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**- An Opinion**

# Shale gas as an energy resource- Pros and cons

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## INTRODUCTION:

It is claimed by oil and natural gas industry that natural gas is an efficient energy source and the cleanest-burning fossil fuel. Natural gas extracted from dense shale rock formations has become the fastest-growing source of gas in the United States and could become a significant new global energy source. Although the energy industry has long known about huge gas resources trapped in shale rock formations in the United States, it is over the past decade that energy companies have combined two established technologies—hydraulic fracturing and horizontal drilling—to successfully unlock this resource. Shale Gas means natural gas generated in-situ and retained in Shale matrix storage, adsorbed onto organic particles, or within fractures in shales of source rock origin and obtained there form through boreholes. Shale Oil means crude oil that is generated in-situ and retained in shale matrix storage in shales of source rock origin and obtained there from through boreholes. Shale Gas and Shale Oil reservoirs are continuous gas or oil accumulations in shale that persist over a large geographical area and are generally characterized by lack of oil-water contacts. These are unconventional in their mode of occurrence and exploitation technology. They are producible only through special stimulation techniques. A recent study (April 2011) by Energy Information Administration (EIA), USA indicates that there is a significant potential for Shale Gas that could play an increasingly important role in global natural gas markets. The Report assessed 48 Shale Gas basins in 32 countries. India is one of the countries covered in this Report along with Canada, Mexico, China, Australia Libya, Brazil etc. The initial estimate of technically recoverable shale gas resource in these countries (5,760 TCF[2]), and USA (862 TCF) put together works out to 6,622 TCF.

## INDAIN SCENARIO:

As of now shale gas is not exploited. Encouraged by results from USA and preliminary assessment by USGS experts, Govt. of India is seriously contemplating to carry out detailed exploration, followed by phased extraction. As per Directorate General of Hydrocarbons, Govt. of India, Shale Gas and Shale Oil blocks will have specific operational window for shale oil/ gas, in terms of sub-surface vertical depth. Any sub-surface formation producing hydrocarbons, other than that which can be geologically classified as shale, under standard and universally accepted norms, are excluded from this policy. India has several Shale formations indicating the presence of Shale Oil/Gas. Preliminary estimates suggest that fairly thick sequences with high shale gas potential are extensively present in the oil, gas and coal sedimentary basins such as Cambay, Gondwana, Krishna-Godavari on land and Cauvery on-land. Directorate General of Hydrocarbons (DGH) has initiated steps to identify prospective area for Shale Gas exploration and acquisition of additional geo-scientific data. With new exploration technologies, such as multistage hydraulic fracturing or "fracking" combined with horizontal drilling, Production of shale gas has become easier and economic, in USA. However, taking into consideration the ill effects of extraction methodology and pollution of the environment due to its usage European countries are not advocating its extraction and usage. EIA study has assessed risked gas-in-place of 290 TCF with technically recoverable resource of 63 TCF for 4 out of 26 sedimentary basins in India. In view of the advances made by the USA in exploration and recovery of shale oil and gas resources, Ministry of Petroleum and Natural gas ( MoP&NG) has entered into an MOU with the United States Geological survey (USGS). In a study conducted by the USGS in 2011-12, technically recoverable resource of moderate quantity is probably available in 3 out of 26 sedimentary basins in India. The study also indicates potential for shale oil in Indian basins. Further, process of identification of potential shale oil/gas resources in 11 other basins has also been initiated. Directorate General of Hydrocarbons, while calling for tenders, has brought out clearly specific issues that would affect shale Gas extraction( Courtecy: DGH released details).

**SHALE GAS EXTRACTION TECHNIQUE:**

The process of bringing a well to completion is generally short-lived, taking a few months for a single well, after which the well can be in production for 20 to 40 years. The process for a single horizontal well typically includes four to eight weeks to prepare the site for drilling, four or five weeks of rig work, including casing and cementing and moving all associated auxiliary equipment off the well site before fracking operations commence, and two to five days for the entire multi-stage fracturing operation.

