (CO_2) and if the combustion process is not efficient, methane (CH_4) will release as well. Methane is a highly flammable gas and is considered as the lightest component combined by one atoms of carbon and four atoms of hydrogen. In the pure form, methane has no color and odor. Due to this characteristic of methane, oil processing companies add some chemical materials to make it smell to detect any gas leaks (Iraq Oil Almanac, 2013). There is a business case for proper harnessing and adequate utilization of associated natural gas, as it can be a source of huge foreign exchange [4]. Offshore associated gas could be treated, recovered and economically utilized in power generation. This is the focus of this project. This view is supported by the outcome of the study by Obadote [5] which suggests that substantial amount of money could be saved if conventional fuel and energy were to be substituted with natural gas. This could also reduce the level of loss reported by Oseni [6]. These have double processing capacity by 2013 and should reduce flaring in the western parts of the Delta. In the offshore regions of Nigeria, gas is captured and brought to the Bonny LNG facility or re-injected. ExxonMobil has increasingly relied on offshore processing [7]. Although Nigeria has reduced flare gas emissions by 28 percent from 2000 levels, the country’s oil industry still wastes about 15cm of natural gas every year [7]. Natural gas may be used to generate electricity in a certain industrial setting, the excess heat and steam produced by this process may be used to fulfill other industrial applications such as space heating, water heating and to power industrial boilers. Increased efficiency saves money and the burning attributes of natural gas helps industries reduce harmful emissions [8]. For years the oil and gas producing company utilization of associated petroleum gas, not only by putting the chemical processing plants, but also by burning a large amount of valuable hydrocarbons. This was because the construction of new pipeline systems and preparation of associated gas was considered by many experts as unprofitable [8]. Major losses of associated gas, that is, its flaring, are formed mainly in the micro, small and medium-sized fields that are remote from each other over long distances can be in regions with poor infrastructure, or their geographical location indicates the presence of unstable ground (marshland) (Roland, 2010). Low carbon content of natural gas compared to other fossil fuels and its availability increased natural gas share as fuel for power generation. Gas turbine based power stations have rapidly increased in Nigeria with 18 new power plants built between 2002 and 2014 [9]. Apart from the physical and environmental differences among battery sites, there are significant variations in the composition and phase of materials being flared and vented [10-13].

2. MATERIALS AND METHODS

Table 1. Mathematical model development

	Total Cost (ST)	Methane (SM)	Total NGL (SN)
YR1	31628553.94	138646.57	1493662.26
YR2	30995734.50	135872.55	1463777.28
YR3	29669598.97	130059.32	1401150.38
YR4	28658010.39	125624.93	1353377.97
YR5	28196568.44	123602.17	1331586.33
YR6	27211059.04	119282.09	1285045.52
YR7	27447723.23	120319.53	1296222.02
YR8	27723594.90	121528.84	1309250.09
YR9	27989176.82	122693.03	1321792.23
YR10	27935421.75	122457.40	1319253.64
∑	**287455442.00**	**1260086.44**	**13575117.73**

The Regression of Cost (CT) on Amount of Electricity (ET) and the Volume of NGL Produced (NT):

$$Y = B_0 + B_1X_1 + B_2X_2 \quad (.1)$$

Where: X_1 = VM; X_2 = VN

Substituting the variables into equation 3.1 …

$$ST = B_0 + B_1.VM + B_2.VN \quad (.2)$$

Where, B_0, B_1 and B_2 are constants

Developing the normal equations.

$$\sum ST = B_0N + B_1 \sum VM + B_2 \sum VN \quad (.3)$$

$$\sum ST.VM = B_0 \sum VM + B_1VM^2 + B_2 \sum VM.VN \quad (.4)$$

$$\sum ST.VN = B_0 \sum VM + B_1 \sum VM.VN + B_2 \sum VN^2 \quad (.5)$$

In Matrix Form

$$\begin{bmatrix} N & \sum VM & \sum VN \\ \sum VM & \sum VM^2 & \sum VM.VN \\ \sum VN & \sum VM.VN & \sum VN^2 \end{bmatrix} \begin{bmatrix} B_0 \\ B_1 \\ B_2 \end{bmatrix} = \begin{matrix} \sum ST \\ \sum ST.VM \\ \sum ST.VN \end{matrix}$$

2.1 Economic Analysis

Economic Evaluation will be carried out on Wells WT2, WT5 and WT7, to determine if the proposed investment with MGPP as shown in the model meets the Profitability Criteria for the field operators. Major methods of valuing projects before decisions are made in investments comprises of the following.

2.2 Net Present Value

This is the difference between the present values of cash inflows to cash outflows over time. NPV is considered during capital budgeting and investment planning to evaluate the profitability of a projected investment. In this work, the net present worth of the project will be calculated in other to evaluate if there will be surplus or shortage of cash flows.

