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Comparison of Underground Natural Gas Storage Methods using the Six Economic Indicators & the (AHP) Tool: (A Case Study of the Niger-Delta)

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Abstract Sadly, the crude idea of ancient times still flourishes in the heart of developing countries. Underground storage options were considered, as research has proven that this is a better option than surface storage. The Niger-Delta was put into consideration. The several underground storage options available, were compared using the Analytical Hierarchical Process model. A tool that beats the short comings of the inconsistency in human mind. Several criteria like the six economic indicators, efficiency, compatibility to the Niger-Delta province and safety, in ascending order of priority were thoroughly studied and used for the judgment. The gas flaring option was also kept in the analysis as a control, to appear least suitable in the scale of priority. It turned out as expected; the gas flaring alternative proved least, with a priority percentage of 18%, next in ascending order of priority was the salt caverns, with a percentage priority of 20%, then the aquifers had 22% priority. Lastly, depleted reserves proved to be the most suitable with 39% priority and even after shifting priority of criteria to compatibility, it still retained most suitable UGS in the Niger-Delta province.

Keywords Aquifers, Depleted Reserves, Natural Gasflaring, Salt Caverns

Introduction

A reply from one Deputy Manager - Field Operations at the Nigerian Petroleum Development Company (NPDC), Mr. Idowu Gabriel; on why the issue of flaring still continues so unperturbed today. He clearly pointed out the lack of maintenance culture and a towering height of laissez-faire attitude to government palaver. According to Aregbe [1], only from 1996 – 2010, Nigeria has lost 12 602 480 25 million cuft of natural gas to flaring (NNPC), some multi-billion-dollar waste, equivalent to losing about 12 967 952 × 10^{12} Btu of energy. In 2015, the World Bank estimated that 140 billion cubic meters of natural gas produced is flared annually, Laws and penalty have been set up to discourage this trend and encourage the green energy alternatives, as it is compatible to nature.

Yet, Nigeria doesn't seem to bother much. In fact, the penalties put in place by the government against flaring is seeming only to mar the same government. Maybe, due to the naturally endowed potentials she possesses, having gas reserves of about (100 trillion scf), more than twice the quantity of her crude oil, that some petroleum professionals usually describe Nigeria as a natural gas province with some quantity of oil in it; this puts the country in the top 10 nations in the world in terms of natural gas reserves [2]. Base on statistical facts, the oil reserves in the province should last for 37 years, whereas the gas capacity should remain till at least 110 years, notwithstanding the country being the second largest flaring nation in the world [3].

Though, some gas handling facilities are currently being set up to tackle the issue, like the Oredo Gas Pan Ocean Operating Company (OGPOOC), Benin, Nigeria, was launched. But considering other similar infrastructural set up like the Warri and Port Harcourt refinery, the response of the Deputy Manager Field operations, NPDC; is almost inevitable.

Underground storage is proposed to be quite a remedy, as it has already proven to be a great aid to similar issues in the west. Hence, it can be reproduced to tackle both the issue flaring and poor maintenance culture in Nigeria. Though, from here arises the real issue of determining which is the most suitable of the underground methods, ranging from factors like economic viability, compatibility, environmental stability and others, which would all be put into consideration.

Materials and Methods

Inventory Verification / Gas Capacity Estimation for Depleted Reserves

The gas storage capacity is the same volume occupied by produced oil. According to Dake L.P. [4], going down into the reservoir the total volume of oil plus dissolved gas produced is NpBo (rb). At the surface NpRs (scf), still persists as dissolved gas. Therefore, the remaining produced gas Np(Rp – Rs) (scf), will exist as the total liberated gas and gas-cap gas produced and in reservoir conditions, Np(Rp – Rs)Bg (rb). The total underground withdrawal term is hence, Np(Bo + (Rp-Rs)Bg) (rb). In standard conditions of gas volumes, we have;

$$V1 = 5.615Np[Bo/Bgi + (Rp - Rs)] \text{ (scf)} \quad (1)$$

i.e Volume previously occupied by produced oil.