**Hydraulic fracturing:**

Hydraulic fracturing is the propagation of fractures in a rock layer, by a pressurized fluid. Some hydraulic fractures form naturally—certain veins or dikes are examples—and can create conduits along which gas and petroleum from source rocks may migrate to reservoir rocks. Induced hydraulic fracturing or hydrofracturing, commonly known as fracking, is a technique used to release petroleum,natural gas (including shale gas, tight gas, and coal seam gas), or other substances for extraction. This type of fracturing creates fractures from a wellbore drilled into reservoir rock formations.

The first use of hydraulic fracturing was in 1947 but the modern fracturing technique, called horizontal slickwater fracturing, that made the extraction of shale gas economical was first used in 1998 in the Barnett Shale in Texas,USA. The energy from the injection of a highly pressurized hydraulic fracturing fluid creates new channels in the rock, which can increase the extraction rates and ultimate recovery of hydrocarbons.

**Fracturing fluids:**

High-pressure fracture fluid is injected into the wellbore, with the pressure above the fracture gradient of the rock. The two main purposes of fracturing fluid is to extend fractures and to carry proppant into the formation, the purpose of which is to stay there without damaging the formation or production of the well.The most commonly used proppant, is silica sand, though proppants of uniform size and shape, such as ceramic proppant, is believed to be more effective. Two methods of transporting the proppant in the fluid are used – high-rate and high- viscosity. High-viscosity fracturing tends to cause large dominant fractures, while with high-rate (slickwater) fracturing causes small spread-out micro-fractures.This fracture fluid contains water-soluble gelling agents (such as guar gum) which increase viscosity and efficiently deliver the proppant into the formation.The fluid injected into the rock is typically a slurry of water, proppants, and chemical additives. Additionally, gels, foams, and compressed gases, including nitrogen, carbon dioxide and air can be injected. Typically, of the fracturing fluid 90% is water and 9.5% is sand with the chemicals accounting to about 0.5%.Due to a higher porosity within the fracture, a greater amount of oil and natural gas is liberated.The fracturing fluid varies in composition depending on the type of fracturing used, the conditions of the specific well being fractured, and the water characteristics. A typical fracture treatment uses between 3 and 12 additive chemicals. The most common chemical used for hydraulic fracturing in the United States in 2005–2009 was methanol, while some other most widely used chemicals were isopropyl alcohol, 2-butoxyethanol, and ethylene glycol.

**Fracture monitoring:**

Measurements of the pressure and rate during the growth of a hydraulic fracture, as well as knowing the properties of the fluid and proppant being injected into the well provides the most common and simplest method of monitoring a hydraulic fracture treatment. This data, along with knowledge of the underground geology can be used to model information such as length, width and conductivity of a propped fracture. For more advanced applications, microseismic monitoring is sometimes used to estimate the size and orientation of hydraulically induced fractures. Microseismic activity is measured by placing an array of geophones in a nearby wellbore. By mapping the location of any small seismic events associated with the growing hydraulic fracture, the approximate geometry of the fracture is inferred. Tiltmeter arrays, deployed on the surface or down a well, provide another technology for monitoring the strains produced by hydraulic fracturing. (Courtesy-Wikipedia, the Free Encyclopaedia)

**ISSUES IN EXPLOITATION OF SHALE GAS/OIL:**

Proponents of hydraulic fracturing point to the economic benefits from vast amounts of formerly inaccessible hydrocarbons the process can extract. Opponents point to potential environmental impacts, including contamination of ground water, risks to air quality, the migration of gases and hydraulic fracturing chemicals to the surface, surface contamination from spills and flowback and the healh effects of these. For these reasons hydraulic fracturing has come under scrutiny internationally, with some countries suspending or banning it.

As per DGH released tender details the following issues need to be taken into consideration, while bidding for blocks, to extract Shale Gas:

I. Optimal Exploitation of Shale Gas/ Oil require Horizontal and Multilateral wells and Multistage Hydraulic fracturing treatments of stimulate oil and gas production from shale.

