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The Unconventional Sources of Oil and Gas: The Fuels for Growth in the 21st Century

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Abstract: The energy scenario today is quite challenging. The demand for energy is increasing day by day. As the world progresses in the 21st century, with more and more people rising above poverty throughout the world, the global energy demand has increased exponentially in the past few decades. The cause of concern is that this demand cannot be met by the depleting conventional reserves, particularly oil and gas. A partial solution to this problem is the unconventional sources of hydrocarbons i.e. Shale, Tight Gas Sands, CBM and Gas Hydrates. Tertiary development through EOR in conventional reserves is very costly. Instead of spending huge sums of money on fields which are in their last stages, we can look to utilize some of that into exploring the unconventional sources of Hydrocarbons.

In this paper, we first try to compare the aspects of exploring new unconventional sources against the improving the present conventional reserves. (Example: Schlumberger has pegged the reserves of gas in shale deposits across the country at 300 times higher than Reliance's Krishna Godavari (D6) basin, by far the largest gas field in the country while the ageing fields are supposed to pull down ONGC's output by 3% in Financial Year 2012). Then we do a detailed analysis of the unconventional sources of Oil and Gas (Shale, CBM, Tight Gas Sands and Gas Hydrates) through 5 strategic management methods (SWOT, BCG MATRIX, 5 Force Model, Involved Threats, Space). On the basis of these analyses, we will derive appropriate conclusions

1. INTRODUCTION

The energy scenario today is quite challenging. The demand for energy is increasing day by day. As the world progresses in the 21st century, with more and more people rising above poverty throughout the world, the global energy demand has increased exponentially in the past few decades. The cause of concern is that this demand cannot be met by the depleting conventional reserves, particularly of coal, oil and gas. Also the alternative/ renewable sources of energy are yet not efficient to be implemented on a large scale. A partial solution to this problem is ***STCG*** i.e. the unconventional sources of hydrocarbons namely **S**hale, **T**ight Gas Sands, **C**BM and **G**as Hydrates

The present energy system which is completely based on conventional sources of hydrocarbons, namely coal, oil and gas is unsustainable. The Hubbert's Peak Theory **(Figure-1)** postulated that for any given geographical area, from an individual oil-producing region to the planet as a whole, the rate of petroleum production tends to follow a bell-shaped curve. The only shortcoming with this theory is that it had not taken into account the unconventional sources of oil and gas and the increase in energy efficiency.

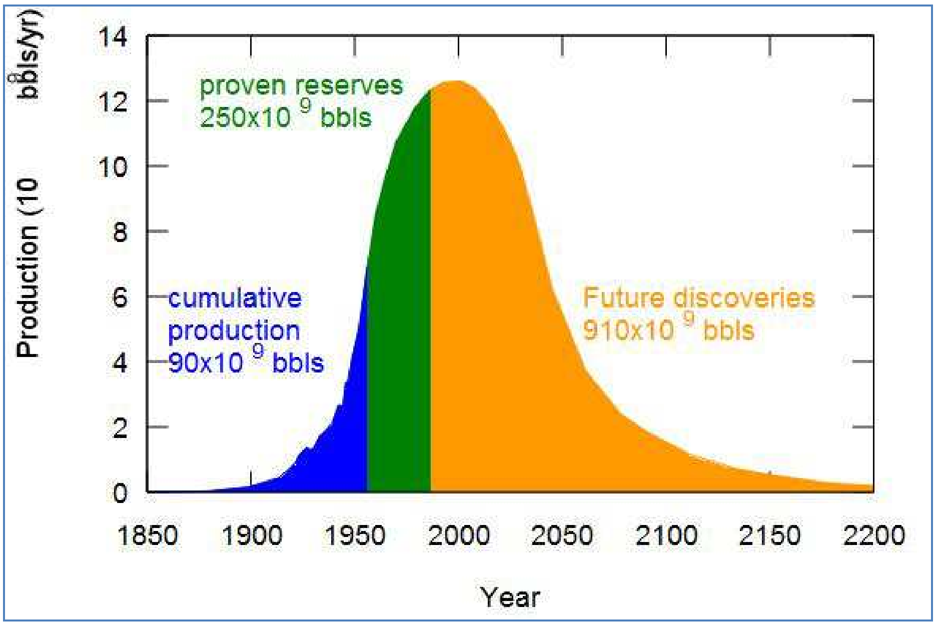


Figure-1: Hubbert's Peak Oil Theory for conventional oil and gas sources [1]

Oil and Natural gas prices are presently at levels that make the exploration and development of unconventional hydrocarbon sources economical. Some unconventional hydrocarbon sources are already being developed, including gas shale, tight gas sands, heavy oil (or oil sands) and coal bed methane. The most important development is the world energy system shifting from having an oil base to a gas base. The gas as a fuel is cleaner and is more energy efficient than coal and oil. The conventional Gas resources worldwide are supposed to be 400 tcm **(Figure- 2).** This is equal to more than 120 years of current annual production. Combining estimates of conventional and unconventional gas shows that there are globally recoverable resources equal to over 250 years of current production. Thus the gas resource base is vast and geographically diverse, with the potential to meet energy needs for almost a century.

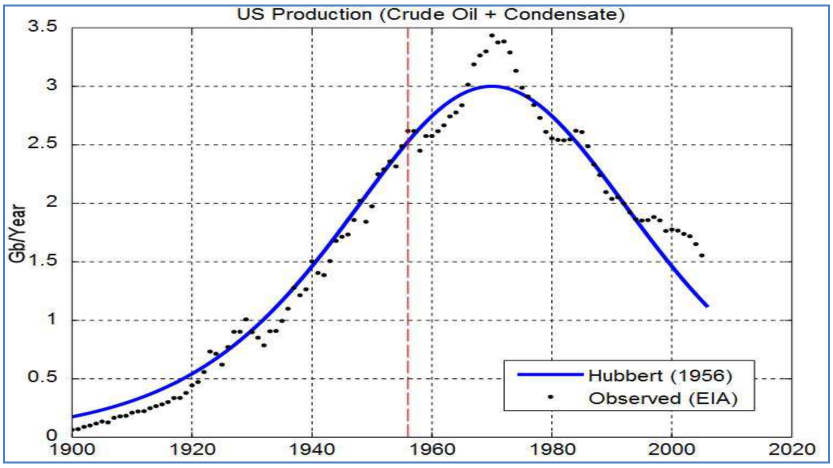


Fig.2: US oil production (Lower 48 states crude oil only) and Hubbert high estimate for the US [1]

Table-1: Remaining Recoverable resources of Natural Gas and indicative Production Cost [3]

	Conventional		Tight Gas		Shale Gas		CBM	
	tcm	$/MBtu	tcm	$/MBtu	tcm	$/MBtu	tcm	$/MBtu
E. Europe & Eurasia	136	2-6	11	3-7			83	3-6
Middle East	116	2-7	9	4-8	14			
Asia/Pacific	33	4-8	20	4-8	51		12	3-8
OECD North America	45	3-9	16	3-7	55	3-7	21	3-8
Latin America	23	3-8	15	3-7	35			
Africa	28	3-7	9		29			
OECD Europe	22	4-9			16			
World	**404**	**2-9**	**84**	**3-8**	**204**	**3-7**	**118**	**3-8**

2. THE UNCONVENTIONAL HYDROCARBON ENERGY SCENARIO

A statistical analysis **(Table - 1)** considering unconventional reserves were carried across the globe and the potential of these reserves shows their reliability being able to substitute the depleting conventional reserves. From the above table we can see, that North America has currently the highest unconventional resources (8,228 Tcf), with Former Soviet Union and centrally planned Asia and China in second and third (approximately 5200 Tcf). Least resources are available in South Asia and Central and Eastern Europe (235 Tcf). While remaining parts of the world have intermediate resources ranging from 1000 Tcf – 5000 Tcf. We can conclude that unconventional resources are in abundance. Moreover, they are geographically well distributed, which promotes their global technological development and production.