While the volume of gas required to replace the entire producible oil;

$$V2 = 5.615N[Bo/Bgi + (Rp - Rs)] \text{ (scf)} \quad (2)$$

Where; Np = Cumm Oil Produced, Stb

N = Initial Oil in Place, Stb

Bo = Initial Oil Formation Volume factor, bbl/Stb

Bg = Initial Gas Formation Volume factor, bbl/scf

Rp = Cumm Gas oil ratio, scf/stb

Rs = Gas solubility, scf/Stb

Breakdown of Expenditure

According to Anyadiegwu [5],

$$S = N + I \quad (3)$$

$$I = C + D + A + G \quad (4)$$

Where; S= Total Storage Cost

N = Annual Storage Cost

I = Initial Investment Cost

C = Cost of Cushion Gas

D = Development Cost

A = Acquisition Cost

G = Gas Gathering Cost

Hence, $S = N + C + D + A + G$ (5)

Acquisition Cost (A): this is the cost of acquiring the abandoned oil/gas well from the company and the cost of the remaining gas insitu. Mathematically,

A = Cgrem + Cwa. (6)

Cost of Acquiring Abandoned Well (Cwa): This is the salvage value for 20% of initial well cost.

Initial Well Cost = Drilling Cost ($/ft) × Depth. (7)

Hence, Cwa = 20% of initial well cost (8)

Cost of purchase of remaining recoverable gas in the formation, (CG rem):

CG rem = Gas prizes × Amount for remaining recoverable gas. (9)

Development Cost (D): This is the cost of drilling new wells and related activities like Installation of well head structures necessary for the re-conditioning of the depleted reservoir for underground storage operations. According to Anyadiegwu [6], 5 observatory wells are needed to permit measurements, to check if injected gas is confined to a design area, controlling gas bubble evolution from the storage facilities and checking for leakages. An extra well would be needed for withdrawal/injection, making a total of 6 wells.

This session consists of; Drilling Cost (CD), cost of installing well head structures (Cws) and cost of installing gathering system (Cgs).

D = Cgs + Cws + CD (10)

Gas Gathering System (G): These are defined as the flow-line network and process flow compartments which transport and direct flow of fluid from well heads to main storage tanks, processing chambers or shipping vessel. Gathering system consist of all or some of these; pumps, emulsion treaters, tanks, valves, dehydrators, pipelines, headers, separators, meters, regulators, compressors and other similar devices. Though in this work, they are summarized as cost of pipelines, compressor stations and metering units. Hence;

G = Ccomp + Cpipe + Cmeter (11)

According to Anyadiegwu [7], a reciprocating compressor of 200-10000 billion hp whose daily input and output is 50MMscf/day is chosen, pipelines of 12', 14' and 18' of length about 40 miles are commonly the ideal, together with 4 metering stations. Hence;

Cost of Cushion Gas (C): Depleted reservoirs usually have this set at 50% MMscf of working gas volume.

C = 50% of Working Volume (12)

Annual Storage Cost (N): This is the amount of needed to run the operations and for storage in the reservoir per annum. Hence;

N = Annual Operating Cost + Annual Reservoir Storage Cost (13)

Annual Reservoir Storage Cost = $0.48 per MMBtu [8] (14)

Annual Operating Cost = Labour + Maintenance + Management Cost (15)

Gross Revenue = Price of natural gas × Working Gas Capacity (Bcf) (16)

Net Revenue = Gross Revenue – Annual Storage Cost (17)

Fixed Cost of Operators [9]:

Cost of Drilling a well per foot	= $150
Cost of Well Head Structures	= $10,000
Cost of installing gathering system	= $50,000
Cost of Compressor Station	= $9,600,000
Cost of Pipeline and Metering Stations	= $10,400,000
Annual Labour Cost	= $4,800,000
Annual Maintenance Cost	= $7,240,000
Annual Management Cost	= $804,000

Reservoir Data Z 17X [10]:

Saturation Pressure, Po	= 3002psi
Discovery Pressure, P	= 3955psig
Stock Tank Oil in Place, N	=1.244MMStb
Reservoir Temperature, T	= 216F
Gas Compressibility factor, Z	= 0.86
Cumm. Oil Produced, Np	= 0.5825MMStb
Initial Gas Formation Volume factor	= 0.004156 bbl/scf
Initial Oil Formation Volume factor	=1.405 bbl/stb
Specific Gravity, SG	=26API
Porosity, ø	=0.25
Height, H	=80ft
Initial Oil Water Saturation	=20%
Well Depth, D	=11000ft
Permeability, k	=30Md
Cumm Gas Oil Ratio, Rp	= 3200scf/stb
Gas solubility, Rs	= 847scf/stb
1 MMBTU	=1000scf