NPV = Total Revenue Generated – Cost of Investment. (.6)

Present Value (PV) of future cash flow for any particular year (i) is given in equation below

$$PV_1 = \frac{C_i}{(1+r)^i} \quad (.7)$$

Therefore,

$NPV_1 = \sum$ stment Cost (.8)

Where r = Int of Return; C_i = Cash flow for year i

If NPV = 0; The Investment is exactly marginal.
NPV > 0; The Investment will be favorable.
NPV < 0; The Investment will be unfavorable.

2.3 Profitability Index (PI)

This is the modification of NPV method. It is a useful tool for ranking projects/investments due to its ability to allow for quantification of the amount of values created per unit of the investment. It is therefore regarded as an investment appraisal technique and calculated by dividing the present value of future cash flows of the project/investment by the cost of the investment.

Mathematical (PI)

$$(PI) = \frac{\text{PRESENT VALUE OF FUTURE CASH FLOWS}}{\text{COST OF INVESTMENT}} \quad (.9)$$

If PI > 1: The Investment will be favorable.
PI < 1: The Investment will be unfavorable.

2.4 Basis for Economic Analysis Calculations

For the sake of the calculations, the following indices will be considered.

1. The price of 1 Standard Cubic Foot (SCF) of natural gas in Global market= $2.5 Source: (/scfhttps://punchng.com/fg-to-release-new-gas-pricing-template-may-29/)
2. 1KWh will be generated from 0.01003 Mscf of natural gas Source: (https://michaelbluejay.com/electricity/fuel.html)
3. The Price of One Kilowatts-hour (KWH) of Electricity in Nigeria = $0.07 Source: (https://www.globalpetrolprices.com/Nigeria/electricity_prices/)
4. 1 SCF of Natural Gas = 0.2374768089 Barrel
5. The cost of investment includes the following:

- Cost of equipment = $18,000,000
- Cost of Shipment
- Cost of labour/Installation = $2,000,000
- Cost of operation
- Cost of raw material

6. Let the Cost of Investment = $20,000,000
7. A tax of 30% would be applied throughout the life of the project.
8. A straight line depreciation value of 20000000/10years = 2000000 per year will be applied
9. The profitability of the project would be tested using a discount rate 5%, 10%, 15%, 20% and 25%.

3. RESULT AND DISCUSSION

3.1 The Modular Gas Processing Plant (MGPP)

Natural Gas from three wells in Field-X is channeled to a single gathering system, Since the volume of the natural gas from the marginal field is considerably small compared to gases from a typical dry gas wells, Modular Gas processing plant (MGP) will be an economical infrastructure to monetize these gases at a low investment cost, so as to discourage gas flaring in Niger delta.

MGP is a miniaturized processing system designed for the separation of methane, ethane and Natural Gas Liquids from a raw natural gas stream consist a minimum of 80% of methane.

The plant consists of a chassis constructed to hold the system for field deployment. It has four distinct sections: A **compressor** for compressing the raw gas stream, a **dehydrator** for removing water from the already compressed gas stream, if any. It also consists of a **refrigerator** that has one or more stages used in lowering the temperature of the compressed and dehydrated gas streams; the last section is **a separation** sub-system which separates the compressed, dehydrated, and refrigerated natural gas stream into three distinct products of at least 75% methane, and some considerable amount of ethane and natural gas liquids, NGL's. The Modular Plant (MAGS-200 field unit) is designed to process 200 mcf of raw natural gas per day. For raw feed rich in NGLs composition, the plant can refine it into a reasonable amount of methane and about 1,700 gallons of Natural Gas Liquids per day.

3.2 Conceptual Model Development

A conceptual Block Model was developed for this project as shown in section 3.2, which is suitable for Associated Gas Utilization in Marginal Onshore Fields.

From Fig. 2, Associated Gas from three Wells (WT2, WT5, and WT7) will be gathered and sent to the Modular Gas Processing Plant, which separates the gas stream to three products.

3.2.1 Lean methane gas

It will be sent to a Gas Turbine Plant for electricity generation. The generated electricity will then be distributed to homes, industries, worship centers, event centers, etc.

3.2.2 Natural gas liquids

The NGL produced will be transported through trucks to distillery for the production of Liquefied Petroleum Gas (LPG) and Gasoline. The LPG will be sent for bottling using trucks while the Gasoline will be sent to station for vehicle fuels.

3.2.3 Ethane gas

The third product is a low grade product designed accordingly which will be dedicated as fuel for running the Modular Gas Processing Plant deployed to the field.

