



**17<sup>th</sup> Convention of the Indian Geological Congress and  
International Conference on 'New Paradigms of Exploration and  
Sustainable Mineral Development : Vision 2050**

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*on*

**INDIAN UPSTREAM HYDROCARBON SECTOR :  
CHALLENGES AND OPPORTUNITIES**

*by*

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**at**

**Indian School of Mines, Dhanbad**

**10<sup>th</sup> November 2011**

## **Indian Upstream Hydrocarbon Sector : Challenges and Opportunities**

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President, Indian Geological Congress  
Chairman & Managing Director, Oil India Limited*

On behalf of the Indian Geological Congress (IGC), I have great pleasure in welcoming you all to the 17<sup>th</sup> Convention of the IGC and this conference organized by the Department of Applied Geology, Indian School of Mines. We are happy to see that many specialists from diverse fields of geoscience and allied disciplines are participating in the Congress.

Ever increasing levels of our knowledge in earth science have demonstrated how complex the Earth system is. Unraveling of such a complex system inevitably demands multi-disciplinary team efforts. I am confident that the IGC convention would provide a platform for robust interaction and cross-pollination of ideas at the interface between disciplines amongst the geoscientific community assembled here. We would like to thank everyone who have made this occasion possible.

Geoscience provides a canvas of the reality of our planet in the enormous span of time and space. The geoscientists are lucky to be able to enjoy that vision of the planet earth, and also, to find groundwater, hydrocarbon and minerals, mitigate landslides, and study earthquakes. At the same time, it is imperative to learn, and to help fellow humans learn, to exploit natural resources while preserving the environment, to live sustainably far beyond our individual tiny niche in space and time. The theme of **the 17<sup>th</sup> Convention of the Indian Geological Congress and International Conference - "New Paradigms of**

**Exploration and Sustainable Mineral Development: Vision 2050”,** I think would reinforce this dual responsibility of the geoscientist community in spirit and thought.

At the outset, I would like to say that it is a matter of great privilege and pride to be one of you and speaking to you today. I would like to thank you as the President of this august society for your unstinted support to the IGC in all its endeavour in promoting geoscience in service to society.

The last half century has been regarded as a golden age for geoscience - a time of major geo-scientific breakthroughs. There are still many exciting questions left to be answered. The incorporation of latest technology including extensive use of computing capabilities, particularly, Real Time Monitoring Systems, Virtual Reality Centres, Artificial Intelligence, Imaging Technologies etc. have given a new dimension to geoscientific studies in terms of precision of data collection and interpretation. For sustainable development, we need to have a look at the natural resources that we can muster.

### **Global Hydrocarbon Outlook, - Challenges we face**

In terms of global natural resources and energy matrix, fossils fuels, - coal and petroleum will continue to play a dominant role in the foreseeable future. I would, now, like to share some my thoughts related to Energy Security in general and the challenges and opportunities in the Upstream Hydrocarbon sector, in particular, in the national context.

Hydrocarbons are one of the most critical sources of energy and will continue to remain so in economic development of nations in the foreseeable future. Energy fuels development and development fuels demand. Growing population, emerging economies and enhanced standards of living in developing

nations are expected to drive energy usage to still higher levels. For developing countries like India, access to affordable energy is critical to the economic growth of the nation and enhanced standards of living of its population.

Security of energy sources is of strategic importance. Majority of the established hydrocarbon resources in the world are confined to and controlled by a few countries, whereas the demand is world-wide. The concerns related to assured supply are threats of supply disruptions, terrorism, instability in exporting nations, nationalist backlash, geopolitical rivalries, speculative trading and business cartels. Recent Global developments like economic downturn of 2008-09 and the geo-political unrests in Middle-East countries have, once again, demonstrated the vulnerability of world's crude oil prices and the resultant impact on economic growth of countries.

Energy security concerns are critical for India as the country faces challenges in meeting its energy needs and depends on imports to meet three-fourth of its hydrocarbon energy requirements. The slower growth in India's domestic oil & gas production and growing consumption of petroleum are the main reasons for the widening gap between demand and supply of hydrocarbons in the country.

### **Reserves – Law of Diminishing Return**

A quick review of the statistics reveals that as of now the world has consumed around 1100 billion barrels of crude oil and the current remaining proved reserves stand at 1000 billion barrels. Significantly, a major portion of the reserves lies in logistically difficult, technologically challenging frontier areas. This has resulted in exploration targets gradually shifting to deeper formations, ultra deep waters and inhospitable and remote territories. Further, geological complexities of the exploration targets coupled with relatively inferior reservoir

quality, heavier oil etc. have a marked impact on the cost per barrel as well overall recovery.