Henry Hub nat gas USD/MMBTU	=$4.05
Price of nat gas/MMBTU	=$4.06 [11]

Calculation Table:

Volume of gas to replace produced oil (Working gas);

$V1 = 5.615 \times 0.5825 \times 10^6$

[(1.4054/0.004156)×(3200 – 847.24)] = 8.8 Bscf

Volume of gas initially in place;

$V2 = 5.615 \times 1.244 \times 10^6$

[(1.4054/0.004156)×(3200 – 847.24)] = 18.8 Bscf

Hence, the remnant gas volume;

V2-V1 = 10.0 Bscf

Initial Cost of Drilling Well, CD = Drilling Cost ($/ft) × Depth = $150 * 11000 ft= $165,000

Cost of Acquiring Abandoned Well, Cwa = 20/100 * $165,000 = $330,000

Cost of Remnant Gas, CGRem = Cost of gas * Remnant gas Volume

=$4.06/MMBTU * 10 Bscf * 0.2

= $4.06 /1000scf * 10 Bscf * 0.2

CGRem = $8,120,000

Acquisition Cost, A = Cwa + CGRem= $330,000 + $8,120,000 = $8,450,000.

Development Cost, D = CD + Cost of Well Heads + Cost of Installing gathering system

D = $165,000 + $ 10,000 + $50,000 = $1,710,000

Cost of Gas Gathering System, G = Ccomp + Cpipe/meter

= $9,600,000 + $10,400,000 = $20,000,000

Cost of Cushion Gas, C = 50% per MMscf of Working gas Volume

The total volume needed to run the facility is the working gas volume and the base gas volume

= (8.8 + 4.4) Bscf = 13.2 Bscf

Since we have 10Bscf as remnant gas, we need 3.2 Bscf to make up the stock.

C = $4.06/1000MMscf * 3.2Bscf = $12,992,000

Total Investment Cost, I = A + D + G +C

I = $8,450,000 + $1,710,000 + $20,000,000 + $12,922,000

I = $43,082,000

Annual Operating Cost = Annual Labour Cost + Annual Maintenance Cost + Annual Management Cost

Annual Operating Cost = $4,800,000 + $7,240,000 + $804,000 = $12,844,000

Annual Reservoir StorageCost = $0.48 per MMBTU * Remnant Gas

= $0.48/1000scf * 8.8Bscf = $4,224,000

Annual Storage Cost (N) = Annual Reservoir + Annual Operating Cost

= $12,844,000 + $4,224,000 = $17,068,000

Gross Revenue = Gas Price * Top Storage = $4.06/1000scf * 8.8 Bscf= $35,728,000

Annual Net Revenue = $35,728,000- $17,068,000 = $18,660,000

Taxation

According to Energy & Natural Resources: Proposed Fiscal Regime, [12], taxation is as low as 50% on income for marginal fields, while fields deeper than 1000ft pay no royalty. This is applicable to this scenario as UGS operations have not been considered in the fiscal policy system in Nigeria. In the US however, the surcharge rates are based on the demand charge, fuel consumption, withdrawal/injection and cushion gas used [13].

The economic indicators can hence be derived

1. NCR = $50,218,000
2. Profit per Dollar Invested = NCR/INV (18)

   Hence, P/$ = $50,218,000/$43,082,000

   P/$ = 1.166

3. Pay-Out = 4 + (5762000/9330000)
   PO = 4.618
4. Present Value @ 15% = $3,743,126.3
5. Present Value / $ Invested = 0.087
6. DCF-ROR = 17.5%

By sensitivity analysis, the six economic indicators were derived for other UGS alternatives in the main work.

Application of the Analytical Hierarchy Process (AHP) Tool

Problem Definition:

In this paper, the comparison of the various means of underground storage is considered as alternatives, while the flaring of gas is set as a control experiment, in-order to determine the performances and to execute thorough cross analysis that optimizes cash returns both on the short, but especially on the long run, as this is a major determinant, together with the other economic indicators. Certain other factors were selected as judgment criteria based on professional advice and veritable journals.

