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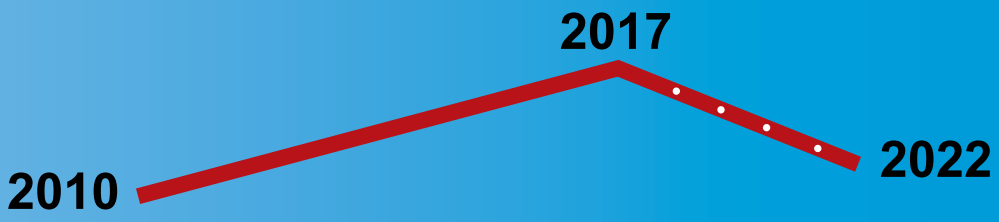

E&P Strategies to Cut Oil Import by 10% by 2022

August 12, 2017
Gulmohar Hall, India Habitat Centre, Lodhi Road, New Delhi

Supported by

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A Seminar Organized by

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Ex-ONGC Executives Welfare Association, New Delhi

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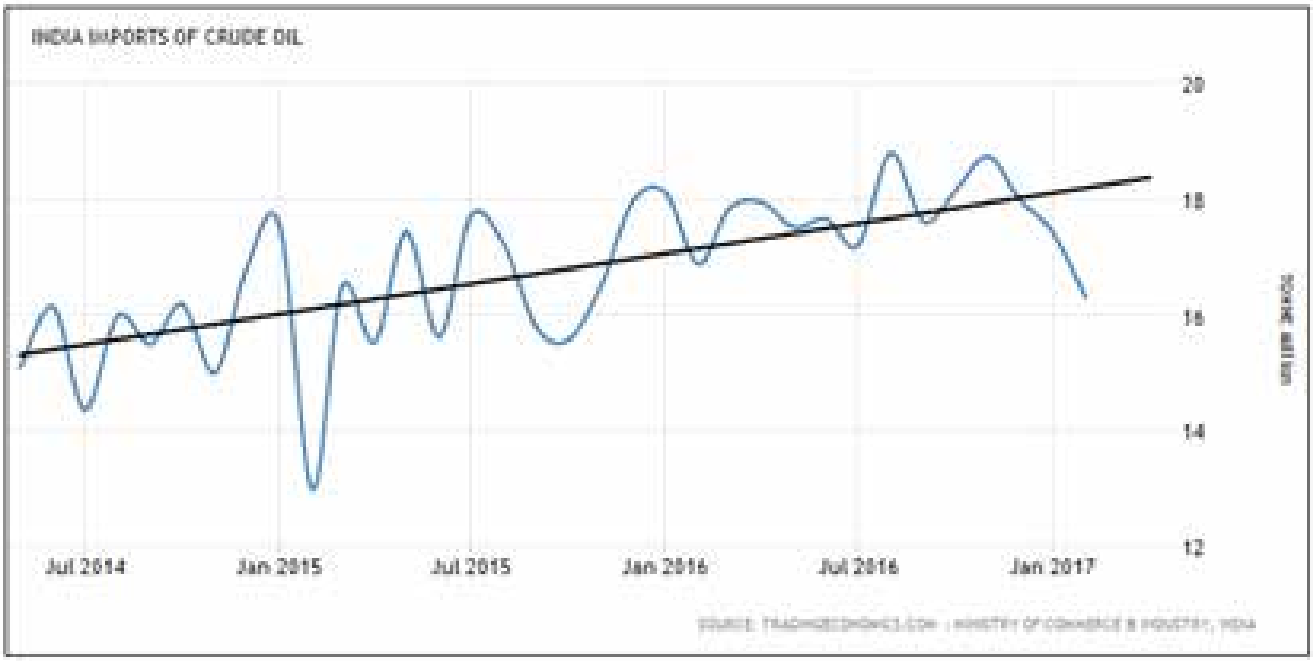
India crude oil production and India imports of crude oil



Foreword

Jauhari Lal
President
Ex-ONGC Executives Welfare Association

It gives me great pleasure in greeting all the delegates, invited guests, chairpersons and Speakers of this Seminar on E&P Strategies to cut oil import by 10% by 2022 on 12th August, 2017. It is for the 1st time that Ex-ONGC Executives Welfare Association has organized such a program on this critical issue. It is said that "Once ONGCian will always remain ONGCian" i.e. even after retirement from the service, they do not lose touch from Oil industry but watch very closely the development taking place in the Industry.

Call given by the Honorable Prime Minister Shri. Narendra Modi ji at Urja Sangam at Vigyan Bhawan on 27th march, 2015 to cut Oil import by 10% by 2022 has become a sacred goal to achieve by all concerned. In order to achieve this target, apart from Oil Industry other agencies engaged in service sector and non conventional energy sector have also geared up.

India is importing about 80% of Oil to meet its domestic requirements and its financial implications had been the focus of Government many times in formulations of its Annual Budget. Government had not left to the Oil companies and others to achieve this goal but they have also prepared strategies as to how to facilitate to achieve this by way of formulating new policies and other initiatives.

Minister of state, in charge of Petroleum and Natural Gas Shri. Dharmendra Pradhan while chairing a ministerial session on current economic strategies in Indian oil and Gas sector at the 22nd World Petroleum Congress at Istanbul, Turkey pointed out that the energy consumption is expected to grow to almost double by 2035 and India is the only country where the demand continuously rises for more than a decade. He further mentioned the resolve of Prime Minister to cut oil import dependence by 10% by 2022. India is the 3rd largest consumer of Oil and Petroleum products.

I am confident that Articles contained in the Souvenir will be quiet informative, educative and interesting. I would like to convey my thanks on behalf of Association to ONGC, OIL, OVL and other companies who have supported this Seminar and publication of this Souvenir. Though all the members of our Executive committee had played their part for the success of the Seminar, I am personally thankful to Mr. Ashok Varma, Vice President of the Association and Convener of this Seminar for involving himself from beginning to end to ensure that each and every aspect is taken care properly for success of Seminar and also publications.

Jauhari Lal

Contents

Participating Companies

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ऑयल इंडिया लिमिटेड
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Message

Dinesh K Sarraf
CMD, ONGC

At the very outset, I must congratulate the Ex-ONGC Executives' Welfare Association for bringing out a timely publication focused on the one of the most relevant topic in the domestic hydrocarbon sector in recent times - that of import reduction. It is further encouraging to know that seminar dedicated to the same issue is also being organized for the larger benefit of the energy industry professionals.

Our country today is positioned at a crucial juncture as what we decide today and how we act subsequently on those decisions will have a lasting impact on the growth that the country will witness in the years to come. The political for growth that the country possesses is enormous and, arguably, next to none in the global arena in terms of human resources pool, talent and resourcefulness.

In this context, the country's high degree of import dependence, particularly in respect of crude oil, becomes a matter of serious concern as it has the potential to constrain our development efforts. Forex outgo on crude oil over the last 10 years cumulatively stands at close a trillion dollars. Imports of natural gas is also on the rise. Even accounting for the steady growth of renewables and improvement in fuel or energy efficiency, demand for both oil and gas will register strong gains year on year, at least in the medium term.

The Hon'ble Prime Minister's call to achieve a 10% reduction in hydrocarbon imports by 2022 is a landmark announcement and depicts a proactive and direct approach to addressing a longstanding problem. ONGC is congnizant of its responsibility in this mission and, toward that end, has devised a roadmap to align its short, medium and long term production strategies with the 10% import reduction initiative of the Government.

I think the next few years in the domestic oil and gas sector are going to be quite exciting and full of possibilities. Even with the persistence of low oil and gas prices the sector remains buoyant and, unlike globally, investment has not slowed down. The Hon'ble PM's vision of 10 percent import reduction provides a further shot of motivation and drive to the industry as a whole.

I am certain the Seminar will be well attended and prove to be immensely useful to all the participants. I wish it will all the very best.

Dinesh K Sarraf

Message

Utpal Bora
CMD, Oil India Ltd.

It gives me immense pleasure to learn that the Ex ONGC Executive Welfare Association (EOEWA), Delhi is holding a seminar with the theme 'E&P Strategies to cut down Oil import by 10% by 2022 at New Delhi on 12th August 2017.

The Seminar will address an extremely relevant topic of national priority and will involve interaction and sharing of views of oil and gas sector professionals, past and present. The experience and expertise of members of EOEWA who, over the years, have contributed significantly to the growth of ONGC as well as the country's oil industry, will be one of the key feature in the deliberations.

It is also hertwarming to know that EOEWA would be commenmorating the occassion with the publication of a souvenir.

My compliments to EOEWA Delhi in their endeavor and an confident that the event will witness very productive interaction and exchange of ideas.

I wish the seminar all the success.

Utpal Bora

Message

S K Manglik
Former CMD, ONGC

I am glad to know that Ex-ONGC Executives Welfare Association is organising a seminar on E&P Strategies to cut oil import by 10% by 2022.

E&P companies in India are striving hard to increase production of oil and gas. Improving recovery factors is an area of focus. Technological improvements in drilling and subsurface technology have enabled E&P industries to locate and produce bypassed oil .

It is now time for India to focus on oil production from non-conventional resources . In addition, there is need for E&P companies to also focus on energy resources other than above.

Some of these would possibly be discussed during the seminar.

My good wishes to the organisers and participants.

S K Manglik

Message

B C Bora
Former CMD, ONGC

I compliment EOEWA for organizing an one day workshop on 12th August 2017 on the theme, "E&P Strategy to cut down oil imports by 10 percent by 2022", and for bringing out a Souvenir on the same theme for the Annual Day function of the Association scheduled for 19th August 2017.

With the 5 to 6 percent projected future annual growth in demand for oil in the business as usual scenario, achievement of this ambitious target will necessarily require a multi dimensional strategy with strict, well defined and measurable mile stones extending to all the components, such as conservation, efficiency improvements, conversions, renewable energy enhancement and increased domestic production of oil and gas, amongst others. These efforts, which obviously have to be fine tuned from time to time as we go along, have very high significance, as very appropriately indicated by prime ministerModiji, in defining the possible road map to achieve 50 percent reduction in imports by 2030.

I am more than sure that the workshop and the publications in the souvenir will help to provide useful inputs to the government to have a re-look at the strategy to plug the loop holes, if any.

I convey my best wishes to the organizers.

B C Bora

Message

R S Sharma
Former CMD, ONGC

I am glad to learn that Ex-ONGC Executives' Welfare Association is bringing out a special issue of its Souvenir on the occasion of 61st ONGC Day.

I am further delighted that taking a national call for reducing import dependency for Oil & Gas, they are also organizing a one day seminar on the subject on 12 Aug-17. I am sure this forum will generate thought provoking deliberations and get views of eminent industry officials and experts to find optimal solutions to enable the national economy to meet its energy needs and grow constantly at the intended GDP growth rate in two digits.

I am pleased to convey my greetings and best wishes to the Association for all these laudable endeavors.

R S Sharma

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E&P strategies to cut oil import by 10% by 2022
Seminar by Ex-ONGC Executives Welfare Association
India Habitat Centre, Lodhi Road, New Delhi
Saturday, August 12, 2017

PROGRAM

0900 - 0930	**Registration & Tea**
0930– 1100	**Inaugural session**
0930– 0935	Welcome Address - Dr. Jauhari Lal, President of Association
0935– 0950	Presentation on the theme–Shri R K Sinha, Chief Executive and Technical Officer to DGH
0950– 1010	Plans and Strategy of OVL Address –Shri N K Verma, MD OVL
1010– 1030	Plans and Strategy of OIL Address –Shri Utpal Bora, CMD-OIL
1030– 1050	Inaugural Address –Shri D K Sarraf, CMD-ONGC, Chief Guest
1050– 1100	Vote of Thanks –Shri A K Hazarika, Vice President of Association.
1100– 1130	**Tea**
1130 – 1300	**1st Technical Session - Chair Person: Shri V P Mahawar, Director (Onshore) ONGC Ltd.**
1130– 1150	Strategies and new technologies adopted –Shri Sudhir Mathur, CEO Cairn India
1150– 1210	Plans and Prospects of HOEC–Shri P. Elango MD, HOEC
1210– 1230	Enhanced Oil Recovery–Shri Garud Sridhar, Schlumberger
1230– 1240	Questions and Answers
1240– 1300	Chair person's observations and remarks
1300 – 1400	**Lunch**
1400 – 1530	**2nd Technical Session – Chair Person : Shri T K Sengupta, Director (Offshore) ONGC Ltd.**
1400 – 1420	Experience and future plans for 98/2– Shri Alok Nandan Executive Director, ONGC
1420 – 1440	Deep water technologies and strategies –Shri Ravi Addala, Baker Hughes - GE
1440 – 1500	Why India would not regret oil import in the long run–Shri Deepak Mahurkar, PWC
1500 – 1510	Questions and Answers
1510 – 1525	Chair Person's observations and remarks
1525-1550	**Tea**
1550 – 1700	**3rd Technical Session: Chair Person : Shri Shashi Shankar, Director (T&FS) ONGC Ltd.**
1550 – 1605	Shri Ajay Kumar, MD BPRL
1605 – 1620	Shri Chandra Shekhar, Director OIL
1620 – 1635	Shri Amit Khera, Partner, Mckinsey & Co.
1635 – 1645	Questions and Answers
1645 – 1700	Chair Person's observations and remarks
1700 – 1800	**Panel Discussion - Chair Person Shri S K Manglik,Former CMD, ONGC**
1700 – 1710	Shri B C Bora, Former CMD, ONGC & OIL
1710 – 1720	Shri C R Prasad, Former CMD, GAIL
1720 – 1730	Shri R S Sharma, Former CMD, ONGC
1730 – 1740	Shri Atul Chandra, Former MD, OVL
1740 – 1750	Shri R S Butola, Former CMD, IOC.
1750 – 1800	Chair Person's observations and remarks
1800	**Vote of Thanks Ashok Varma Vice-President of Association**

Strategies of ONGC to cut import by 10% - Roadmap for future

By Dinesh K Sarraf

Dinesh K Sarraf
CMD, ONGC

Dinesh K Sarraf, 59, is the Chairman & Managing Director of Oil and Natural Gas Corporation Ltd (ONGC), India's most valuable Maharatna public sector enterprise and one of the most premier E&P companies in the world. ONGC is one of the most valuable companies of India andone of the Fortune's Most Admired companies in the world.

Mr. Sarraf is also the Chairman of ONGC Videsh Ltd, operating across 17 countries, Chairman of Mangalore Refinery & Petrochemicals Ltd (MRPL) and four other ONGC Group companies (OPaL- ONGC Petro-additions Ltd, OMPL – ONGC Mangalore Petrochemicals Ltd, MSEZ- Mangalore SEZ Ltd, and OTPC- ONGC Tripura Power Company Ltd).

Mr. Sarraf graduated in Commerce from Shri Ram College of Commerce of Delhi University and did his post-graduation from the same University. He is an associate member of the Institute of Cost and Works Accountants of India and the Institute of Company Secretaries of India.

He has experience of over three and half decades in the oil and gas industry, having started his oil and gas career in Oil India Ltd. He joined ONGC in 1991 and handled various key assignments at corporate offices. He was elevated to the post of Director (Finance) in ONGC Videsh in 2005 where he served till 2007. During this period, ONGC Videsh made significant acquisitions in Syria, Brazil, Colombia, Venezuela, Cuba, Egypt and Myanmar. In December 2007, he joined back ONGC as Director (Finance).

In 2011, Mr. Sarraf went back to ONGC Videsh assuming the charge of Managing Director. As MD he transformed ONGC Videsh into an aggressive growth engine for ONGC Group by clinching many high value deals within a short span of time. He was instrumental in several oil and gas acquisitions in Mozambique, Brazil and Azerbaijan by ONGC Videsh to ensure energy security for the country. In March, 2014, he joined back ONGC as its Chairman & Managing Director. As CMD, ONGC he has been focussing primarily on augmentation of Oil and Gas production from domestic assets.
Mr. D K Sarraf, is the driving force of extra ordinary growth of company and strategic approach to oil and gas exploration and production. In the present environment when global oil and gas prices have plummeted, ONGC under his leadership is strongly emphasising on adoption of the best operational & cost practices and appropriate oil and gas technologies, for realisation of greater operational efficiencies. As Chairman, ONGC Group of Companies, he primarily focused on building a diversified group portfolio of Oil and Gas Exploration, Production, Refining, Pipelines, Petrochemicals, Power, Renewables and Infrastructure development. With a focussed approach, ONGC's all first integration projects have been commissioned and are performing remarkably well.

Under his leadership, ONGC has committed itself to the development of the country's deepwater oil and gas resources with an investment of over $5 billion, a testament to his strategic decision-making in pursuit of domestic energy security. ONGC's foray into the deepwaters is all set to considerably reduce hydrocarbon import dependence and help the nation move closer to being a gas based economy.