Among the challenges facing the industry, diminishing sizes of new discoveries would perhaps top the list. With the big size reserves, by and large, already discovered, the current discoveries mostly lie in the small to medium size range. This leads to greater pressure on resources – financial, physical, manpower, services and increasing competition for them. Above all, there is a growing cry for “More Technology per barrel” to achieve success. On the production front, many of the major oilfields, discovered in the late eighties and nineties, have matured and, presently, are in the permanent decline phases. There is an urgent need to focus more on Enhanced Oil Recovery / Improved Oil Recovery initiatives. Statistically, barely one percent increase in global recovery efficiency can result in an additional recovery of around 80 billion barrels, almost three years’ global consumption at the current rate. Imperatives for this include additional investment and niche, fit-for-purpose cutting edge technology.

### **Technology - the Key to Success**

We have come a long way since the discovery of oil in the nineteenth century. Right from survey for identifying prospects for hydrocarbons to refining of oil for the ultimate users have seen many technological innovations. Gas, which was an unwanted product once, has become a very important part of our energy stream. In the wake of the demand for energy growing exponentially, geopolitical upheavals and market manipulations, many experts predicted crude oil prices would hit \$150 a barrel and beyond. Others claimed that world oil reserves would dry up within 50 years. As they saw it, petroleum couldn’t maintain its primacy as the world’s economic, plentiful fuel of choice. Well, they were wrong, and today:

- Oil and natural gas still provide 61% of the world’s energy.

- Oil is now selling for about \$120 a barrel, with indications to settle somewhere around \$100 or so in the medium term.
- With oil consumption at about 85 million barrels per day, the world still has about 45-50 years supply – and we continue to add to our reserve base.

How did that happen? The Petroleum industry – through better management, innovation and technology – made it happen. Technological innovation has a crucial role to play in ensuring security of energy supply. Such sea-change in our skill level has been possible only because of tremendous contribution made in the field of higher education in petroleum by universities around the world. From the drill pipe in our wells to the tail pipe of our vehicles, technology is transforming this business.

In our upstream business, we have made fantastic advances in determining where our best chances of success are before we drill. One of the key has been the development and application of technological advancements like three dimensional seismic imaging, 3D and 4D seismic coupled with sophisticated, computer-enhanced processing, drilling engineering, wireline imaging and advanced well testing etc. which have opened up new vistas for exploration and development.

The premise of synergy merits a moment's reflection. An ancient Indian folk tale narrates the story of a group of visually handicapped men encountering an elephant for the first time. Depending on whether each man touches an ear, the trunk, the elephant's stomach or tail, he proclaims the animal to be a leaf, snake, wall or rope. The animal is only identified when the men compare notes – integrating their observations. This analogy cannot simply be over-emphasized since we can ignore it only at our peril. Data, by themselves, can miss the essence of a problem. Progressively integrated through teamwork though, they gain in value, contribute to knowledge of the petroleum system, and finally allows decisions for optimal E&P operations.

## **Policy Initiatives**

As resource nationalism and India's dependence on imported crude oil increase, so does the Indian government's concern regarding energy security. The government is trying to mitigate supply-side risks by encouraging domestic exploration and production activities (through NELP Bidding Rounds, enhanced oil recoveries, exploration in marginal fields and frontier exploration), acquiring oil equities abroad and building strategic petroleum reserves. On the demand side, India is focusing on improving its energy efficiency, expanding its public-transport network and rationalizing fuel subsidies to optimize consumption of hydrocarbons. The development of alternative source of energy is equally critical.

The Indian upstream oil and gas sector currently faces several challenges, including depleting conventional oil reserves and maturing fields, restricted access to, and intense competition for, oil and gas resources abroad, rising costs of production and a looming human capital shortage. While these challenges have limited the growth options for players, they have also resulted in opportunities.

At times of global economic slowdown and the resultant softening in oil prices, oil and gas assets are expected to be available at low valuations abroad. At such times, it is an opportune moment for Indian upstream players to actively pursue the inorganic growth option, through innovative funding mechanisms. An attendant slowdown in global exploration and production activity is expected to relax the tight demand-supply situation prevailing in the oilfield services (OFS) space, which, in turn, should lower the finding and development (F&D) costs for companies.

The rising power of national oil companies (NOCs) has transformed the competitive landscape in the global upstream sector, and reduced the importance of international oil companies (IOCs). However, IOCs and Indian

players can tap considerable growth opportunities by forging win-win partnerships with the NOCs of resource-rich nations.

Participation of IOCs is vital to the development of the domestic upstream sector, as IOCs possess advanced technologies and project-management skills. Government policy support will go a long way in attracting IOCs to the country.

### **Hydrocarbon Exploration in India: Present & Future Scenario**

The total sedimentary basinal area in India is around 3.14 million sq km. The sedimentary area - both onland and offshore, down to the 200m isobath, has an area extent of 1.79 million sq km and covers 26 sedimentary basins. The sedimentary area covered under deep waters beyond the 200 m isobath is estimated as 1.35 million sq km. A large part of the vast sedimentary expanse still remains unexplored or poorly explored at best.