Table-1: Distribution of Unconventional Gas Reserves [4]

Region	Coalbed Methane (Tcf)	Shale Gas (Tcf)	Tight-Sand Gas (Tcf)	Total (Tcf)
North America	3,017	3,842	1,371	8,228
Latin America	39	2,117	1,293	3,448
Western Europe	157	510	353	1,019
Central and Eastern Europe	118	39	78	235
Former Soviet Union	3,957	627	901	5,485
Middle East and North Africa	0	2,548	823	3,370
Sub-Saharan Africa	39	274	784	1,097
Centrally planned Asia and China	1,215	3,528	353	5,094
Pacific (Organization for Economic Cooperation and Development)	470	2,313	705	3,487
Other Asia Pacific	0	314	549	862
South Asia	39	0	196	235
World	9,051	16,112	7,406	32,560

3. NEW UNCONVENTIONAL SOURCES VERSUS IMPROVING ON THE PRESENT ONES

In the 1980s, when many of America's oil fields started depleting, the concept of EOR came into picture and was developed into a full upstream operations field over the period of time. So, these EOR operations had been able to satisfy the need of oil until now. The E&P companies have started realizing that the EOR/IOR operations, though being successful till now, will not be able to satisfy the global demand for Oil and gas for more than 3 decades(except the middle east and Russia). So, the concept of Unconventional sources of hydrocarbons has come into picture, And as EOR/IOR has been developed in the last 30-40 years, the same will be case for unconventional sources of oil and gas, particularly ***STCG*** i.e. **S**hale, **T**ight Gas, **C**oal Bed Methane and **G**as Hydrate in the decreasing order of relative importance in the present situation. The relatively recent successful US Shale gas exploration, development and production model is a shot in the arm for the proponents of the usage of unconventional sources of Hydrocarbons.

The recent example of ONGC's EOR projects in Bombay High fields and all over India make a strong case for going for exploration and production of unconventional hydrocarbons and justifies the case for going towards unconventional sources from developing the conventional fields. ONGC is investing huge sums of money for developing its old fields through EOR/IOR techniques and yet in the long run they would have to go for unconventional sources for oil and particularly gas for sustaining and improving their production. Rather than investing in old fields, it would be beneficial to look for unconventional oil and gas fields and start exploration activities these fields. Even the fields stimulated through EOR/IOR will die in some years, so it is profitable to go for new unconventional fields.

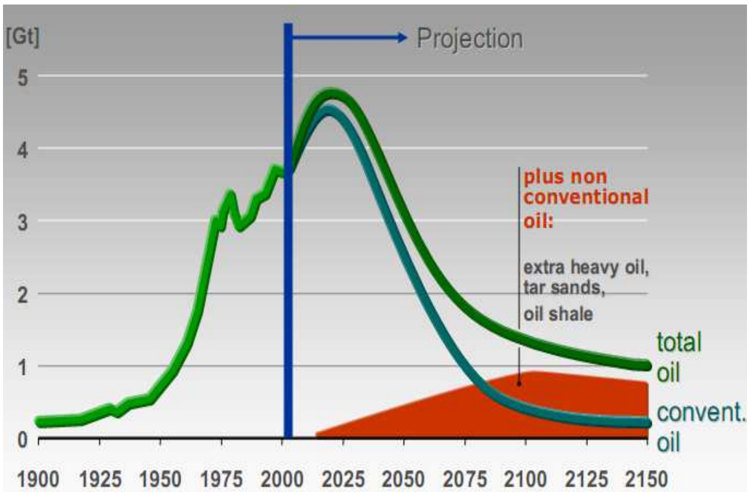


Figure 3: Energy Scenario [5]

By the end of the financial year 2010, cumulative expenditure on IOR/EOR and redevelopment projects was Rs 25,797 crores. In the six ongoing projects, the likely investment is expected to be Rs 8,300 crores **(Figure 3)**.

Over 85 per cent of ONGC's crude oil production in onshore areas comes from 32 fields, which are over 30 years old and have entered into declining phase. Offshore fields in Mumbai are also more than 30 years old and have crossed their plateau peak production and are on the decline.

In last 5 years, ONGC's standalone crude oil output declined by 6.26% to 24.419 metric tons. The production, including the JVs, has also declined by 2.36 per cent to 27.279 mt. Gas production, though it has not declined, has registered a marginal increase. Standalone gas production excluding the JVs rose 2.91 per cent to 23.095 billion cubic metres in the period while output including the JVs rose merely by 1.65 per cent to 25.323 bcm. Therefore going for the vast unconventional resources of gas and converting them into reserves will not only benefit ONGC but also the nation.

If one has to understand the importance of shale gas and other unconventional sources of hydrocarbons of oil and gas. One can refer to the noted economist Swami Nathan Ankleshwar Aiyar who has predicted that China might invade India which supposedly had a treasure trove of shale oil in Arunachal Pradesh and other parts of the north-east. It is supposed these deposits could produce 140 million tonnes per year for 100 years, making India a net oil exporter. This could be a source of envy to a resource hungry neighbor like China which might be actually after the Shale Oil.

Shale gas production is now booming in the US, and will meet a quarter of US needs by 2020. Top Indian oil companies, from Reliance to BPCL, have acquired stakes abroad in shale gas companies to gain fracking expertise, to be used later in India. The petroleum ministry is working on a new policy to encourage shale gas exploration.

The future of India's energy sector does not look that bleak after all. Schlumberger, a global leader in oilfield services, has pegged the reserves of gas in shale deposits across the country at 300 times higher than Reliance's Krishna Godavari (D6) basin, by far the largest gas field in the country. Such resources have the potential to move the Indian gas market from gas-constrained to gas-balanced, if not turn the country into a gas-surplus one.

4. A BRIEF ON STCG

4.1. Types of Gas Resources:

Gas resources are conventional or unconventional in nature. At present, the former dominates worldwide production, accounting for over 85% of total marketed output today. Most of the Oil field produces natural gas in form of “associated gas”. These gases are found at several ranges of temperature, pressure and depth.

Unconventional natural gas resources include

- Shale gas (S)
- Tight gas (T)
- Coal Bed Methane (C)
- Gas hydrates (G)

4.2. The global potential of unconventional gas:

The potential of unconventional gas is now looked upon worldwide with the depletion of conventional sources. India also with its fifth CBM licensing round and a shale gas licensing round scheduled for 2012 is developing its unconventional potential.

In Indonesia, CBM resources are banked upon to replace its conventional gas output. Over 20 CBM Production Sharing Contracts have been signed and the government is organizing new tenders. Development of shale gas is clearly lagging, with the regulatory framework still being developed and contracts expected to be signed in 2012 at the earliest.

Tight Gas shows significant potential in several Middle East and North African countries, including Saudi Arabia, Oman, Jordan, Algeria and Tunisia. The challenge to meet the demand, being not fulfilled by conventional gas, will decide the development of unconventional resources in these countries.

Globally the potential of shale gas is unchallenged. The only competition it might get in terms of resource base can be matched only by gas hydrates.

4.3. CBM- Coal Bed Methane:

4.3.1. Coal Exploration:

Coal reserves are discovered through exploration activities. The process usually involves creating a geological map of the area, then carrying out geochemical and geophysical surveys, followed by exploration drilling. This allows an accurate picture of the area to be developed. The area will only ever become a mine if it is large enough and of sufficient quality that the coal can be economically recovered. Once this has been confirmed, mining operations begin.