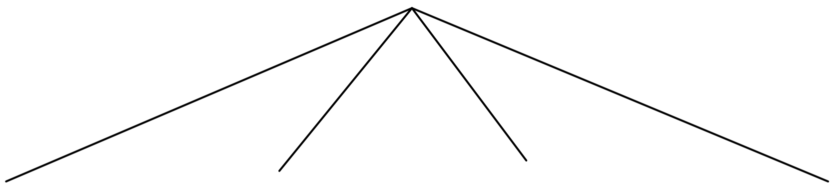
Putting into considerations also future regulations and trends to a zero-emission atmospheric desire and other long-term effects on the earth and man himself, environmental impact and health safety was carefully factored as pertinent to engineering standards ‘’Safety first’’.

Lastly, since primary data used here are from foreign scenarios and not in the Niger/ Delta petroleum province, because this approach is novel; as much as possible, compatibility with subsurface compartments and availability of naturally existing physical subsurface leverages is factored too as a judgment criterium.

Hence, the chart below shows the goal of the AHP, various alternatives of underground storage and several judgment criteria considered.

Hierarchy of Criteria

Leve1: Goal Selecting the most suitable UGS



Level 2: Alternative — Depleted Reserves | Salt Caverns | Aquifers | Gas Flaring

Level 3: Judgment Criteria

A: Economic Indicators
1. Net Cash Recovery NCR
2. Profit/ $
3. Payout Time PO
4. PV @ 15%
5. PV / $ Invested
6. Rate of Returns ROR

B: Niger / Delta Compatibility
1. Availability of structures & Feasibility of operation
2. Conversion Efficiency

C: UGS Efficiency
1. Injection/ Withdrawal Rates (Deliverability)
2. Structure Integrity/ Durability and Leakage

D: Environmental Impact
1. Health & Safety
2. Failure Tendency and Risk of disasters

By following the AHP procedure, the hierarchy of the problem can be deduced, showing relative preferences and priority for decision of the most suitable (UGS) Underground Storage [14].

Table 1: Relative Scale of preference with the Six Indicators and 3 more Criteria Pertaining to the Niger Delta from the main work

	Depleted Reserves (A)	Salt Caverns (B)	Aquifers (C)	Gas Flaring (D)
NCR	\$50,218,000	\$39,246,667	\$33,300,000	-\$17,600,000
Profit/\$	1.166	0.476	0.555	0
Pay-Out	4.618	6.78	6.43	∞
DCF-ROR	17.5%	8%	9%	0%
Compatibility	Fairly	Moderately	Very much	Highly
Efficiency	Moderately	Highly	Poorly	Very much
Safety	Highly	Fairly	Very much	Negatively

Results of the Analysis

Hierarchical Synthesis: The following could be done automatically, but was done manually here to allow close follow-up on the decision analysis. The synthesized matrix would be gotten first from the pair-wise comparisons by dividing each element on the pair-wise matrix by its column total. Next the priority vector is obtained by finding the row averages of the synthesized matrix.

Table 2: Pair-wise comparisons for Safety

	A	B	C	D
A	1	3	2	9
B	1/3	1	1/2	6
C	1/2	2	1	7
D	1/9	1/6	1/7	1

Table 3: Synthesized Matrix for Safety

	A	B	C	D	Priority Vector
A	0.514	0.486	0.549	0.391	0.485
B	0.171	0.162	0.137	0.261	0.182
C	0.257	0.324	0.274	0.304	0.290
D	0.057	0.027	0.039	0.043	0.042
					Σ = 1

λmax = 4.051, CI = 0.0171, RI = 0.9, CR = 0.019 < 0.1 ok

Consistency Check: The eigen values of the comparison is calculated by summing up the product of the pair-wise matrix and the priority vectors.

0.485(1, 1/3, 1/2, 1/9) + 0.182(3, 1, 2, 1/6) + 0.29(2, 1/5, 1 1/7) + 0.042(9, 6, 7, 1)

= (1.993, 0.734, 1.193, 0.166).

1.993/0.485 = 4.109, 0.734/0.182 = 4.032, 1.193/0.290 = 4.114, 0.166/0.042 = 3.951

λmax = (4.109 + 4.032 + 4.114 + 3.924)/4 = 4.051

CI = (λmax -n)/n – 1= (4.051-4)/4 - 1

CI = 0.0171

Since we are dealing with a 4×4 matrix with n = 4, from table 4.2 we have our Random Consistency Index = 0.9

Hence, Consistency Ratio = CI / RI

CR = 0.171/0.9 = 0.019.

