# AN INVESTMENT ANALYSIS OF DEVELOPING A NEW OIL WELL IN THE PREVAILING ECONOMIC DOWNTURN IN THE PETROLEUM SECTOR OF NIGERIAN ECONOMY

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## ABSTRACT

*From 2017 to year 2020 (except for a gradual rise in 2018), the price per barrel of oil has been on the decline, thereby slowing down investment in the petroleum sector of Nigerian economy. This dwindling oil price creates an impelling need to investigate the viability or otherwise of investing in this sector. The net present value (NPV) and internal rate of return (IRR) are two major indicators used to assess the viability of investing in projects. In this paper the two indicators have been used to assess the viability of investing in the oil sector of Nigerian economy. Analysis shows that given the cost of drainage per barrel of oil at US$25, a 40% royalty payment, an overall 10% taxation on profit, and price per barrel of oil at US$40, the net present value of a new oil well will be negative while the cost of capital will be higher than return on investment. However the break-even point occurs at US$42 price per barrel, yielding an internal rate of return equal to cost of capital. The conclusion is that the investment climate of the Nigerian oil sector is currently gloomy. Our analysis also shows that the investment climate can be improved by applying a dynamic royalty system whereby the royalty payable to the Federal Government is reduced when the oil price declines, and increased when the oil price rises.*

## INTRODUCTION

Between 2011-2012, oil price was as high as US112 dollar per barrel. But with success in the cracking process of oil production from heavy crude, price per barrel of crude crashed to as low as US42 dollars in 2017. However, price per barrel of crude oil gradually rose to as high as US74 dollars in 2018 and began to dwindle in 2019 due to the success in the design and production of electric cars. The Covid-19 Pandemic which led to lockdown of industrial activities further affected oil price. Consequently, oil price fell to as low as US11 dollars per barrel in April 2020 (macrotrends.net). After the lifting of lockdown on industrial activities, the price of oil rose again to between 39-43 US dollars per barrel. This research is meant to show the viability or otherwise of investing in the petroleum sector in view of the prevailing economic down turn in this sector.

## METHODOLOGY

In order to analyse whether profitable or not to open a new oil well in view of the present price per barrel of crude oil, the following steps were taken.

1. A hypothetical oil well was chosen for analysis of its flow rate from the initial flow rate to economic limit flow rate

using the exponential decline model (Arps. J.J 1945).

$$q_t = q_i e^{-Dt}.$$

Where:

$q_t$ = flow rate at time t

$q_i$ = initial flow rate

$D$ = rate of decline (in fraction or %)

2. A royalty in percentage of gross profit was chosen as bench mark. Using the flow rate estimated above, the existing price per barrel of oil and cost of drainage per barrel, a cash flow table was developed.

3. Furthermore, cash flow tables at expected future prices per barrel of oil were developed using the minimum bench mark royalty.

4. Annual net profits were discounted using an acceptable cost of capital to the corporate entity.

5. Net present values at various prices per barrel of oil were estimated using the following formula $NPV = \sum_{i=1}^{t} N_p - T_c$ (Pandey 2006).

6. The cash outflow was discounted and utilised in capital outlay estimation using the following formula

$$T_c = 0.25T$$

$$T = \frac{T_o}{0.75}$$

(Nwosu and Uwalaka 2020)

Where T = total expenditure on project

$T_c$ = capital outlay for the project

$T_o$ = operating cost of project discounted to the present day

7. A graph of price per barrel of oil was plotted against the various NPVs to define the price at which NPV is zero. This price is the break-even price on investment. The discount rate applied to discount the net profits becomes the internal rate of return since this is the discount rate at which NPV is zero.

**RESULTS AND DISCUSSION**

In order to assess the investment climate in the Oil Sector of Nigerian economy in considering the dwindling oil price in the sector, NPV and IRR of the hypothetical oil well were established using the following techno-economic data.

Table 1: Techno-economic data for well planning

| Initial flow rate barrels per annum | Drainage cost per barrel US$ | Price per barrel of oil US$ | Decline rate | Economic limit flow rate per barrel | Royalty |
|---|---|---|---|---|---|
| 200, 000 | 25 | 40 | 4% | 73,000 | 40% |

The following steps were applied as stated in the methodology.

Annual flow rates down to economic limit flow rate were estimated using the following formula

$$q_t = q_i e^{-Dt}.$$

$q_1$ = 200,000$e^{-0.04 \times 1}$ = 192,000 barrels

$q_2$ = 200,000$e^{-0.04 \times 2}$ = 184,000 barrels

$q_3$ = 200,000$e^{-0.04 \times 3}$ = 177,000 barrels

| - | - | - | - | - | - | - | - |
| - | - | - | - | - | - | - | - |

$$q_{25} = 200{,}000e^{-0.04\times25} = 74{,}000 \text{ barrels}$$

$$q_{26} = 200{,}000e^{-0.04\times26} = 70{,}691 \text{ barrels}$$

The above calculation shows that the well will reach its economic limit flow rate at 25th year of operation ($q_{25}$ =74,000 barrels > 73,000 barrels and $q_{26}$ = 70,691 barrels < 73,000 barrels). The annual flow rates throughout the life of the well are shown in column 2 of table 2.

Furthermore, cash flow was developed using the data in table 1 and is presented in table 2.