II. This may require large volume of water~3-4 million gallons per well (11000 to 15000 cubic metres of water required for drilling / hydro fracturing depending upon the well type and Shale characteristics).

III. The water after Hydraulic fracturing is flowed back to the surface and may have high content of Total Dissolved Solids (TDS) and other contaminants (typically contains proppant (sand), chemical residue occur in many geologic formation, mainly in shale). Therefore, the treatment of this water before discharge to surface / subsurface water needs to be in line with the Central / State Ground Water Authority regulations.

IV. Possibility of contamination of Aquifer (near surface and subsurface) from hydro-fracturing and fracturing fluid disposal and the need for safeguarding the Aquifer. Multiple casing programme (at least 2 casings) will be mandatory requirement across all sub-surface fresh water aquifers. Although there are no specific provisions as on date relating to regulation of the process of hydraulic fracturing, and water injection process as has been provided in the Safe Drinking Water Act (SDWA) brought out by the Environment Protection Agency (EPA) in the USA, the water (prevention and control of pollution) act 1974, has stringent provisions to regulate / prohibit disposal of polluting matters into water streams / wells (section 24-25). As per section 3(J) (iv) of the Act, streams include subterranean waters, which would include Aquifers.

The National environment policy 2006 states as under:

"Suitable sites for dumping the toxic waste material may be identified and remedial measures may be taken to prevent the movement of the toxic waste in the ground water."

**Proposed Policy For Exploration And Exploitation Of Shale Oil & Gas:**

In line with the policy of the Government of India attracting private investment to move towards self reliance in the indigenous production of oil and gas sector, it has been decided by DGH/MOP&NG to have a framework to facilitate and regulate Shale Oil and Gas Exploration and Exploitation. This initial technical study undertaken in the country has indicated presence of Shale Gas as a hydrocarbons resource that can be commercially explored and exploited.

Exploration of Shale oil / gas will be accordance with the law of the land, including the Water (prevention and control of pollution) act, 1974, Air (prevention and control of pollution) act, 1981 and the overall ambit of environment protection measures. As shale gas / oil production is likely to be made in small quantity but over a longer period, it is proposed that the mining lease (ML) may be given for 30 years.

**Favourable indicators in support of Shale gas usage:**

Since we are short of energy resources any addition is useful in meeting ever increasing energy demand. As such, extracting shale oil and gas is supported by the oil industry experts and the government. As per Soeder (2011) gas industry claims that no case of ground water contamination caused by hydraulic fracturing has ever been documented. In most instances, fracking takes place at such great depths that it is highly unlikely to affect shallow aquifers in any way. Detailed microseismic data in both the Marcellus and Barnett shales of USA showed that none of the induced fractures in the shales approached within several thousand vertical feet of the deepest freshwater aquifers overlying them. In support of hydraulic fracturing an executive vice- president of Devon Energy, USA has stated that multiple barriers stand between ground water and fracking. Each well bore is surrounded by at least two casings with a layer of cement between them and around the outside diameter. Further preventing contamination is the layer upon layer of impenetrable rock.

## NEED FOR A RELOOK INTO THE POLICY OF SHALE GAS EXTRACTION:

It is noticed from different mining operations, including large scale iron ore mining, that rules and regulations framed by both the state and central governments can be easily violated due to absence of proper quality control mechanism. Shale gas, as stated above by the circular released by DGH, is going to be exploited in small quantities, over a period of about 30 years. The blocks/ zones known to be having Shale gas reserves are already being used to extract coalbed Methane and Natural Gas. These operations have already polluted the environment, inspite of putting in operation established quality control norms. In a country like US, where abundant quantity of Shale gas is available, considerable environmental problems are noticed. In our country, some of the identified Shale Gas resource blocks are located in saline water intruded vulnerable coastal segments. Already fertile lands have become less potential polluted lands in these segments. Oil well blows and pollution through shallow conduits have created considerable damage to the coastal ecosystem. In these segments, if fracking is permitted we would be creating a big environmental hazard.