Taking into account Energy Security, India is on the path of accelerated growth and the demand for energy will increase multifold from the current levels. Coal is the primary source of Energy meeting the country energy requirement. The hydrocarbon resources of India are limited and the nation needs to diversify and explore energy resources. India having the 3rd largest proven coal reserves in the world holds significant prospects for commercial recovery of CBM. Prognosticated CBM resource has been estimated to be around 4.6 TCM. Extraction of the CBM through degassing of the coal seams prior to mining of coal is also a cost effective means of boosting coal production and maintaining safe methane level in working mines. At present, the demand of Gas in 35% more than the supply. With this wide gap, there is an urgent need of large amount of gas to meet the demand. India being the third largest producer of coal, has huge quantities of trapped coal bed methane and this play a vital role as an energy source in future generation.

4.3.2 CBM Specifications:

(i). Reservoir Characterization

- Quantify fracture systems and variability
- Identify areas with high permeability
- Absorbed-gas content measurement
- Permeability measurements
- Identification of behind-pipe reservoir

(ii). Drilling Operation

- Rapid, reduced cost drilling
- Reduced drilling “footprint” Horizontal well stability
- Horizontal well stability

(iii). Completion Operations

- Non-damaging cementing
- Formation access
- Increased hydraulic-fracturing effectiveness

(iv). Production Operations

- Artificial lift / Water disposal
- Enhanced production

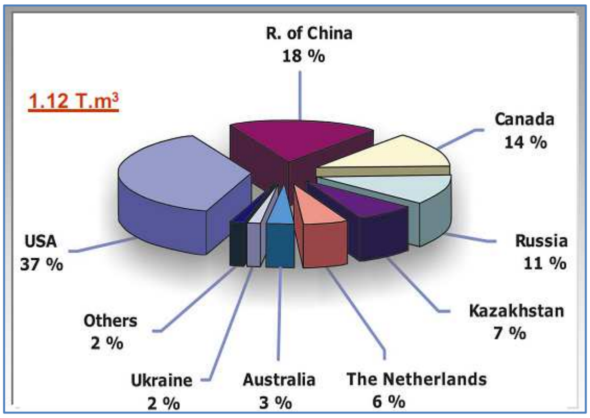


Fig.4: Distribution of CBM Gas Reserves[6]

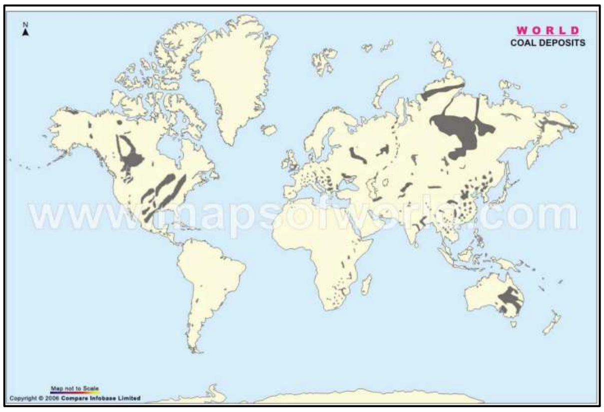


Fig.5: World Coal Deposits[6]

4.3.3. CBM Potential:

Significant CBM Exploration Activities: The potential of CBM is very high in India. But several factors are in its way as

1. Lack of technical understanding and experience
2. Insufficient training and education skills
3. Lack of advanced technology suited to mining and geological conditions.
4. Little understanding of the market conditions and commercial issues.

In India, 16% of the area is identified for exploration, 22% of the area in which the exploration has been initiated. Total coal bearing area is of 35400 sq km consisting of 44 major coal and lignite fields distributed in 12 states depicting the prognosticated CBM Resources of162 TCF.

According to some estimates that CBM could be able to contribute up to 15% of India's natural gas production. The current activities in CBM exploration and production depicts that 16 Blocks were awarded under CBM- I & II, Area Opened-up for CBM Exploration: 7800 sq km CBM resource in the awarded blocks are to the tune of 820 BCM. The production potential of these Blocks are 23 MMSCMD with a exploration commitment of 121 Core Holes and 211Test/Pilot Wells.

The cost of the project was to the tune of US$ 150 million. The success story of this project indicates the significant discovery of CBM in central & eastern part of India with a steady flow of 10,000 m3 of gas per day was achieved. Drilling of pilot/development wells are in progress. Commercial potentiality of the identified fairways was established. The commercial production was expected in the last end of 2007. During this operation air drilling technology employed for the first time in India for drilling of CBM test wells. Faster drilling and well completion rates of average 7 days/well and 15 days/core hole achieved against an average of 60 days required earlier for similar operations. To establish the commercial potentiality of the identified fairways in different blocks, additional 80 wells are proposed to be drilled. Continuous CBM gas flaring is in progress in the test wells drilled in eastern and central parts of India.

The profitability of a CBM project depends on:

1. The price of gas
2. Royalties and taxation imposed by the Government
3. Drilling costs
4. The well productivity rate.

The May 2007 National Energy Board (Canada) **(Table-2)** report showed that, based on a well productivity rate of 2.1 million cubic meter per day (77 million tcf/d), a price of USD 6/M Btu would yield a rate of return of 13.6%, close to the 15% generally expected in the industry. However, this report emphasized that a cost increase of 15% would lower the rate of return to only 10.7%. Similarly, a decline of about 15% in the productivity rate would bring profitability below 10%. This would explain why CBM projects have slowed somewhat on the North American market even though prices are rising. Fears of further cost increases would account for this. Obviously, this example is not representative of the situation in other countries, such as China or India, but it does illustrate that CBM projects currently find themselves in an economically tight situation in the industrialized countries, in the absence of tax incentives.

Table-2: Estimate world CBM resources[7]

Tm^3	Low end	High end
Asia	18.3	95.1
North America	26.9	124.1
South America	0.4	0.9
CIS	113.3	456.3
Europe	4.6	7.6
Africa	0.8	1.6
World	**164.2**	**685.7**

Two environmental advantages: The development of CBM represents two advantages from the environmental perspective and more specifically with respect to the greenhouse gas problem, in the sense that it:

- Has potential as a CO2 storage solution
- Avoids methane emissions at operating coal mines, knowing that methane has a high global warming potential and represents a hazard (mine gas explosion).

4.4. Shale [8]:

Shale gas belongs to the category of unconventional natural gases, which also includes coal-bed methane, gas from tight sandstones ("tight gas□) and methane hydrates. Shale is a sedimentary rock formation which contains clay, quartz and other minerals. Much of the oil or gas formed in the shale (this body is known as source rock, being the source of the hydrocarbon) migrates to porous and permeable rock, such as sandstone, for example. Tremendous energy is needed to extract these compounds, making this shale rock appealing only in regions where other sources of oil for energy have been exhausted.

4.4.1. Resource/Reserve Base: Worldwide shale gas reserves have been quantified only in USA and in other few countries. Recent studies estimate the resource endowment (gas in-place) of five major shale gas basins in the USA at 3,760 tcf, of which 475 tcf is considered to be economically recoverable, while two Canadian basins are estimated to hold 1,380 tcf, with about 240 tcf recoverable.