3.2.4 Mathematical model for cost evaluation

Since the project Profit Margin is dependent on the sales of the Methane gas for power generation and Natural Gas Liquid, NGL for cooking and vehicle fuels, mathematical Model was developed using Linear Regression Model Approach. Total Sales (ST) (dependent variable) from the field is dependent on sales of Methane (SM) (Controlled Variable) for Electricity Generation and sales of NGL (SN) (Controlled Variable) for gasoline and LPG Production. Processing Plant deployed to the field.

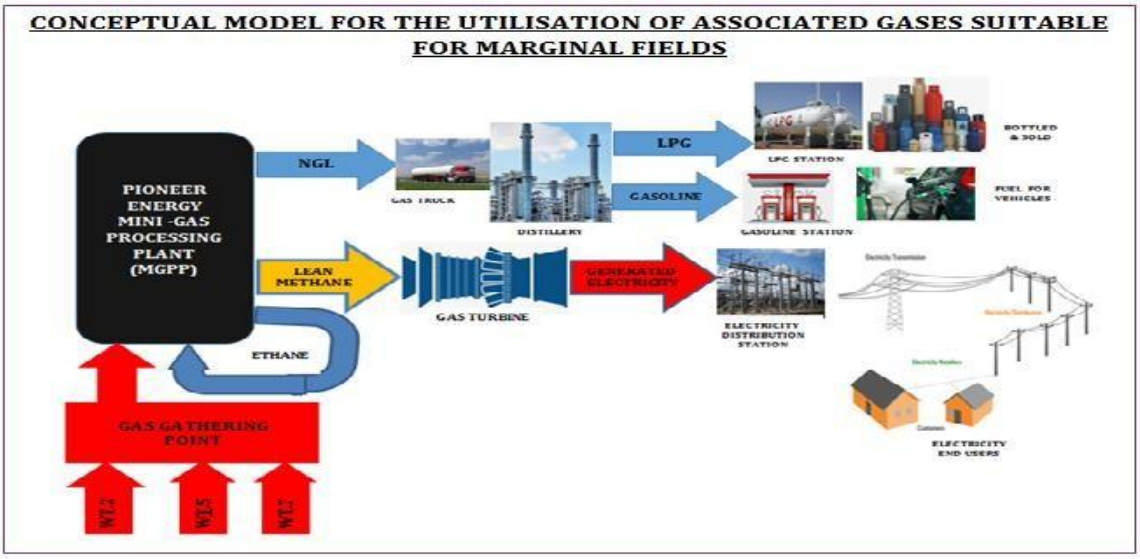

Fig. 1. Conceptual model for associated gas utilization in field-X

Table 2. Computation of the model parameters from the matrix box

(P)	(ST)	(VM)	(VN)	(VM^2)	(VN^2)	(VM.VN)	(ST.VM)	(ST.VN)
YR 1	31628553.94	138646.57	1493662.26	19222871373	2.23103E+12	2.07091E+11	4.38519E+12	4.72424E+13
YR 2	30995734.5	135872.55	1463777.28	18461349844	2.14264E+12	1.98887E+11	4.21147E+12	4.53709E+13
YR 3	29669598.97	130059.32	1401150.38	16915426719	1.96322E+12	1.82233E+11	3.85881E+12	4.15716E+13
YR 4	28658010.39	125624.93	1353377.97	15781623038	1.83163E+12	1.70018E+11	3.60016E+12	3.87851E+13
YR 5	28196568.44	123602.17	1331586.33	15277496429	1.77312E+12	1.64587E+11	3.48516E+12	3.75462E+13
YR 6	27211059.04	119282.09	1285045.52	14228216995	1.65134E+12	1.53283E+11	3.24579E+12	3.49674E+13
YR 7	27447723.23	120319.53	1296222.02	14476789299	1.68019E+12	1.55961E+11	3.3025E+12	3.55783E+13
YR 8	27723594.9	121528.84	1309250.09	14769258952	1.71414E+12	1.59112E+11	3.36922E+12	3.62971E+13
YR 9	27989176.82	122693.03	1321792.23	15053579611	1.74713E+12	1.62175E+11	3.43408E+12	3.69959E+13
YR 10	27935421.75	122457.4	1319253.64	14995814815	1.74043E+12	1.61552E+11	3.4209E+12	3.68539E+13
Σ	**287455442**	**1260086.43**	**13575117.72**	**1.59182E+11**	**1.84749E+13**	**1.7149E+12**	**3.63133E+13**	**3.91209E+14**

Substituting the value from Table 3 into the normal equation

$$\begin{bmatrix} 10 & 1260086.43 & 13575117.72 \\ 1260086.43 & 1.59182E+11 & 1.7149E+12 \\ 13575117.72 & 1.7149E+12 & 1.84749E+13 \end{bmatrix} = \begin{bmatrix} 287455442 \\ 3.63133E+13 \\ 3.91209E+14 \end{bmatrix}$$