Table 2: Cash flow of the well

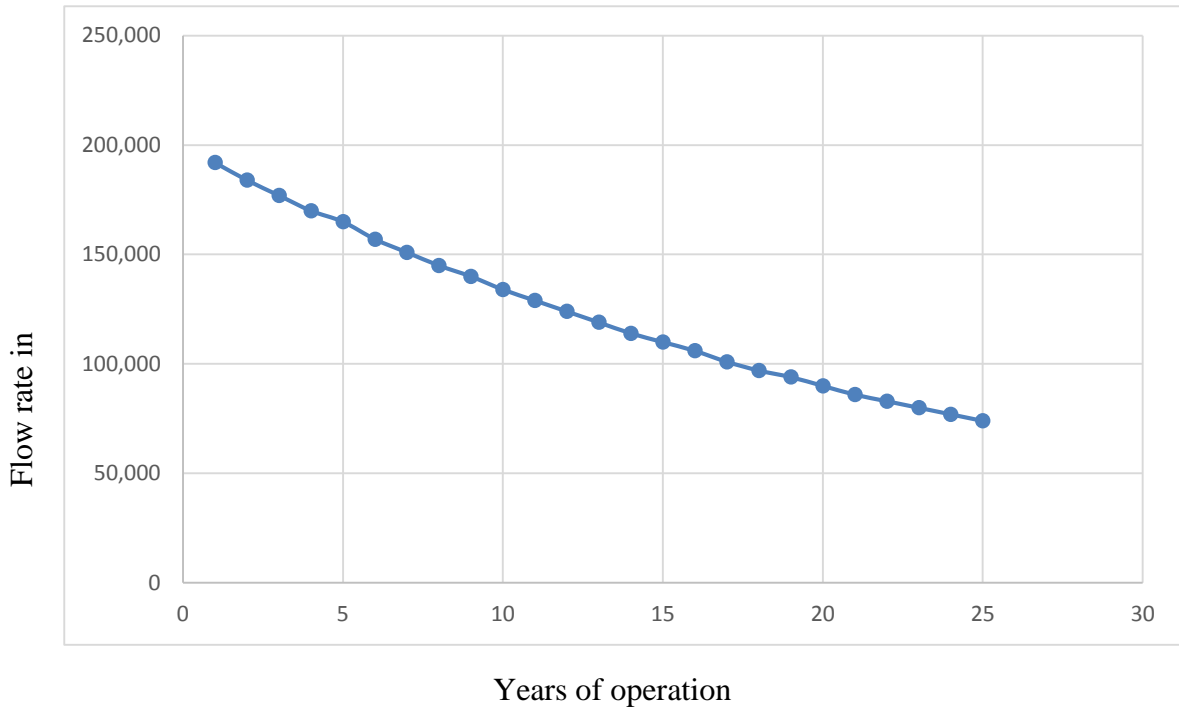| Year of production | Flow rate (in barrels) | Cash outflow (US$) | Cash inflow (US$) | Gross income (US$) | 40% Royalty | Profit before tax (US$) | Tax (US$) | Net profit (US$) | Discounted cash outflow at 10% | Discounted net profit at US$40 per barrel |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 192,000 | 4800000 | 7680000 | 2880000 | 1152000 | 1728080 | 172800 | 1555200 | 4363636.36 | 1413818.8 |
| 2 | 184,000 | 4600000 | 7360000 | 2760000 | 1104000 | 1656000 | 165600 | 1490400 | 3801652.89 | 1231735.54 |
| 3 | 177,000 | 4425000 | 7080000 | 2655000 | 1062000 | 1598000 | 159300 | 1433700 | 3327067.67 | 1077969.93 |
| 4 | 170,000 | 4250000 | 6800000 | 2550000 | 1020000 | 1538000 | 153000 | 1377000 | 2910958.90 | 948150.68 |
| 5 | 165,000 | 4125000 | 6600000 | 2475000 | 990000 | 1485000 | 148500 | 1336506 | 2562111.80 | 830124.22 |
| 6 | 157,000 | 3925000 | 6280000 | 2355000 | 942000 | 1413000 | 141800 | 1271700 | 2217514.12 | 718474.58 |
| 7 | 151,000 | 3775000 | 6040000 | 2265000 | 906000 | 1359000 | 135900 | 1223100 | 1935897.44 | 627230.77 |
| 8 | 145,000 | 3625000 | 5800000 | 2175000 | 870000 | 1305000 | 130500 | 1174500 | 1693925.23 | 548831.78 |
| 9 | 140,000 | 3500000 | 5600000 | 2100000 | 840000 | 1260000 | 126000 | 1134000 | 1483050.85 | 480508.47 |
| 10 | 134,000 | 3350000 | 5360000 | 2070000 | 804000 | 1206000 | 120600 | 1085400 | 1293436.29 | 41973.36 |
| 11 | 129,000 | 3225000 | 5160000 | 1935000 | 774000 | 1161000 | 116100 | 1044900 | 1131578.95 | 366631.58 |
| 12 | 124,000 | 3100000 | 4960000 | 1860000 | 744000 | 1116000 | 111600 | 1004400 | 987261.15 | 319872.61 |
| 13 | 119,000 | 2975000 | 4760000 | 1785000 | 714000 | 1071000 | 107100 | 963900 | 862318.84 | 279391.30 |
| 14 | 114,000 | 2850000 | 4560000 | 1710000 | 684000 | 1026000 | 102600 | 923400 | 750000 | 243000 |
| 15 | 110,000 | 2750000 | 4400000 | 1650000 | 660000 | 990000 | 99000 | 891000 | 659472.42 | 213669.06 |
| 16 | 106,000 | 2650000 | 4240000 | 1590000 | 636000 | 954000 | 95400 | 858600 | 577342.05 | 187058.82 |
| 17 | 101,000 | 2525000 | 4040000 | 1515000 | 606000 | 909000 | 90900 | 818100 | 500000 | 162000 |
| 18 | 97,000 | 2425000 | 3880000 | 1455000 | 582000 | 873000 | 87300 | 785700 | 436151.08 | 141312.95 |
| 19 | 94,000 | 2350000 | 3760000 | 1410000 | 564000 | 846000 | 84600 | 761400 | 383986.93 | 124411.76 |
| 20 | 90,000 | 2250000 | 3600000 | 1350000 | 540000 | 810000 | 81000 | 729000 | 334323.92 | 108320.95 |
| 21 | 86,000 | 2150000 | 3440000 | 1290000 | 516000 | 774000 | 77400 | 696600 | 290540.54 | 94135.14 |
| 22 | 83,000 | 2075000 | 3320000 | 1245000 | 498000 | 747000 | 74100 | 672300 | 254914.00 | 82592.14 |
| 23 | 80,000 | 2000000 | 3200000 | 1200000 | 480000 | 720000 | 72000 | 648000 | 223463.69 | 72402.23 |
| 24 | 77,000 | 1925000 | 3080000 | 1155000 | 462000 | 693000 | 69300 | 623700 | 195431.47 | 63819.89 |
| 25 | 74,000 | 1850000 | 2960000 | 1110000 | 444000 | 666000 | 66600 | 599400 | 170821.79 | 55346.26 |