Since, CR < 0.1, it is okay and consistent. The rest of the criteria follow the same pattern to obtain the overall priority indices.

Table 4: Pair-wise comparisons of Efficiency

	A	B	C	D
A	1	1/3	2	1/2
B	3	1	4	2
C	1/2	1/4	1	1/3
D	2	1/2	3	1

Table 5: Synthesized Matrix for Efficiency

	A	B	C	D	Priority Vector
A	0.154	0.118	0.200	0.130	0.151
B	0.462	0.353	0.400	0.522	0.434
C	0.077	0.088	0.100	0.087	0.088
D	0.308	0.177	0.300	0.261	0.262
					Σ = 0.9343

λ max = 4.03, CI = 0.0103, RI = 0.9, CR = 0.0114 < 0.1 ok

Table 6: Pair-wise comparisons of Compatibility

	A	B	C	D
A	1	1/2	1/3	1/4
B	2	1	1/2	1/3
C	3	2	1	1/2
D	4	3	2	1

Table 7: Synthesized Matrix for Compatibility

	A	B	C	D	Priority Vector
A	0.100	0.077	0.087	0.12	0.096
B	0.200	0.154	0.130	0.16	0.161
C	0.300	0.308	0.261	0.24	0.277
D	0.400	0.462	0.522	0.48	0.466
					Σ = 1

λ max = 4.03, CI = 0.0103, RI = 0.9, CR = 0.0114 < 0.1

Table 8: Pair-wise comparisons of DCF-ROR

	A	B	C	D
A	1	3	2	7
B	1/3	1	1/2	3
C	1/2	2	1	4
D	1/7	1/3	1/4	1

Table 9: Synthesized Matrix for DCF-ROR

	A	B	C	D	Priority Vector
A	0.506	0.474	0.533	0.467	0.495
B	0.169	0.158	0.133	0.200	0.165
C	0.253	0.316	0.267	0.267	0.276
D	0.072	0.053	0.067	0.067	0.065
					Σ = 1.0005

λ max = 4.021, CI = 0.0069, RI = 0.9, CR = 0.0076 < 0.1 ok

Table 10: Pair-wise Comparisons of Pay-Out

	A	B	C	D
A	1	4	3	9
B	¼	1	½	6
C	1/3	2	1	7
D	1/9	1/6	1/7	1

Table 11: Synthesized Matrix for Pay-Out

	A	B	C	D	Priority Vector
A	0.590	0.558	0.646	0.391	0.546
B	0.148	0.140	0.108	0.261	0.164
C	0.197	0.279	0.215	0.304	0.249
D	0.066	0.023	0.031	0.043	0.041
					Σ = 1

λ max = 4.138, CI = 0.0459, RI = 0.9, CR = 0.0511 < 0.1 ok

Table 12: Pair-wise comparisons for Profit/$

	A	B	C	D
A	1	3	2	9
B	1/3	1	1/2	5
C	½	2	1	7
D	1/9	1/5	1/7	1

Table 13: Synthesized Matrix for Profit/$

	A	B	C	D	Priority Vector
A	0.514	0.484	0.549	0.409	0.489
B	0.171	0.161	0.137	0.227	0.174
C	0.257	0.323	0.274	0.318	0.293
D	0.057	0.032	0.039	0.045	0.0433
					Σ = 0.9993

λ max = 4.042, CI = 0.01403, RI = 0.9, CR = 0.0156< 0.1 ok

Table 14: Pair-wise Comparisons for NCR

	A	B	C	D
A	1	2	3	7
B	1/2	1	2	5
C	1/3	1/2	1	4
D	1/7	1/5	¼	1

Table 15: Synthesized Matrix for NCR

	A	B	C	D	Priority Vector
A	0.506	0.541	0.480	0.412	0.485
B	0.253	0.270	0.320	0.294	0.284
C	0.169	0.135	0.160	0.235	0.175
D	0.072	0.054	0.040	0.059	0.056
					Σ = 1.0000

λ max = 4.046, CI = 0.0153, RI = 0.9, CR = 0.01696 < 0.1 ok

Table 16: Pair-wise Comparisons for the 7 Criteria (Considering Safety first)