It is true that Shale formations contain abundant natural gas. Through unconventional recovery technique known as hydraulic fracturing, or fracking, it may be economically viable to extract shale gas. In the suggested fracking process, a well is drilled horizontally through shale formations, which generally lie at a depth of 1000 meters or more beneath the surface. During fracking explosives are used to blow holes through the well casing. Then a fluid consisting mainly of water and sand is injected down the well at very high pressures, causing the shale to fracture. Once pressure is released, the fracking fluid flows back to the surface and gas from the shale flows into the well. Although fracking fluids are more than 90% water and sand, they also contain a number of chemicals, including some that are toxic, such as benzene, antimicrobial agents, and corrosion inhibitors (Kramer, 2011). Since, we are importing considerable quantities of crude oil and gas, both public and private oil industries are planning to extract shale gas to bolster our energy resource base. While, we appreciate such an initiative we are concerned about disposal of waste water and use of large quantities of sand. Already we are facing considerable problems in removing surface water pollutants and lessening the impact of sand mining. As per Kapusta (2011) at least three environmental problems are noticed due to the mining of sand. First, the topography of the land will be changed forever; the bluffs will be gone. Second, the dust from silica sand causes a variety of lung diseases, including cancer. Third, large trucks continually transporting the sand to wells will negatively affect the natural beauty and serenity of the area. In addition we need huge quantities of water. Already we are having considerable problem in sustaining our food production, due to shortage of water. Many of our surface water bodies have been polluted due to inflow of industrial wastes. Our ground water domain is under tremendous stress. Experts are continuously warning us that already an irrevocable pollution has set in, due to rat hole mining of ground water. In Shale Gas extraction, groundwater is not the only concern. In April 2011, a shale gas well in northern Pennsylvania blew out during fracking, spilling thousands of gallons of fracking fluid on surrounding land. A similar event occurred in June2010, at a well in the same state, and for 16hours thousands of gallons of fracking fluid spilled over the surrounding fields. Some of the American residents, who have suffered due to fracking operations, have stated that most of them are concerned about fugitive emissions that occur at multiple points during fracking and production. In addition to methane, those emissions include neurotoxin carbon disulfide (Kramer, 2011). USGS Director, Marcia McNutt has stated that hundreds of earthquakes have occurred in Arkansas where fracking waste water was being injected to depths 2-4 km. The largest, a 4.7magnitude termor, caused some damage in nearby towns. After, state regulators halted further waste injections the number and magnitude of earthquakes have fallen dramatically (Kramer, 2011). A study by Duck University found a strong correlation between elevated methane levels in water wells and shale gas drilling in the Marcellus (Kramer, 2011). As K-G basin, Gondwana graben and Cambay basin are known to be associated with moderate level seismic activity, if these areas are used for fracking and subsequent injection of waste fluids in to waste disposal wells there is every possibility of witnessing seismic activity leading to overall abolishing of oil and gas extraction. The uproar created by couple of blow outs in Pasarlapudi of K-G basin is still haunting the ONGC. Since shale gas resultant energy is of limited nature there is no logic in taking such risks that affect both the habitats and the environment.

In view of very clear warnings, cited above, let us not create new problems in the name of energy security. Energy demand is an unending process. It is time we curb all initiatives that are degrading our environment, as the population explosion will not allow stabilization of demands. A time has come for us to take strong measures, even if they are bitter in taste. Let us control private vehicle population, as done in Singapore. Let us stop large scale misuse of electricity, in the name of social justice. It is important for the scientific and regulatory communities to focus on protecting water resources, air quality, habitat, and ecosystems. From the available data, it is evident that if shale gas production is permitted we will not be in a position to protect vital life saving commodities----water and air, in the Shale Gas extraction zones. If government is committed to go for Shale Gas and Oil production, objective data are needed to update state oil and gas regulations, to identify environmental concerns, and define migration strategies for the production of this energy resource.

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