

The Shale Gas Story – Current and Prospective Realities



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(UNDER MINISTRY OF PETROLEUM & NATURAL GAS)

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Overview of Indian E&P Industry Conventional Vs Unconventional

Shale Oil & Gas

1867 – The journey started





- 1859 World Oil Discovery
- 1867 Digboi, Oil Discovery in India : still producing @ 150 BOPD

The Giant Field – Mumbai High





- 1974 The Miocene Giant by ONGC
- > 12 Billion Barrels
- Producing @ 200, 000 **BOPD**
- **Other majors Heera**, Neelam, Bassein and Gandhar



INDIAN SEDIMENTARY BASINS





26 Sedimentary Basins

Total area : 3.14 million Km2

ONLAND 1.39 Million Sq Km SHALLOW WATER 0.4 Million Sq Km



DEEP WATER 1.35 Million Sq Km



EXPLORATION ACREAGES



AREA LICENCED YET TO OFFER **ONLAND ONLAND** DEEP WATER **DEEP WATER** 0.99 Million Sq Km 0.86 Million Sq Km 0.49 Million Sq Km 0.4 Million Sq Km 46 % 40 % 40% 50% 14% 10% SHALLOW WATER SHALLOW WATER 0.3 Million Sq Km 0.1 Million Sq Km 2.15 Million Sq Km (68%) 0.99 Million Sq Km (32%)





✓ > 180 Discoveries





EXPANDING GAP >>>> Unconventional HC



INDIA's RESOURCES



	Туре	Resources	In place Reserves	
Conventional	Oil & Gas (15 Basins)	206 Biliion bbl	72 Billion bbl <mark>(35%)</mark>	
	СВМ	92 TCF	9 TCF <mark>(10%)</mark>	
	Gas Hydrate	Under evaluation (~1894 TCM)		
Unconventional	Shale Gas	Under evaluation (1000's TCF)		
	Oil Shale	Under evaluation (~ 3000 MMBBL)		



Unconventional Hydrocarbon Resources

- Coal Bed Methane (CBM)
- Gas Hydrate (GH)
- Shale Oil & Gas
- Oil Shale
- Underground Coal Gasification

UCHR – Status



- ✓ CBM
- ✓ Gas Hydrate
- ✓ Oil Shale
- ✓ UCG

- Commercialized
- Shale Oil & Gas Under Policy formulation
 - Under R&D stage
 - Under R&D stage
 - Under Policy formulation





Shale Oil & Gas





Generation

Emergence of Shale Gas



- Large untapped Resource of Shale Gas available in Source Rock(s) – Source Rock Reservoirs/Kitchens
- Earlier shale gas wells drilled vertical and nonprofitable due to low Producibility
- Declining conventional oil/gas reserves necessitated unconventional reserves supplementation to meet demand- supply gap
- Modern technologies like <u>Horizontal wells &</u> <u>Hydro-fracturing</u>

Shale Gas / Oil – Critical Points



✓ Technical

- TOC > 2, VRo> 0.8 (for Oil), VRo> 1.0 (for Gas)
- Permeability (nD Vs mD)
- Fractures & Fracturability
- Mineralogy & Geo-Mechanics of Shale (Clay & Brittleness)
- \checkmark Large volumes of water (3 4 MM Gallons / Well)
- ✓ Large number of wells (1000's Vs Tens)
- Infrastructure (Pipeline & Service providers)

World Scenario



- USA Huge Success (25% of Gas Production)
- Technology Driven Process



- Projects initiated in Canada, Europe, China, Indonesia etc
- Environmental concerns raised







SHALE GAS - Resources



Huge Shale Gas Potential



Figure 1. Map of 48 major shale gas basins in 32 countries



Source: EIA, April 2011 – Study of 48 Basins in 32 countries including India



EIA Study Results



Continent	H-H Rogner (Tcf)	EIA/ARI (Tcf)
1. North America*	3,842	7,140
2. South America	2,117	4,569
3. Europe	549	2,587
4. Africa**	1,548	3,962
5. Asia	3,528	5,661
6. Australia	2,313	1,381
7. Other***	2,215	n/a
Total	16,112	25,300

* Includes U.S. shale gas in-place of 3,.824 Tcf, based on estimated (ARI) 820 Tcf of technically recoverable shale gas resources and a 25% recovery efficiency of shale gas in-place.