By Gauss-Jordan elimination method

$$\begin{bmatrix} 1 & 0 & 0 & 5060.052567 \\ 0 & 1 & 0 & -25.964658 \\ 0 & 0 & 1 & 23.581567 \end{bmatrix}$$

Therefore;

$B0 = 5060.0526$

$B1 = -25.96466$

$B2 = 23.5816$

Substituting the constants into equation 3.2

The Regression Model for the Amount that can be generated from Methane and NGL using the Proposed Modular-Gas Processing Plant (MGPP) in Field -x

ST = 5060.0526 -25.9657VM+ 23.5816VN

ST = Total Cost of methane and NGL from the field

VN = Volume of NGL processed using MGPP

VM = Volume of Methane Processed for Electricity using MGPP

Table 3. Results of economic analysis on well WT2

T	F (MSCF)	Methane Gas (MG) 0.77769xF (MSCF)	E=MG ÷0.01003 KWH	Sales of Electricity E*0.07 ($)	NGL (X) = 0.03528*R (MSCF)	NGL (N) =0.23748*X (Barrel)	NGL Sales = N x $21.11 ($)	Total Sales
YR1	64126	49870.15	500197.59	35013.83	2262.37	537259.29	11341543.6	11376557.38
YR2	62821	48855.26	490018.29	34301.28	2216.32	526325.76	11110736.8	11145038.07
YR3	57200	44483.87	446173.20	31232.12	2018.02	479232	10116587.5	10147819.64
YR4	54310	42236.34	423630.53	29654.14	1916.06	455019.05	9605452.24	9635106.38
YR5	52477	40810.84	409332.71	28653.29	1851.39	439661.85	9281261.6	9309914.89
YR6	48212	37493.99	376064.72	26324.53	1700.92	403928.9	8526939.12	8553263.65
YR7	47600	37018.04	371290.98	25990.37	1679.33	398801.45	8418698.71	8444689.08
YR8	47600	37018.04	371290.98	25990.37	1679.33	398801.45	8418698.71	8444689.08
YR9	47912	37260.68	373724.65	26160.73	1690.34	401415.45	8473880.09	8500040.82
YR10	48340	37593.53	377063.15	26394.42	1705.44	405001.31	8549577.63	8575972.05
$\sum$	**530598**	**412640.8**	**4138786.81**	**289715.1**	**18719.50**	**4445446.52**	**93843376**	**94133091.04**

Table 4. Results of economic analysis in well WT5

T	F (MSCF)	Methane Gas (MG) 0.77769xF (MSCF)	E= MG÷0.01003 KWH	Sales of Electricity E*0.07 ($)	NGL (X) = 0.03528*R (SCF)	NGL (N) = 0.23748*X (Barrel)	NGL Sales = N x $21.11 ($)	Total Sales ($)
YR1	52,228	40617.19	407390.50	28517.33	1842.60	437575.68	9237222.60	9265739.93
YR2	50,172	39018.26	391353.20	27394.72	1770.07	420350.14	8873591.42	8900986.14
YR3	50,817	39519.87	396384.30	27746.90	1792.82	425754.07	8987668.32	9015415.22
YR4	48,300	37562.43	376751.10	26372.58	1704.02	404666.18	8542503.10	8568875.68
YR5	47,980	37313.57	374255.10	26197.85	1692.73	401985.16	8485906.80	8512104.65
YR6	47,942	37284.01	373958.70	26177.11	1691.39	401666.79	8479185.99	8505363.10
YR7	48,100	37406.89	375191.10	26263.38	1696.97	402990.55	8507130.41	8533393.79
YR8	49,400	38417.89	385331.40	26973.20	1742.83	413882.18	8737052.86	8764026.06
YR9	51,341	39927.38	400471.60	28033.02	1811.31	430144.23	9080344.75	9108377.77
YR10	50,923	39602.31	397211.20	27804.78	1796.56	426642.15	9006415.84	9034220.62
$\sum$	**497,293**	**386669.8**	**3878298**	**271480.90**	**17541.32**	**4165657.13**	**87937022.11**	**88208502.96**