1. Energy Demand - India

Energy is a vital input to any country's developmental goals and economic aspirations. Indian economy has grown faster than any other big economy of the world during last few years. Its rate of growth has been 7% average during last 10 years. Energy being the basic prime mover of growth, the country's energy demand has also registered an annual increase of 5.9 percent during last 10 years.

In terms of oil requirements, consumption of petroleum products has recorded an annualised 5 percent demand growth. However, on account of limited availability of domestically produced crude oil, our imports have risen, and at a greater pace (CAGR 7.4 percent), in the same time-period. As a result, our import dependency for petroleum has been increasing with the rate of growth of the economy we are aspiring, Make-in-India initiative of the Hon'ble Prime Minister of India and our country's per-capita energy

consumption being less than one-third of the global average, India's hydrocarbon demand in the decades to come is slated to increase even at a faster pace.

2. Call for 10% import reduction

The growing concern around this increasing dependence on energy imports found articulation during the Urja Sangam held on 27th March, 2015 at New Delhi, when the Hon'ble Prime Minister of our country set a target of 10 percent reduction in our hydrocarbon imports dependence by 2022. It marks a remarkable shift in attitude towards a longstanding problem of the domestic energy landscape – from reactive to proactive. It was important that higher reliance on external energy sources seriously imperils the country's energy security which consequently constrains and affects our growth outlook as well.

In order to take this vision forward, Hon'ble Minister of Petroleum & Natural Gas constituted a committee under the Chairmanship of Additional Secretary, MoPNG on "Preparing a roadmap to reduce import dependency in energy by 10% by 2021-22".Subsequently, Report of the Committee on Roadmap to reduce import dependency in Energy by 10% by 2021-22 was prepared in consultation with various stakeholders and circulated in end – 2016.The committee estimated that India's import dependency on oil and gas can be reduced by 10% by 2021-22 as compared to the business-as-usual scenario by following a five-pronged strategy on reduction of imports if the associated initiatives required to be taken are implemented timely and required inter-ministerial synergy is accomplished effectively. The five-pronged strategy encapsulates,

1. Increasing production of domestic crude oil and natural gas
2. Enhancing energy efficiency and conservation
3. Demand substitution
4. Promoting alternate fuels/ renewables
5. Improvement in Refinery processes

But the development of this unique chapter in our domestic oil and gas landscape has taken place even as the oil and gas markets are reeling from a persistent period of low oil prices. Global oil and gas companies have responded to this sustained bear market through deep capex cuts, aggressive layoffs and portfolio optimization through divestment of non- core assets. As per certain estimates, total capex cuts on account of this depressed market is to the tune of a trillion dollars over a period of 5 years. A period of low oil prices bodes well for an import-dependent country like ours: forex outgo on account of crude imports dropped by over 50% from around $143 bn in FY'2013-14 to under $70 bn in FY'2016-17. However, when it comes to bolstering energy security there is no replacement for higher indigenous supplies as it mitigates to a great extent the vulnerabilities that arise out of the country's exposure to volatility in the external or international markets. This makes the Hon'ble PM's vision statement of import reduction, or greater self-sufficiency in hydrocarbon, a remarkably foresighted one – one that looks factors in the larger picture even as market conditions did not necessarily warrant such a mission.

3. Roadmap of ONGC – Augmentation of Oil and Gas production

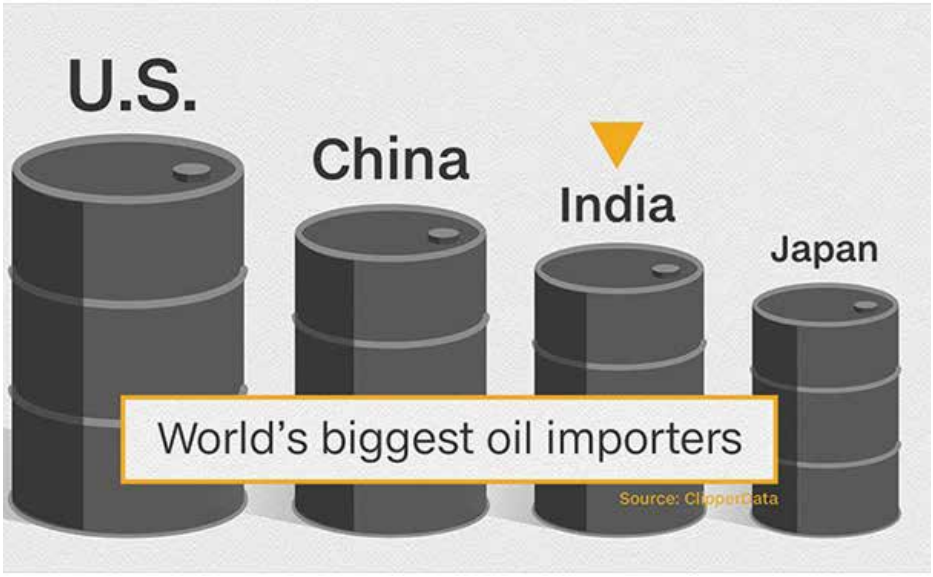
As the country's premier Oil and Gas Company and a Maharatna PSU, ONGC is well seized of the priorities of the domestic energy scenario and the urgency required to address the issue of stagnating domestic output, grossly insufficient in the face of our rapid energy demand growth. IEA projects more than doubling of the country oil requirements and more than tripling of its gas needs by the year 2040.
Despite the crash in oil prices in mid-2014 and the emergence of a consensus of a 'lower for longer' outlook on oil prices at least in the medium term, ONGC has adopted a counter-cyclical approach to projects and investment plans. Not only has it sustained its capex levels at around the same levels (Rs 28k-30k Cr) for the last three years, it has also embarked upon, arguably, one of its most aggressive and focused period of portfolio consolidation through significant project decisions.

It must be noted that most of ONGC's domestic production comes from a mature portfolio of fields that are of at least 30 years vintage. These fields have crossed their plateau and entered the natural decline phase since past several years which is a natural phenomenon in the producing life of oil & gas fields. A proactive approach to targeting production enhancement was the need of the hour – one that not only ensures the relevance and preeminent stature of ONGC is maintained in the future energy landscape of the country but also caters to the larger goal of delivering on the OM's goal of 10 percent import reduction.

Hence, a two pronged strategy has been chalked out by ONGC management not only to sustain but also increase production of crude oil and natural gas i.e through redevelopment of existing brown fields and monetisation of new reserves through development of new fields.

4. Projects for monetisation of reserves – a snapshot

4.1 During last three financial years (FY'15 to FY'17), a total of 15 mega development projects (including 8 brownfield re-development projects and 7 greenfield development projects), were completed with a total investment of Rs. 54,373 Crore. The envisaged production from these projects is expected to be around



87 MMT of oil and 56 BCM of gas.

These projects contributed about 22% to ONGC's oil and 16% to ONGC gas production from nominated blocks during FY'17(Oil 4.985 MMT, Gas 3.537 BCM).

4.2 Besides above, 17 more development projects with a capital investment of over Rs. 76,000 Crore were approved during last three years which are under various stages of execution.These projects would enable monetisation of about 69.24 million tonnes of crude oil and 118.44 BCM of natural gas. The collective production from these projects is expected to be 22.24 MMT of O+OEG during the financial year 2020-21.This amounts to 50% of crude oil and natural gas production of ONGC from its nomination blocks during FY'17.

4.3 Most significant among these projects is the development of fields under Cluster 2 of our deepwater block in eastern offshore – KG-DWN 98/2 – which was approved by the Board with a budget of over 34,000 Crore. This is the highest-ever investment in a single project in the history of ONGC. This decision was taken at a time when most of the global major E&P companies were cutting Capex on new projects due to subdued oil and gas prices. Once operational, this project will not only significantly bolster the country's energy security but would also have a compounding effect in terms of contribution to Indian exchequer, employment generation, technological breakthrough and opening a new avenue to Deep water production in Indian waters.

This project would monetise 45.49 MMT of crude oil and 25.87 BCM of natural gas with annual peak production of 15.57 million cubic meter of gas per day (MMSCMD) and 78,000 barrels of crude oil per day, which is about 24% and 17% of ONGC's current (FY'17) gas and crude production respectively from the nominated blocks. Production from the project is expected to commence from March 2020 (gas), while first oil is projected to realize in mid-2020.

4.4 Although approving all these projects at a time when the oil and gas prices are so low was quite challenging but it was possible with the support of all the stakeholders. ONGC is of the view that this is the best time for developing oil and gas projects for long term sustainability. The price of oil field services, equipment, LSTK costs are low due to lower development activities globally in E&P. At the same time, more reliable vendors are now willing to implement ONGC's major offshore projects ensuring faster project implementation with lower risk of time over-runs. It is also expected that that Government would review gas prices and would eventually deregulate gas pricing and marketing. Government now fully understands that the current gas prices are not viable and ONGC incurs significant under-recoveries in its gas business.

4.5 Some of the projects have already started giving production, increasing our gas production by about 5% in 2016-17 over the past year and gas production is expected to go up by another 10% during 2017-18. As a result of progressive completion of various projects, significant jump of 11% in Gas production has already been seen during Q1 of FY'18 vis-à-vis Q1 of FY'17 .

4.6 The company is also now actively working on monetising the Kutch-Saurashtra discoveries where we have made significant progress in terms of accumulating several discoveries to gather confidence that these can be monetised in a clustered approach. We

expect this to initiate production in next 3 years. This would be the eighth basin of India to start production. Cauvery basin was the seventh (last) to start production, more than 30 years back.

5. Project strategy aimed towards 10% import reduction

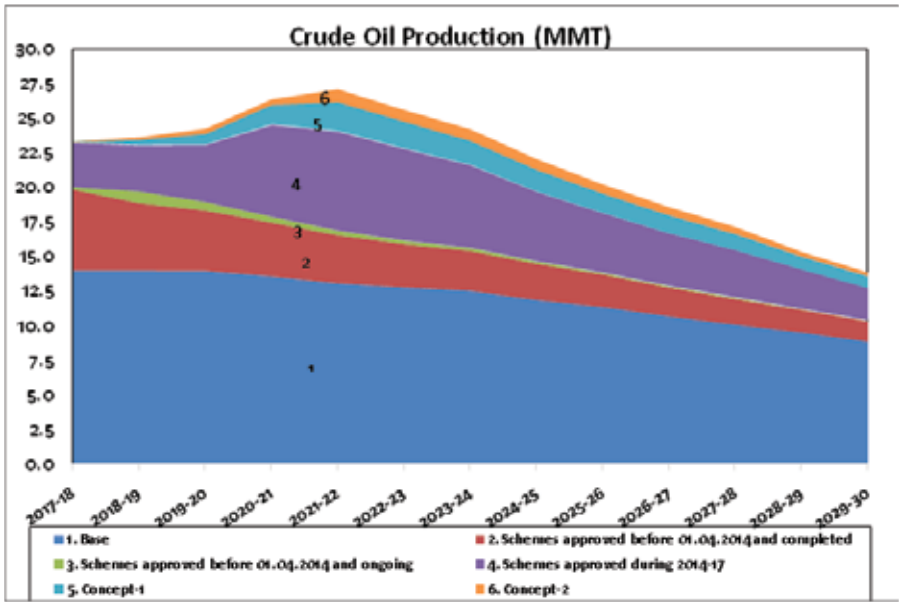
To achieve the goal of 10 percent import reduction, ONGC, on its part, has devised a roadmap to align its short, medium and long term production strategies with the 10% import reduction initiative of the Government. Adopting a more proactive approach, the Long Term Oil and Gas Profile (LTOGP) of the company has been revisedto align with the primary target of reducing the country's import dependence. "Long-Term Oil and Gas Profiles – 2017 (LTOGP-2017)", have been derived out of an exhaustive review of all current operations and future plans for ONGC owned and operated fields in keeping with the present production scenario and as per the predicted/ envisaged profile.

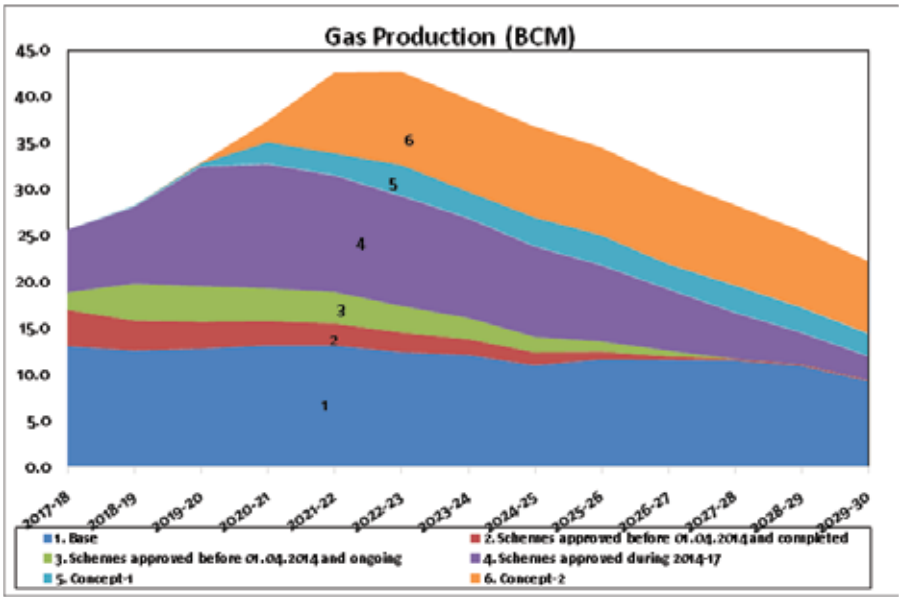
Strong focus is now accorded to all past un-monetized discoveries, current exploration successes, ongoing projects and upcoming plans of development in terms of their contribution to meeting the target of import reduction.

ONGC has 577 hydrocarbon discoveries as on 1st October, 2016. Most of these are already in production and action to monetize the remaining discoveries are at different stages of implementation depending on the nature of discovery.
These discoveries have now been classified into various categories, as stated below,

a. Base profile: Already monetised and in production discoveries and production profile is generated on existing hydrocarbon wells inventory, as on 01.04.2016.
b. Firm Activity: Investment approval on these hydrocarbon discoveries is already taken and Oil & Gas profile in this category is generated based on ongoing/ approved schemes and released locations.
c. Concept-1: Discoveries where scheme/ investment is under approval and it is expected that investment approval in respect of these schemes would be obtained within calendar year 2017.
d. Concept-2: Discoveries where scheme/ investment is under conceptualization and it is expected that investment approval in respect of these schemes would be obtained by 2018.
e. Concept-3: Discoveries for which production potential is being estimated along with formulation of the conceptual development plan/ feasibility. It is expected that investment approvals would be obtained in respect of these discoveries generally by 2019.

A time frame has been fixed for approval of development plan for each un-monetized discovery. The exercise has addressed monetization plan of all the discoveries of ONGC, barring about 42 discoveries which are isolated/far from existing infrastructure, or have very low volumes or are located in difficult areas. These are categorized under Concept-3. Further, efforts are underway to explore the possibility of





moving Concept-3 fields into higher categories.

Once on stream, projects under Concept 1, 2 & 3 would produce oil and gas with peak oil of 6.5 MMT during 2023-24 and 18.3 BCM gas during 2025-26.

As per the envisaged plan of project advancement through the five year period of 2017-22 targeting the overarching goal of minimizing the country's import dependence, ONGC's oil and gas production in the terminal year 2021-22 stands at 27.12 MMT and 42.71 BCM respectively, of which contribution from new oil and gas accruing from ongoing development schemes and planned/proposed projects contribute 52% and 69% respectively. Projected production of our future domestic oil and gas portfolio is also represented for reference (sea-blue represents production from our legacy and existing streams – base – with the rest depicting new oil and gas additions).

It is pertinent to mention here that work along these formulated pathways must also move expeditiously in order to capitalize on the reduction in the service and operating costs prevailing as a result of the cost deflation in the oilfield services in the downturn. The window to do the same is brief. Eventually, once accomplished, these projects will testify what we have always championed – that the long-term gains from a promising oil projects will finally always outweigh the short-term pains of a downcycle.

As activity ramps up and more oil and gas production moves to frontier and unconventional resource areas, projects are becoming larger and more complex. ONGC like other global majors is managing several projects at a time which need to be prioritised not only on financial goals and risks but also increasingly based on the availability of scarce resources like engineering talent. To overcome this, ONGC has set up a dedicated Project Monitoring Office (PMO) with modern tools and hardware to monitor projects across organisation based on Stage Gate concept. Decision checkpoints, or stage gates, mark the end of formal project phases and to move from one stage to the next.

Diversified portfolio of oil and gas projects coupled with value addition projects with a focus on mission of "Make-in-India" would not only bring constant revenue streams to the balance sheet of the company but would also position ONGC as a Major Integrated Energy company in near future.