4.4.2. Fracturing: Hydraulic fracturing is a well stimulation job which is done in order to increase the conductivity of the reservoir by creating channels. It is a technique that is most suitable to wells in low to moderate permeability reservoirs that do not provide commercial production rates. The process involves application of pressure through a fluid column to a reservoir face at a rate higher than the formation can accept in order to crack open the formation rock. After the fracture has been started, pumping is continued with the pad fluid to increase the fracture's length, width, and height. Then slurry composed of fluid and proppant is flushed through the formation and pumping ceases. When the treating pressure is released, the formation will try to close. The fracture closing pressure starts to seal the fractures, but the proppant holds the fracture open. This permits the well fluids to flow along the fractures to the wellbore. And thus the required fracturing job gets completed.

4.4.3. Shale Gas Economics: Technological advancement in field of horizontal drilling & hydraulic fracturing has led to the development of Shale gas production and has been a potential game changer in world energy market.

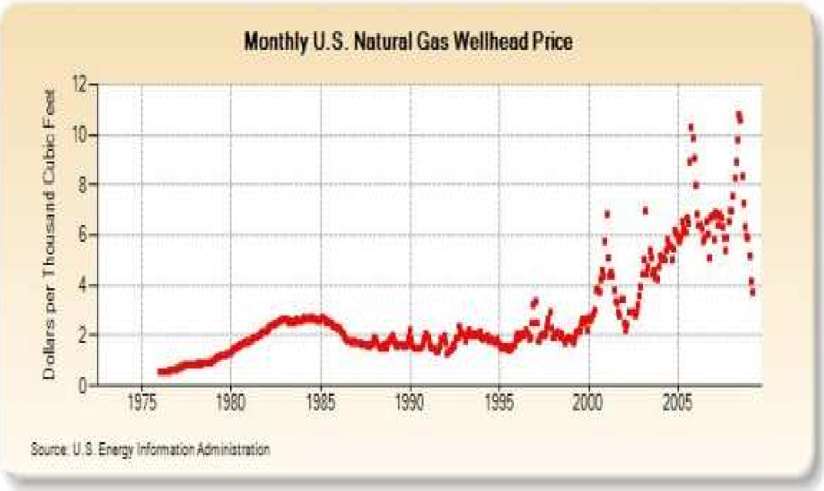


Figure 6: Monthly US Natural wellhead prize

4.4.4. Economic Viability: Although shale technology offers large amounts of potential energy resources, political, environmental, legal and economic difficulties mean it may not be viable in some regions. According to research from the University of Pittsburgh, use of hydraulic fracking to extract shale gas is extremely expensive. Drilling just a single shale gas well can add $2.5 million to the overall total cost for a conventional well of up to $7.6 million on average, according to the research. In the United States it is estimated prices between $5.50 per million British thermal units (Btu) and $6/mBtu are needed for shale gas production to be economically sensible. In Europe, conventional sources of gas supplies and liquefied natural gas (LNG) imports compete with shale, and many analysts predict shale extraction will remain too expensive in Europe to compete with these sources.

4.5. Gas Hydrate:

Gas hydrates, also known as clatherates, are frozen, crystalline solids comprising gas molecules contained within a lattice of water molecules. The most common form of gas hydrate is methane hydrate, but other gas molecules include ethane, propane, butane, iso-butane, pentane, nitrogen, carbon dioxide and hydrogen sulphide.

Gas recovery from hydrates is challenging because the gas is in a solid form and because hydrates is widely dispersed in hostile Arctic and deep marine environments. Similar to conventional hydrocarbon production, the first recovery of hydrate resources will occur in areas with the greatest concentration. Proposed methods of gas recovery from hydrates generally deal with disassociating or “melting” in-situ gas hydrates, by heating the reservoir beyond the temperature of hydrate formation or decreasing the reservoir pressure below hydrate equilibrium. Depressurization is considered to be the most economically promising method for the production of natural gas from gas hydrates.

4.5.1. Hydrate Deposits That Are Production Targets.

The production targets must have the following abilities:

- Confirmed presence of high hydrate saturation (preferably by coring and well logging, or by geophysical methods at a minimum)
- Occurrence within sediments of sufficient reservoir quality to support well-based production methods
- Site accessibility through proximity to existing infrastructure, and
- Access to gas markets through pipeline availability.

Such potential targets are limited because these requirements further restrict the possible choices from among the scant deposits for which data are available. In this section we discuss the features and attributes of hydrate deposits (permafrost or oceanic) that are either known or likely targets for gas production, and we analyze the geologic and engineering factors that control their ultimate resource potential.

4.6. TIGHT Gas (T) [9]:

Natural gas which is difficult to access because of the nature of the rock and sand surrounding the deposit is called tight gas. Tight reservoirs are those which have low permeability, often quantified as less than 0.1 milli darcies. Because this gas is so much more difficult to extract than natural gas from other sources, companies require a large financial incentive to go after it; as energy prices rise, so does interest in extracting tight gas. Several global oil and gas companies control significant tight gas reserves, including BP, which has also sunk substantial resources into learning more about extracting tight gas.

As the demand for natural gas has grown, many companies have started exploring whether tight gas deposits could be accessed. While tight gas is costly to extract, higher gas prices can make the cost worth it, especially if the gas has a composition which is favorable to distillation, allowing the company to extract several valuable fractions from a single well.

Consequently, different production schemes have been developed to economically produce tight gas.

- **Down spacing:** A spacing unit is defined as the area which one well can effectively drain. Studies in the United States have shown that in tight reservoirs, wells spaced as closely as 30 per section may be needed to drain a reservoir effectively, and perform as well as more conventionally spaced wells. In Canada, up to eight wells per section have been drilled, giving a drainage area of 80 acres per well.
- **Directional Drilling:** Horizontal wells are used to expose more of the formation to the well bore and to intersect natural fracture systems more efficiently. In addition, directional techniques allow for the drilling of multiple wells from one drilling pad, mitigating the environmental impact of down spacing.
- **Measurement while drilling:** Down hole sensors near the bit, which gather and relay information to the surface, are used to help steer the bit through portions of the reservoir with the greatest potential.
- **Underbalanced drilling:** In underbalanced drilling, conventional drilling mud is replaced with fluids such as foams and inert gasses. The hydrostatic pressure exerted by these fluids is less than the reservoir pressure, inhibiting fluid invasion and the consequent formation damage prevalent with tight reservoirs.

- **Advanced fracturing techniques:** Advances in fracturing technology provide not only more job-specific fracture fluids and proppant, but also allow for multiple fracture jobs and more accurate proppant placement.

5. ANALYSIS OF THE UNCONVENTIONAL SOURCES OF OIL AND GAS

5.1. The Strategic Position and Action Evaluation (SPACE) Matrix (Table-3):

The Strategic Position and Action Evaluation or the SPACE Matrix is a four-quadrant framework which indicates whether aggressive, conservative, defensive, or competitive strategies are most appropriate for a given enterprise or company. The axes of the SPACE Matrix represent the two internal dimensions of a competitive firm which are its financial strength or FS and its competitive advantage or CA and two external dimensions which are environmental stability ES and industry strength or IS.

We will select a set of variables to *define financial strength (FS), competitive advantage (CA), environmental stability (ES), and industry strength (IS).*

Now, we will assign a numerical value ranging from +1 (worst) to +6 (best) to each of the variables that make up the FS and IS dimensions, a numerical value ranging from -1 (best) to -6 (worst) to each of the variables that make up the ES and CA dimensions.

5.1.1. Environmental Stability (ES) – *(Numerical Value):*

Shale gas- *(-2)*: There are significant environmental concerns surrounding the extraction and transport of natural gas from the Marcellus shale. Protecting the natural habitat for plants and animals is a concern as ecosystems may be destroyed where new drilling sites are constructed. Comparatively less carbon emission compared to coal is one of the major strengths of shale gas.

