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Renewables, Shale Gas and Gas Import- Striking a Balance for India

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Abstract

India's primary energy basket is heavily weight in favour of coal, oil and gas (92%) and balance 8% renewables, hydro and nuclear. The eco-friendly energy resources like natural gas and renewables (wind & solar) account only for 9% and 2%. The long term energy demand forecast also suggests contribution of coal, oil and gas to slide down to 87%. The Natural gas demand though on increase but the consumption is constrained due to limited domestic production and inadequacy of LNG import facilities. Considering the huge import bill on oil, gas and coal imports ($150 billion, Kelkar 2013) and the ever increasing concern for environment, the eco-friendly non-conventional resources as shale gas are getting preference. This paper examines the potential contribution from Shale Gas to meet the energy demand to fuel the economic growth of India

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Keywords: Non-Conventional; Shale Gas, India Imports

1. Introduction

India is the 2nd largest country with 17.4% of the world population, next to China (19.2%) (indiastat.com) and its per capita electricity consumption is merely 529.10 Kwh, standing at 154th position in the world and from total primary energy consumption point of view India stands at 4th position after China, US and Russian Federation. However, except for Coal Reserves and Wind Energy Production where India stands at 5th position, for no other energy resource India comes within top 10

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countries of the world. The Indian import of the primary energy is pegged at 39% thus draining a huge foreign exchange of $150 billion during 2012, (Kelkar, 2013).

There is a danger of the world running out of fossil fuels not in too distant future. Coal and other fossil fuels which have taken millions of years to form are likely to deplete soon. In the last two hundred years 60% of available resources have been consumed. The remaining 40% of these reserves are continually diminishing at a faster pace with increasing consumption According to the Planning Commission, coal-based thermal power plants are likely to contribute about 300 GW in 2030, up from about 113 GW in 2011 (Planning commission, 2011). With the large number of coal-based thermal power plants are likely to be commissioned; coal consumption in the power sector will be 610 MT up from 380-500 MT by 2011-12 and 1.3 Billion tons by 2021-22 (Chikkatur & Sagar, 2009). Meeting the growing energy demand based on the current pattern of energy supply will become increasingly difficult in view of the need for keeping Greenhouse Gases (GHG) emissions and crude oil import bill low. India needs to augment its eco-friendly domestic energy resources for addressing three issues viz, energy growth, environmental consideration and foreign exchange saving. The maximum exploitation of renewable resources is not likely to meet the projected energy requirement. Out of the 24913 MW installed capacity , the net realization for solar and wind is limited by their PLF being less than 25% (Hossain et al., 2012, groups.google.com) and the contribution of renewables in India to rise from 1.9% to 4.2% projected up to 2035. The conventional natural gas resources also are limited (R/P for India=33.1 years), (BP, 2013). It is therefore essential for India to exploit non-conventional hydrocarbon resources of which Shale Gas has a major potential.

Traditionally, natural gas prices in the global trade are linked up with crude oil price (except for regional trading hubs and recent LNG contracts from US). The volatility of crude oil price in the market place is not dictated by the market sentiments but by the OPEC and other oil majors of different regions. Because of this, the search for alternative energy resources has been undertaken by several countries. The example of U.S, having followed vigorously the Shale Gas (E&E) in 2008 when gas price shot up exceeding $8/mmbtu is not only a success story of Shale Gas growth in U.S and a game changer but also is an example for such initiative globally. India therefore needs to exploit its unconventional Shale Gas Resources to cop up with the ever increasing demand and to address the environmental concern. According to IEA report, unconventional resources are expected to have 16% share of total resources.