Make in India - Oil and Gas Sector

Towards reduction of import dependency of Oil and Gas by the year 2022: OIL's roadmap

By Utpal Bora

The nation has been relentlessly pursuing E&P efforts towards finding and developing hydrocarbon within the country for reducing its dependency on imported oil and gas. Further impetus to these efforts was received when, during the inauguration of 'Urja Sangam 2015', Hon'ble Prime Minister highlighted the current import dependency of the nation and emphasized on working together to achieve energy security of the country. All stakeholders were urged to increase the domestic production of oil and gas to reduce import dependence by 10% by the year 2022, when India celebrates its 75 years of independence. By achieving the target, the citizens would pay a true homage to the freedom fighters who sacrificed their lives for the sake of the country.

For taking this vision forward in a highly focussed way, a committee on "Preparing a roadmap to reduce the dependency on import in energy by 10% by 2021-22" was constituted by Hon'ble Minister of State (I/C), P&NG.The committee has alreadychalked out a five-pronged strategyto achieve this goal whichbroadly comprises of increasing domestic production of oil and gas, promoting energy efficiency and conservation measures, giving thrust on demand substitution, capitalizing untapped potential in biofuels and other alternate fuels/ renewables and implementing measures for refinery process improvements.

Being a major E&P player in the India's upstream sector, Oil India Limited(OIL) is mandated to play a pivotal role in achieving this target by the strategy of increasing domestic oil &gas production.As part of the strategy OIL has prepared a road map with its present portfolio of existing domestic fields/assets by adopting a number of key initiatives for achieving the goal of reducing the dependency on import in energy by 10% by 2021-22.

History of Oil India Limited

OIL's legacy is deeply rooted to the pioneering efforts of oil exploration in India- dating back to the 19th century - in the dense jungles of Upper Assam in the extremenorth-eastern cornerof our country. The first commercial discovery of crude oil in the country was made in 1889 at Digboi, by the Assam Railway and Trading Co. Ltd. Albeit with a very low production, Digboi still retains the distinction of being the world's oldest continuously producing oilfield. Subsequently the AOC (Assam Oil Company) was formed in 1899 to look after the running of the oil business in this area. In 1953, the first oil discovery of independent India was made at Nahorkatiya in the state of Assam,very near to Digboi,which was followed bydiscovery of oil at Moran in1956. In order to ensure systematic development and production of the discovered prospects of Nahorkatiya and Moran and to increase the pace of exploration in northeastern India, Oil India Private Ltd. was incorporated in 1959. It was registered as a Rupee Company with two-third shares owned by Assam

Utpal Bora
CMD, (OIL)

Sri Utpal Borais the Chairman and Managing Director of Oil India Limited (OIL), India's second largest National E&P Company.

Prior to taking up leadership of OIL, Sri Bora has had a rich and varied experience of over 33 years in the E&P Sector. Sri Bora has served in various capacities at ONGC Ltd. including OVL,the international branch of ONGC. He had been Executive Director- Asset Manager of ONGC's Mehsana Asset and is credited with turning around ONGC's highest producing onshore Asset and steering it towards newer heights. Under his leadership the Asset received the Best Onshore Award of ONGC in 2015. At OVL he was specifically engaged in framing of policy directives and its implementation, co-ordination with the NOC of Venezuela, PDVSA, under projects like PetroCarabobo and San Cristobal.

Sri Bora holds a degree of Bachelor of Technology in Petroleum Engineering from the prestigious ISM, Dhanbad, an Advanced Management Certificate from IIM, Lucknow and has completed a Leadership Development Programme from ISB, Hyderabad. Besides being an avid reader, Sri Bora enjoys cricket and movies.

Oil Company (AOC) / Burmah Oil Company (BOC) and one-third by the Government of India (GOI). By a subsequent agreement in 1961, GOI and BOC transformed OIL to a Joint Venture Company (JVC) with equal partnership.In 1981, OIL became a wholly owned Government of India enterprise and the management of Digboi oilfields changed hands from the erstwhile AOC to OIL. Although initially confined to the north-eastern region of the country, the Company grew into a strong fully integrated E&P Company and spread its activities to different Basins of India and abroad.

OIL was granted Miniratna status in October, 1997 and subsequently became a schedule "A" Company in July, 2004. OIL joined the elite Navratna club in April 2010, thereby gaining greater functional autonomy. Today OIL's core competencies are in the upstream and midstream petroleum business, especially in E&P and pipeline technology.The Company owns and operates a trunk crude oil pipeline in the Northeast for transportation of crude oil produced by OIL and ONGC in the region to feed three refineries. The Company continues reverse pumping of imported crude for IOCL to Bongaigaon refinery since 2003 through its existing Barauni-Bongaigaon Trunk pipeline section.OIL also holds business stakes in the hydrocarbon sector viz., Numaligarh Refinery Limited, Brahmaputra Cracker and Polymer limited and Duliajan – Numaligarh Pipeline Limited.

With its operational headquarters in Duliajan, Assam,the main operating and producing areas of the company, at present, are in Assam and Arunachal Pradesh. Today apart from its presence in the Northeast, Rajasthan, KG Basin and participation in a number of NELP blocks in Rest of India, OILhas anexpanding global portfolio with presence in Russia, USA, Venezuela, Gabon, Libya, Mozambique, Nigeria, Myanmar and Bangladesh.

OIL's Presence in the DomesticUpstream Sector

OIL acreage in the Northeast comprises of twenty nominated PMLs and threenominated PELs.Though OIL is operator in most of the areas, a small oil and gas field in Arunachal Pradesh is being operated by a Joint Venture in which OIL has participating interest. Apart from the Northeast, OIL has two nominated PMLs in Rajasthan from where it is currently producing heavy oil andalso producing gas since 1996. In addition to its producing assets, the exploration acreages of OIL include nine active NELP blocks spread over India, including a Block each in KG Basin and Mizoram and;a Pre NELP JV (Dirok). During 2016-17, OIL has produced 3.277 MMT oil and 2.936 BCM gas.

Key initiatives & road map to achieve target oil and gas production

As per the projected oil & gas production profile, OIL will be required to achieve 7.25 per cent increase in oil production and 30.4 per cent increase in gas production by the end of 2021-22 from its 2014-15 level of production (overall ~18.1% increase in O+OEG). In order to achieve the targeted levels OIL has prepared a road map with the present portfolio of existing domestic fields/assets by adopting a number of key initiatives for achieving the goal of reducing the dependency on import in energy by 10% by 2021-22. The thrust of these initiatives are in the Company's domestic oil and gas producing hubs in the Northeast and Rajasthan.

Development drilling Campaign

Enhancement of oil and gas production is expected from the Company's portfolio of existing reservoirs. OIL has plans to undertake a massive development drilling campaign in newly discovered prospectsand infill drilling under its plans for systematicredevelopment of its mature fields. Additionally, OIL has been steadily making new discoveries in its operational area. During the period 2009-10 to 2015-16 there have been 37 discoveries by OIL in the Northeast out of which 40% have been in the prolific Eocene Formation. Additional development locations are expected to be drilled till FY'22 in newly discovered areas.

Exploratory drilling of New Prospects

Exploration activities constitute identification of new prospects in new area and identification of new prospects in existing areas. In north-eastern India, a substantial inventory of exploratory locations currently stand released for drilling. On-goinggeo-scientific studies are expected to identify additional prospects to be probed by exploratory drilling.

However, a substantial part of the Northeast is covered by forests and national parks/ sanctuaries. Forest De-reservation approvals and Wild Life Clearancesarebeing pursued to obtain environmental clearances to drill these locations.Additionally, approval of grant of leases from Government authorities is being followed up in an expeditious manner so that planned operations can be carried out.

Certain areas within OIL's operational area are poorly covered by seismic data due to surface logistics constraints. Some areas lie close to discovered oil and gas fields and in the vicinity of the frontal Naga Thrust. These areas are envisaged to have high potential for the presence of hydrocarbon prospects and exploration success of these locations is expected to add to the oil and gas production potential in the Northeast. By systematic planning and deployment of optimal resourc-

es these areas are planned to be covered by 2D seismic in order to optimise drilling campaigns.

Redevelopment of Mature fields

Some major oilfields located in the Northeast in OIL's portfolio were discovered way back in 1950s and 1960s. Makum-NorthHapjanis an oilfield presently contributing substantially to the Company's production and had been discovered in 1995. Apart from in-house studies, to prolong plateau production and to increase the recovery factor, the field is being studied under a collaborative effort of OIL and University of Houston, USA.Implementation of recommendations from the study is expected to enhance production, identify and provide tangible improvementto existing set-up of surface facilities to removebottlenecks in order to improve performance and arrest the decline.Geo-cellular and dynamic model of the reservoirsare also being revisited for optimizing field development.

The over hundred year old Digboi field, is also being studied in technical collaboration with M/s Belorusneft, Republic of Belarus, in order to redevelop the field and enhance production/ recovery.

Arresting decline in existing fields with IOR-EOR activities & well interventions

Production enhancement measures are being implemented in the reservoirs of our mature fields and include,

- Increasing rig resources to carryout workover/well interventions in a larger number of non-flowing wells.
- Enhancing water injectionby adding additional reservoirs to the existing ones.
- Carrying out of chemical water shut off jobs.
- Implementing radial drilling techniques.
- Hydraulic fracturing in tight / low permeable sands and matrix acidization for removal of near wellbore damage.
- Gravel pack campaign to counter sand ingression.
- Installation of ESPs and gas lifts are being carried out on a regular basis.
- On-going studies for Chemical EOR and Carbonated Water Injection.
- Plans for full field scale heavy oil development in Rajasthan.

New Surface Production facilities / debottlenecking of existing facilities

- OIL has initiated a number of projects for creating surface infrastructures for production and transportation of oil which includes construction of Group Gathering Stations (GGS), construction of a number of oil and gas pipelines to connect the far flung installations; construction of Secondary Tank Farm (STF) and capacity augmentation of an existing tank farm.
- An initiative to carry out Produced Water Re-injection (PWRI) is also being envisaged to strategically manage increasing volumes of produced water and increase the longevity of the producing wells.
- All the projects are planned to be completed by 2020-21.

Road map to achieve target gas production

- OIL plans to increase gas production by 30.4 % by end 2021-22 from its level of production in 2014-15 to reach the level of 3.7 BCM for which a number of projects have been initiatedfor creating infrastructure for production and transmission of natural gas. A few of the major initiatives to achieve the projected gas production targets are.
- Augmentation of gas production fromthe Company'smost prolific gasfield by removing the constraints in the form of facilities and sand ingression issues.
- A number of gas upsides are presentin OIL's major producing fields and to tap thisgas potential,limitations in evacuation and producing facilities arebeing ramped up bythe completion of under construction pipelines and additional wells.
- Recent gasdiscoveries in far flung areas within OIL's operational area will be monetized by construction of GGS and pipelines for increase in gas production potential.
- In Rajasthan, the gas production potential has been enhanced with the recently drilled development wells as well as successful workover campaign. Effortsare being made to enhance the sale of gas through new contracts to overcome constraints of limitation of gas production due to lesseroff-take by consumers than the contractual quantum.

All statutory clearances are being pursued vigorously,with necessary support from appropriate authorities / statutory bodies,and work being monitored closely so that all the projects can be completed within the respective timelines.

It is envisaged that the additional oil and gas potential gain through theseinitiatives will help in increasing production of oil and gas from OIL's domestic assets to contribute to the country's planned overall incremental production of 0.23 MMT and 36.4 MMTOE for oil & gas respectivelyfrom domestic production,required in 2021-22 from the levels in 2014-15. The company's actual production profile, till date, is almost in line with the required mandate. The market and infrastructure will play a critical role in OIL's annual gas potentialwhich is supposed to reach the level of 3.7 BCM by 2021-22 through the planned efforts of OIL,is expected to be provided for by the country's demand for natural gas which is expected to grow at a CAGR of 4.6 per cent.

Low Oil Price and India's Import Reduction

By Narendra K Verma

In March 2015, while Hon'ble Prime Minister sounded the clarion call for reduction of import of crude oil by 10% by 2022, every industry veteran worth hissaltwas pondering on where oil prices had moved since mid -2014; a question that even now haunts the industry three years since the sustained decline in oil prices began. Having braved a debilitating drop in 2008 in the immediate aftermath of the financialcrisis, oil had recovered to levels close to its historic highs, before something historically inexplicable happened to the sector in 2014.

In 2008, oil markets were on a joyride, fueled by seemingly unstoppable global growth, whenthe Lehmann-Brothers collapseacted as the trigger to send the entire global economy into a tailspin. But the industry could draw comfort then from the fact that the crisishad pervaded all sectors-financial, industrial, commodities, manufacturing, services. The might of governments were thrown behind revival efforts, and commodities, especially a strategic commodity like oil, recovered quickly to participate in an global economy fueled by aids and revival plans funded by governments. The 2014 drop provided no such comfort for the oil and gas sector. The sustained drop is inexplicable for a sector long used to being the central focus of all commodities, a strategic and geo-economically crucial industry that governments and nations can never ignore. So what is different now?

The History of Oil price Declines

Let us study the history of recentoil price crashes. In 1991, the end of the gulf war brought in a global recession. The Asian Crisis of 1998 again crashed the oil markets as seismic shocks of Asian Giants collapsing rippled throughout the globe. The world saw a recession again in 2001, and of course we had the Financial Crisis of 2008. In each of the above instances, oil prices declined continuously for consecutive trading days,ranging from 90 days in case of 1991, to 484 days in the case of the Asian Crisis, before reversing. We arealready approaching over650+ trading days where oil prices have struggled at 50 and below in the presentcycle, notwithstanding its recovering from its lowest point of USD26/bbl in January of 2016(a low not seen since 2003, and not witnessedeven in the 2008 crisis). Each of the above historical examples had an obvious geopolitical trigger (war, nations' economies collapsing, financial systems imploding); there is no such trigger visible now.

How is this downturn different?

The low oil price regime that we see now (which analysts christened the "the lower for longer" scenario) thus stands out in its uniqueness,defined by the following characteristics:

1. We are witnessing one of the longest slumps in oil price history
2. This slump is fundamentally different from historical dips, taking virtually no cues from geopolitical triggers (Libya, Syria, Nigeria, Crimean sanctions). Analytical evidence points towards a clear and fundamental supply-demand predicated downturn.
3. From the time that OPEC came into international prominence

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MD and CEO,
ONGC Videsh Ltd.

Mr. Narendra K Verma is the overseas arm of ONGC, India's premier State-owned petroleum major. ONGC Videsh operates exclusively outside India and currently has a portfolio of 38 oil and gas assets spread across 17 countries.

Mr. Verma, anaccomplished exploration geologist and manager with nearly 37 years' of experience in upstream Oil & Gas industry in India and abroad, joined ONGC in 1980 and has worked in various technical, operational, commercial and management roles through his long stint.

Mr. Verma holds a Masters degree in Applied Geology from Lucknow University and M.Tech. in Petroleum Exploration from Indian Institute of Technology (ISM) Dhanbad. He also holds a Masters in Business Administration in Finance. Mr. Verma is recipient of prestigious 'National Mineral Award' given by the Government of India in the field of geosciences, mining and allied areas.

Mr. Verma is one of the Vice Chairs of Bureau of Expert Group for Resource Classification for United Nations Economic Commission for Europe (UNECE).

He has published more than 20 technical papers and authored over 40 technical reports.

as a muscle-hefty cartel in the 1970s, the world has been used to OPEC interventions; to protect price, to cut production, influence global and regional flows. This was a first experience with an initiallyconsciously passive OPEC, which finally galvanized itselfinto taking some concerted action, only to realize to its utter chagrin that one of the highest compliance reductions that the cartel ever enforced still saw the prices unmoved. In other words, the world is facing the startling reality of the increasing irrelevance of OPEC in influencing prices.

4. As recently as 2007, oil analysts and oil producers were discussing the impact of the nascent shale oil industry in academic terms. A few years since then, shale oil has contributed in making the biggest oil consumer in the world virtually self-sufficient in oil production. As a corollary, the balance of producing power, and ability to manage swing production, has shifted from a clutch of producing nations acting as a cartel, into the hands of 2500+ independent producers, for whom the only consideration is the additional dollar they can squeeze from the marginal barrel.
5. Most importantly, trillions of dollars are being transferred from oil producing countries to oil consuming countries. The benefits for our nation in terms of foreign exchange reserves and balance of payments have been reiterated by experts in multiple fora and is well documented and understood. Clearly, since the dawn of the oil age, the geo-economic balance of power is shifting.

Lower for Longeror Lower Forever?