After formulation of New Exploration Licensing Policy (NELP), exploration for hydrocarbon in India got a momentum. The Directorate General of Hydrocarbons (DGH) has identified blocks for exploration in both onshore and offshore areas in India and offered them to E&P companies through competitive bidding in terms of data acquisition and exploratory drilling program. A total of nine rounds of NELP bidding had been completed till date.

There have been two significant discoveries during the post NELP era in India - discovery of gas in offshore KG basin by RIL where the estimated in place gas is around 7 TCF and discovery of oil by Cairn Energy in Rajasthan with an estimated reserve of around 1500 MMBOE. Data provided by DGH indicates that 137 new hydrocarbon discoveries have been made in recent years. The East Coast has emerged as one of the most prospective new areas for exploration, extending right from Cauvery Basin to the NE coast.



The future key focus area for hydrocarbon exploration and production enhancement in India may be the deep and ultradeep waters, onshore frontier areas and increasing recovery from old fields with new technology. The following provide critical challenges which call for huge investment in capital and technology:

- A) Exploration in Deepwater Sedimentary Basins;
- B) Exploration in Frontier areas viz., Himalayan Fold Belts, sub-basalt zones etc.
- C) New Technology in Old Fields, specially IOR / EOR

### **Unconventional Hydrocarbon Resources**

A major part of the world's hydrocarbon resources are entrapped in "unconventional reservoirs" which are difficult to develop economically but are extremely large in volume. Among these, maximum importance has been given to exploitation of "shale gas" reservoirs, as new technology and gas price has made the economics attractive.

In India, exploration for shale gas has already been started. ONGC has carried out studies on the sedimentary basins and prioritized Damodar Basin and Cambay Basin as the two prospective basins for shale gas exploration. In a well drilled in Damodar Basin by ONGC, presence of shale gas has been established. DGH is acquiring data from various basins to identify prospective areas for shale gas exploration. Oil India Limited has also initiated a study to evaluate shale gas prospect in Assam Arakan Basin and Rajasthan (Jaisalmer & Bikaner Nagaur Basin). Since about 60% of total sedimentary rock is made up of shale there is ample opportunity for exploration of shale gas in India.

Other proven source for unconventional hydrocarbon for the future are Coal Bed Methane (CBM), Gas hydrate, Tight Gas, Shale oil etc,

### **The Road Ahead**

Apart from looking aggressively to locate new oil and gas within the country, an important and well recognized policy initiative for country's energy security is to invest in energy assets abroad. India has ambitious plan for acquiring equity participation in producing properties and also investing in exploration projects.

The global credit crunch is expected to bring divestments from highly leveraged companies and distress sales from private equity firms and hedge funds on redemption calls, which will result in lower transaction values and multiples. The liquidity crises have decreased the valuation of oil and gas companies, and this will enable India's companies to buy global assets at a more reasonable price than before.

Depleting conventional oil reserves, higher crude oil prices and restricted access to resource-rich nations are driving exploration activities to harsher frontiers and increasing the development of unconventional and alternative sources of energy. These resources have long gestation periods, high exploration and development costs and are subject to stringent environmental norms. Consequently, hydrocarbon projects are becoming more complex and technically demanding. The application of new and efficient technologies on an unprecedented scale has become critical for upstream companies to sustain themselves in the upstream space.

The looming human capital deficit is a major challenge for the industry. In order to remain competitive, it is imperative that companies strengthen their scientific, engineering and project management skills by hiring and retaining skilled employees.

The enormous spread of challenges and opportunities in the upstream hydrocarbon space gives a clarion call to the industry specialists in geoscientific community, policy makers and the academia to join hands to add to hydrocarbon

resource base and exploit the same for sustainable development of mankind. The need of the hour is for creative collaboration amongst the key players

We then come to the really hard question: who is going to do all of this? Who amongst the geoscientific community will make this work? How will the bridges be built across the digital divide? How do the petroleum industry and academic institutes ultimately ensure better quality of life to our teeming millions? The answer, to my mind, lies in a story that I will like to narrate:

*It is the story of some mischievous young boys who set out to embarrass the village wiseman. They wanted to prove that the old man was just as foolish as all the others. They went to him with a small bird, held cupped in their hands, behind their backs. And they asked him if it was dead or alive. If he said it was dead, they would let the bird fly; if he said it was alive, they'd wring its neck and kill it. One way or the other, the old man had to lose.*

*"Old man", they said, "Is the bird dead or alive?"*

*The old man looked them in the eye and said with a smile. "The power is in your hands".*

Who will bring new strands of geoscientific knowledge and information technology to ignite economic development where we now have poverty? Who will ensure that the international community in general, and countries like ours in particular, will work hand in hand to achieve an equitable and economic energy supply to the world? The answer, to my mind, is the same as that given by the old man:

*Friends, that power is in our hands.*

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