	NCR	P/$	PO	DCF	CO	EF	SA
NCR	1	1/2	1/3	1/4	1/6	1/5	1/7
P/$	2	1	1/2	1/3	1/5	1/4	1/6
PO	3	2	1	1/2	1/4	1/3	1/5
DCF	4	3	2	1	1/3	1/2	1/4
CO	6	5	4	3	1	2	1/2
EFF	5	4	3	2	1/2	1	1/3
SA	7	6	5	4	2	3	1

Table 17: Synthesized Matrix for the 7 criteria (Considering Safety First)

	NCR	P/$	PO	DCF	CO	EF	SA	Priority Vector
NCR	0.0357143	0.023256	0.021051	0.022556	0.037526	0.02746	0.055142	0.031815
P/$	0.0714286	0.046512	0.031579	0.030072	0.044941	0.034325	0.064397	0.046179
PO	0.1071429	0.093023	0.063158	0.045113	0.056176	0.045762	0.077122	0.069642
DCF	0.1428571	0.139535	0.126316	0.090226	0.074894	0.06865	0.096402	0.105554
CO	0.2142857	0.232558	0.252632	0.270678	0.224704	0.274601	0.192805	0.237466
EFF	0.1785714	0.186047	0.189474	0.180452	0.112352	0.1373	0.128524	0.15896
SA	0.25	0.27907	0.31579	0.360903	0.449408	0.411901	0.385609	0.350383
								Σ = 1

λ max = 7.198, CI = 0.033, RI = 1.32, CR = 0.025 < 0.1 ok

Table 18: Overall Priority Matrix Vector

	NCR (0.032)	P/$. (0.046)	PO (0.070)	DCF (0.106)	CO (0.237)	EF (0.159)	SA (0.350)	Overall Priority Vector
A	0.485	0.489	0.546	0.495	0.096	0.151	0.485	0.388874
B	0.284	0.174	0.164	0.165	0.161	0.434	0.182	0.201798
C	0.175	0.293	0.249	0.276	0.277	0.088	0.29	0.219864
D	0.056	0.0433	0.041	0.065	0.466	0.262	0.042	0.180852
							Σ = 0.991388	