So, is the "Lower for Longer" scenario here to stay for the near-foreseeable future? Anecdotal evidence may point towards the affirmative. Here are a few obvious reasons:

1. Inventories are at all-time highs; any hope of inventory drawdowns in one month are offset with increases in the next. As long as inventories are at 30% premium to five year averages, a demand-supply led price drop is not going to alleviate itself.
2. China was the fuel for the oil industry for all of the first decade of this millennium. Chinese economic growth headwinds are no longer a matter of conjecture, it is an established reality. Oil is the first commodity to suffer.
3. Iran is back as an international oil player, desirous and anxious to regain its place as a principal oil exporter, a status it enjoyed before sanctions. The OPEC intervention had to do without Iran's participation, and Iran will obviously try to make up for lost time.
4. The US shale oil producers have been the dark horse in this entire oil price conundrum. Experts pointed at their imminent demise at $60 a barrel, then at $45; bankruptcies and falling rig count notwithstanding, the industry continues to produce. In a study, Woodmac pointed out that at $35/bbl, 3.4 million b/d of oil production is cash negative and should have been shutdown ; but only a miniscule 100,000 bopd actually went offline. To use an American phrase, people are hanging in there. More so now, as oil inches around $50 a barrel.
5. Changes in automotive technology, the fight against climate change and explosion in renewable alternatives are dampening the world's appetite for crude. Speculation in the E&P industry has shifted from so-called peak oil to peak demand, when reserves considered valuable assets today wind up being left in the ground. Royal Dutch Shell CEO Mr. Ben Van Buerden has recently stated that his company has adopted a "lower forever mindset".

So, is it all gloom and doom?

The answer is a categorical No.
The Industry has gained in a substantial way from innovation and technology upgradation. Lower oil prices have resulted in cutting of flab, and the industry is learning to survive through innovative and out-of-the-box thinking processes. A case to point is the US shale oil industry. Technology on shale oil/tight oil extraction has seen the maximum innovation in recent years, propelling US to one of the largest oil producers in the world. Efficiency gains and project optimization benefits are visible throughout the E&P value chain;US Lower 48 unconventionals sector was the amongst the first sectors to react to falling prices and come out with innovative cost-saving technologies, by continuously going back to the drawing board.

Across the industry, from Majors to NOCs to independent producers, rapid cost deflation through increased efficiency has been sustaining competitiveness. The industry is seeing new benchmarks everyday in scope optimization,-deferring non-essential capex without compromising on operational deliverables,capturing cost deflation in the market through negotiations, competitive bidding ,leveraging currency devaluations and increasing local content, optimizing resources including revisiting opex estimates. The complacence brought about by high oil prices may not have sustained such a culture for innovation.

The Indian Context

Domestic portfolio of oil and gas fields particularly of NOCs is quite matured, and it is perceived that there is limited Yet-To-Find(YTF) potential in the existing acreage portfolios. Private sector may have a relatively young portfolio, but there has been steep decline in their pro-

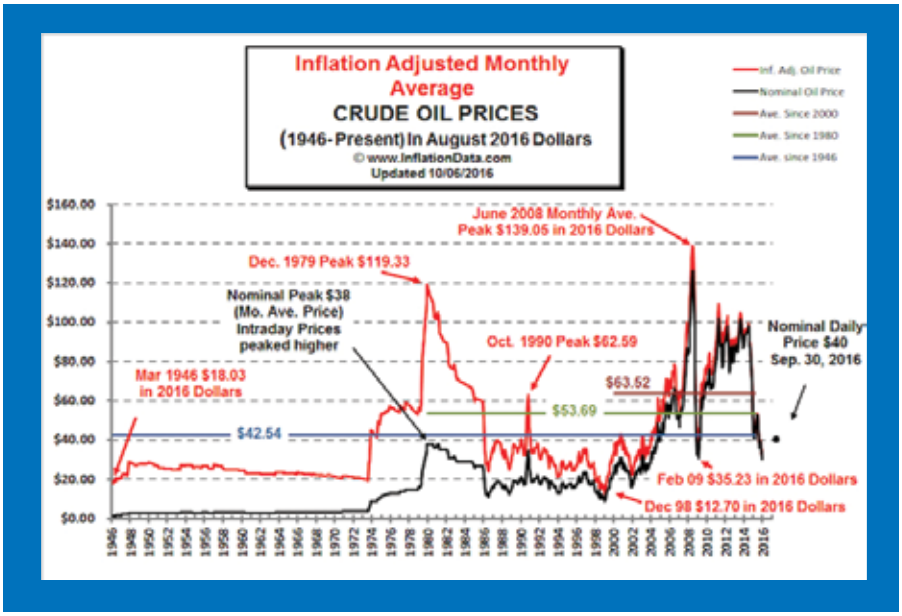
duction in recent times. The Government has recently overhauled the entire E&P fiscal and operational framework to align it to accelerated growth, and 1.5million sq km of sedimentary area is expected to be brought into play. However, the bulk of this is in challenging geology and logistics, and even with aggressive implementation will not contribute to the 2022 target. Under the circumstances best-case scenario for domestic production growth by 2022 will be between 15-25 MMToe/annum, provided that further decline of existing production portfolio does not happen/is compensated by the corroborating IOR/EOR interventions.CBM/ shale gas/tight gas reservoirs with additional thrust can at the most contribute 2-3 Mmtoe/annum.

Hence imports will be a continuing necessity going forward. In an era of lower oil prices, direct import costs have obviously seen a huge reduction, directly benefiting the exchequer. However, direct import even at reduced prices does not equal domestic self-sufficiency, however stable the markets may remain. Any volatility in international geo-strategic environment or market conditions can swiftly wipe put the gains which have accrued over the past three years. Equityand growth in E&P abroad is the evident hedge for domestic self-sufficiency; equity oil and gas abroad not only optimizes the volatility in oil prices, and it also ensures supplies on a long-term basis. Onceinvestments are made in a project, it provides long term supplies at cost prices-it's an invest and reap approach. It is to be remembered that oil isa fungible commodity and can be swapped - So every dollar earned is actually a dollar saved.

In the last one and half decades Indian companies under the leadership of ONGC Videsh have secured around 20 Mmtoe of equity of oil and gas and have built global footprint. However ,it'sstill much smaller than the portfolio of competing international entities like Chinese and Japanese companies.If it has to grow at a faster pace to offset demand growth, a focused approach with matching business and financial resource support would be required. At least part of Crude oil purchases need to be integrated with overseas investments in oil and gas /infrastructure.

A peek into the global future

There is no reason why the laws of economics should be defunct in 2017. Countries that are net importers of oil make up the bulk of the world economy. For them, lower

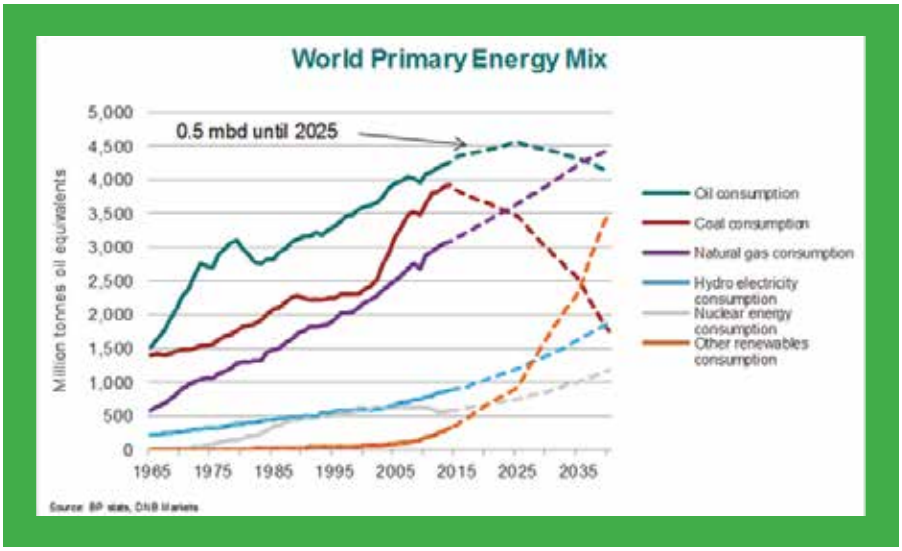


Open Acreage Licensing Opens Almost Entire Sedimentary Areas for Oil Hunt

On July 1, 2017, the Government of India placed around 90% of the country's total sedimentary areas for a pick by the investors under the Open Acreage Licensing Program (OALP).

OALP is a clear departure from the current licensing policy of the government's role in identifying and putting the blocks on auction. Considering that half of sedimentary basins have remained unexplored and oil and gas production in India is only from 7 sedimentary basins, the Government has come out with the present offer for 2.7 million square km, almost 90% of India's total sedimentary area of 3.14 million square kilometers spread over 26 sedimentary basins. This comprises of 1.5 million square km of onshore and 1.2 million square km of offshore area. Under the OALP, a prospective bidder can submit an Expression of Interest (EoI) for any area. The block then will be put on auction.

The prospective bidder will, however, have to compete with other bidders in the auction though it gets 5% additional weight vis-à-vis competitors during the technical evaluation process. The bidder company must have one-year operatorship experience in exploration, development or production of Oil, Gas or CBM plus the required financial net worth. The financial bids will be evaluated on the basis of revenue share offered to the Government and committed biddable Minimum Work Program, both caring equal weights. The auction of oil and gas blocks will be conducted twice a year, with the first round likely to be held in December this year.



oil prices translate into higher real incomes, which should increase private consumption.Demand stimulus is inevitable.

The demand stimulus from lower oil prices is usually reinforced by a positive supply shock. The marginal barrel, which plays a crucial role in supply-side dynamics, tends to get squeezed out as production economics kick in. However, these supply-side effects are not immediate; it takes time before lower prices works its way through the system, affecting production plans, and then reach the point where supply falls even as demand surges. This cycle needs to play out its course; and it will.

To quote an industry doyen, oil, along with coal and natural gas, will remain the bulwarks of the global energy system, providing the energy to fuel transportation, run industry, generate power and electrify homes. Oil rests currently on the pillar of mobility. Looking forward, this pillar will not be replaced by another fuel source. Our energy infrastructure for transport is built around liquid fuels. It will take many years and massive investment to create an alternative that can transport, distribute and market non-liquids.

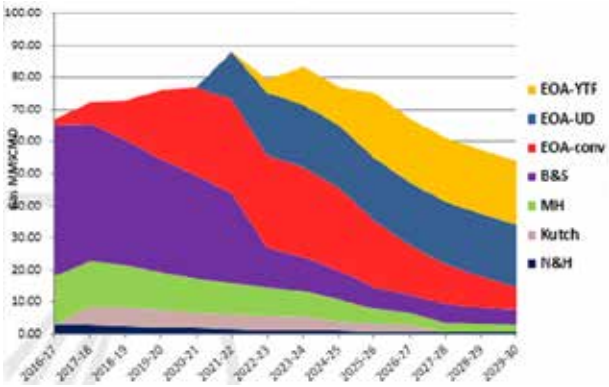
However, the wise do not forget the lessons that history teaches them. Oil and its then principal derivative, kerosene, did lose out to the incandescent bulb in the 1800s, before the internal combustion engine came to its rescue. Renewables, climate change, growth of electrical vehicles, all are credible challenges that the industry would do well to accept.

Experience and future plans for 98/2

By Alok Nandan

Abstract

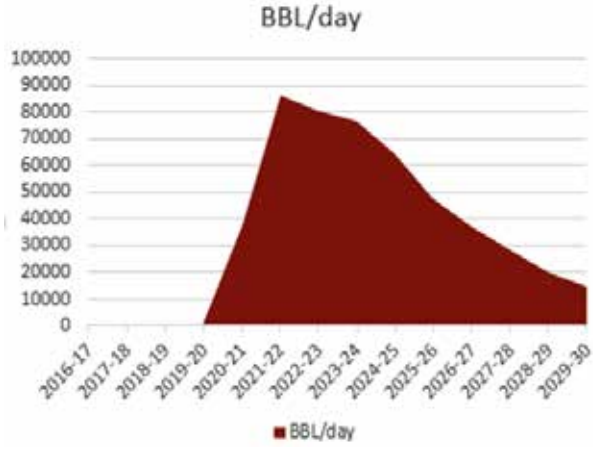
In the scenario of declining production, ONGC embarked upon the enormous task of development of KG-DWN-98/2 block in East Coast of India. A clustered mode of development was adopted subdividing the block into three clusters namely I, II and III. Actions for development of cluster II were initiated way back in 2013 with hiring of a consultant for preparation of concept.



FDP for cluster II was prepared evaluating various options taking into cognizance the geographical conditions of east coast and existing infrastructure in vicinity. The final concept identified includes various aspects of deep water developments including subsea production systems, FPSO, Process Platform and an onshore processing facility. Parallel actions were initiated for undertaking marine survey jobs.ONGC is presently in the process of tendering of major work packages for project execution. Peak Production of about 15.5 MMSCMD of gas and 78000 BOPD is envisaged and timelines for project completion include first gas by June 2019 and first oil by March 2020.

Cluster I of the block is planned for integrated development along with adjoining PEL block GS-29. With ultimate recoverables of 10.83 BCM of gas and 2.43MMm3 of oil,a peak production of 3 MMSCMD and 9450 BOPD is expected. Actions for preparation of field development plan are in progress and it is envisaged to commence production from the field by 2021.

Cluster III is predominant gas field located about 150kms from the shore inwater depths varying from 2500 – 2850m with ultimate recoverable of 76.91 BCM and peak production of 19.5MMSCMD. ONGC held brainstorming sessions with various global service providers for identifying development options for this ultra-deep water field and has plans of commencing production from this field around 2022.



Alok Nandan
Executive Director, ONGC

Alok Nandan, Executive Director - ONGC is currently the Asset Manager of ONGC's Eastern Offshore Asset at Kakinada. A mechanical engineering graduate from MMM Engineering College, Gorakhpur,he had completed Post Graduate Certificate Course from IMT Ghaziabad. With ONGC poised to venture into deep and ultra-deep water developments, he is responsible for spearheading the forthcoming oil and gas projects of ONGC in offshore east coast of India. Prior to this assignment, he served as the Chief Well Services of ONGC responsible for well services activities of all work centres of ONGC.

He started his career at Mumbai Offshore as Well Services Engineerinvolved in planning and execution of well completions, well stimulation and work-over jobs and has completed 36 years with ONGC. With diversified experience of various E&P activities covering oil field operations, IMR, Well Services, Project Management and Human Resource Development he is known to be extremely efficient and effective team leader and project manager. He also headed ONGC's Graduate Training Programs, Accreditation Courses and Business Development related to Training. He played a key role in taking ONGC's hydro-fracturing facilities toworld class level during his tenure at WSS, Ahmedabad as Head Well Stimulation Services on PAN India basis.

Journey 2022 - Key Milestones to Cross

By P Elango

The destination has been decided; 10% oil import reduction by 2022, we need to now prepare a clear journey plan. To my mind, there are 5 complementing routes to follow and they need to be integrated and monitored on a mission mode;

1. Step up domestic Exploration for oil and gas
2. Designate & Fast track National Key Stone Development Projects
3. Identify & focus on sectors for priority switch from liquid fuel to gas
4. Accelerate Energy Conservation and Fuel Efficeiency Improvement measures
5. Promote Renewables and measure its domestic impact on fossil fuel consumption

Idea is to focus on discovering and producing more, switching to gas, consuming less and promoting renewables.

Government has taken policy initiatives in all these fronts, part 1 of my talk will specify what more can be done at a National level.

Part 2 of my presentation will focus on North East Region and how it can contribute to our National Goal of 10% oil import reduction by 2022.

The North-East Region of India is set to play a vital role in the development of future energy security. 'Hydrocarbon Vision 2030' for North-East India has outlined the long term and broad objectives for the exploration, exploitation of hydrocarbons in North-East India and highlighted its potential in the economic and social development of the region. Resting its idea on five pillars: People, Policy, Partnership, Projects and Production; it aims at doubling Oil and Gas production by 2030, making clean fuels accessible, fast tracking projects, generating employment opportunities and promoting cooperation with neighbouring countries.

- The two sedimentary basins – Upper Assam Shelf and Assam-Arakan Basin – cover an area of 116,000 sq km and contain prognosticated hydrocarbon resources estimated around 5,040 MMT (36000 mmboe), out of which 2,224 MMT (15886 mmboe) (44%) has been established so far, leaving considerable opportunity to establish and develop the remaining 56%.
- Crude oil production in NER declined from 4.84 MMT in 2010-11 to 4.54 MMT in 2014-15 because of maturing fields and limitations on exploring and producing oil from yet-to-find (YTF) areas. By contrast, the Natural Gas production scenario in the region has been positive over the last few years. Production is expected to reach 20.6 MMSCMD by 2030 (includes gas production upside from Tripura), growing at a compounded annual growth rate (CAGR) of 4 % from 11.3 MMSCMD in 2014-15.
- Limited pipeline connectivity in the region has adversely impacted the development of the local market as well as transport of oil and gas in NER. A proposal to lay pipelines of around 7,500 km and other spur lines for the CGD network in the next 4-5 years have been suggested by the Government of India for the region
- An energy corridor needs to be developed in NER for utilising the resources available, producing POL products and exporting to the rest of India as well as Bangladesh, Myanmar and Nepal, fuelling overall growth in the region.