Fig 1: Predicted annual flow rates of the well for 25 years of operation
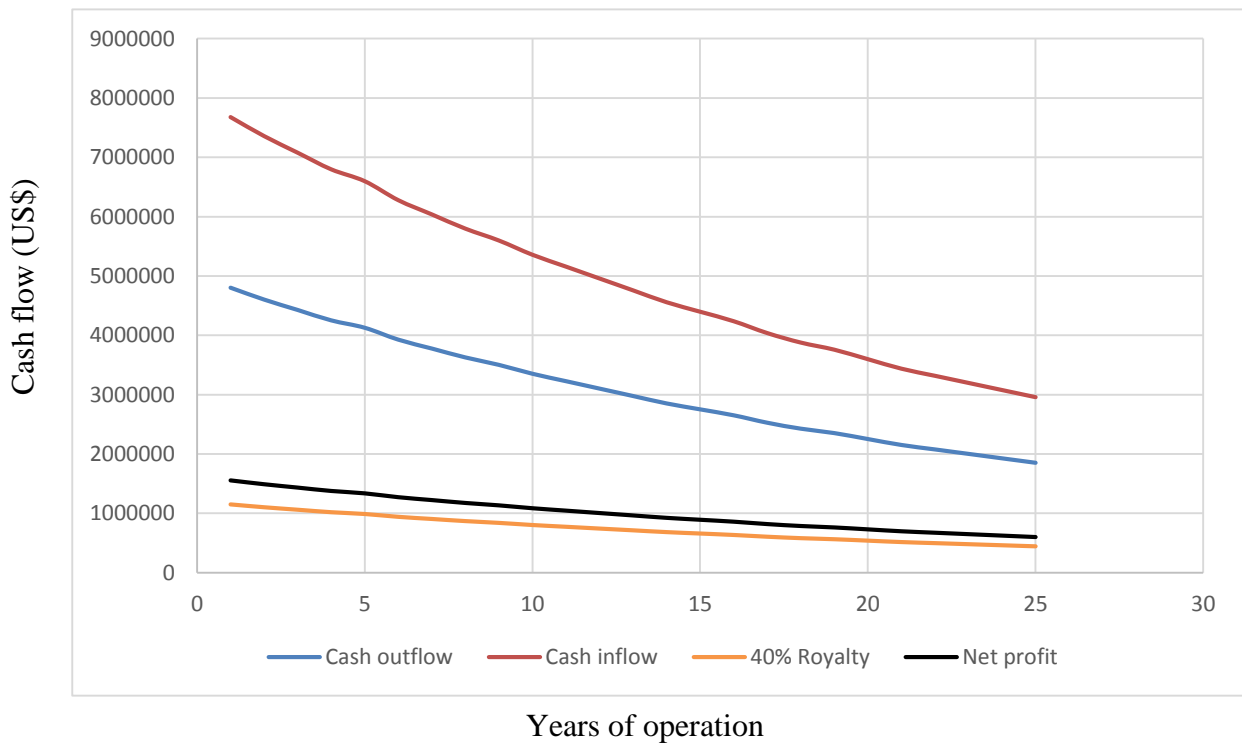


Fig 2: Economic indicators of the well

In order to estimate $T_o$ (sum of the present value of annual operating costs) cash outflow column was discounted to the present day using the following formula

$$P_t = \frac{F_t}{(1+\frac{r}{100})^t}$$

Where:

$P_t$ = Present value of future expenditure $F_t$ (or future earnings as the case may be), t varying from 1-25.

Therefore the present value of expenditures in column 3 (cash outflow) are:

1$^{st}$ year - $P = \dfrac{4800000}{\left(1+\dfrac{10}{100}\right)} = \dfrac{4800000}{1.1} =$ US$4363636.36

2$^{nd}$ year - $P = \dfrac{4600000}{\left(1+\dfrac{10}{100}\right)^2} = \dfrac{4600000}{1.21} =$ US$3801652.89

- - -    -    -    -    -    -    -    -

- - -    -    -    -    -    -    -    -

25$^{th}$ year - $P = \dfrac{1850000}{\left(1+\dfrac{10}{100}\right)^{25}} = \dfrac{1850000}{10.83} =$ US$170821.79

The discounted cash outflows for 25 years of operation of the well is given in column 10 of table 2, amounting to a total of US$33346858.

Therefore, the present value of total expenditure on the project (capital and operating) is estimated as

$$T = \frac{T_o}{0.75} = \frac{33346858}{0.75} = US\$44462477$$

Therefore capital outlay,

$T_c = 0.25 \times 44462477 =$ US$11.12million.

Similarly the present values of annual net profits can be estimated using column 8 of table 2. That is

1$^{st}$ year - $P = \dfrac{1555200}{\left(1+\dfrac{10}{100}\right)} = \dfrac{1555200}{1.1} =$ US$1413818.8

2$^{nd}$ year - $P = \dfrac{1490400}{\left(1+\dfrac{10}{100}\right)^2} = \dfrac{1490400}{1.21} =$ US$1231735.54

- - -    -    -    -    -    -    -    -

- - -    -    -    -    -    -    -    -

25$^{th}$ year - $P = \dfrac{599400}{\left(1+\dfrac{10}{100}\right)^{25}} = \dfrac{599400}{10.83} =$ US$55346.26

The discounted net profits for 25 years of operation of the well is stated in column11 of table 2 cumulating to a discounted net profit of US$10425280 (US$10.43million).

Therefore, the net present value of the well is

NPV = 10.43 – 11.12  =  <u>US$-0.7million</u>

The above result shows that at a price of US$40 per barrel and a cost of capital of 10% (discount rate), a royalty of 40% will render the well development business unprofitable.

In order to find the price at which NPV is zero, we estimate the annual net profits when price per barrel is US$50. The annual net profits for this price have been estimated and stated in column 2 of table 3 and the discounted net profits are stated in column 3 of table 3.
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Table 3: Net profit and discounted net profit of the well for US$50 per barrel

| Year of production | Net Profit at US$50 per barrel | Discounted net profit at 10% |
|---|---|---|
| 1 | 2592000 | 2356363.64 |
| 2 | 2484000 | 2052892.56 |
| 3 | 2389500 | 1796616.54 |
| 4 | 2295000 | 1571917.81 |
| 5 | 2227500 | 1383540.37 |
| 6 | 2119500 | 1197457.63 |
| 7 | 2038500 | 1045384.62 |
| 8 | 1957500 | 914719.63 |
| 9 | 1890000 | 800847.46 |
| 10 | 1809000 | 698455.69 |
| 11 | 1741500 | 611052.63 |
| 12 | 1674000 | 533121.02 |
| 13 | 1606500 | 465652.17 |
| 14 | 1539000 | 405000 |
| 15 | 1485000 | 356115.11 |
| 16 | 1431000 | 311764.71 |
| 17 | 1363500 | 270000 |
| 18 | 1309500 | 235521.58 |
| 19 | 1269000 | 207352.94 |
| 20 | 1215000 | 180534.92 |
| 21 | 1161000 | 156891.89 |
| 22 | 1120500 | 137653.56 |
| 23 | 1080000 | 120670.39 |
| 24 | 1039500 | 105532.99 |
| 25 | 999000 | 92243.77 |
|  |  | **18007303.63** |

Consequently, the NPV of the well for US$50 per barrel becomes
        NPV = 18.01 – 11.12  =  US$6.89million.

The positive value of NPV shows that at US$50 per barrel and royalty of 40% the well business will be profitable.

We now estimate the price at which NPV is zero. This was done by plotting a graph of price per barrel of oil versus NPV (Fig 3). As can be seen from the graph, the NPV is zero at a price of US$42 per barrel. Other values of NPV for prices above US$42 with the royalty constant at 40% are shown in table 5 and Fig 4.