Table 5. Results of economic analysis in well WT7

T	F (MSCF)	Methane Gas (MG)0.77769xF (MSCF)	E= MG ÷0.01003 KWH	Sales of Electricity E*0.07 ($)	NGL (X) = 0.03528*F (SCF)	NGL (N) = 0.23748*X (Barrel)	NGL Sales (S) =N x $21.11 ($)	Total Sales ($)
YR1	61,926	48159.23	483037.09	33812.60	2184.75	518827.29	10952444.03	10986256.63
YR2	61,720	47999.03	481430.24	33700.12	2177.48	517101.38	10916010.17	10949710.29
YR3	59,221	46055.58	461937.46	32335.62	2089.32	496164.31	10474028.49	10506364.11
YR4	58,926	45826.16	459636.39	32174.55	2078.91	493692.74	10421853.78	10454028.33
YR5	58,478	45477.76	456141.89	31929.93	2063.10	489939.32	10342618.97	10374548.90
YR6	57,226	44504.09	446376.00	31246.32	2018.93	479449.83	10121185.97	10152432.29
YR7	59,014	45894.60	460322.81	32222.60	2082.01	494430.02	10437417.76	10469640.36
YR8	59,269	46092.91	462311.87	32361.83	2091.01	496566.46	10482517.93	10514879.76
YR9	58,513	45504.97	456414.90	31949.04	2064.34	490232.55	10348809.19	10380758.23
YR10	58,200	45261.56	453973.43	31778.14	2053.30	487610.18	10293450.94	10325229.08
SUM	**592,493**	**460775.88**	**4621582.09**	**323510.75**	**20903.15**	**4964014.08**	**104790337.23**	**105113847.98**

3.3 Economic analysis

For this work, secondary data was obtained from a known marginal field in Niger-Delta, for a period of ten years, ranging from 2009 to 2018. Economic Analysis was carried out to determine the cash flow as well as other profitability indicators for three oil wells (WT2, WT5 & WT7) in FIELD-X over these periods. The following are some of the calculated variable.

3.4 Profitability Indicators for the Project

Profitability indicators for this project were determined by considering the cost of in the Marginal field for the utilization of the produced associated gases. By inquiry, the cost of the Modular Gas Processing Plant also known as Mobile Alkane Gas Separator (MAGS), these were suitable for the Associated Gas operating parameters and daily production which is $18,000,000. The Modular Gas Plant considered for this project is one of the patented equipment of Pioneer Energy, USA. Meanwhile the cost of shipment, labour/installation and other miscellaneous expenses required to put the equipment to work is estimated as $2,000,000. By implication, the total cost of the investment is estimated as $20,000,000. Ten (10) years projection was used for analysis based on the volume of gases that was produced and flared over 10-year period (2009- 2018). A tax of 30% was applied throughout the life of the project. A straight line depreciation value of 20000000/10years = 2000000 per year was used in the analysis.