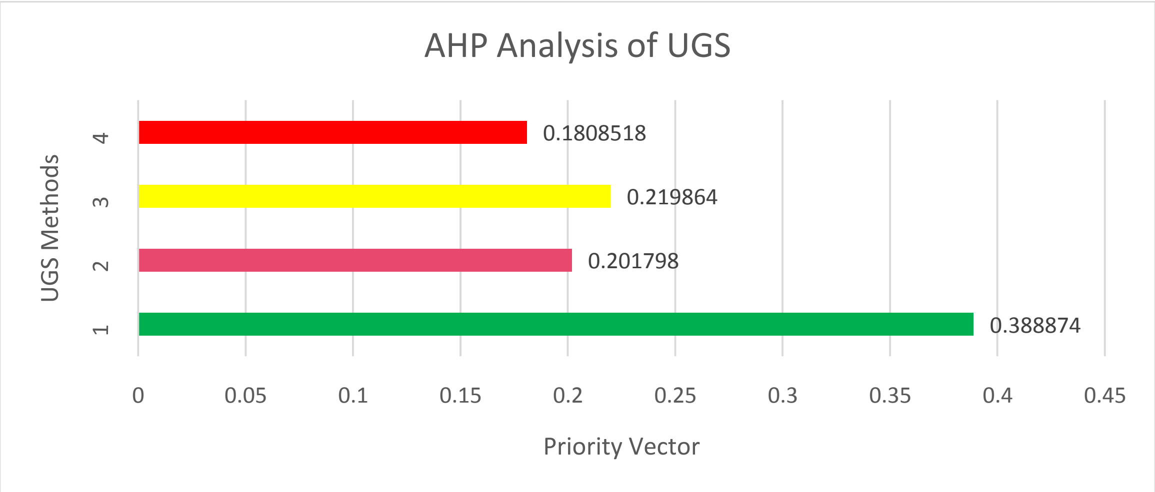


Figure 1: Bar Chart Showing Relative Priority Vectors of UGS Operations

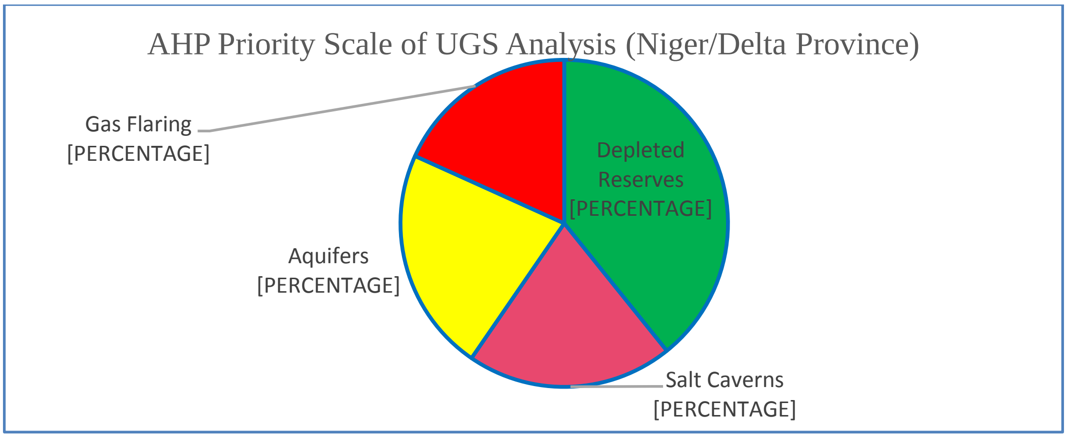


Figure 2: Pie-Chart Showing Relative Percentages of UGS Priority Based on AHP Model

In bid to check for the sensitivity of criteria priority. We choose to vary compatibility as most important factor rather than safety, as some might argue that the feasibility of a project comes before its safety. Hence, placing compatibility to the Niger-delta as pre-eminent reveals thus;

Table 19: Pair-wise Comparisons for the 7 Criteria (Considering Compatibility first)

	NCR	**P/$**	**PO**	**DCF**	**CO**	**EF**	**SA**
NCR	1	1/2	1/3	1/4	1/7	1/5	1/6
P/$	2	1	1/2	1/3	1/6	1/4	1/5
PO	3	2	1	1/2	1/5	1/3	1/4
DCF	4	3	2	1	1/4	1/2	1/3
CO	7	6	5	4	1	3	2
EFF	5	4	3	2	1/3	1	1/2
SA	6	5	4	3	½	2	1

Table 20: Synthesized Matrix for the 7 criteria (Considering Compatibility First)

	NCR	**P/$**	**PO**	**DCF**	**CO**	**EF**	**SA**	**Priority Vector**
NCR	0.036	0.023	0.021	0.023	0.055	0.027	0.038	0.032
P/$	0.071	0.047	0.032	0.030	0.064	0.034	0.045	0.046
PO	0.107	0.093	0.063	0.045	0.077	0.046	0.056	0.070
DCF	0.143	0.140	0.126	0.090	0.096	0.069	0.075	0.106
CO	0.250	0.279	0.316	0.361	0.386	0.412	0.450	0.351
EFF	0.179	0.186	0.189	0.180	0.128	0.137	0.112	0.159
SA	0.214	0.233	0.253	0.271	0.193	0.275	0.225	0.238
							Σ = 1.0001	

λ max = 7.198, CI = 0.033, RI = 1.32, CR = 0.025 < 0.1 ok

Table 21: Overall Priority Matrix Vector (Considering Compatibility First)

	NCR (0.032)	**P/$. (0.046)**	**PO (0.070)**	**DCF (0.106)**	**CO (0.351)**	**EF (0.159)**	**SA (0.238)**	**Overall Priority Vector**
A	0.485	0.489	0.546	0.495	0.096	0.151	0.485	0.3018
B	0.284	0.174	0.164	0.165	0.161	0.434	0.182	0.2149
C	0.175	0.293	0.249	0.276	0.277	0.088	0.29	0.246
D	0.056	0.0433	0.041	0.065	0.466	0.262	0.042	0. 232
							Σ = 0.9946	

Conclusion/Recommendation: As can be deduced from the above tables and analysis, it is observed that as well expected, the gas flaring option is last on the scale, while depleted reserve is the most desirable underground storage option for the Niger-Delta province even after varying the priority of the compatibility with safety. Further study on depleted reserve option is recommended

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