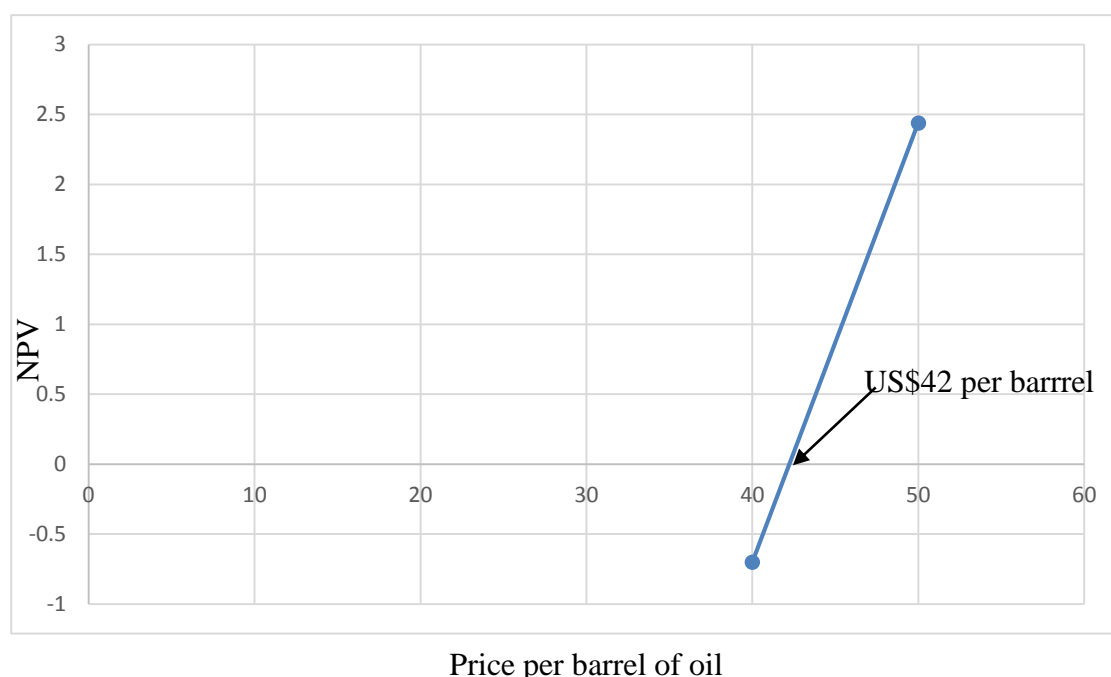Price per barrel of oil

Table 4: Price versus NPV for prices above the break-even (royalty constant at 40%)

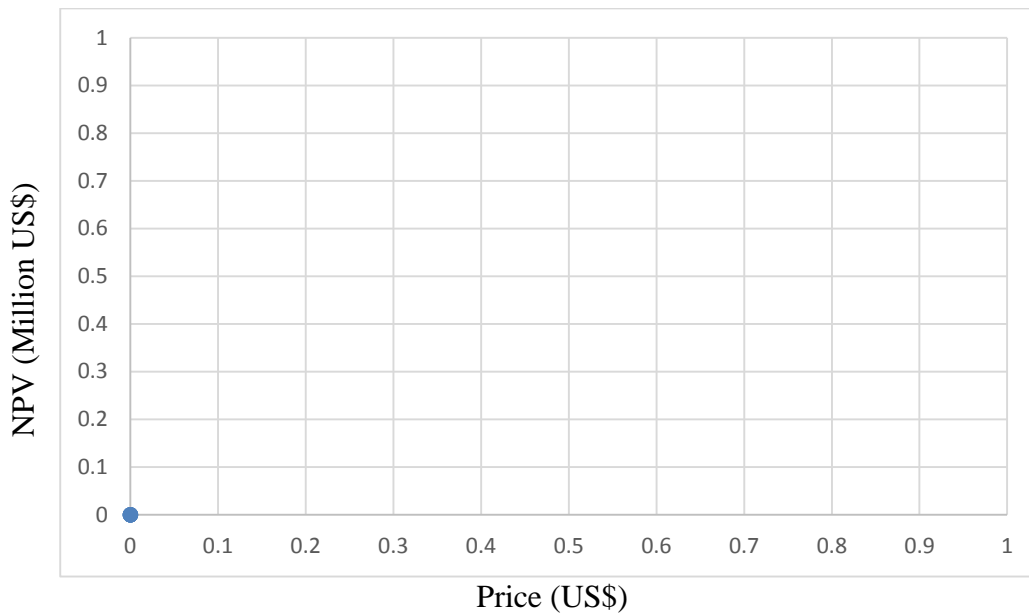| Price (US$) | 50 | 60 | 70 | 80 | 90 | 100 |
|---|---|---|---|---|---|---|
| NPV (Million US$) | 6.89 | 14.09 | 21.29 | 28.50 | 35.70 | 42.81 |

Fig 4: Graph of price versus NPV for prices above the break-even

## Internal Rate of Return

At 10% cost of capital and price per barrel equal to US$40, NPV is negative, showing that the internal rate of return is less than the cost of capital. However, as price per barrel of oil rises to 42 dollars, the NPV becomes equal to zero (fig 1). The implication of this is that the internal rate of return now is equal to the cost of capital. This is the break-even point, meaning that at oil price of US$42 per barrel, investor loses nothing but gains nothing. Currently the oil price is US$40 dollars per barrel which poses serious deterrent to investment in this sector.

## *A Dynamic Royalty System As A Tool For Stabilizing The Investment Climate In The Petroleum Sector*

While the royalty was 40% and the price per barrel of oil was US$40, the NPV was negative. Let us consider what happens when the royalty is decreased to 35% and 30% respectively with price still held at US$40 per barrel. Following the above procedure as used above, NPVs at 35% royalty and 30% royalty respectively were estimated and presented in table 4 (see appendices 1 & 2 for details). The positive values of these NPVs show that even at a price of US$40 per barrel, the investment attractiveness can be restored by decreasing the royalty to at least 35%.

The impact of royalty in increasing the NPV when lowered or decreasing NPV when increased can be used to stabilize the investors' interest in the oil sector. This can be done by lowering the royalty when price falls and increasing the royalty when price rises, thus, maintaining investor's interest in the sector at period of decline and reducing over profiteering at period of price rise. To show the impact of royalty in achieving this goal, NPVs have been estimated by increasing royalty as prices rise. For prices between US$50 - US$70 per barrel, royalty was increased to 50% while for prices between US$70 – US$100 per barrel royalty was increased to 60%. The values of NPVs versus royalty and price have been presented in table 6 and fig 5. (See appendices 3 - 7 for details).