Tight Gas- *(-1*): Most countries around the world have made their environmental regulations stricter, so synthesis gas production faces tougher strictures in production. It also has a comparatively less carbon emission as in coal or oil.

CBM- *(-4*):CBM development can affect land, water, wildlife and communities in many ways through produced water disposal, ground water with drawl, methane venting, surface disturbances and noise, air pollution etc.

Gas Hydrates- *(-5):* Gas Hydrates are environmentally cleaner fuel than oil, coal, or oil shale which all has an immense environmental impact during production and combustion. But, at the same time during, the process of extraction, leakage happens and adversities like earthquakes and landslides in the sea floor, also can happen which harms the environment stability.

5.1.2. Financial Strength (FS) *(Numerical Value):*

Shale Gas – *(+6*): It's potential of becoming cheapest energy option. Shale gas production can bring down the price of natural gas, because of the enormous size of its deposits. Hydraulic fracturing techniques have opened up many shale gas wells as potential sources of natural gas. Another technology that has made shale gas extraction more economical is horizontal drilling. Horizontal drilling seeks to modify the path of a borehole to better penetrate a as rich shale.

Tight gas – *(+3):* Since the natural gas is normally surrounded by deposits of porous rock, with lots of small holes for the gas to seep through. Sometimes, the gas literally pumps itself. In the case of tight gas, the surrounding sandstone, shale, or other rock is not so permeable, looking much denser in cross-section.

Because this gas is so much more difficult to extract than natural gas from other sources, companies require a large financial incentive to go after it; as energy prices rise, so does interest in extracting tight gas.

CBM- *(+4)*: The price of gas is one parameter determining the financial strength of a CBM project. But it is not the only one. Whether or not a project is economically viable also depends on royalties and taxation, on drilling costs and on the well productivity rate. In the absence of tax incentives these projects experiences an economically tight situation.

Gas Hydrates- *(+1)* : Considerably greater energy potential then the other unconventional sources like shale, coal, CBM, etc and conventional natural gas because of various reasons like ample reserves and wide uniform geographical distribution. But, the recovery process is so complex and capital intensive, that large research and developments are required in future. This can result in participation of all sorts of companies, no matter small or large only in future.

5.2.3 Competitive Advantage (CA) *(Numerical Value)*:

Shale Gas *(-2)* :The fast development of shale gas industry could slow down the further development of renewable energy industry, especially if shale gas (as it is expected) becomes one of the cheapest energy options.

Tight Gas *(-4)* : While tight gas is costly to extract, higher gas prices can make the cost worth it, especially if the gas has a composition which is favorable to distillation, allowing the company to extract several valuable fractions from a single well.

CBM *(-3)*: In CBM, the production is much easier and less expensive as compared to other alternatives. This gives CBM a competitive edge to CBM over others. But still, the development of CBM cannot reach its fuall potential until and unless coal lobbies stop there interference.

Gas Hydrates *(-3)*: Gas hydrates have a wide geographical distribution. This will result in higher participation, even from the smaller players after certain time. Not only this, it will result in cutting down the monopoly of the current capital dominated market. So, in near future we can expect a wide participation from companies in this field.

Extensive efforts are required to bring gas hydrates into world energy balance. As this is a totally unexplored field, there's an initial hindrance towards the global prospects of gas hydrates in the market. So, extensive efforts will be required to bring gas hydrates on a global energy balance.

5.2.4. Industry Strength (IS) (*Numerical Value*) :

Shale Gas – *(+6):* It's still too early to say that the shale gas will be one of the game's changers in global energy market but the potential is undoubtedly there. It is because of the fact that the shale gas have enormous deposits in the world and because of this, it is expected to become the cheapest fuel in the coming future.

Tight Gas- *(+4):* In future when gas will get costly, tight gas is expected to get wide recognition as an energy source. Moreover the by-products obtained from distillation will be highly favorable for the industry.

CBM- *(+5):* Drilling operations are comparatively easier and fewer facilities can be accommodated for production to lower down the production costs. This opens up the gates for the smaller players to enter this field.

Gas Hydrates- *(+1):* Enormous amount of methane is sequestered within clatherates structures at shallow sediments depths within 2000m of the earth's surface. Moreover, this distribution is wide and enormous. So there is no specific concentration of gas hydrates on the global map, which results in providing greater opportunities for the industry to expand and diversify in future.

Table-3: SPACE Matrix Evaluation

	Internal Strategic Position		External Strategic Position	
	Competitve (CA)		**Industry (IS)**	
A	(-6 Worst, -1 Best)		(+1 Worst, +6 Best)	
X	-2	Shale Gas	+6	Shale Gas
I	-4	Tight Gas	+4	Tight Gas
S	-3	Cbm	+5	Cbm
	-3	Gas Hydrates	+1	Gas Hydrates
X	Average -3		Average +4	
	Total Axis X Score +1			
A	**Financial (FS)**		**Environmental (ES)**	
X	(+1 Worst, +6 Best)		(-6 Worst, -1 Best)	
I	+6	Shale Gas	-2	Shale Gas
S	+3	Tight Gas	-1	Tight Gas
	+4	Cbm	-4	Cbm
Y	+1	Gas Hydrates	-5	Gas Hydrates
	Average +3.5		Average -3	
	Total Axis Y Score +0.5			

Adding the two scores on the (x-axis) and (y-axis) and plot the resultant point on X and Y respectively. We will draw a directional vector from the origin of the SPACE Matrix through the new intersection point. This vector will reveal the type of strategies recommended for the organization i.e.: ***Aggressive, competitive, defensive, or conservative.***

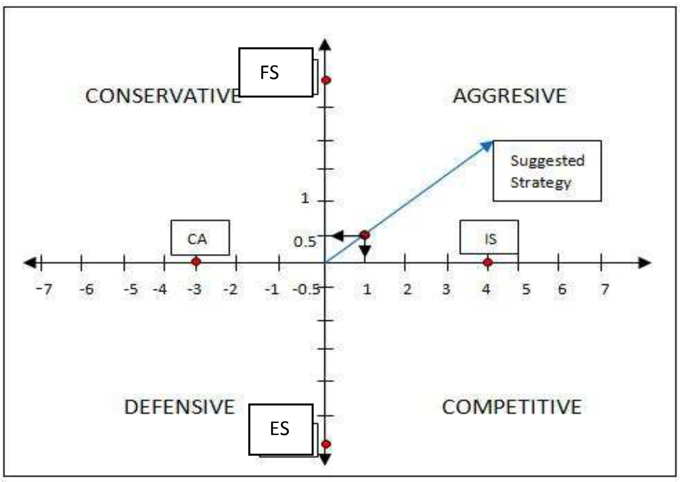


Figure-7: SPACE Graphical Presentation

From the above analysis, while covering all the aspects of unconventional sources we find out that the vector falls in the first quadrant of the graph which suggests ***aggressive strategy type***. Also from the present market scenario, with ever increasing prices of oil and gas, and their decreasing reserves, it becomes necessary for us to look out for new alternative unconventional sources. So, we can say a new aggressive approach is immediately required, where the government plays a proactive role instead of hindrance and the companies take the initiative in research and development of such sources in collaboration with the academic institutes.