2. Shale Gas Exploitation and Exploration (E&E) in India– The Key Factors

Considering the success story US which has become net exporter of gas from gas imports. Even India has tied up contract for import of LNG from US. It was therefore thought to analysis issues as to why India has not taken up Shale Gas E&E in India. The key factors responsible for the same have been found out through a research study (Negi BS 2013) by employing a structured process (the process adopted is the extensive review the existing literature and survey the peers for formulation of a questionnaire to develop a conclusive model employing proven statistically tool) have been identifies as; Techno-social issues, Risk and Uncertainties, Technical and Service Support, Govt. Support (local, State and Central), Causal Effect, Land Issue, Water Related Issue, Transportation Issue, Cost of Production and Collection of Shale Gas, Policy Issue, Population and Environmental Issue, Judicial/Market System. The study concludes that the Shale Gas E&E can be successful in India if the factors found out through research study are addressed**.**

3. Indian Shale Gas Potential

The studies conducted so far indicates presence of various Shale Plays in India located in numerous basins (B. Kumar, 2011). However the assessment of reserves has not yet been carried out for enabling any Commercial exploration for Shale gas. The available information is tabulated below:

Table 1: Shale Gas Potential Assessment for India (Compiled from various sources)

S.No.	Resource Potential(tcf)	Remarks
1	3526	Compiled by Society of Petroleum Engineers, combined for India and China.
2	63	EIA Independent Statistics & Analysis Report April, 2011, Report shows China Reserves at 1235 tcf. Thus combined reserves for India and China are 1385 tcf.
3	500	Report from Hardy Oil presented during Shale Gas India 2011 Conference (for KG basin, Cauvery and Cambay basin only).
4	33-100	McKinsey & Co.

The table above shows that it is too preliminary information to be relied upon for any commercial exploration. Government of India has signed an MOU with US in November, 2010, which has following four important provisions: Resource assessment (in association with US Geological Survey), Co-operation on Technical issues. Developing a policy frame work and Exchange of experience. Thus the intentions are clear but speed is important. As of now no significant progress is reported. The characteristics of various Indian Shale basins shown in Table- 2. The major opportunities identified for India are as follows. There are significant number of geologic basins across the country. The technology which was developed in US over the past three to four decades is available for application around the world. New technology is becoming a worldwide commodity through efforts of major service companies operating in many countries. Increased Global demand for energy will continue to be an incentive for worldwide unconventional energy sources, India being no exception.

Table.2: Experimental data from Indian Shale Plays (EIA report 2012)

Basin Parameters	**Cambay Basin**	**K-G Basic**	**Cauvery Basin**	**Assam-Arakan Belt**	**Gondwana**	**Vindhyan**
Formation	Older Cambay Shale and Younger Cambay Shale	Raghavapuram Shale (Kommugudem formation)	Settapadi formation and Andimedam formation	Disang Shale and Bhuban Shale	Borren measures and baraker formation	Chokaria olive Shale, ghanurgarh Shales
Geologic Age	Paleocene- Lr. ecocene	Late cretaceous , Permian-carboniferous	Late cretaceous, Early cretaceous	Paleocene, Eocene and Miocene	Early to late Permian	Proterozoic
Depth (m) Average	1200-2000	>2000	2000-3000	>2500	>2000	>1800
Thickness (m)	500-1200	300-1500	300-750	400-1000	500-100	>350
TOC (%)	1.5-4.0	1.4-5.3	0.31-4.76	0.64-1.00	4.0-10	0.40-6.04
VRo (%)	0.75-1.20	0.90-1.30	0.65-1.20	0.57-1.94	.40-1.20	No data
Kerogen type *	II & III	II & III	II & III	II & III	III	II & III
Gas concentration (Bcf/sq. Mile)	231	143	143	120	123	No data
Prognosticated Resources (tcf)	217	280	80	55	85	Not Estimated

3.1 Indian Field Experimentation

Both private and public Sector companies have done experimental work to examine the Shale prospects in various basins in India, a few of them are discussed below.