Table 5: NPV behaviour as royalty is decreased to 35% and 30% respectively.

| Royalty (%) | Cumulative  Discounted net Profit | NPV |
|---|---|---|
| 30 | 12.61 | 1.49 |
| 35 | 11.70 | 0.58 |

Table 6: Behaviour of NPV with increment of royalty as price rises.

| Price (US$) | 60 | 70 | 80 | 90 | 100 |
|---|---|---|---|---|---|
| Royalty (%) | 50 | 50 | 60 | 60 | 60 |
| NPV | 9.89 | 15.94 | 15.29 | 20.09 | 24.88 |



Fig 5:

Fig 5 above shows the behaviour of NPV with changes in royalty and price. When royalty of 50% was charged on gross profit, the NPV was US$9.89 million for a price of US$60 per barrel. However when price rose to US$70 per barrel NPV rose from US$9.89 million to US$15.95 million. This calls for increase in royalty to reduce over-profiteering by the oil industries at the expenses of Government revenue. With the increment of royalty from 50% of gross profit to 60%, the curve was flattened from point Y to point Z bringing royalty down to US$15.30 million. This process can be continued for as long as price rises.

## CONCLUSION AND RECOMMENDATION

At the current price of US$40 per barrel, the investment climate in the oil sector of Nigerian economy is gloomy with a negative net present value and an internal rate of return less than cost of capital. When the price rises to US$42 per barrel the NPV will turn zero and the internal rate of return will be equal to the cost of capital. This is a break-even point for the investor. The oil price requires to be above this break-even point for investment to be attractive in this sector. The investment climate can be improved to attract investor's interest by reducing royalty to atleast 35% of gross profit. When prices rise well above the break-even point, royalty should be increased. This will reduce over profiteering by investors at period of high price, while the investor's interest can be retained at period of low price through a reduction of royalty.

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Appendix 1: Cash flow table based on 30% Royalty and US$40 price per barrel

| Year of Prod | Cash outflow | Cash inflow | Gross income | 30% Royalty | Profit before tax | Tax | Net profit | Discounted net profit |
|---|---|---|---|---|---|---|---|---|
| 1 | 4800000 | 7680000 | 2880000 | 86400 | 2016000 | 201600 | 1814400 | 1649454.55 |
| 2 | 4600000 | 7360000 | 2760000 | 828000 | 1932000 | 293200 | 1738800 | 1437024.79 |
| 3 | 4425000 | 7080000 | 2655000 | 796500 | 1858500 | 185850 | 1672650 | 1257631.58 |
| 4 | 4250000 | 6800000 | 2550000 | 765000 | 1785000 | 178500 | 1606500 | 1100342.47 |
| 5 | 4125000 | 6600000 | 2475000 | 742500 | 1732500 | 173250 | 1559250 | 968478.26 |
| 6 | 3925000 | 6280000 | 2355000 | 706500 | 1648500 | 164850 | 1483650 | 838220.34 |
| 7 | 3775000 | 6040000 | 2265000 | 679500 | 1585500 | 158550 | 1426950 | 731769.23 |
| 8 | 3625000 | 5800000 | 2175000 | 652500 | 1522500 | 152250 | 1370250 | 640303.74 |
| 9 | 3500000 | 5600000 | 2100000 | 630000 | 1470000 | 147000 | 1323000 | 560593.22 |
| 10 | 3350000 | 5360000 | 2070000 | 603000 | 1407000 | 140700 | 1266300 | 488918.92 |
| 11 | 3225000 | 5160000 | 1935000 | 580500 | 1354500 | 135450 | 1219050 | 427736.84 |
| 12 | 3100000 | 4960000 | 1860000 | 558000 | 1302000 | 130200 | 1171800 | 373184.71 |
| 13 | 2975000 | 4760000 | 1785000 | 535500 | 1249500 | 124950 | 1124550 | 325956.52 |
| 14 | 2850000 | 4560000 | 1710000 | 513000 | 1199000 | 119700 | 1077300 | 283500 |
| 15 | 2750000 | 4400000 | 1650000 | 495000 | 1155000 | 115500 | 1039500 | 249280.58 |
| 16 | 2650000 | 4240000 | 1590000 | 477000 | 1113000 | 111300 | 1001700 | 218235.29 |
| 17 | 2525000 | 4040000 | 1515000 | 454500 | 1060500 | 106050 | 954450 | 189000 |
| 18 | 2425000 | 3880000 | 1455000 | 436500 | 1018500 | 101850 | 916650 | 164865.11 |
| 19 | 2350000 | 3760000 | 1410000 | 423000 | 987000 | 98700 | 888300 | 145147.06 |
| 20 | 2250000 | 3600000 | 1350000 | 405000 | 945000 | 94700 | 850500 | 126374.44 |
| 21 | 2150000 | 3440000 | 1290000 | 387000 | 903000 | 90300 | 812700 | 109824.32 |
| 22 | 2075000 | 3320000 | 1245000 | 373500 | 871500 | 87150 | 784350 | 96357.49 |
| 23 | 2000000 | 3200000 | 1200000 | 360000 | 840000 | 84000 | 756000 | 84469.27 |
| 24 | 1925000 | 3080000 | 1155000 | 346500 | 808500 | 80850 | 727650 | 73873.19 |
| 25 | 1850000 | 2960000 | 1110000 | 333000 | 777000 | 77700 | 699300 | 64570.64 |
| SUM TOTAL | | | | | | | | 12605112.56 |