5.2. SWOT Analysis:

Shale Gas (S)

STRENGTH	The most evident strength of Shale is its huge reserves across the globe. With the increase in depleting conventional sources, shale resources can be a better replacement as a source of energy and shale gas can be utilized in place on natural gas. This huge strength of being available globally can lead to its world wide acceptance as a fuel in future.
WEAKNESS	Shale deposits are non porous in nature leading to a very difficult extraction process. Its permeability is quite less, which makes it even more difficult to extract from sub surface. Shale gas disposal and utilization is a very weak parameter as technological advancement is still not able to develop facilities for its efficient disposal. Waste water treatment facilities are not sufficient to make the water useful for other purposes. In this manner, huge water reserves are wasted.
OPPURTUNITY	Large reserves of Shale deposits are still unexplored as technological advancement for shale was not thought few years ago. Now development is taking its high to provide efficient extraction facilities in order to extract the shale oil. The future of oil shale may have finally arrived. Extracting oil from shale is no simple task, which is why the reserves remain almost completely undeveloped.
THREAT	The shale extraction process may cause fire to the drinking water wells after methane leaked into wells. Water being extracted from these areas may contain traces of the chemicals injected into the wells drilled for shale extraction process. Drinking water may get contaminated and will lead to several diseases.

Tight Gas (T)

STRENGTH	In future, when the prices of gas will increase, the production from tight gas will become essential, because of their huge and uniform geographical availability in nature. The distillation products from Tight Gas will also hold great importance, which will add to its market value.
WEAKNESS	Extraction of tight gas is a really complex and challenging tasks to the companies, as its production is very difficult in comparison to other sources of energy. These demands for high financial incentives on the part of companies in the areas of R&D, and production. So, until and unless the market prices are high, the interest of the companies in tight gas is expected to remain low.
OPPURTUNITY	The opportunities of tight gas lie in its potential. We can say that the tight gas is energy source of future. Moreover, its by-products obtained from distillation add a lot of values and opportunities to it.
THREAT	Large financial supports and high risk taking ability is required for the extraction of tight gas, which acts as hindrance to the companies.

CBM- Coal Bed Methane (C)

STRENGTH	The gas extracted from Coal Bed Methane is an eco-friendly natural gas, stored in coal seams. Its extraction is easy as drilling into coal is efficient after the technological advancement. CBM gas transport is easy and economical and can also be flared as it does not disrupt the environmental regulations. Coal being more porous than shale, its extraction is easy as compared to shale reserves The total cost for well completion and production are low to moderate in comparison with conventional natural gas as coal seams are usually discovered at shallow depth.
WEAKNESS	The dewatering process leaves huge amount of waste water which cannot be directly used for other purposes. Filtration processes are also not able to make them available for drinking or irrigation purposes CBM are low permeability reserves. Permeability varies from 0.1 to 1 mD which makes their extraction process difficult.
OPPURTUNITY	With the recent advances in technology and infrastructure, CBM has an increased proved reserve base. Several new extractions technologies for extracting methane from coal are being looked upon for maximum extraction
THREAT	The main concern is oil and gas price fluctuation. CBM development needs to reach a critical volume of production in order to be economically viable. Costs include gas treatment, compression, transportation, geologic and engineering services, and field operations CBM development is a threat to climate change. With limited storage facilities, enormous amount of gas is being fared before the quantity reaches optimum value to be transported to buyers.

Gas Hydrate (G)

STRENGTH	The worldwide amounts of methane bound in gas hydrates is conservatively estimated to total twice the amount of carbon to be found in all known fossil fuels on Earth. The availability at very low depths. (location) Quality of gas trapped in clatherates is supposed to be very good as a pure methane molecule is trapped by water molecules in solid form.
WEAKNESS	Gas hydrates are too dispersed for economic extraction. Difficult detection of viable reserves; and development of the technology for extracting methane gas from the hydrate deposits is a weakness of this unconventional resource. Recovering methane and economically transporting it, pose a challenge to technologists and scientist No development model for successful extraction of Gas Hydrate

OPPURTUNITY	Gas Hydrates are a potentially important future source of hydrocarbon fuel.
THREAT	The sudden release of large amounts of natural gas from methane clathrates deposits has been hypothesized as a cause of past and possibly future climate changes. Threat of earthquakes and fire pose danger to extraction of gas hydrates.

5.3. Five Force Model:

Suppliers: Even though the scope in non-conventional fields is high, there are not many suppliers in the market at present. Such fields require investors with huge capital for research and development. Along with this, risk and loss bearing capabilities for such companies is also important. Due to such a nature of non-conventional sources, it is expected that only few big players can enter the market for now. Which can gradually result in monopolizing the whole market, if in coming years no subsequent entries from smaller companies are seen?

Substitutes: The substitutes of non-conventional sources are renewable sources, which are comparatively more costly (when produced on individual basis) and non-reliable. As most of them are totally based on forces of nature like sun, wind, water currents, etc we cannot rely on their availability at all times, for example, at times of forecasts, non-windy weather etc. Moreover, the operation and maintenance cost of their equipment are really high which cannot be individually sustained by all strata of societies.

Buyers: The demand for energy is never going to decrease. With time this demand have constantly increased and rocketed to the skies due to increase in population, increase in the standard of living of large masses society, opening of new industrial ventures and development of mankind on the whole. So such kinds of sources are highly valuable, seeing the rapid depletion and uncertainty of the presence of current resources in future.

Degree of Rivalry: The degree of rivalry in the present scenario is really minimal. This is totally because of high risk involved and unexplored nature of this field. Huge capital investment and risk bearing capacity also minimizes the involvement of smaller companies in this field. But with time as this field gets explored and outcomes are generated we can expect a sudden rush of new entrants and collaborations of smaller players in this field. So there is a large scope for new entrants to enter the market. But at the moment it is expected to remain low.

Threats of New Entrants: Due to high capital expenditures involved, there is no threat of new entrants as such right now. The market is ruled by the big players itself. But once these fields are fully explored and developed we can expect grown interest from smaller players too, in form of collaborations and investments in it.

5.4. PESTLE Analysis

5.4.1. Political Analysis: Political analysis examines the current and potential influences from political pressures. In terms of regulations, the government has the power to set potential fines for the companies that did not meet their standard law requirements.

Changes in laws and regulations are expected in these fields, such as accounting standards, taxation requirements and environmental laws and foreign jurisdictions which can affect the involved companies as well as their entry in foreign countries. The political conditions of the country are also basis of the study, especially in internal markets and other governmental changes that affects their ability to penetrate the developing and emerging markets that involves the political and economic conditions. **5.4.2. Economic Analysis:** Economic analysis examines the local, national and world economy impact which includes the issue of recession and inflation rates.

Shale Gas(S) - In Europe, conventional sources of gas supplies and liquefied natural gas (LNG) imports compete with shale, and many analysts predict shale extraction will remain too expensive in Europe to compete with these sources.

But besides this, shale have potential of becoming cheapest energy option in future because of its vast and uniformly distributed reserves.

Tight Gas (T): This gas is much more difficult to extract as compared to natural gas from other sources, companies require a large financial incentive to go after it; as energy prices raise, so does interest in extracting tight gas will increase.

CBM (C): Economically viability of a project depends on royalties and taxation, on drilling costs and on the well productivity rate. In the absence of tax incentives these projects experiences an economically tight situation.

Gas Hydrates (G): Considerably greater energy potential then the other unconventional sources like shale, coal, CBM, etc and conventional natural gas because of various reasons like ample reserves and wide uniform geographical distribution.

5.4.3. Sociological Analysis:

This analyzes the ways in which changes in society affect the organization such as changing in lifestyles and attitudes of the market. Incidences like BP oil spills create an impression on the mind-set of people that Oil & Gas Companies are rich and mean, which shadows over many social and CSR work that such companies indulge in. With growing concerns among people regarding the depletion of conventional resources we have experienced a slight shift towards the alternative sources, but because of limited availability of such sources, it has become the need of the hour to develop new alternate sources. So, we can expect a promising support to such fields from various spheres of industries, societies and governments.