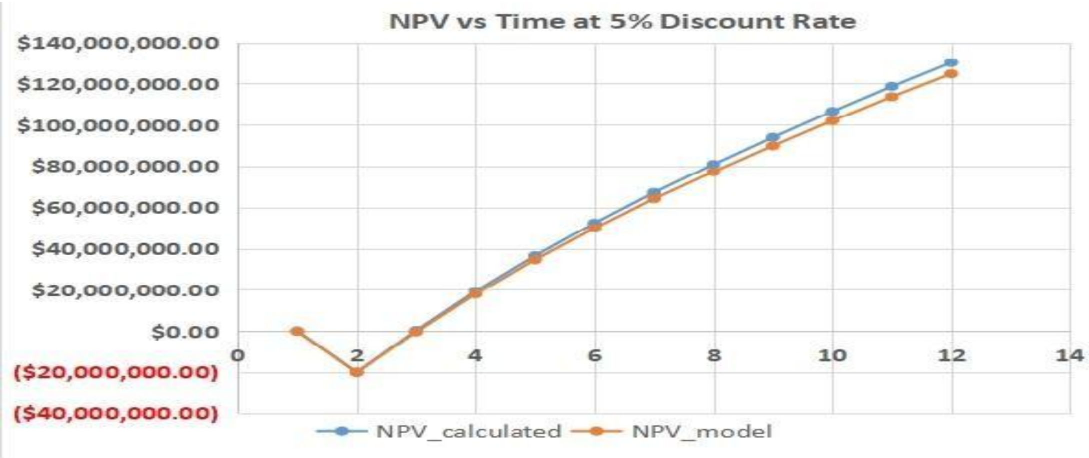

Fig. 2. Plot of Net Present Value (NPV) vs Time (in years) at 5% discount rate

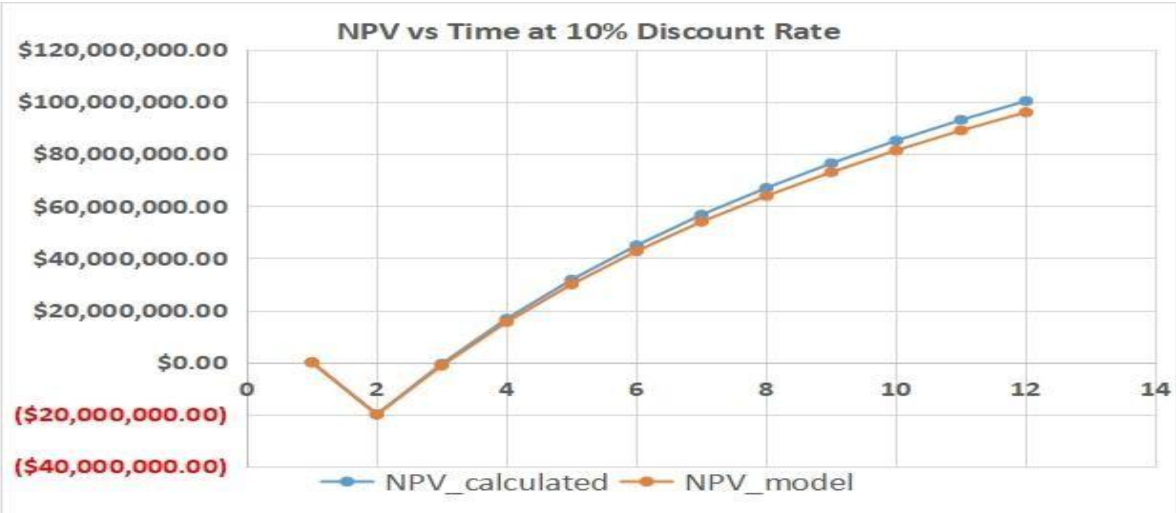

Fig. 3. Plot of Net Present Value (NPV) vs Time (in years) at 10% discount rate

Table 6. Table showing economic parameters for observed calculation and model for discount rate of 5%

Economic Parameters	Calculated	Model	Error
ROI	6.51	6.24	4.15%
IRR	94%	90%	3.74%
NPV	$130,135,602.55	$124,729,749.20	4.15%

Table 7. Table showing economic parameters for observed calculation and model for discount rate of 10%

Economic Parameters	Calculated	Model	Error
ROI	5.01	4.80	4.29%
IRR	85%	81%	3.96%
NPV	$100,217,103.14	$95,915,264.08	4.29%