NPV = 12.61 – 11.12 = **US$1.49million**

Appendix 2: Cash flow table based on 35% Royalty and US$40 price per barrel

| Year of prod | Cash outflow | Cash inflow | Gross income | 35% royalty | Profit before tax | Tax | Net profit | Discounted net profit |
|---|---|---|---|---|---|---|---|---|
| 1 | 4800000 | 7680000 | 2880000 | 1008000 | 1872000 | 187200 | 1684800 | 1531636.36 |
| 2 | 4600000 | 7360000 | 2760000 | 966000 | 1794000 | 179400 | 1614600 | 1334380.17 |
| 3 | 4425000 | 7080000 | 2655000 | 929250 | 1725750 | 172575 | 1553175 | 1167800.75 |
| 4 | 4250000 | 6800000 | 2550000 | 892500 | 1657500 | 165750 | 1491750 | 1021746.58 |
| 5 | 4125000 | 6600000 | 2475000 | 866250 | 1608750 | 160875 | 1447875 | 899301.24 |
| 6 | 3925000 | 6280000 | 2355000 | 824250 | 1530750 | 153075 | 1377675 | 778347.46 |
| 7 | 3775000 | 6040000 | 2265000 | 792750 | 1472250 | 147225 | 1325025 | 679500 |
| 8 | 3625000 | 5800000 | 2175000 | 761250 | 1413750 | 141375 | 1272375 | 594567.76 |
| 9 | 3500000 | 5600000 | 2100000 | 735000 | 1365000 | 136500 | 1228500 | 520550.85 |
| 10 | 3350000 | 5360000 | 2070000 | 703500 | 1306500 | 130650 | 1175850 | 453996.14 |
| 11 | 3225000 | 5160000 | 1935000 | 677250 | 1257750 | 125775 | 1131950 | 397184.21 |
| 12 | 3100000 | 4960000 | 1860000 | 651000 | 1209000 | 120900 | 1088100 | 346528.66 |
| 13 | 2975000 | 4760000 | 1785000 | 624750 | 1160250 | 116025 | 1044225 | 302673.91 |
| 14 | 2850000 | 4560000 | 1710000 | 598500 | 1111500 | 111150 | 1000350 | 263250 |
| 15 | 2750000 | 4400000 | 1650000 | 577500 | 1072500 | 107250 | 965250 | 231474.83 |
| 16 | 2650000 | 4240000 | 1590000 | 556500 | 1033500 | 103350 | 930150 | 202647.06 |
| 17 | 2525000 | 4040000 | 1515000 | 530250 | 984750 | 98475 | 886275 | 175500 |
| 18 | 2425000 | 3880000 | 1455000 | 509250 | 945750 | 94575 | 851175 | 153089.03 |
| 19 | 2350000 | 3760000 | 1410000 | 493500 | 916500 | 91650 | 824850 | 134779.41 |
| 20 | 2250000 | 3600000 | 1350000 | 472500 | 877500 | 87750 | 789750 | 117347.79 |
| 21 | 2150000 | 3440000 | 1290000 | 451500 | 838500 | 83850 | 754650 | 101979.73 |
| 22 | 2075000 | 3320000 | 1245000 | 435750 | 809250 | 80925 | 728325 | 89474.82 |
| 23 | 2000000 | 3200000 | 1200000 | 420000 | 780000 | 78000 | 702000 | 78435.75 |
| 24 | 1925000 | 3080000 | 1155000 | 404250 | 750750 | 75075 | 675675 | 68291.88 |
| 25 | 1850000 | 2960000 | 1110000 | 388500 | 721500 | 72150 | 649350 | 59958.45 |
| SUM TOTAL | | | | | | | | 11704442.83 |

NPV = 11.70 − 11.12 = **US$0.58million**

Appendix 3: Cash flow table based on 50% Royalty and US$60 price per barrel

| Cash outflow | Cash inflow | Gross Income | 50% Royalty | Profit before tax | Tax | Net Profit | Discounted net Profit at 10% |
|---|---|---|---|---|---|---|---|
| 4800000 | 11520000 | 6720000 | 3360000 | 3360000 | 336000 | 3024000 | 2749090.91 |
| 4600000 | 11040000 | 6440000 | 3220000 | 3220000 | 322000 | 2898000 | 2395041.32 |
| 4425000 | 10620000 | 6195000 | 3097500 | 3097500 | 309750 | 2787750 | 2096052.63 |
| 4250000 | 10200000 | 5950000 | 2975000 | 2975000 | 297500 | 2677500 | 1833904.11 |
| 4125000 | 9900000 | 5775000 | 2887500 | 2887500 | 288750 | 2598750 | 1614130.44 |
| 3925000 | 9420000 | 5495000 | 2747500 | 2747500 | 274750 | 2472750 | 1397033.99 |
| 3775000 | 9060000 | 5285000 | 2642500 | 2642500 | 264250 | 2378250 | 1219615.39 |
| 3625000 | 8700000 | 5075000 | 2537500 | 2537500 | 253750 | 2283750 | 1067172.99 |
| 3500000 | 8400000 | 4900000 | 2450000 | 2450000 | 245000 | 2205000 | 934322.03 |
| 3350000 | 8040000 | 4690000 | 2345000 | 2345000 | 234500 | 2110500 | 814864.83 |
| 3225000 | 7740000 | 4515000 | 2257500 | 2257500 | 225750 | 2031750 | 712894.74 |
| 3100000 | 7440000 | 4340000 | 2170000 | 2170000 | 217000 | 1953000 | 621974.52 |
| 2995000 | 7140000 | 4165000 | 2082500 | 2082500 | 208250 | 1874250 | 543260.87 |
| 2850000 | 6840000 | 3990000 | 1995000 | 1995000 | 199500 | 1795500 | 472500 |
| 2750000 | 6600000 | 3850000 | 1925000 | 1925000 | 192500 | 1732500 | 415467.63 |
| 2650000 | 6360000 | 3710000 | 1855000 | 1855000 | 185500 | 1669500 | 363725.49 |
| 2525000 | 6060000 | 3535000 | 1767500 | 1767500 | 176750 | 1590750 | 315000 |
| 2425000 | 5820000 | 3395000 | 1697500 | 1697500 | 169750 | 1527750 | 274775.18 |
| 2350000 | 5400000 | 3290000 | 1645000 | 1645000 | 164500 | 1480500 | 241911.76 |
| 2250000 | 5400000 | 3150000 | 1575000 | 1575000 | 157500 | 1417500 | 210624.07 |
| 2150000 | 5160000 | 3010000 | 1505000 | 1505000 | 150500 | 1354500 | 183040.54 |
| 2070000 | 4980000 | 2910000 | 1455000 | 1455000 | 145500 | 1309500 | 160872.24 |
| 2000000 | 4800000 | 2800000 | 1400000 | 1400000 | 140000 | 1260000 | 140782.12 |
| 1925000 | 4620000 | 2695000 | 1347500 | 1347500 | 134750 | 121750 | 123121.83 |
| 1850000 | 4440000 | 2590000 | 1295000 | 1295000 | 129500 | 1165500 | 107617.73 |
| SUM TOTAL | | | | | | | 21008797.36 |