5.4.4. Technological Analysis

Technology is the main focus of the analysis where the introduction and the emerging technological techniques are valued. This creates opportunities for new developments and improvements in terms of exploration and production. As the technology advances, new techniques are introduced which can help in improved productivity and efficiency.

Shale Gas(S): Recovery rates for gas shale on an average are approximately 20 per cent as compared to up to 75 per cent for conventional reservoirs.

Tight Gas (T): Natural gas production in such reservoirs, are similar to the conventional sources production. The major difference lies in poor permeability in case of tight gas reservoirs. Different production schemes have been developed to economically produce tight gas like Directional Drilling, Underbalanced Drilling, and Advanced Fracturing Techniques

CBM(C): Drilling operations are comparatively easier and fewer facilities can be accommodated for production to lower down the production costs. . Moderate R&D is required in this field which makes it a high potential source for future. This opens up the gates for the smaller players to enter this field.

Gas Hydrates (G): Production from gas hydrates focus on changing the composition from gas hydrates to gas plus water in the reservoir, deep inside the earth. There are three main processes that are envisaged for production:

- Change the pressure conditions in the earth by drilling a well and either removing other gases or confined water, or simply exposing the gas hydrates to the lower surface pressure communicated to the reservoir by the well.
- Release the natural gas by injecting steam or hot water to destabilize the gas hydrate.
- Change the chemical conditions for gas hydrate formation by introducing a chemical inhibitor such as methanol.

The goal is to determine which of these opportunities might be economically viable and practical from an engineering point of view.

5.4.5. Legal Analysis: Legal aspect focuses on the effect of the national and world legislation. Hydraulic Fracturing is required in the production in CBM, shale gas etc. But in recent time's governments of countries like France has imposed ban on it on the basis of environmental concerns, in effect nullifying two exploration licenses issued last year to Schuepbach Energy and one exploration license to Total last year. Europe also faces legal battles on property rights.In U.S., the land owners own the resources in their grounds, while in European countries individuals generally do not have the right to sell the commodities found on their land. Such kind of legal complications and setbacks have resulted adversely to this field. Though there have not been many such cases, but legal formalities and resolutions need to be framed properly.

5.4.6. Environmental Analysis:

Environmental analysis examines the local, national and world environmental issues.

Shale gas (S): Where new drilling sites are constructed, protecting the natural habitat for plants and animals becomes a major concern as ecosystems may be destroyed. Though, less carbon is emitted as compared to coal, it becomes one of the major strengths of shale gas.

Tight Gas (T)-: Most countries around the world have made their environmental regulations stricter, so synthesis gas production faces tougher strictures in production.

CBM (C): CBM development can affect land, water, wildlife and communities in many ways through produced water disposal, ground water with drawl, methane venting, surface disturbances and noise, air pollution etc.

Gas Hydrates (G): Gas Hydrates are environmentally cleaner fuel than oil, coal, or oil shale which all have an immense environmental impact during production and combustion.

From the observations above we can analyze that sources like Gas Hydrates and Shale Gas are economically viable sources, which can provide cleaner energy and helps in keeping the environment clean. While during the production from sources like CBM and Tight Gas, environment, plants and animals, soil etc can get contaminated and damaged, but through proper management and execution we can manage to carry on production without much adversity to the environment.

5.5. Threats Involved:

The main threats involved in the use of Non Conventional Sources are as follows:

I. Risk involved in Exploration: As we are aware of the high stakes involved in exploration ranging from financial losses, environmental losses and even lives of personnel working on site, this continues to be a major threat for it.

II. Capital Requirement: Capital Requirements are pretty high due to the involvement of new technology and equipments. As the non conventional sources are a completely new and unexplored field, the capital investments are expected to be pretty high in research and on field developments.

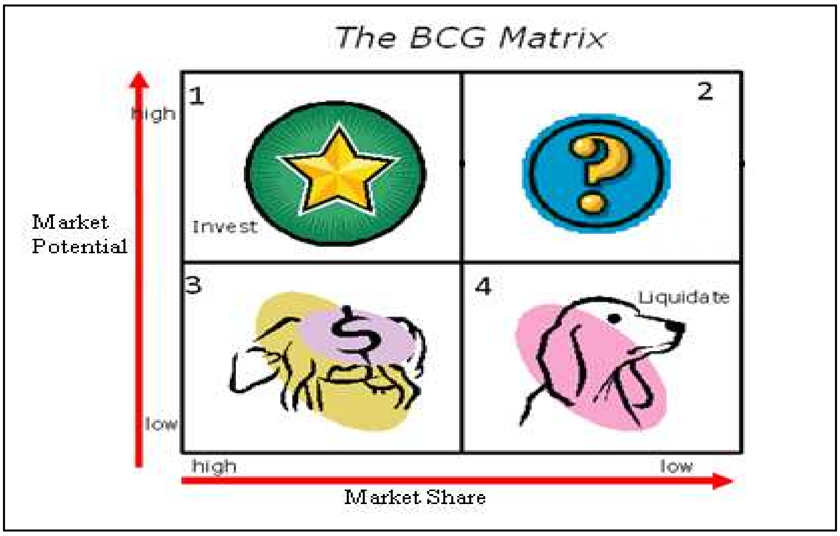
III. Psychological Hindrance: As these fields have never been explored before, outcomes of such fields are still unknown and are totally theoretical based. Because of such risks involved, psychological hindrance is bound to happen among the smaller companies' dues to lack of capital and risk bearing capacities in them.

IV. Legal Issues::As this field is totally new and little different from the present energy sector Undertaking of sensitive negotiations with government is necessary.

V. Rules & Regulations: Formation of a new set of rules and regulations for the non-conventional field are expected which can result in intellectual conflicts, unnecessary formalities and delay in undertaking of projects and work among involved parties and government.

VI. Renewable Resources: Resources like wind energy, solar energy, tidal energy, etc have been in use and are constantly developed for the past few years. The stakes and risks involved in these sources are comparatively lower as compared to non-conventional sources. Subsequently we can expect them to act as substantial competitors to the non-conventional resources, based on their known outcomes, explored techniques and predictable results.

5.6. BCG MATRIX



Current Scenario

Table-4: Current Scenario

FIELD	MARKET POTENTIAL	MARKET SHARE	B.C.G. RESULT
SHALE GAS (S)	High	High	STAR
TIGHT GAS (T)	High	Currently Low	Question Mark
CBM (C)	High	Currently low	Question Mark
GAS HYDRATES (G)	Low	Low	Dog

Expected Future Scenario

Table-5: Expected Future Scenario

FIELD	MARKET POTENTIAL	MARKET SHARE	B.C.G. RESULT
SHALE GAS (S)	High	High	STAR
TIGHT GAS (T)	High	High	STAR
CBM (C)	Low	High	COW
GAS HYDRATES (G)	High	Unknown	Question Mark

Shale Gas (S): Shale gas has the potential of becoming cheapest energy option in future. Hydraulic fracturing techniques and horizontal drilling have opened up many shale gas wells as potential sources of natural gas and also have made it a lot economical. Shale gas production can cut down the price of natural gas, because of the enormous size of its deposits. And therefore the market potential of shale gas is always going to be high, with market share in countries like USA being high; we can consider shale gas to be a STAR product in present and future scenario.

Tight Gas (T): Tight gas is expected to get wide recognition as an energy source in future when gas will get costly. Moreover the by-products obtained from distillation will be of high value too for this industry. Because this gas is so much more difficult to extract than natural gas from other sources, companies require a large financial incentive to go after it; as energy prices rise, so does interest in extracting tight gas. So, keeping in mind that market share is too low right now for this gas, it will get high in future, and as market potential for this source will always remain high.