P. Elango
Managing Director, HOEC

In his career spanning over 28 years in Upstream Oil & Gas Sector, Elango has held several leadership roles in different areas of the business and is a recognized leader in the Indian industry. Currently Elango is the Managing Director of Hindustan Oil Exploration Company Ltd (HOEC) since February 2015.

Prior to joining HOEC, he was the Chief Executive Officer & Whole Time Director of Cairn India Limited. Over his long association with Cairn, he played a key role in building Cairn into a leading Oil & Gas company operating over 30% of the crude oil produced in India.

Elango holds a Masters degree in Business Administarion and began his career with ONGC in 1985 and over a span of 10-years, has performed diverse roles and joined Cairn in January 1996.

- Under his leadership, Cairn India has been adjudged:
  a) The fastest growing energy company in the World as per Platts 2012 and 2013 ranking
  b) Winner of Oil Industry Safety Award in 2013
  c) Winner of Golden Peacock Award for Corporate Governance in 2012
- Elango was one of the five finalists for Platts' first-ever Asia CEO of the Year award 2013

Presenters

Ajay Kumar V
MD (In Charge), BPRL

Shri Ajay Kumar V is currently the Managing Director (In Charge), Bharat Petro Resources Ltd (BPRL) and was appointed as Director (Ops & amp; BD), BPRL w.e.f. 21.5.2015.

Shri Ajay Kumar V is M.Sc in Geology with first rank from University of Kerala. He has vast experience of over 33 years in various facets of the upstream industry spanning from well-site operations, exploration and development drilling, field development studies and preparation of FDP for discoveries, resource and reserve estimates for prospects and fields, tech economic assessments, sub-surface mapping and interpretation leading to discoveries both in India and abroad. Prior to taking over as Director (Operations & amp; Business Development) in BPRL, he was General Manager in ONGC Videsh Ltd. with experience of around eight years in Business Development leading to key asset acquisitions for ONGC Videsh Limited and a Director on the Boards of ONGC Mittal Energy India and ONGC Mittal Services India Ltd.

He is a Fellow member of Geological Society of India, Bangalore, Active member of the American Association of Petroleum Geologists, Tulsa, USA and Founder member of the Association of Petroleum Geologists (APG), India.

R K Sinha
Chief Executive and Technical Officer to DG, DGH

Mr. Rajeev Kumar Sinha is Chief Executive and Technical Officer to Directorate General, DGH. He is a Chemical Engineer from Regional Engineering College, Rourkela. He worked for one year in HPCL refinery Mumbai before joining Oil and Natural Gas Corporation (ONGC) in 1991.

Mr. Sinha joined Directorate General of Hydrocarbons (DGH) in the year 2003 and since then involved in various decision making process for oil and gas policy formulation. He has been actively involved in NELP promotions and bidding rounds. He has been a part of the team from DGH for making XIIth plan document for oil and gas sector, different policies for PSC regime as well in monitoring of various development projects Mr. Sinha is also associated with formation of major E&P policies such as 10% import reduction by 2022, North East vision document, Hydrocarbon Exploration and Licensing Policy, PSC reforms, Gas pricing policy etc. Ha has also been part of the National Gas Hydrate Programme where he had represented India as a member of world science team during Gas Hydrate Expedition for hydrate core collection and MDT test at North Slope, Alaska (USA).

Mr. Sinha is delivering a presentation on key policy framework implemented by the Government for achieving the ambitious target of 10% import reduction.

Sudhir Mathur
Acting CEO
Member of the EC, CIL

Sudhir Mathur, was appointed Acting Chief Executive Officer of Cairn India Limited in June 2016, bringing nearly thirty years of senior management experience to the role. Since joining Cairn in 2012 as Chief Financial Officer and Member of the Executive Committee, he has been instrumental in the continuing growth and success of the Group. During his career, which has spanned a number of sectors, he has had responsibility for Strategy, Restructuring, Supply Chain, Corporate Finance, Treasury, M&A and External Affairs.

Prior to Cairn, Sudhir was the CFO of Aircel Cellular Limited and Business Head of Netco, where he was instrumental in the roll out of its Pan India Operations. He was Chief Commercial Officer of Delhi International Airport Limited where he was oversaw the positioning of the airport as an international and domestic passanger and cargo hub post privatisation. Following a number of years within the Management Consultancy division of PriceWaterhouseCoopers India, he also held senior management positions at Idea Cellular and Ballarpur Industries.

Sudhir is a Bachelor of Economics from Shriram College of Commerce, Delhi University and MBA from Cornell University, New York.

Ravi Addala
Sr. Sales Manager, SDS Baker Hughes, a GE company, Kakinada, India

Ravi grew up in Visakhapatnam. He is a Electronics and communication Engineer and did his Masters in computer science from IIIT Hyderabad.

Ravi's first job was as scientist for missile controls at DRDO – Defense research in Hyderabad.After 3 years at DRDO, he moved to GE in 2005 working on industrial controls as software engineer and then as project manager. In 2008 he moved to Oil and Gas business with in GE (which is now Baker Hughes), setting up subsea controls engineering team at Hyderabad and leading the team for 5 years. He later moved from engineering to sales and for past 3 years based out of Kakinada.

Ravi has couple of patents on "Subsea Software analytics, down time reduction", and he active member of SPE Kakinada chapter.

Garud B Sridhar
Business Manager for Enhanced Oil Recovery

Garud Bindiganavale Sridhar is currently the Business Manager for Enhanced Oil Recovery sub-product line under the Integrated Production Services Product Line of Schlumberger Production Group. In his most recent role he was the Engineering Program manager for Well Services Surface Equipment in the Well Services and Coil Group based out of Sugar Land, Texas, USA.

He began his career as a design engineer with Wireline logging cables in 2003 and has spent the last 15 years in different engineering, manufacturing, and management roles for wireline cables, well services and coiled tubing surface equipment. Garud eaned a Bachelor of Engineering degree with distinction from Regional Engineering College, Mangalore University, India in Mechanical Engineering; a Masters of Science from University of Texas at Austin, TX in Mechanical Engineering with a thesis on high strength steels, and recently an MSc in Management of the Oil and Gas Industry with distinction from Heriot Watt University, Edinburgh, UK. He has been very active in technology development for Schlumberger in different domains, and currently has 15 US patents granted.

Deepak Mahurkar
Business Manager for Enhanced Oil Recovery

Deepak Mahurkar is a Mechanical Engineer, PG in Finance and Marine Engineering currently undertaking Doctoral research thesis in Energy Policy (Causality between Energy & Economy). He is the National Leader of oil & gas industry practice in PWC India. During his 25 years of professional career, Deepak gained diverse consulting, technical, marketing, commercial and sales experience in the petroleum, distributed power generation and marine industries.

In consulting, his experience spans market analysis, policy & regulations, financial analysis, operational efficiency and business planning. He has effectively offered services for creating attractive investment regime, managing business entry, turning businesses sustainable and improving operational efficiencies. He was engaged with private and public companies, government bodies and industry associations for advisory, consulting and public policy advocacy in E&P, refining, marketing, pipeline, gas, LNG, fertiliser, marine, power generation, coal and renewable sectors.
He sits on several prestigious committees of India's Energy Sector Viz. Energy Security sub-committee of Hydrocarbon Committee of FICCI – the apex chamber of commerce in India; Policy & Planning Committee of Petroleum Federation of India, an advocacy body for oil & gas industry in India; US India Energy Cooperation Program entered into by GoI and US TDA; Energy Committee of PHD Chamber of Commerce, a Indian regional chamber of commerce for small & medium entrepreneurs, etc.

Mr Mahurkar is an acclaimed and sought after speaker in professional circles. He has spoken in many international and numerous national conferences. In PetroTech International Conference 2010 he chaired the "Unconventional Hydrocarbon Plenary Session". He contributes to public consultation and debate through print media. His articles have been published by international, national, local journal and newspapers of repute. He also participated in visual media debates and experts' view programs.

As a part of his PwC consulting career Mr Mahurkar leads numerous complex and cross territory projects. He has worked with Governments, Regulators, National Oil Companies, International Oil Companies and with Industry Associations.

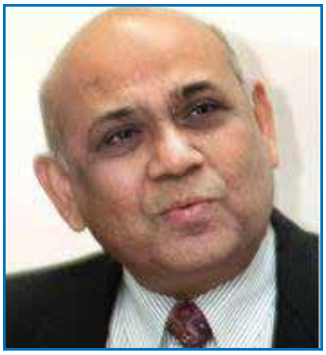
Session Chairs & Panelists

Shashi Shankar
Director (T&FS)

T K Sengupta
Director (Offshore)

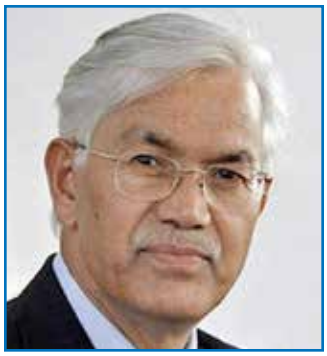
S K Manglik
Former CMD, ONGC

V P Mahawar
Director (Onshore)



Atul Chandra
Former MD,OVL

B C Bora
Former CMD, ONGC and OIL



R S Butola
Former CMD, IOC

C R Prasad
Former CMD, GAIL

R S Sharma
Former CMD,ONGC

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Enhancing Oil and Gas Exploration in NE India

By B C Bora

It is interesting to note thatthe Government of India has recently decidedto provide a special package to the explorers of oil and gas in NE India. This petroliferous basin with the history of oil discovery more than one hundred years back, has about a quarter of the current estimate of prognosticated resources of oil and gas in the onshore and shallow water basinal area of the country.Of the current estimates of the prognosticated resources of 5080 million tonnes of oil and gas in the region, only about 40 per cent havethus far been established.It is thereforea fact that NE India is today the most promising onshore pasture for oil and gas exploration in India. Keeping in view that a vast part of the sedimentary area of 116,000 Sq.Km is yet to be explored in this petroliferous basin, it is very likely that the prognosticated resources can be still higher, a view expressed by quite a few geoscientists of international repute.Though Assam by far has the largest share of this basinal area, the other six states (Arunachal, Nagaland, Meghalaya, Mizoram, Manipur and Tripura) too have their own shares. What is more is that these tracts mostly falling in the foothills have very high prospects of oil and gas. The review process of resources and reserves of the country recently initiated by the Ministry of Petroleum &Natural Gas, Government of India, is expected to come up with a similar view. Admittedly, the geology of the region is complex with multiple folding, faults, shallow boulder beds etc. and the terrain too is difficult at times. Ensuring zero, or at best minimal, impact on the pristine environment of the region including the flora and fauna, a few of which have today fallen into rare and endangered category, will necessarily be an equally important issue for the explorers to contend with. These bring considerable challenges to the explorers, but then the rewards can also be very high.

While the improved terms and conditions for Exploration &Production (E&P)activity may attract more investors, though not necessarily quality operators, it has to be appreciatedthat the operators with impeccabletrack record and in-depth knowledge of similar geology, terrain, logistical and socio-environmental issues elsewhere are only likely to make a success, both technologically and economically. Looking at what Assam Railways and Trading Company faced in discovering the Digboi oilfield in Upper Assam more that twelve decades ago and by Assam Oil Company (a subsidiary of Burmah Oil Company UK), the predecessors of Oil India Ltd (OIL),in successfully operating the field (they had also discovered Badarpur field in southern Assam in early twentieth century and operated it for nearly thirty years) for eight decades, it really seems like a joke when the current day operators try to cry hoarse over what they call "inadequate infrastructure and socio-environmental difficulties "in spite of the much improved facilities now available. It is a different matter that the Digboi oilfield is still on production even today since it was acquired by OIL in 1981. The fact of the matter universally is that oil and gas are found wherever they are and have to be prospected in the same place only. The seasoned internationals and even some niche operators understand this reality and they readily set their feet into any region with attractive geological promises and fiscal terms. They necessarily develop fit for purpose nimble footedness to manage the subsurface, logistical, socio-political and environmental issues.

Along with the special package therefore, the Government will do well if carefully selected international operators with experience of operating in similar situations (geological, logistical and socio-environmental) can be attracted to

B C Bora
Fomer Chairman & Managing Director , ONGC

Mr B C Bora, a petroleum professional, has been associated with the petroleum sector spanning over a period of more than five decades since he joined the Assam oilfields of Oil India Ltd way back in 1962.

He superannuated from the position of Chairman & Managing Director of ONGC in 2001. Prior to moving to ONGC as the CMD in 1995, he was the CMD of Oil India Ltd from 1992 to 1995. Mr Bora continues to be associated with the Petoleum Industry and has been on the Boards of Governors of quite a few public and private sector companies and educational institutions as non-executive/ independent Directors. He is also associated with a number of NGOs and industry bodies connected with the energy sector.

take up E&P work in this region. This can only see the early and effective success of the improved E&P regime of the Government by making available much needed additional production of oil and gas to the country from this region. The fly by night or quick profit seeking investors likely to be attracted by the improved fiscal terms have surely to be kept at bay if the Government is serious about scaling up the production from the region and hence the country, on a fast track as well as on a sustainable basis.

At the same time, it is well known that the two National Oil Companies (NOCs), ONGC andOIL have long experience of operating in the region (OIL by themselves as well as through their predecessors Assam Oil Company in the Upper Assam shelf sub-basin and ONGC in both Upper Assam shelf and Assam-Arakan Fold Belt sub-basins). Both the NOCs have sizeable oil and gas production in the region that isalso on a rising trend in the recent time.Therefore,both of them very largely meetthese criteria. OIL has most of their personnel stationedin the region and so are their geo-technical study, research, oilfield servicesfleet and operating facilities.ONGC too has a large deployment of personnel, geo-technology study centersand services fleet spreading over both the sub-basins. That surely makes them the preferred prospectors in the region.Being NOCs, they can as in the past, share geo-scientific data/knowledge, each other's facilities and services fleets as required for their mutual benefits. It is therefore expected that in the new scheme of things, ONGC and OIL will be encouraged by the Government to play much larger roles in the E&P operations within NE India, besides encouraging them to tie up with quality multinational E&P companies with requisite expertise/experience in specific cases. The state governments of the North East should also be persuaded to work closely with the central government to play an enabling role in furthering such collaborative endeavours.

E&P Strategies to cut down the oil import by 10% by 2022

By C R Prasad

Introduction

Challenges in the Nation's hydrocarbon sector do exist. Increased domestic production and investment in nation's E&P sector will not only ease worries about India's future energy security, but also reduce the nation's trade deficit and rejuvenate the rupee on international foreign exchange market.

Oil is a vital input for the production of a wide range of goods and services, because it is used for transportation in business of all types. Higher oil prices thus increase the cost of inputs; and final product price increases inflation. In a net importer of oil economy like India, higher oil import shrink foreign reserves of the economy, affect the purchasing power of the economy in terms of International trade. The Minister of State (I/C) for Petroleum & Natural Gas Shri DharmendraPradhan informed the RajyaSabha in a written reply that the total quantity of import of oil 2015-16 was 202.85 Million Metric ton (MMT) at an Annual Oultay of Rs. 416, 579 crore.

According to a report published by PwC, the economic benefits that could result if India becomes import-free today is equivalent to more than a whopping 6.5% of India's current GDP. If 50% of the domestic requirement is met by home production it is likely to generate an additional value of 47.2 billion USD, as per the report. In this scenario, 3.7 million person years of employment too can be generated over a period of 20 years.

The report suggests ways of achieving energy security by bringing onboard an effective partnership of the central government, the national oil companies, the private and inward investing companies, the service companies and the state governments.

The report states among its key insights, for accomplishing energy security, developing the services sector in India would be rewarding since this would help avoid delays and premiums for obtaining E&P services. More than 60% of the E&P spend is for specialized services, they form the backbone of the E&P industry. Along with this finding, the report also points to another – significant benefits would accrue to state governments by developing the E&P sector. Rajasthan transitioned from a revenue deficit state into a revenue surplus one in 2010-11 on the back of the Barmer facility which wascommercialized in late 2009 and Gujarat too has immensely benefited from sector supplies. In addition to the economic benefits, self-sufficiency can generate an additional inflow for the government of an amount equivalent to almost 25% of the current total revenues that accrue to the government from the petroleum sector.