NPV $= 21.01 - 11.12 =$ **US$9.89million**

Appendix 4: Cash flow table based on 50% Royalty and US$70 price per barrel

| Cash Outflow | Cash Inflow | Gross Income | 50% Royalty | Profit before Tax | Tax | Net profit | Discounted net profit at 10% |
|---|---|---|---|---|---|---|---|
| 4800000 | 13440000 | 8640000 | 4320000 | 4320000 | 432000 | 3888000 | 3534545.46 |
| 4600000 | 12880000 | 8280000 | 4140000 | 4140000 | 414000 | 3726000 | 3079338.84 |
| 4425000 | 12390000 | 7965000 | 3982500 | 3982500 | 398250 | 3584250 | 2694924.81 |
| 4250000 | 11900000 | 7650000 | 3825000 | 3825000 | 382500 | 3442500 | 2357876.71 |
| 4125000 | 11550000 | 7425000 | 3712500 | 3712500 | 371250 | 3341250 | 2075310.56 |
| 3925000 | 10990000 | 7065000 | 3532500 | 3532500 | 353250 | 3179250 | 1796186.44 |
| 3775000 | 10570000 | 6795000 | 3397500 | 3397500 | 339750 | 3057750 | 1568076.92 |
| 3625000 | 10150000 | 6525000 | 3262500 | 3262500 | 326250 | 2936250 | 1372079.44 |
| 3500000 | 9800000 | 6300000 | 3150000 | 3150000 | 315000 | 2835000 | 1201271.19 |
| 3350000 | 9380000 | 6030000 | 3015000 | 3015000 | 301500 | 2713500 | 1047683.49 |
| 3225000 | 9030000 | 5805000 | 2902500 | 2902500 | 290250 | 2612250 | 916578.95 |
| 3100000 | 8680000 | 5580000 | 2790000 | 2790000 | 279000 | 2511000 | 799681.53 |
| 2975000 | 8330000 | 5355000 | 2677500 | 2677500 | 267750 | 2409750 | 698478.26 |
| 2850000 | 7980000 | 5130000 | 2565000 | 2565000 | 256500 | 2308500 | 659571.43 |
| 2750000 | 7700000 | 4950000 | 2475000 | 2475000 | 247500 | 2227500 | 534172.66 |
| 2650000 | 7420000 | 4770000 | 2385000 | 2385000 | 238500 | 2146500 | 467647.06 |
| 2525000 | 7070000 | 4545000 | 2272500 | 2272500 | 227250 | 2045250 | 405000 |
| 2425000 | 6790000 | 4365000 | 2182500 | 2182500 | 218250 | 1964250 | 353282.37 |
| 2350000 | 6580000 | 4230000 | 2115000 | 2115000 | 211500 | 1903500 | 311029.41 |
| 2250000 | 6300000 | 4050000 | 2025000 | 2025000 | 202500 | 1822500 | 270802.38 |
| 2150000 | 6020000 | 3870000 | 1935000 | 1935000 | 193500 | 1741500 | 235337.84 |
| 2075000 | 5810000 | 3735000 | 1867500 | 1867500 | 186750 | 1680750 | 206480.34 |
| 2000000 | 5600000 | 3600000 | 1800000 | 1800000 | 180000 | 1620000 | 181005.59 |
| 1925000 | 5390000 | 3465000 | 1732500 | 1732500 | 173250 | 1559250 | 158299.49 |
| 1850000 | 5180000 | 3330000 | 1665000 | 1665000 | 166500 | 1498500 | 138365.65 |
| **SUM TOTAL** | | | | | | | **27063026.82** |

NPV = 27.06 – 11.12 = **U$$15.94million**

Appendix 5: Cash flow table based on 60% Royalty and US$80 price per barrel

| Cash Outflow | Cash Inflow | Gross Income | 60% Royalty | Profit before Tax | Tax | Net profit | Discounted net profit at 10% |
|---|---|---|---|---|---|---|---|
| 4800000 | 15360000 | 10560000 | 6336000 | 4224000 | 422400 | 3801600 | 3456000 |
| 4600000 | 14720000 | 10120000 | 6072000 | 4048000 | 404800 | 3643200 | 3010909.09 |
| 4425000 | 14160000 | 9735000 | 5841000 | 3894000 | 389400 | 3504600 | 2635037.59 |
| 4250000 | 13600000 | 9350000 | 5610000 | 3740000 | 374000 | 3366000 | 2305479.45 |
| 4125000 | 13200000 | 9075000 | 5445000 | 3630000 | 363000 | 3267000 | 2029192.55 |
| 3925000 | 12560000 | 8635000 | 5181000 | 3454000 | 345400 | 3108600 | 1756271.19 |
| 3775000 | 12080000 | 8305000 | 4983000 | 3322000 | 332200 | 2989800 | 1533230.77 |
| 3625000 | 11600000 | 7975000 | 4785000 | 3190000 | 319000 | 2871000 | 1341588.79 |
| 3500000 | 11200000 | 7700000 | 4620000 | 3080000 | 308000 | 2772000 | 1174576.27 |
| 3350000 | 10720000 | 7370000 | 4422000 | 2948000 | 294800 | 2653200 | 1024401.54 |
| 3225000 | 10320000 | 7095000 | 4257000 | 2838000 | 283800 | 2554200 | 896210.53 |
| 3100000 | 9920000 | 6820000 | 4092000 | 2728000 | 272800 | 2455200 | 781910.83 |
| 2975000 | 9520000 | 6545000 | 3927000 | 2618000 | 261800 | 2356200 | 682956.52 |
| 2850000 | 9120000 | 6270000 | 3762000 | 2508000 | 250800 | 2257200 | 594000 |
| 2750000 | 8800000 | 6050000 | 3630000 | 2420000 | 242000 | 2178000 | 522302.16 |
| 2650000 | 8480000 | 5830000 | 3498000 | 2332000 | 233200 | 2098800 | 457254.90 |
| 2525000 | 8080000 | 5555000 | 3333000 | 2222000 | 222200 | 1999800 | 396000 |
| 2425000 | 7760000 | 5335000 | 3201000 | 2134000 | 213400 | 1920600 | 345431.65 |
| 2350000 | 7520000 | 5170000 | 3102000 | 2068000 | 206800 | 1861200 | 304117.65 |
| 2250000 | 7200000 | 4950000 | 2970000 | 1980000 | 198000 | 1782800 | 264784.55 |
| 2150000 | 6880000 | 4730000 | 2838000 | 1892000 | 189200 | 1702800 | 230108.11 |
| 2075000 | 6640000 | 4570000 | 2742000 | 1828000 | 182800 | 1645200 | 202113.02 |
| 2000000 | 6400000 | 4400000 | 2640000 | 1760000 | 176000 | 1584000 | 176983.24 |
| 1925000 | 6160000 | 4235000 | 2541000 | 1694000 | 169400 | 1524600 | 154781.73 |
| 1850000 | 5920000 | 4070000 | 2442000 | 1628000 | 162800 | 1465200 | 135290.86 |
| SUM TOTAL | | | | | | | 26410932.99 |