CBM (C): The price of gas largely determines the financial strength of a CBM project. Economic viability of a project also depends on factors like royalties and taxation, on drilling costs and on the well productivity rate. In the absence of tax incentives these projects experiences an economically tight situation currently. But at the same time, in CBM, the production is much easier and less expensive as compared to other alternatives. Moreover, the reserves are wide, and market prices of gas are low. Also moderate R&D is required in this field which makes it a average market potential for this source, while market share still keeping low which we can expect to be pretty high in future.

Gas Hydrate (G): Gas hydrates have a wide geographical distribution. Extensive efforts are required to bring gas hydrates into world energy balance. Gas Hydrates require huge R&D investment and the working conditions are pretty complex. The economical extraction of gas hydrates is still not possible. This is a capital intensive field which is still highly unexplored. Such complexities involved with Gas Hydrates make the current market potential low, which we can expect to improve along with its market share in future with proper research and development.

6. ENVIRONMENTAL ISSUES OF UNCONVENTIONAL SOURCES

6.1. Environmental Problems of Shale ad CBM:

6.1.1. Fresh Water Withdrawals and Flow Back Water: Typical wells use between 3 and 5 million gallons per well. Industry practice has been to use fresh water as the base. The water that is brought back up after the fracturing step is known as flow back water. Shale operations are unique in that only about a quarter to a third of the water returns, the rest staying in the formation. Also, the flow-back water is usually brackish. This is because the water in the pores is usually very salty. So, in principle it cannot be re-used. Handling this salinity is the first big objective of water conservation.

Eventually one could expect the industry to develop fracture fluids tolerant of even higher salinities. That would open up some very interesting outcomes. Today sea water and brackish water reverse osmosis plants have a problem waste comprising brines with about 75,000 ppm dissolved solids. This waste could potentially be usable by the drilling industry, pending environmental study. The shale gas industry could move from being a net drain on the fresh water environment to becoming an example for water sustainability.

6.1.2. Produced Water: Water associated with the gas is produced at some stage of the recovery, usually at the tail end of the process - this is water trapped in the pores of rock (connate water) in or near the shale formation. In some cases early production occurs due to infiltration of the fractures into the underlying saline water body. Whether from connate water or the water layers below, the water will be very saline, in part because of the age of the rock. Disposal of this water is a major issue.

Produced water offers the promise of being usable for makeup water after some modest treatment.

6.1.3. Contamination of Drinking Water:

One is the migration of fracturing operation cracks from the reservoir up to the water body. The other is gas or fluid leakage from the well side from the fact that cracks will not propagate the significant distances to the aquifers, were they inclined to do so; they would likely heal due to the earth overburden stresses

Gas leakage from the well should not happen if the well is drilled and completed correctly. A fundamental feature of regulation has always been to design for isolation of fresh water in all petroleum exploitation, not just in the shale.

In summary, the environmental issues related to shale gas production can be addressed in a similar way as for other fuels, i.e. by a combination of technology, regulation, and transparency. The importance of shale gas to national priorities such as energy security, a low carbon future and health of industry calls for all concerned collaborate to expeditiously understand and then deal with the issues.

6.2. The principal Environmental challenges are:

1. The treatment and disposal of large volumes of produced water. The amount of water being produced prior to gas extraction and along with the gas. The Water produced is managed relative to its composition and volumes and local site characteristics

- Water being again injected into aquifers
- Dispersed on the surface
- Water kept in evaporation ponds or impoundments
- Water being discharged into local streams.

2. The intense amount of land being used for development is another concern.

6.3. Environmental Aspects of Gas Hydrate:

The large volumes of methane hydrates that exist in the seafloors and permafrost regions around the world have huge impact on global warming. Global warming is widely regarded as being driven by increased atmospheric concentrations of gases that enhance the greenhouse effect. Carbon dioxide is the most common greenhouse gas in the atmosphere. However, methane is ten times by weight more effective as a greenhouse gas than carbon dioxide. If large volumes of gas hydrate formations become unstable and decompose, then large volumes of methane will be released to the atmosphere. Increased levels of methane gas in the atmosphere will enhance the greenhouse effect, thereby leading to an increase in global warming. Theoretically, it appears possible that a single explosive methane release, such as may occur with a large seafloor collapse event, could cause a significant climate change over a short time period. For instance, catastrophic releases of methane could have triggered the notable increase in temperature that occurred over the last few decades of the most recent ice age (approximately 15,000 years ago) (Suess et al., 1999). In theory, increased global atmospheric temperatures caused by the decomposition of methane hydrates could launch a vicious circle of more dissolution of hydrates, leading to further increases in global warming.

6.4. Government policies

Gas consumption and fuel choices are directly related to Government policies and the infrastructure required implementing those policies.

For example, energy and environmental policies may encourage greater gas use through favorable taxation or subsidies to end-use prices and the development of infrastructure; but they can also constrain demand, for example, by mandating or promoting alternative technologies, such as renewable and nuclear power. The uncertainty surrounding future energy policy choices is high in many countries. The biggest source of uncertainty concerns the strength and type of action that will be taken in the longer term to address climate change, whether in the form of financial incentives, production targets and capacity mandates to support the deployment of low-carbon power-generation technologies. Pricing reform and the removal of fossil-fuel subsidies, whether motivated by environmental or economic concerns, will also be important. Regulations to reduce local pollution could also have a major impact on the share of gas in the energy mix, especially in the least developed countries that are coping with the environmental impacts of more intensive energy use. By and large, natural gas is likely to benefit from more stringent environmental policy action, particularly where it is aimed at dealing with local pollution.

7. CONCLUSION

From the above analysis we can conclude that unconventional sources of oil and gas hold the key to the future of global energy security. The present processes of EOR/IOR for oil and gas though satisfying the energy needs in the short term can't compete with the attractiveness and potential of unconventional sources of oil and gas ***(STCG)*** in the long run.

We carried out various analysis methods in this paper to reach to a conclusion. From SPACE Matrix Analysis, we can conclude that aggressive approach is required for exploration and production of unconventional sources.

By analyzing the unconventional sources by BCG analysis method, we notice that Gas Hydrates falls under Dog category due to complex procedures involved in it, while we expect it to get changed into Question Mark in coming years. Shale gas falls under Star category and we can conclude that it will continue to be there in future seeing its enormous reserves. CBM and Tight Gas falls under Question Mark currently, while from our analysis, CBM will get into the COW category and Tight gas will get into Star category in near future. From SWOT analysis, we can conclude that the strengths and opportunities of unconventional sources are immense while few threats and weaknesses which we face right now will diminish with time and development of technologies.

From this paper we have derived that shale**(S)** is the mother lode of hydrocarbons which can be a game changer in the very near future. Coal Bed Methane **(CBM/C)** requires some more time and also government support. Tight Gas **(T)** is already a part of some E&P companies operations and productions, and it's expected to grow immensely in future. Gas Hydrates **(G)** on the other hand have the largest resource base of all but their economic viability is marred by technological and environmental constraints.

So it can be concluded that ***STCG*** are the sources for the future oil and gas industry but require adequate government and organizational support throughout the globe be it in terms of tax breaks or more research work.

APPENDIX- 1

STCG - *Shale, Tight Gas, CBM, Gas Hydrate*

BCG - Boston Consultancy group

SWOT Analysis - Strength, Weakness, Opportunity, Threat

SPACE - Strategic Position and Action Evaluation matrix,

PESTLE - Political, Economic, Social, and Technological Legal and Environment

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