Govt. Approach for import reduction

In order to achieve fast and sustainable long-term development, energy security is one of the prime focus areas of the Government. In the year 2015 'UrjaSangam' was organized at New Delhi. The aim of this global hydrocarbon meet was to showcase India's potential in the hydrocarbon sector to create an investor-friendly atmosphere, besides positioning India's thought leadership by creating a new "Energy Security" Platform.During the UrjaSangam held on 27.03.2015 at New Delhi, Hon'ble Prime Minister has assigned the target for reduction of import dependency in energy by 10% from current level of about 77% by 2021-22.

Based on discussions, a committee was constituted for "Preparing a roadmap to reduce the dependency on import in energy by 10% by 2021-22". The Committee has submitted its report which envisages a five pronged strategy to achieve the targets as shown below. The report has been accepted by the Government.

- Increasing production of oil and gas

C R Prasad
Chairman & Managing Director, EPPL

33 years' association with Hydrocarbon industry in ONGC and GAIL since 1968 with thorough exposure to various facets of the industry such as Exploration and Production of Oil and Natural gas, Engineering and Construction of large oil/gas production complexes located offshore, setting up of mega petrochemical complexes, petrochemical production and marketing, transmission and distribution of natural gas across through cross-country pipelines, city gas distribution to the domestic/commercial/industrial consumers, Compressed Natural Gas (CNG) as fuel for automobiles, transmission of LPG through cross-country pipeline etc.

- Promoting energy efficiency and conservation measures
- Giving thrust on demand substitution
- Capitalizing untapped potential in biofuels and other alternate fuels/renewable
- Implementing measures for refinery process improvements

Govt.initiatives

In order to reduce import dependency on crude oil, Government has is taking a number of initiatives to increase domestic production of crude oil and to promote conservation of petroleum products. To accelerate the pace of exploration and production of oil and gas in the country, various steps are being taken by the Government. Last couple of years has seen implementation of major policy reforms in upstream hydrocarbon segment in India and many others are under consideration. All such policies/ guidelines being considered by the Government in the interest of the upstream Oil and Gas sector are listed below:

- Discovered Small Field (Marginal) Policy
- New domestic Natural Gas Pricing Guidelines
- Hydrocarbon Exploration Licensing Policy (HELP)
- Policy for extension of Production Sharing Contracts (PSC)
- National Data Repository (NDR)
- Site Restoration Guidelines on petroleum operations
- Encouraging E&P activities in North East India
- Policy Framework for Relaxations, Extensions and clarifications at the Development and Production stage under PSC regime for early Monetization of hydrocarbon discoveries.
- Exploration in Mining lease areas
- Multi-client Geo-scientific surveys
- Re-assessment of prognosticated hydrocarbon resources of India.
- Appraisal of Un-appraised Sedimentary areas.
- Policy Guidelines of Exploration and Exploitation of Shale Gas and Oil.

Technological advancements have allowed operators to save time, reduce operational costs, and lessen their environmental impact. New drilling technologies include the following techniques:

- Oil Recovery (IOR)/Enhanced Oil Recovery (EOR) measures
- Horizontal Drilling
- Multilateral Drilling
- ExtendedReachDrilling
- ComplexPathDrilling

Appraisal of about 1.5 million sq km un-appraised area of the Indian Sedimentary Basins and acquisition of geo-scientific data under Multi client and non-exclusive policy.Besides, Petroleum Conservation Research Association (PCRA), under the Ministry of Petroleum & Natural Gas, has been given the mandate to promote conservation of petroleum products in the major sectors of economy like transport, industry, households and agriculture through direct technical assistance, R&D educational and training programmers and mass awareness campaigns. PCRA's activities cover conservation of all energy sources, development, evaluation and commercialization of efficient equipment and additives, popularizing production of bio-fuels, environment protection etc.

National Oil Companies Initiatives

ONGC

- Oil and Natural Gas Corporation Ltd. (ONGC), engaged in exploration and exploitation of oil, natural gas and value added products (VAP), was incorporated on June 23, 1993 under Companies Act 1956.
- ONGC has 7.59 billion tonnes of In-place hydrocarbon reserves.
- The oil output from ONGC operated fields in the year 2015-16 stood at 22.36 MMT, Compared to 22.26 MMT in 2014-15.
- The natural gas production during the year 2015-16 at 21.18 BCM relative to 22.02 BCM in FY 2014-15.
- ONGC owns and operates more than 28,139 kilometers of pipeline in India, including 4,500 kilometers of sub-sea pipelines.
- During FY 2015-16,Projects valuing about 24800 Crore were completed. This through their lifecycles will contribute over 60 MMTOE of new oil and gas supplies. And seven projects valuing about 48000 Crore were approved during the year. Cumulatively these will translate to additional oil and gas of over 97MMTOE.
- ONGC invested in development of Bokaro CBM project. This project envisages CBM gas production of 4.09 BCM in 20 years with a peak of 0.9 MMSCMD.The production from this project is expected to commence during 2017-18.
- ONGC Ranked 14th among global Oil and Gas Operations industry in Forbes Global 2000 list-2016.
- As an integrated energy company, ONGC constructed two wind farms-one in Gujarat with a capacity of 51 MW and other is 102 MW farm set up in Rajasthan.

ONGC plans for 2030

- Production of 130 MMTOE of oil and oil equivalent gas (O + OEG) per year and accretion of over 1,300 MMTOE of proven reserves.
- Grow ONGC Videsh Limited (OVL) six fold to 60 MMTOE of international O+OEG production per year by 2030.
- To achieve More than 20 MMTOE of O+OEG production per year in India coming from new unconventional sources such as shale gas, CBM, deep-water and HPHT (High Pressure & High Temperature reservoirs).
- Over 6.5 GW power generation from nuclear, solar and wind and 9 MTPA of LNG.
- Scaling up refining capacity to

over 20 MMTPA and targeted investments to capture downstream integration in petrochemicals.

OIL

- OIL has accumulated over a hundred years of experience in oil and gas production since the discovery of Digboi oilfield in 1889. Oil India Limited (OIL), a Government of India Enterprise, 'A Navaratna Company' is engaged in the business of exploration, production and transportation of crude oil, natural gas both in-country and overseas.
- During 2015-16, crude oil production was 3.247 MMT as against production of 3.440 MMT in 2014-15.
- OIL operates a total network of 1220 Km of Crude Oil Pipelines. During 2015-16, OIL transported a total of 6.37 MMT of crude oil and 1.74 MMT of products through pipelines.
- The natural gas production was 2838 MMSCM in FY 2015-16 against 2722 MMSCM in FY 2014-15 which is higher by 4.26%.
- During FY 2015-16, LPG production was 41030 MT against 43570 MT in FY15.
- OIL is operating in 5 (five) PEL and 22 (twenty two) PML areas, allotted under the nomination regime in the states of Assam, Arunachal Pradesh and Rajasthan. as on 31.03.2016, OIL holds Participating Interest (PI) in total of 18 NELP Blocks with the right of Operatorship / Joint Operatorship in 10 Blocks and the remaining 8 (eight) Blocks as a Non-operator.
- OIL's overseas E & P portfolio comprises of 16 blocks and is spread over 11 countries covering Libya, Gabon, Nigeria, Yemen, Egypt, Venezuela, USA, Mozambique, Myanmar, Bangladesh and Russia. In addition OIL also holds stake in 741 Km long pipeline construction and operation project in Sudan completed in 2005.

Oil future out look

- Since OIL has significant presence in the North East part of India and presently operating in the Upper Assam basin which happens to be one of the most prolific basins in India, OIL will concentrate efforts in the North East to achieve continued reserve accretion.
- To enhance recovery, water injection and other EOR (Enhanced Oil Recovery)/IOR (Improved oil recovery) technologies will be adopted which has the ability to liberate additional production capacity of around 0.32 to 0.35 MMTPA of crude over the next 12 to 15 year period, if focused approach is adopted and implemented.
- OIL will continue to pursue acquisition of prospective overseas E&P opportunities to ensure energy security for the country, to grow by enhancing own E&P portfolio and decrease risks in existing E & P portfolio.
- While E & P business shall continue to be OIL's core focus, selective diversification into midstream, downstream and renewable energy segments, such as, pipelines, wind/solar energy, CGD, LNG, refineries etc. would also be planned to balance the existing portfolios.

IOCL

- During 2015-16 the Indane LPG cooking gas production stood at 2.45MMT and maintained a market share of 47.8% in the Industry. Its customer base stands at 9.88 crore, including addition of 1 crore connections during 2015-16.
- During the year 2015-16, The Corporation recorded the highest ever petrochemicals sales of 2.538 MMT as compared 2014-15 which is 2.487 MMT.
- In 2015-16, IOCL played a pivotal role in domestic market sales in core product categories, (i.e., Petrol, Diesel and LPG) and sold 72.65 million tonnes of petroleum products during the financial year 2015-16, as against 68.47 million tonnes during the previous year. In addition, 3.46 million tonnes of petroleum products were exported, as against 3.65 million tonnes exported during the previous financial year 2014-15.
- Indian Oil controls 11 of India's 23 refineries. The group refining capacity is 80.7 million metric tonnes per annum (MMTPA) - the largest share among refining companies in India. It accounts for 35% share of national refining capacity. And the company is aiming at a refining capacity of about 100-110 MMTPA by the year 2022 and progressively scale it up to least 150 MMTPA by the year 2030.
- Indian Oil Corporation Ltd. operates a network of about 11,750 km long crude oil, petroleum product and gas pipelines with throughput capacity of 85.5 million metric tons per annum of oil and 9.5 MMSCMD of gas.
- Projects under implementation would further increase the length of the pipelines network from 11,750 km currently to about 17,000 km, and throughput capacity from 85.5 to 102 million tons per annum.
- The Corporation is pursuing implementation of city gas distribution (CGD) networks through Joint Venture Companies, Theses Joint Venture Company has also received authorization from Petroleum and Natural Gas Regulatory Board in 5 more geographical areas during 2015-16, viz., Panipat, Daman, Ernakulam, Udhamsingh Nagar and Dharwad.
- IOCL is implementing a 5-MMTPA import, storage and regasification terminal at Kamarajar Port (Ennore) near Chennai through a Joint Venture Company, Indian-Oil LNG Pvt. Ltd. The LNG Terminal is scheduled to be commissioned in 2018-19
- The IOCLs E&P portfolio consists of 15 active blocks which consists of 8 domestic (including 2 coal bed methane blocks) and 7 overseas blocks, with participat-

ing interest ranging from 3.50 percent to 50.00 percent. The overseas portfolio includes seven blocks spanning USA, Canada, Venezuela Libya, Gabon, Nigeria, and Yemen.

- The IOCLs has three producing assets, viz., Niobrara Shale Project (USA), Pacific Northwest LNG Project (Canada) and Carabobo Project (Venezuela). During the 2015-16, the production from these assets increased to 3501.76 MBOE (Million barrels of oil equivalent) from 3299 MBOE in 2014-15,registering an 6 per cent rise. The proved and proved-developed reserves have increased from 2.18 MTOE(Million tonnes of oil equivalent) as on 31st March, 2015 to 3.19 MTOE as on 31st March, 2016, registering an increase of 46.3 per cent
- The Corporation has set itself the target of equity oil & gas production of 5 MMTPA for 2021-22. The overseas acquisition drive has been pivotal in building the E&P portfolio and it envisages achieving these targets through further acquisitions/farm-in of producing/ near-producing upstream assets, besides production from existing E&P assets.
- As an energy company, the Corporation has a portfolio of 69.3-MW Wind, 9-MW Solar PV grid connected projects and 1.4-MW off-grid solar PV projects.

GAIL

- GAIL (India) Ltd. GAIL (India) established on 16th August, 1984 was erstwhile known as Gas Authority of India Limited. It was incorporated with an objective to create gas sector infrastructure for sustained development of the natural gas sector in the country. GAIL is the youngest PSU to be accorded Maharatna Status.
- GAIL holds around 71.24 % market share in India's gas marketing. During 2015-16, gas sales were 73.67 MMSCMD, compared to 72.07 MMSCMD in the previous financial year.
- GAIL owns and operates a network of about 11000 km of natural gas high pressure trunk pipelines with a pan-India capacity of around 206 MMSCMD of natural gas. The average gas transmission during the 2015-16 was 92.09 MMSCMD, compared to 92.10 MMSCMD in the previous financial year.
- GAIL is the first company in India to own and operate pipelines for LPG transmission. The LPG transmission system has a capacity to transport 3.8 MMTPA of LPG. In 2015-16, the LPG transmission throughout achieved was about 2.82 Million MT.
- In 2015- 16, total liquid hydrocarbon production was about 1.09 Million MT, which mainly included 0.85 Million MT of LPG, 0.13 Million MT of Propane, 0.02 Million MT of Pentane and 0.08 Million MT of Naphtha.
- GAIL also has significant presence in petrochemical segment. During 2015-16, GAIL produced 344.168 Thousand MT of polymers and sold 333.5 Thousand MT of polymers.
- GAIL and Hindustan Petroleum Corporation Limited ('HPCL') are exploring the possibility of setting up a Greenfield petrochemical complex in the east coast of India primarily based on imported ethane.
- Gail is evaluating various opportunities for setting up/ booking LNG regasification capacity in the country.
- In 2011, GAIL contracted 3.5 MMTPA of LNG from Cheniere Energy, USA on FOB basis for an initial period of 20 years. Further, in 2013 your Company subsidiary GAIL Global (USA) LNG LLC also signed a Terminal Service Agreement (TSA) for booking 2.3 MMTPA of liquefaction capacity in the Dominion Cove Point terminal for 20 years. The initial supplies from both these contracts are expected to commence from early 2018. Currently, Company is in the process of long term charter hiring of LNG ships through the international competitive bidding route.
- The Company imported 55 LNG cargos (equivalent to approximately 3.5 MMTPA of LNG) during the financial year 2015-16 from various international sources on short term and spot basis to cater to the immediate requirement of the domestic market.
- During 2015-16, GAIL Gas CNG sales increased to 38 MMSCM in 2015-16. And the PNG sales volume from industrial, commercial and domestic customers grew to 702.80 MMSCM from 526 MMSCM during previous year
- GAIL has its presence in City Gas Distribution (CGD) business, Exploration and Production through equity and Joint Venture participations.
- GAIL has participating interest in 13 E&P blocks of which 11 blocks are in India and 2 in Myanmar. Drilling activities were initiated in 4 (out of 5) blocks obtained during NELP-IX bidding round. Gas discovery has been notified to Government in one block. Survey activities are planned in the remaining NELP-IX blocks.
- GAIL Company is pursuing the Turkmenistan–Afghanistan–Pakistan–India (TAPI) Pipeline project (i.e 1800 km transnational pipeline) to receive natural gas supply from the Galkynysh fields of Turkmenistan. Investment Agreement was signed on April 07, 2016. GAIL holds 5% equity in TPCL.
- GAIL is also entering into coal gasification by setting up surface coal gasification based urea project at Talcher. The project is envisaged for production of 2200 MTPD Ammonia and 3850 MTPD Urea .The success of this project would pave the way for the production of fertilizers from abundantly available domestic

coal, thus resulting in lesser dependency on their imports.
- GAIL is also a member of National Gas Hydrate Programme (NGHP) being coordinated by DGH and is actively involved in activities related to Gas Hydrate exploration.
- GAIL Company has total installed capacity of 123MW out of which 118MW is wind and 5 MW is solar energy plant. And the Company is also setting up 5.76 MW grid connected roof top captive solar power plant at Pata Petrochemical Complex, Uttar Pradesh.

OVL

- ONGC Videsh was incorporated as Hydrocarbons India Private Limited, on 5th March 1965. ONGC Videsh Limited is a wholly owned subsidiary of ONGC. The primary business of the company is to prospect for oil and gas acreages abroad, which includes acquisition of oil and gas fields in foreign countries as well as exploration, production, transportation and sale of oil and gas.
- The company's share of proved reserves as on 31st March 2016 stood at 199.467 MMTOE (O+OEG).
- The Crude Oil Production (including condensate) was 5.510 MMT during 2015-16 as compared to 5.533 MMT during 2014-15. Production of natural gas was 3.406 BCM during 2015-16 as compared to 3.341 BCM during 2014-15.
- ONGC Videsh share the oil and gas equivalent oil (O+OEG) output from ONGC Videsh increases to 8.92 MMTOE in FY 2015-16, which is 0.5 % higher than last year's (i.e FY 2014-15) production of 8.87 MMTOE.
- ONGC Videsh has stake in 37 oil and gas projects in 17 Countries out those 14 are producing, 4 are discovered, 17 are exploration projects and 2 are pipeline projects.
- ONGC Videsh has a production target of 20 MMTOE of oil and gas from its overseas assets by FY 2017-18 and 60 MMTOE by FY 2029-30.