NPV =  26.41 – 11.12  =  **US$15.29million**

Appendix 6: Cash flow table based on 60% Royalty and US$90 price per barrel

| Cash outflow | Cash inflow | Gross income | 60% Royalty | Profit before tax | Tax | Net profit | Discounted net profit @ 10% |
|---|---|---|---|---|---|---|---|
| 4800000 | 17280000 | 12480000 | 7488000 | 4992000 | 499200 | 4492800 | 4084363.64 |
| 4600000 | 1656000 | 11960000 | 7176000 | 4784000 | 478400 | 4305600 | 3558347.11 |
| 4425000 | 15930000 | 11505000 | 6903000 | 4602000 | 460200 | 4141800 | 3114135.34 |
| 4250000 | 15300000 | 11050000 | 6630000 | 4420000 | 442000 | 3978000 | 2724659.53 |
| 4125000 | 14850000 | 10725000 | 6435000 | 4290000 | 429000 | 3861000 | 2398136.65 |
| 3925000 | 14130000 | 10205000 | 6123000 | 4082000 | 408200 | 3673800 | 2075593.22 |
| 3775000 | 13590000 | 9815000 | 5889000 | 3926000 | 392600 | 3533400 | 1812000 |
| 3625000 | 13050000 | 9425000 | 5655000 | 3770000 | 377000 | 3393000 | 1585514.02 |
| 3500000 | 12600000 | 9100000 | 5460000 | 3640000 | 364000 | 3276000 | 1381135.59 |
| 3350000 | 12060000 | 8710000 | 5226000 | 3484000 | 348400 | 3135600 | 1210656.37 |
| 3225000 | 11610000 | 8385000 | 5031000 | 3354000 | 335400 | 3018600 | 1059157.99 |
| 3100000 | 11160000 | 8060000 | 4836000 | 3224000 | 322400 | 2901600 | 924076.43 |
| 2975000 | 10710000 | 7735000 | 4641000 | 3094000 | 309400 | 2784600 | 807130.43 |
| 2850000 | 10260000 | 7410000 | 4446000 | 2964000 | 296400 | 2667600 | 702000 |
| 2750000 | 9900000 | 7150000 | 4290000 | 2860000 | 286000 | 2574000 | 617266.19 |
| 2650000 | 9540000 | 6890000 | 4134000 | 2756000 | 275600 | 2480400 | 540392.16 |
| 2525000 | 9090000 | 6565000 | 3939000 | 2626000 | 262600 | 2363400 | 468000 |
| 2425000 | 8730000 | 6305000 | 3783000 | 2522000 | 252200 | 2269800 | 408237.41 |
| 2350000 | 8460000 | 6110000 | 3666000 | 2444000 | 244400 | 2199600 | 359411.76 |
| 2250000 | 8100000 | 5850000 | 3510000 | 2340000 | 234000 | 2106000 | 312927.19 |
| 2150000 | 7740000 | 5590000 | 3354000 | 2236000 | 223600 | 2012400 | 271945.95 |
| 2075000 | 7470000 | 5395000 | 3237000 | 2158000 | 215800 | 1942200 | 238599.51 |
| 2000000 | 7200000 | 5200000 | 3120000 | 2080000 | 208000 | 1872000 | 209162.01 |
| 1925000 | 6930000 | 5005000 | 3003000 | 2002000 | 200200 | 1801800 | 182923.86 |
| 1850000 | 6660000 | 4810000 | 2886000 | 1924000 | 192400 | 1731600 | 159889.29 |
| **SUM TOTAL** | | | | | | | **31212661.65** |

NPV = 31.21 – 11.12 = **US$20.09million**

Appendix 7: Cash flow table based on 60% Royalty and US$100 price per barrel

| Cash Outflow | Cash Inflow | Cash Inflow | Gross Income | 60% Royalty | Profit before Tax | Tax | Net profit | Discounted net profit at 10% |
|---|---|---|---|---|---|---|---|---|
| 4800000 | 19200000 | 19200000 | 14400000 | 8640000 | 5760000 | 576000 | 5184000 | 4712727.27 |
| 4600000 | 18400000 | 18400000 | 13800000 | 8280000 | 5520000 | 552000 | 4968000 | 4105785.12 |
| 4425000 | 17700000 | 17700000 | 13275000 | 7965000 | 5310000 | 531000 | 4779000 | 3593233.08 |
| 4250000 | 17000000 | 17000000 | 12750000 | 7650000 | 5100000 | 510000 | 4590000 | 3143835.62 |
| 4125000 | 16500000 | 16500000 | 12375000 | 7425000 | 4950000 | 495000 | 4455000 | 2767080.75 |
| 3925000 | 15700000 | 15700000 | 11775000 | 7065000 | 4710000 | 471000 | 4239000 | 2394915.25 |
| 3775000 | 15100000 | 15100000 | 11325000 | 6741000 | 4494000 | 449400 | 4044600 | 2074153.85 |
| 3625000 | 14500000 | 14500000 | 10875000 | 6525000 | 4350000 | 435000 | 3915000 | 1829439.25 |
| 3500000 | 14000000 | 14000000 | 10500000 | 6300000 | 4200000 | 420000 | 3780000 | 1601694.92 |
| 3350000 | 13400000 | 13400000 | 10050000 | 6030000 | 4020000 | 402000 | 3618000 | 1396911.29 |
| 3225000 | 12900000 | 12900000 | 9675000 | 5805000 | 3870000 | 387000 | 3483000 | 1222105.26 |
| 3100000 | 12400000 | 12400000 | 9300000 | 5580000 | 3720000 | 372000 | 3348000 | 1066242.04 |
| 2975000 | 11900000 | 11900000 | 8950000 | 5370000 | 3580000 | 358000 | 3222000 | 933913.04 |
| 2850000 | 11400000 | 11400000 | 8550000 | 5130000 | 3420000 | 342000 | 3078000 | 810000 |
| 2750000 | 11000000 | 11000000 | 8250000 | 4950000 | 3300000 | 330000 | 2970000 | 712230.22 |
| 2650000 | 10600000 | 10600000 | 7950000 | 4770000 | 3180000 | 318000 | 2862000 | 623529.41 |
| 2525000 | 10100000 | 10100000 | 7575000 | 4545000 | 3030000 | 303000 | 2727000 | 540000 |
| 2425000 | 9700000 | 9700000 | 7250000 | 4350000 | 2900000 | 290000 | 2610000 | 469424.46 |
| 2350000 | 9400000 | 9400000 | 7050000 | 4230000 | 2820000 | 282000 | 2538000 | 414705.88 |
| 2250000 | 9000000 | 9000000 | 6750000 | 4050000 | 2700000 | 270000 | 2430000 | 361069.84 |
| 2150000 | 8600000 | 8600000 | 6450000 | 3870000 | 2580000 | 258000 | 2322000 | 313783.78 |
| 2075000 | 8300000 | 8300000 | 6230000 | 3738000 | 2492000 | 249200 | 2242800 | 275528.26 |
| 2000000 | 8000000 | 8000000 | 6000000 | 3600000 | 2400000 | 240000 | 2160000 | 241340.78 |
| 1925000 | 7700000 | 7700000 | 5775000 | 3465000 | 2310000 | 231000 | 2079000 | 211065.99 |
| 1850000 | 7400000 | 7400000 | 5550000 | 3330000 | 2220000 | 222000 | 1998000 | 184487.53 |
| **SUM TOTAL** | | | | | | | | **35999202.89** |

NPV = 36.00 – 11.12 = **US$24.88million**