(A). Reliance Industries Ltd. (RIL): RIL has done experimental drilling for Shale Gas in Cambay Basin covering Tectonic blocks of: Patan block, Ahmedabad -Mehsana Block, Tarapur Block, Broach Block and Narmada Block. The Stratigraphy of Cambay basin is given in Table 4. The observations based on the core analysis are as follows (Sudipta Basu 2012). Cambay Shale TOC (1.2-5.7) & HI (75-200): Good Source Potential; At the penetrated sections maturity (VRo): 0.7 to 1; Basin model: Good calibration with measured data; Significantly matured (wet gas window) section with good thickness emaciated; Average Clay - 38%; Average Quartz - 36%; Organic Richness & Maturity: Satisfactory at the drilled locations; Maturity map derived from basin modeling suggests suitable zones of future interest: Well calibration boosts confidence; Thickness of Cambay Shale: significant; Genetic gas characterization: Gas found in the sections drilled are of thermogenic origin; Hence, gas generation potential is proven in the study area; Integrated approach is useful for evaluating gas Shale potential in areas with few wells drilled.

(B). GSPC Shale Gas Project: In 2004, GSPC collected experimental data from Tarapur, Ahmedabad, Ankleswer, Sanand and Mirali. Data collected have been encouraging.

Table 3: Generalized Stratigraphy - Cambay Basin (RIL experimental Data)

Sub- Surface Strata	**Age**
Gujarat Alluvium	Recent to Pleistocene
Jamusar Formation	Recent to Pleiatocene
Broach Formation	Pliocene
Jhagadia Formation	UP Miocene + Mid Miocene
Kand Formation	Mid Miocene
Babaguru Formation	LR Miocene
Tarkeswara Formation	LR Miocene
Dadhar Formation	Oligocene
Vaso Formation	UP Eocene
Younger Cambay Shale	LR Eocene
Older Cambay Shale	LR Eocene
Olpad Formation	Paleocene
Daccen Trap Group	Upper Cretaceous
Somonla Formation	Lower cretaceous to Jurassic

(C). ONGC Damodar Valley project: Damodar valley basin Project (Costing INR 1.28bn) launched with engagement of Schlemburger as the contractor. The selection of site based on ONGC's experience for conventional fields. Following are the salient features of the project details and the findings (Roy, 2012). a) Sites selected: Karanpur and Raniganj b) Experimental well drilled for core analysis: Core data analyzed for TOC, Gas contents, Gas stratigraphic data. c) From core analysis, Type-III Kerogen noticed data compared with US Shale Gas plays from 12 Gas producing and 50 prospective plays. It is noted that Damodar Shale has High TOC, Maturity 0.9 to 1.0 at 700 to 800 meter and Indian Shale is thickness

ranges from 800 to 1500M (which is thicker as compared to US Shale). d) DV Shale has high maturity at shallow depth is good for Hydro Fracking. e) Schlumberger drilled vertical well and the Shale Gas was produced on 24th Jan. 2011 from a depth of 900m.

(D). Joshi Technology Shale Gas finds: These finds relate to the observations during carrying out normal E&P activities in the conventional E&P blocks. There was an accidental find of Shale Gas from: 1) Dholka Field –Cambay basin, Finds (1989 and 2009) rEported by Joshi Technology. Depth of Shale from 1307 to 1317 meter. 2) Kanwara field Cambay basin (Tarapur Tectonic Block), thickness of Shale play more than 1000meter. TOC value of 1.5 to 4% and VRo value of 0.8 to 1.2, showing dry gas. A concept of finding sweet spots goes every well with Shale Gas E&E. First, the regional or basin sweet spots are identified in the manner where Shale is encountered while drilling conventional well as in above case within the basin. There after the local or operating area sweet spot are confirmed by drilling pilot well and core & logging measurement from pilot wells provide data to update whether pilot well has intersected a sweet spot (Karen Salivan Glaser et. al. 2014). Sweet spots are the most prospective area and aligning the well bore for maximum bore-hole exposure to this zone.

(E). Shale Gas initiative of OIL: OIL has been doing Shale Gas experiment in North East. Data generated from field exploration have not yet been made public. The experimental and exploratory data collected by various companies who took Initiative for exploration of Shale Gas in India. The data indicate that Indian Shale Plays have good TOC and the thickness of Shale Plays varies from 500 meter to 1500 meter. The depth of Shale structure varies from 300 meter to 1200 meter. We can conclude that India will have reasonably good Shale prospects. As can be seen from table 4, the Indian Shale Gas initiative is in a nascent stage. The PSU's have been undertaking E&P activities for almost a century now and have reasonably good idea about the sedimentary basins of India. They would therefore need to attempt wild cat drilling as it is said that the oil & gas is first found in the mind of the explorer and thereafter in the field. The wild cat drilling is defined as the process adopted by the companies that look for oil & gas where other don't believe it is located.