Conclusion

Maharatna Oil and Gas PSUs and private Oil and Gas companies in India have to work very hard with novel E&P strategies to discover more oil and gas to achieve the Prime Minister's target for reduction of import dependency in energy sector by 10% from the current level (2015) of about 77% by 2021-22.

Strategies for E&P to Reduce India's Import Dependence

By R S Sharma

The critical importance of India's energy security has invited the attention of no one less than the Hon'ble Prime Minister Shri Narendra Modi, who gave a clarion call at the inauguration of Petrotech-2016 in Nov last year, to reduce our import dependence by 10% by 2022. He has also led from the front, by engaging in "Energy Diplomacy" with resource rich countries and taking initiatives to develop energy infrastructure to provide clear fuels like natural gas in the remote parts of the country thereby deepening the Gas Economy.The call has been duly echoed by the Petroleum Minister, Shri Dharmendra Pradhan at various fora subsequently. However, I feel,given the ground realities, it is an over ambitious call.

On the Economy front, while India is recovering from the temporary adverse effects of demonetization, the World Bank has projected a strong 7.2 per cent growth rate for India this year against 6.8 per cent growth in 2016.While the World Bank has revised India's growth figures by 0.4 percentage points as compared to its January forecast, India remains the fastest growing major economy in the world. Also,the demand for Oil and Gas (O&G) continues to grow at an unprecedented rate. India is the third-largest net importer of crude oil after United States and China. In the gone fiscal yearour rapidly growing economy imported 81% (approx.) of its crude oil and other petroleum needs. Further, OPEC has estimated that India's demand for oil will reach 10 million b/d by 2040.

Faced with the scenario of global oil price uncertainty, and pressures of huge domestic demand for energy, India needs to chart a way forward to realistically meet its energy requirements while simultaneously ensuring equitable economic growth. For an import-dependent country like India, energy security is no longer just a desire, but a critical imperative,a task seemingly challenging to achieve, yet worth pursuing; a dream realizable only when the country starts producing hydrocarbons in sufficient quantities. The Ministry of Petroleum & Natural Gas and the Indian Oil and gas sector together will thus have to play a pivotal role in upholding our nation's energy security and fueling its economic growth.

Most of crude oil production in the country is from ageing fields in Western Offshore and in the states of Andhra Pradesh, Assam, Arunachal Pradesh, Gujarat, Rajasthan, Tamil Nadu and Rajasthan. However, the oil companies are implementing new technologies to enhance recovery from ageing fields.The oil companies have taken/are taking several measures to revive the sick wells to increase oil production, such as improved Oil Recovery/Enhanced Oil Recovery schemes. The key focus area for India's future upstream sector would be increasing the domestic production by encouraging exploration to meet the huge demand for O&G in future.

In order to ensure that this potential is realized, we need to adopt policies and take measures to provide a conducive environment to both Indian and International companies so that E&P activity in India could be invigorated. There is a need for a concentrated strategy to unleash the domestic E&P potential, so that the maximum of energy resources from within the domestic

R S Sharma
Former CMD
ONGC

Mr. R S Sharma is the former Chairman and Managing Director of India's premier national oil company- Oil and Natural Gas Corporation Ltd (ONGC). He was also concurrently the Chairman of ONGC Videsh Ltd (OVL), Mangalore Refinery & Petrochemicals Ltd (MRPL) and five other ONGC Group companies during 56 month period May-06 to Jan-11. Earlier he was Director (Finance) of ONGC from March 02 to Dec 07.

Mr. Sharma was intensely associated with various industry associations and federations in responsible capacities during his tenure as CMD ONGC. Post superannuation, he has been on the Boards of various companies, besides Chairman Quality Review Board of the Institute of Cost Accountants of India for four years. He was also Chairman of Expert Committee for review of Maintenance of Cost Records & Cost Audit Rules, and member of Kelkar Committee for Roadmap for enhancing domestic production of Oil & Gas and sustainable reduction in import dependency by 2030.

He continues to hold the position of Chairman-FICCI Hydrocarbon Committee. Currently, he is Senior Advisor to Mckinsey & Co.

basins could be exploited. This will not only be a constructivemove in the direction to make India self-sufficient in energy and save precious foreign exchange, it would help in containing the burgeoning current account deficit and create employment opportunities in the economy.

Hydrocarbon exploration successes during the first decade since the launch of NELP in 1999 had given the confidence of achieving this dream, noticeably Barmer oil discovery by Cairn Energy and KG-D6 Offshore gas discovery by RIL. The subsequent period however does not sustain that confidence. Though the hydrocarbon exploration sector takes several years for policies to result into production gains, it is never too late to look forward. The sector is promising both for investors as well as the industry.

Developing the domestic exploration and production sector comes with a set of challenges. It is commendable how the government has played a proactive role in implementing policy reforms and has taken certain measures to provide a conducive environment to both Indian and foreign firms so that E&P activity in India could be developed.

Some of the recent initiatives that the government has taken to incentivize domestic E&P are enumerated below:

- Inviting bids, awarding, and signing contract, for discovered small fields, and granting extension to the production sharing contracts under Pre-NELP regime.
- With broader objectives of enhancing E&P activities, the Hydrocarbon Exploration Licensing programmewas introduced in March 2016 and formally launched in June-17. The new policy regime intends to:
  (a) Boost domestic oil and gas production;
  (b) Attract substantial investments and generate employment in the sector and allied industries; and
  (c) Bring in much needed transparency and stability in the E&P sector.
- The introduction of Uniform licensing policy provides the liberty of exploring and producing all hydrocarbons under one license.
- The Open Acreage Licensing Policy (OALP) under HELP allows the explorers to study the data available and bid for blocks of their choice is a great measure to increase the participation of global E&P companies. To encourage investment in deepwater and ultra-deepwater projects, which are considered to be risky but rewarding, royalty rates for both oil and gas were rationalized.
- To consolidate and store all the Geoscientific data available in the country and to create a base for Open Acreage Licensing Policy, GoI has taken initiative to build National Data Repository (NDR) for Oil and Gas Industry in India.Setting up of the National Data Repository is one of the milestones achieved for Open Acreage Licensing Policy.

Apart from the above measures new policies and administrative directives are bound to stimulate future growth of the sector.

State owned upstream major ONGC has been striving hard to explore more fields and increase productivity of existing fields. In the financial year 2016-17, ONGC discovered 23 fields and commercial production from these fields would boost domestic oil and gas supply in the near future.Oil companies are focusing on vertical integration for next stage of growth.

Simultaneously, private companies are putting efforts to increase production from existing fields. Last month, RIL and BP jointly announced a fresh investment of USD 5 billion to develop satellite discoveries in their KG D-6 offshore block. Efforts are being made to increase recovery from the maturing fields. Encouraging results from the first bidding round of small discovered fields could be replicated in the future.

Despite these advancements, the domestic E&P sector has large possibilities for reforms, advancements and growth. Though there have been some positive moves, but the immediate need is an actionable operating philosophy and favorable framework of policies that can help accelerate the efforts for exploring and developing oil and gas, thereby ensuring energy self-sufficiency for the nation.

The following are a few strategies on what needs to be done to unleash the domestic E&P Potential, which will not only make us self-sufficient in energy, but will also create opportunities for establishing a vibrant manufacturing sector in the E&P space.

- Faster regulatory & statutory clearances are required to facilitate investments in India by E&P service industry.
- To restore the confidence of the investors it is important to bring about stability in the tax regime.
- Measures need to be taken to expand reserves. National Seismic Programme should consider undertaking a fresh appraisal in all sedimentary basins across India and Re-Assessment of Prognosticated Hydrocarbon Resources of India should be done.
- Development of Infrastructure- It is the need of the hour to provide better quality rail & road infrastructure to enable easy movement of equipment.
- Make in India could be effectively realized in E&P manufacturing. Currently the extent of Indian manufacturing in country's E&P is between 22-25%, as against Brazil and Norway's 50-60%.
  - o India could very well adopt the 3 key factors that contributed to significant increase Brazil's local E&P
    a) Procurement policy,
    b) Direct financial incentives, tax-breaks from the government and special programme on modernization

of supply vessels and
c) Emphasis on building R&D and in-house capabilities.

- Even though close to India's 60% of Oil & Gas assets are in offshore, contribution of Indian shipping industry to E&P activities is negligible. Shipping industry needs to be strengthened via a combination of order commitment and fiscal incentives.
- The government could consider setting up of Service Industry Clusters which could not only meet indigenous needs but also be used for exports.
- Oil & Gas service industry needs to be strengthened by providing thrust on Skill development, creation of joint ventures for manufacturing and R&D and correcting fiscal regime to ensure indigenous manufacturing is preferred over imports.
- New reforms for difficult areas like CBM, Shale Gas and National Gas Hydrates Programme should be accelerated as suggested below:
  - Coal Bed Methane (CBM)
    - The estimated CBM resources are of the order of 2600 BCM/91.8 TCF spread across 11 states and current production is 1.64 MMSCMD
    - Further relaxation in Coal Bed Methane (CBM) Policy should be considered.
  - Shale Gas
    - According to Energy Information Administration (EIA), USA in 2013, 584 TCF of shalegas and 87 billion barrels of shale oil in 4 basins: Cambay Onland, Damodar, KrishnaGodavari & Cauvery Onland.
    - NOCs to assess the Shale Gas potential
    - India should fast-track its National Gas Hydrate Programme to establish the presence and potential of gas hydrates and develop producible gas hydrates discovered in KG deep offshore areas to deal with its increasing energy demand, uncertainty of its supplies, and urgent need to reduce greenhouse gases (GHG). However, like other countries, India, too, is in a nascent stage of developing its NGH resources, in part due to economic and technical challenges which should be addressed.It is projected that the success in the Gas Hydrates should be encountered in the next 10 years.

There has been a steady decline in India's domestic O&G production—oil production fell by 4.7 percent in the last four years, i.e., 37.8 MMT in 2013–14 to 36 MMT in 2016–17, while natural gas production fell by 7.7 percent, i.e., 97 MMSCMD to 87.4 MMSCMD21. Therefore, increasing domestic production is critical to reduce India's import bill and to build a gas based economy. Higher domestic production in the near future would not only boost supply of crude oil to the existing refineries and upcoming mega refineries but may also assist India to emerge as a refining hub in Asia. Additional incentives to domestic service companies will allow them to compete with the global majors. Also, these incentives will foster entry of new players who have not entered the sector owing to various reservations about the prospects.

The draft National Energy Policy released by NITI ayog in June-17 is a genuinely sincere effort to address the energy security issue in a comprehensive manner.

Undoubtedly, the concerted efforts of the government along with new policy initiatives are well directed to enhance domestic hydrocarbon production. However, cutting down the import dependency by 10% through 2022 is anambitious task and may take a much longer time to realize.

E&P Strategy to cut oil imports by 10% by 2022: ONGC's Imperatives

By T K Sengupta

The growth of India and the growth of all its social, developmental and economic aspirations have largely been fuelled by the hydrocarbon industry, be it upstream, mid-stream or downstream. If India today has emerged the third largest economy in the world, Oil & Gas have played a key role it and is poised to play the much greater role in future given India's momentum towards occupying the next higher pedestal. In 2015 itself, India has witnessed 5.2% growth in primary energy consumption as compared to china which witnessed a slow growth of only 1.5% and world witnessing growth of only 1%. India has contributed the single largest share of growth, around 25%, in global energy demand. So, India has been and will continue driving the energy consumption in the world.

The year ahead is going to witness a sustained period of rapid growth in energy consumption based on the fact that huge energy will be required for many a new government initiatives like developing manufacturing base through "Make in India", employment generation through "Stand-Up India", modernisation plans through "Smart cities" and the rising income combined with large young population aspiring the better way of life.

So India requires huge energy. India requires big oil & gas volumes. The demand for crude oil and natural gas in India is growing at a steady rate as seen from the charts below. The demand forecast for crude oil show more than 300% increase by year 2040 compared to year 2000. But our efforts to domestically produce crude oil and natural gas are not matching with our demand. India's oil supply Growth for the period 2005-14 has seen CAGR 2.2% whereas India demand growthfor the same period 2005-14 has witnessed a CAGR 4.4%.So,to bridge the ever widening gap between demand and supply, we are importing huge oil volumes of hydrocarbons. Close to 77% oil & gas volumesis being imported by India to meet all its developmental aspirations and in the process, India has to spend a huge amount of valuable foreign exchange to import those precious hydrocarbons.Close to 1000 billion US dollars have been spent by the country on import of crude oil since 2006 onwards till FY'2016.

Few things are happening now. India's movement up the ladder in world economic order is requiring a huge amount of energy but our domestic production is only a fraction of what we need. Imports has saved us in the past and still imports are the only option in the near future. But the way geopolitics are changing and the resource nationalism is happening across the world and the way civil tensions are being witnessed in the oil exporting countries, India needs to have a re-look at its import options. The political turmoil in Nigeria, Syria, Iraq, Angola, South Sudan, Russia-Ukranie crisis, South China Sea disputes are some of the eye-openers that may impact the way oil & gas business will be carried out in future. Adding to the great concern is the sustained low oil price regime and the subsequent portfolio reshuffling which all the major players are going for. In all likelihood, the low oil price regime is going to continue till significant time in future, thereby hampering and de-accelerating the efforts for bringing new volumes to the surface

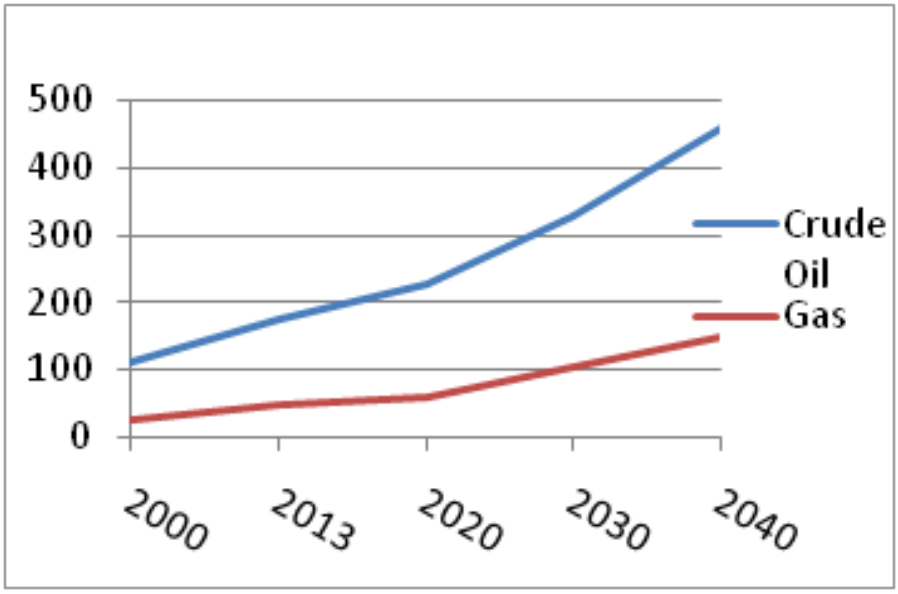
T K Sengupta
Director (Offshore),

Shri Tapas Kumar Sengupta took over as Director (Offshore) ONGC on 01.02.2014. He is also Director in charge Business Development & Joint Ventures and Marketing. He is Director in the Board of OVL, Pawan Hans Ltd. and Dahej SEZ Ltd. A first-class Chemical engineering graduate from Jadavpur University, Calcutta, Sengupta holds a Diploma in Management and a leadership certificate from ESCP, France and IMI Delhi.

Tapas Kumar Sengupta belongs to the select club of production engineers from ONGC who has a balanced exposure to both onshore and offshore oilfield operation in the last 36 years of his long career with ONGC. He has received ONGC's Highest Award i.e. Chairman Award twice, in 1994 & 2001, for production enhancement in Western Offshore fields with introduction of new technologies. He has also served in Sudan as General Manager in Greater Nile Petroleum Operating Company (GNPOC), on deputation to ONGC Videsh Ltd., for 4 years.