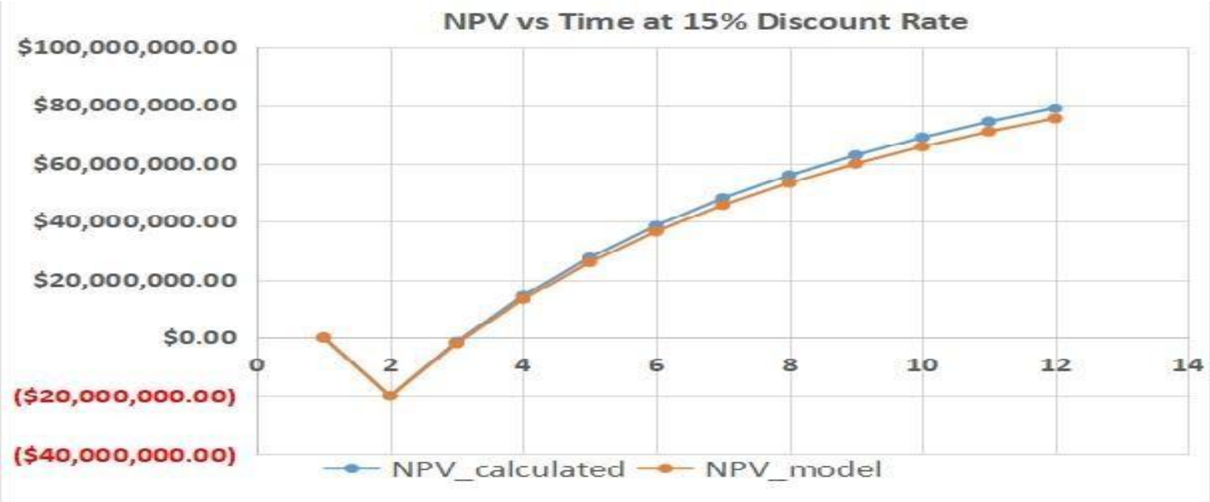

Fig. 4 Plot of Net Present Value (NPV) vs Time (in years) at 15% Discount Rate

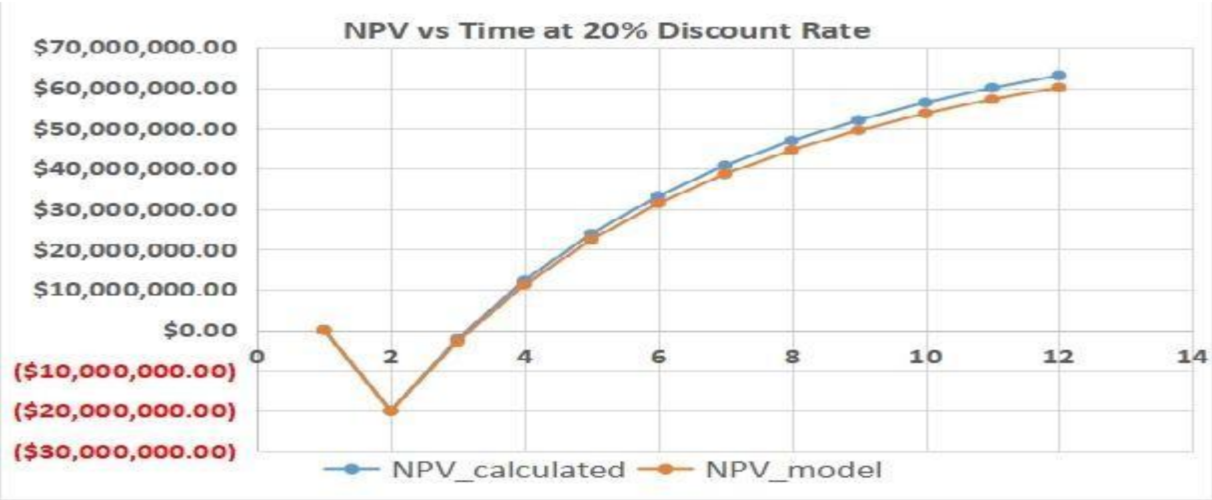

Fig. 5. Plot of Net Present Value (NPV) vs Time (in years) at 20% discount rate

Table 8. Table showing economic parameters for observed calculation and model for discount rate of 15%

Economic Parameters	Calculated	Model	Error
ROI	3.94	3.76	4.46%
IRR	77%	73%	4.22%
NPV	$78,786,725.96	$75,272,956.86	4.46%

Table 9. Table showing economic parameters for observed calculation and model for discount rate of 25%

Economic Parameters	Calculated	Model	Error
ROI	3.15	3.00	4.66%
IRR	69%	66%	4.52%
NPV	$62,998,551.70	$60,063,208.83	4.66%

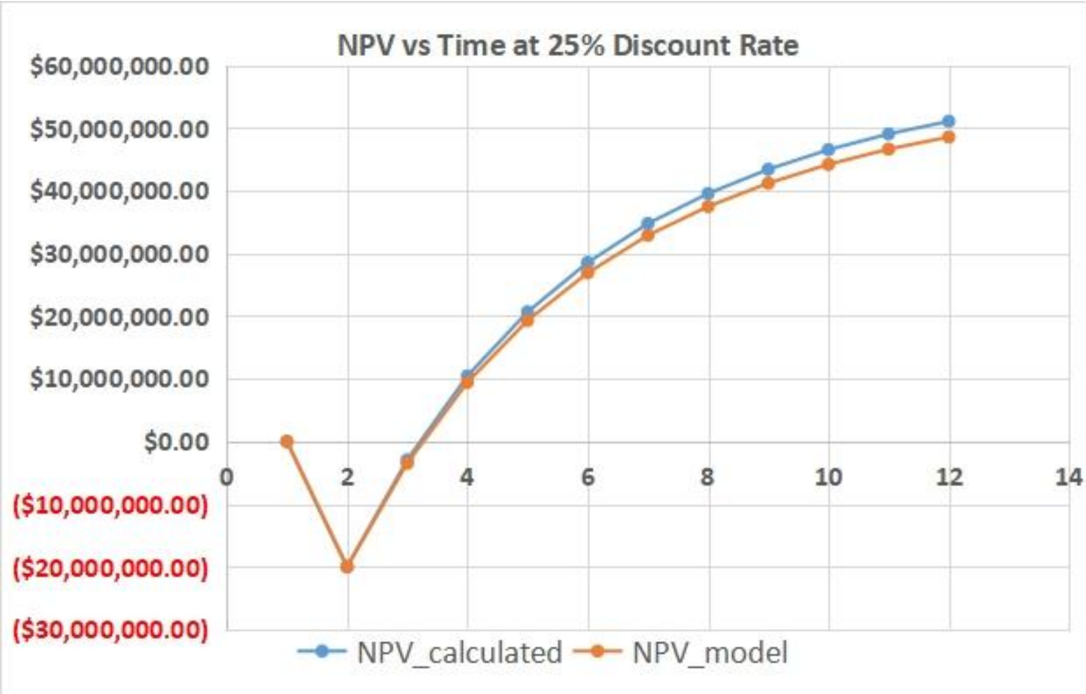

Fig. 6 Plot of Net Present Value (NPV) vs Time (in years) at 25% Discount Rate

Table 10. Table showing economic parameters for observed calculation and model for discount rate of 25%