Table 4: Indian Exploratory Initiative

S. No.	Characteristics	RIL	GSPC	JTI	ONGC
1	Location	Ahmedabad, Patan, Bharooch etc	Tarapur, Ahmedabad, Sanand etc	Dholka, kanwara	Damodar(Karanpur, Raniganj
2	Organic richness TOC %	1.2 - 5.7	High	1.5-4.0	High
3	Vitrinile Reflection VRo	0.7 – 1.0	Not Reported	0.8 – 1.2	0.9 – 1.0 (700-800 M)
4	HI	75 - 100	Not Reported	N/R	N/R
5	Thickness	significant	Above 800 M	900-1200 M	800 - 1500M
6	Clay	38%	Not Reported	Accidental Shale Find	Not reported
7	Quartz	36%	Not Reported		Not reported
8	Well depth	N/A	2500 M	1310 M	2400 M
9	Shale Gas Potential	Established (Year-2009)	Established (Year-2004)	Established (Jan 2010)	Production (Jan.2011)

4. Shale Gas Policy in India

Director General of Hydrocarbons (DGH) the upstream Regulator in India was established in 1993 by an administrative order of the government. DGH operates under the administrative control of the Ministry of Petroleum & Natural Gas (MoPNG). Government had issued guidelines for New Exploration & Licensing Policy (NELP) in 1998. Under this policy the first round of bidding for exploration blocks started in 1999. Till now nine round of bidding have been completed and 254 blocks have so far been awarded to various E&P contractors. Preparations for 10th round of bidding are on and there have been certain changes in the NELP bidding to be incorporated from 10th round. Significant among them are the abolition of Cost recovery and allowing production sharing as the major criterion for weightage in the bidding. There is no policy for Shale Gas E&E in India. Government of India notified Draft Shale Gas Policy in April 2012 seeking public comments. The author made certain suggestion to the government of India on the draft Shale Gas Policy, which are briefed below:

(i). Shale Gas Plays Exploratory Data: The exploratory data from various Shale Plays are required for a competitive bidding. As of now we do not have enough data on most of our Shale plays. Shale oil/gas Policy therefore needs to define the time bound acquisition of field exploratory data indicating the "Sweet Spots" and the responsibility for such data acquisition as a project. The role of DGH shall have to be defined in the Policy frame work.

(ii). Shale Gas Price: Whereas the draft policy suggests that the Shale oil can be sold as oil produced from conventional E&P blocks with import parity. The policy does not bring clarity in respect to marketing of Shale gas. It only states that the Shale Gas can be marketed as per Gas Pricing and Gas allocation policy of the Government. This is a negative factor because it neither gives the freedom to market nor it assures market driven price.

Suggestion: To begin with, producers should have freedom to market gas at arm's length at a price not less than the weighted average cost of domestic gas and LNG import price (other than spot cargos)

(iii) While addressing Fiscal issue, the Shale Gas Policy needs to provide 7 year tax holiday as provided in CBM policy.

(iv) The water management in Shale Gas E&E is very cost intensive and has high environmental impact. As mentioned in the Dft. Shale Gas Policy, the applicable provisions are the Water (prevention and control of pollution) Act 1974 but the same does not answer all these questions. It is therefore suggested that based on global experience, we carve out the process and parameters.

(v) India has very high population density with highly fractured land holding pattern. This would make land acquisition a difficult task for Shale Gas E&E. A profit sharing provision for individual land owner in proportion to the area of their land acquired may provide a solution.

Suggestion: Production sharing from Shale Plays may either be made as bidding condition with flat rate of production sharing mentioned in the bid document or it could be a biddable parameter (having the weightage of say 10% marks carved out 5% each from work programme and production sharing with the government or alternatively 10% marks carved out of production sharing provision alone)

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Biography

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