** Rogner estimate includes one-half of Middle East and North Africa (1,274) and Sub-Saharan Africa (274 Tcf).

*** Includes FSU (627 Tcf), Other Asia Pacific (314 Tcf) and one-half of Middle East/North Africa (1,274) Tcf.

Source: EIA, April 2011

		EIA Study Results - India				
	Continent	Region	Country	Risked Gas In- Place (Tcf)	Technically Recoverable Resource (Tcf)	
		XI. China		5,101	1,275	
	Asia	XII. India/Pakistan	<mark>India</mark> Pakistan	$\frac{290}{206}$	⁶³	
<u> </u>						

Source: EIA, April 2011

Resource Summary - India



 Schlumberger (Jan 2011) – Media reports Resources 300-2100 TCF

• EIA (April 2011) – 4 Basins out of 26 Basins

- GIP Concentration 1170 TCF
- Risked Gas in place 290 TCF
- Recoverable

- 63 TCF

• USGS (Jan 2012) as per MOU – 3 Basins out of 26 Basins

- Technical Recoverable 6.1 TCF
- Potential for Shale Oil deposit
- Further studies in progress

NGRI (Dr AM Dayal) – Media reports (May 2012)

- 527 TCF
- 260 TCF recoverable





• ONGC Pilot Project (TerraTek, Schlumberger, USA)

- Raniganj : GIP ~ 48 TCF
- Further studies by ONGC & CMPDI in progress

Varying Potential (upto 2100 TCF) + Shale Oil





STATUS





Shale Gas Development initiated by MoPNG/ DGH in 2010

Multi Organisation Team (DGH, ONGC, OIL & GAIL) formed

Basins identified, Compilation of data for Phase-1

Interaction with USGS, Deliberations on Identification of areas & Projects





- Recoverable Reserves ~6.1 TCF for 3 Basins
- Basins have Shale Oil Potential Further studies in progress
- Consulations on Regulatory framework
 - Several meetings and visits



- Identification of Prospective Basin/areas
 - 6 Basins/Areas identified under Phase-1
 - Area identification in Gondwana (6 sub basins) by CMPDI under way
 - Area identification by ONGC for 11 Basins





	BASIN	GEOLOGICAL AGE
1	CAMBAY	TERTIARY
2	GONDWANA	PERMIAN
3	ASSAM-ARAKAN	TERTIARY
4	KG - ONSHORE	CRETACEOUS
5	CAUVERY - ONSHORE	CRETACEOUS
6	INDO - GANGETIC	PROTEROZOIC/ TERTIARY

Others basins are also prospective

32



Issues related to Shale Oil & Gas – Including Environmental Issues

ISSUES - Water



- Use (Drilling & Hydro-fracturing)
- 3-4 million gallons/well i.e. 11000-15000 cubic meters/well
- Water Sourcing, transport, storage and disposal
- Flow-back water treatment / recycle / disposal may contain high TDS, sand, chemical residues and trace amounts of *radioactive elements (NORM)*

Key issue is water availability for thousands of shale gas wells and disposal of produced / flow-back water



Composition of Hydraulic Fracturing Fluid





*Eliminated in many fracturing operations.

Acids: Hydrochloric or muriatic acids; commonly used in swimming pools.

KCI:

Food preservative; low sodium table salt.

Surfactants:

Used in shampoos, household detergents.

Source: ARI, 2009 after Arthur, J. D., et al, 2008

ISSUES - Land



- Shale Gas development require 1000's wells
- High population density
- Many uninhabited lands are forest land, tribal land, animal reserves etc.
- A multi-well drilling pad may be required.
 Typical well spacing is 60-160 Acre.

Key Issue is land availability for thousands of shale wells and other related infrastructure (Production Facilities, Pipelines, Roads etc.)





✓ Water availability and Disposal of Produced / flow-back water

✓ Availability for thousands of shale wells and other related infrastructure (Production Facilities, etc.)

✓ Lack of Infrastructure (Pipeline etc.)

✓ Environmental issues

✓ Lack of availability of service providers





Shale Oil & Gas Policy

Existing NELP & CBM Policy



NELP

- Cost Recovery
- <u>Sharing of Profit Petroleum</u>
 <u>based on IM</u>
- Royalty
- BEC
 - WP
 - Fiscal (IM & Cost recovery)
 - Technical competence

- CBM No Cost recovery
- <u>Sharing of Production</u> <u>Linked Payments (PLP)</u>
- Royalty
- BEC

- WP
- PLP
- Technical competence





 Draft Shale Oil & Gas policy was put on website of DGH/MoPNG in July 20112 & circulated to various stakeholders for comments/suggestions

- Salient Features of the Draft Policy
 - No Cost recovery
 - Biddable PLP
 - Biddable WP (Wells)



- Inputs on draft policy for Shale Oil & Gas under further discussion
 - Existing contractors may be allowed to explore Shale Oil & Gas in their blocks
 - Exploration & Exploitation of all type of hydrocarbons (Oil, Gas, Shale Oil & Gas etc.) under proposed Unified Policy

Mandatory Work Programme for Shale Oil & Gas

Identification of Prospective Basin/areas – studies in progress

Draft Shale Oil & Gas policy under finalization

Discussion with various US agencies

Thank you