Economic Parameters	Calculated	Model	Error
ROI	2.55	2.43	4.90%
IRR	62%	59%	4.88%
NPV	$51,067,500.11	$48,567,557.88	4.90%

The profitability of the project at discount rate 5%, 10%, 15%, 20% and 25% was evaluated with 10% discount rate being the base assumption value. Fig. 2 through Fig. 6 shows a plot of Net Present Value (NPV) of the project against time. The payback period for each scenario was approximately 2 years. NPV tends to increase almost linearly with time until later periods (about 5 years) which the relationship non-linearity was visible. This suggests that the project was approaching its peak production, or/and there was a progressive decrease in the amount of gas flared at the later years due to the intervention of the gas flare policies in the mid 2010 ‘s (e.g. the Nigerian Gas Flare Commercialization Program, NGCFP in 2016). The Net Present Value (NPV) and Return on Investment (ROI) which is a fair indication of the profitability index of the project increased with reducing discount rate as shown in Table 2 and Fig. 3. An NPV of approximately $130 million, $100 million, $79 million, $63 million, and $51 million was recorded for discount rates of 5%, 10%, 15%, 20%, and 25% respectively. Profitability Index PI of 6.51, 5.01, 3.94, 3.15, and 2.55 was recorded for discount rates of 5%, 10%, 15%, 20%, and 25% respectively. All values of NPV were positive, and the Profitability Index (PI) of the project was greater than one. The Internal Rate of Return (IRR) was also greater than the discount rate, showing a good, favorable and profitable indication for investment. The regression model was also compared with the observed data from the field and the percentage error in prediction was less than 5% for all sceneries of discount.

4. CONCLUSION

A model for the utilization of Associated Gas was developed and proposed for use in a typical marginal Field-X in Niger Delta, for power generation for the nearby communities and for the production of NGL for sales. The Gas Processing under review is designed and own by Pioneer Energy USA, which is proposed for use in an onshore marginal field with just three producing oil wells and having a substantial amount of Natural gases produced alongside. The said wells are tagged, WT2, WT5 and WT7 In other to convert waste to riches for the wellbeing of the society, the field operator should adopt the developed models in this work. There should application of cost effective Modular Gas Processing Plant (MGPP) for use in Marginal Fields for the utilization of associated Petroleum Gases

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Walker A. Nigeria's gas profits go up in smoke. Nigeria. BBC News; 2009). Available:http://www.culturechange.org/cms/content/view/286/1/
2. Schlumberger Limited. Flare gas Oilfield Glossary; 2011. Available: http://www.glossary.oilfield.slb.com/en
3. International Energy Agency (IEA). Today in energy; 2011. Available: https://www.eia.gov/todayinenergy/detail.php?id=12251
4. Iwayemi A. Nigeria’s Dual Energy Problems: Policy Issues and Challenges. International Association for Energy Economics. 2008, 17–21. Fourth Quarters Fourth Quarters; 2008.
5. Obadote DJ. Energy crisis in Nigeria: Technical issues and solutions. Power Sector Prayer Conference, Abuja, Nigeria; 2009.
6. Oseni P, Musiliu O. Improving Households’ access to electricity and energy consumption pattern in Nigeria: Renewable energy alternative. renewable and sustainable energy reviews. Elsevier. 2012;16(6):3967-3974.
7. Nigerian National Petroleum Corporation. Annual Statistical Bulletin; 2013;47-56. Available:https://www.nnpcgroup.com/NNPCDocuments/Annual%20Statistics%20Bulletin%E2%80%8B/20 13%20ASB%201st%20edition.pdf.
8. Knizhnikov A, Poussenkova N. Russian Associated Gas Utilization: Problems and prospects. Annual Project Report, Environment and Energy: International Context World Wildlife Fund and Institute of World Economy and International Relations of the Russian Academy of Sciences; 2009.
9. Akosile O. Power generation using flare gases; 2017 Available:www.minarticles.com
10. Orubu C, Odusola A, Ehwarieme W. The Nigerian oil industry: environmental diseconomies, management strategies and the need for community involvement. Journal of Human Ecology. 2004;16(3):203-214.
11. Nigerian National Petroleum Corporation. Annual Statistical Bulletin; 2014). Available:https://www.nnpcgroup.com/NNPCDocuments/Annual%20Statistics%20Bulletin%E2%80%8B/20 14%20ASB%202nd%20Edition.pdf

12. Mignacca B, Locatelli G. Modular circular economy in energy infrastructure projects: Enabling factors and barriers. Journal of Management in Engineering. 2021;37(5): 04021053.

13. Baldea M, Edgar TF, Stanley BL, Kiss AA. Modular manufacturing processes: Status, challenges, and opportunities. AIChE Journal. 2017;63(10):4262-72.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/84725