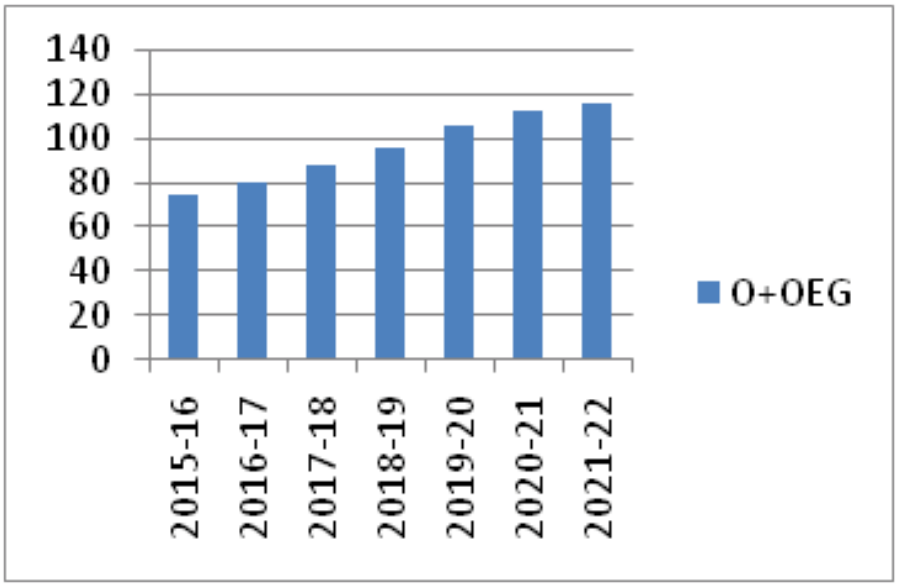
Mr Senguptais actively associated with Society of Petroleum Engineers (SPE), USA and he is presently inducted in the International SPE Board as Regional Director of Asia Pacific Region.

Oil and Gas Demand(MMTOE)



Source: IEA India Energy Outlook 2015

Projection for O+OEG (MTOE) production



Source: PPAC

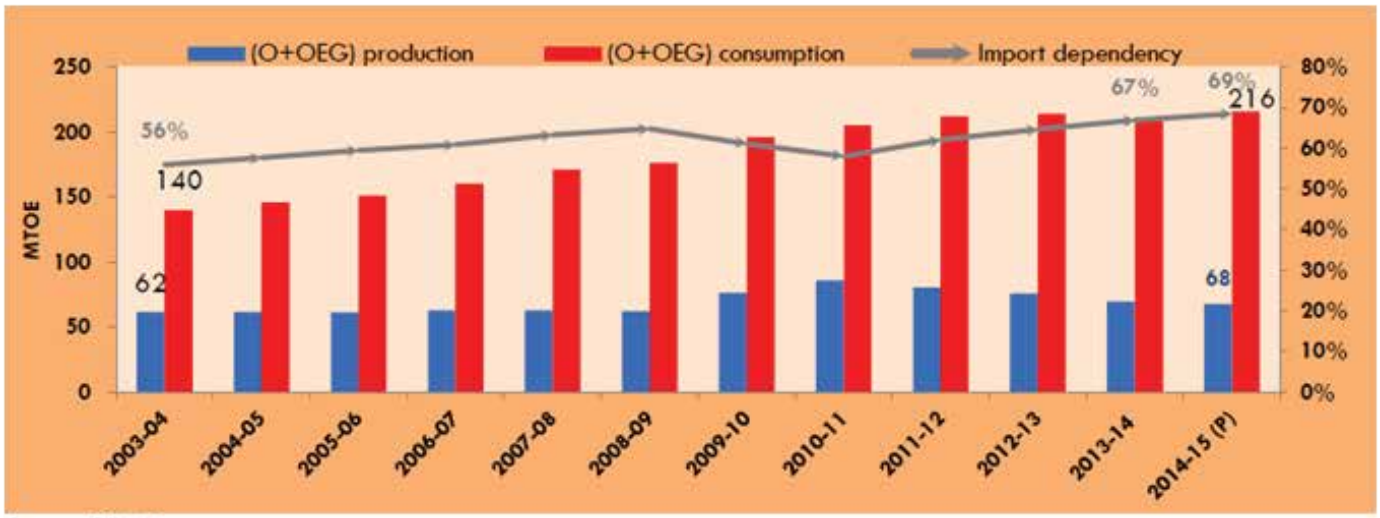
offsetting the natural decline that will creep-in anyway.

So given these geo-political and market imperatives, it becomes quite imperative for importing nation like India to augment its domestic production of oil & gas and cut-down whatever little we can towards import dependency. The chart below shows the combined estimated import dependency on crude oil and natural gas. It indicates that O+OEG production has grown at a CAGR of about 0.8% from 2003-04 to 2014-15, whereas the domestic consumption of O+OEG has increased at a much higher CAGR of 4%. This shortfall in domestic production resulted in import of O+OEG which was about 56% of O+OEG consumption in 2003-04 and increased to more than 69% of consumption by 2014-15.Currently the import dependency for Crude Oil is around 79% and for natural gas it is around 36%.

Probably, this larger picture might be there in mind ofthe Government when our Honourable Prime Minister gave us a clarion call to reduce our oil imports bill by 10% by 2022 while addressing during the Urja Sangam on 27th March 2015. He said "We currently import around 77% in energy sector, in oil, gas and petroleum sector. We can reduce this import by at least 10 percent by 2022. This 10 percent we will produce ourselves and this should be our dream."Out of many elements involved in this, the significant one is augmenting the production of oil & gas domestically.

To meet the intended objective, Government has harped on a 5 pronged strategy: Increasing Domestic Production; Promoting Energy Efficiency and Conservation Measures; Demand Substitution; Capitalizing potential in Biofuels and other Alternate Fuels/ Renewables; Implementing measures for Refinery Process Improvements. But the major thrust is on augmenting domestic oil & gas production. But this 10% import reduction by 2022 is not the end of the story. To my understanding, the Honourable PM requires all of us in this sector here to pull up our socks, to fast pace our efforts and give the country whatever extra we can give from the huge potential which is lying below our earth within Indian Territory.

On the basis of the direction set, some road maps have emerged and these roadmaps are getting further fine-tuned to get rolled out. The estimated demand in 2021-22 happens to be around 318 MMTOE and requirement for 10% import reduction works out to be around 62 MMTOE. As expected, huge onus is lying on the shoulder of ONGC to make this 10% import reduction dream into a reality. Over the last 70 years of its existence, ONGC has been fuelling the aspirations of this nation in a very big way contributing around 70% of total domestic



Source: PPAC
(Note: 1 BCM of natural gas= 1 MTOE)

hydrocarbon productions and in future as well, a huge volume is expected from the fields which ONGC has in its kitty.

ONGC has done the ground work and has come out with the road map towards meeting the PM's clarion call. ONGC has to produce around 2 MMT Oil extra over and above whatever ONGC has planned through its long term production projection. To meet 10% import reduction, ONGC's projection for Gas production by 2022 is in line with what is expected. So ONGC has now three issues in hand:First: to roll out effectively whatever ONGC has planned to meet its projected numbers for 2022. Second: To work out from where the extra numbers will come to meet the 10% import target. And Three: To conceive and projectise whatever potential it has in her fold to steer the country forward.

Strategy-1

The very first strategy is to boost deliverables from our base profiles. Since inception, ONGC has put on production 295 oil & gas fields, both prolific bigger ones and smaller fields as well, in a phased manner and another 46 fields are on the verge of producing oil and gas volumes. The prolific fields are still producing despite turning matured and still holds significantly good potential to produce. We have planned to improve recovery factor in these fields through many a redevelopment and additional development schemes and also through some enhanced oil recovery mechanism.

Through, 16 schemes in offshore areas and 6 schemes in onshore areas which have either completed recently or likely to get completed in a year or two, we are trying to add significant volume in our kitty and this will form the bulk of our volume (around 72%) that will be added by 2021-22. With a capex of over Rs. 72,000 crore, we are sure to give the country incremental (over the base volume) cumulative oil volume of 71 MMT and cumulative gas volume of over 137 BCM in the project life which varies from 10-15 years. 3rd phase redevelopment of Mumbai high North and South fields, development of Daman field, 3rd phase redevelopment of Neelam field, Enhanced recovery from Bassien field, development of Vashistha & S1 field in eastern offshore and development of smaller fields like C-26, B-127, B-55, B-173A,etc in offshore areas and redevelopment of Gamij field, redevelopment of North Kadi field, development of Madanam field and enhanced oil recovery schemes in Bechrajee and viraj fields in onshore areas are some of the schemes which are almost nearing completion and which are expected to add significant incremental volumes under this first strategy which at ONGC we call Firm category schemes.

Strategy-2

ONGC's next strategy is to monetise around 25 discoveries where development plans has already been conceptualised and where technical due-diligence and investment proposals have already moved to advance stage and where we are expecting the project roll out in a year time.

Through 13 schemes in offshore areas and 5 schemes in onshore areas, we are hopeful of giving country incremental oil volume of 56 MMT and cumulative gas volume of over 75 BCM in the project life which varies from 10-15 years. Some of these projects will start producing oil around the target year and is expected to contribute around 28% of target crude oil production of 2021-22. 4th phase of redevelopment of Mumbai High, 3rd phase of redevelopment of Heera field, 4th phase development of NBP field, development of R-series & R-12 fields and development of KG-DWN-98/2 cluster-II field and development of smaller fields like BSE-11, B-147, B-134..etc in offshore waters and development of Nagayalanka, Gamij, Chinnewala tibba, Bhuvangi-

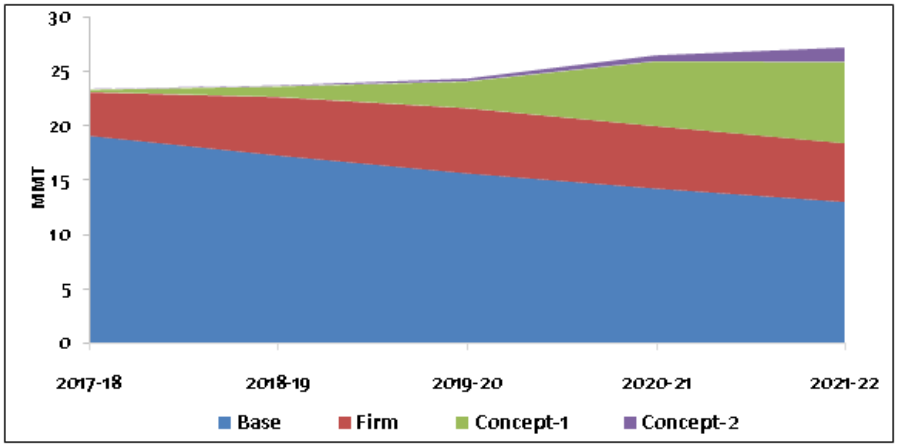
ri & Periyakudi fields in onshore areas are some of the schemes which are witnessing good progress under this second strategy which at ONGC we call Category-1 schemes.

Strategy-3

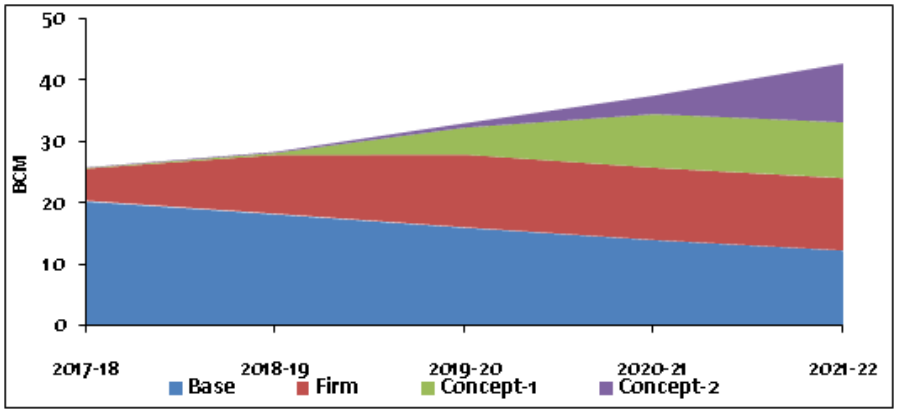
Moving forward, ONGC has also identified around 48 discoveries for which conceptualisation, technical due-diligence and investment proposals have started taking shape and which by all probability likely to get approval and roll out in two years' time. This, however, does not form part of expected volumes targets of 2021-22 but will act as a "next things" to take the honourable Prime Minister's vision forward beyond 2022.

Through 16 schemes in offshore areas and 3 schemes with a cumulative volume of around 5 MMT of oil and 114 BCM of gas (subjected to further corrections), we have plans to look into the upside potentials of Heera, Neelam, B-173A, B-22 cluster, B-193 C cluster fields, development of GK-28/42 field, additional development of North Tapti field and development of SD-1 fields in western offshore areas; development of KG-DWN-98/2 Cluster-III, KG-OSN-2004/1 & GS-49/-2 and Vaitneteyam field in eastern offshore areas and development of Chintallpalli, Medapadu, Manepalli and Ghotaru fields in onshore areas besides the 2nd phase redevelopment of Nagayalanka field and polymer flooding in Bechrajee are some of the schemes which we are intended to look into under this strategy which at ONGC we call Category-2 schemes.

Crude Oil Production Projection (in MMT) for ONGC 2017-18 to 2021-22



Natural Gas Production Projection (in BCM) for ONGC 2017-18 to 2021-22



Apart from the various schemes as identified under Strategy-1, Strategy-2 and Strategy-3 labelled as Firm, Category-1, Category-2, we have also identified around 42 Discoveries for which production potential is under estimation right now along with formulation of the conceptual development plan/feasibility. It is expected that investment approvals would be obtained in respect of these discoveries most probably within a period of three years. Projectisation of these discoveries will act as a "next things" to take the honourable Prime Minister's vision forward beyond 2022.

So ONGC is engaged and fully geared up to exploit the good volumes from the old matured fields and bringing new volumes from the new & smaller fields. We are putting in place the best of technology, tools and tackles commensurate with our field characteristic & requirement to fetch additional volumes. In next 5 years' time, we have planned some 2200 development inputs, 72% of which is planned for projects under firm category as described under strategy-1.

We are also relooking at our exploratory efforts and aligning it with our efforts towards 10% import reduction. We are concentrating on enhancing value by augmenting reserves of existing discoveries which currently are not economically viable (discoveries under Concept-II & III); by carrying out sustained efforts to consolidate the leads and by accreting new reserves through accelerated exploration. Apart from the technology induction and pursuing innovative measures/techniques to improve production from individual wells & reservoir.

We are also pursuing Enhanced Oil Recovery techniques aggressively to produce some bigger numbers. Having seen good success of our initial EOR projects in onshore fields, we are planning to push EOR techniques further in our onshore

fields like Alkaline Surfactant Polymer flooding (ASP) in Viraj & Jhalora field, Polymer flooding at Bechrajee field, Cyclic Steam Stimulation in Lanwa field,Water-alternating-Gas (WAG) flooding in GS-9 sand of Gandhar field, Immiscible gas injection in KSU-V sand of Boroholla field. Most importantly, we are pursuing EOR in carbonate reservoir of Mumbai high field through low salinity water flooding techniques. Worldwide EOR techniques in carbonate reservoir has not met much success (except the few in USA fields) but seeing the expectations which we have from the nation, we are trying our best feet forward to find some EOR solutions for our most prolific Mumbai High field. We are constantly re-visiting our development methodologies to fast-track our efforts. Wherever felt necessary, we are "rebooting" our knowledge, skills, strategies, practices, procedures, indulgence and all the other aspects of the operations, process &projects to ensure that expected deliverability is achieved.

Our ex-ONGCians are aware of the strength and the capabilities of their organisation. They have put their best of efforts to see where the organisation is today. Through this article, I wish to reassure them that ONGC is capable of fulfilling the aspirations of the nation and in specific terms, is geared up to meet 10% import reduction call given by our honourable Prime Minister. With the roadmap and strategies in place, we are sure of coming with flying colours.

Comments on draft National Energy Policy

By M R Pasrija

Incentivize mature fields to maximize economic recovery of hydrocarbons

The Draft National Energy Policy emphasizes the need to rejuvenate mature fields & extract full value. While encouraging closer association between the National Oil Companies (NOCs) & private sector, one key policy lever already acknowledged by the Draft policy is equally important to incentivize mature fields to maximize their economic recovery. Many countries have successfully deployed this policy tool. In the Indian context, this calls for a forward-looking policies for production sharing contract (PSC) extension and Enhanced Oil Recovery (EOR) projects.

PSC extension on same fiscal terms

In a welcome move, Government of India (GOI) introduced Production Sharing Contract (PSC) Extension policy for Pre-NELP Small, Medium sized and Discovered fields & Pre-NELP exploration blocks. This enables oil & gas investors to plan & commit investments and create more certainty for investors.

It is well accepted that most of the fields during the extension phase are on a decline with higher operating expenditure & development costs. These need new technologies to sustain and increase production. Given that India is short on hydrocarbons & all future projections portend increased dependence, it is imperative that it attracts investments. To this end, existing contracts should be extended on same fiscal terms & conditions. However, the provision of 10% increase in GOI's share of profit petroleum & payment of royalty & cess on higher terms are a step backward.

A quick analysis of global examples, across tax regimes, highlights that the investments & production maintenance & growth are key drivers for government strategies towards license extension. Only in a few countries, government revenue consideration drives license extension. More importantly, very rarely, government revenue consideration drive license extension in an oil importing country.

In the extended period of contract, investors will witness significant erosion of value given that government has increased its share of project revenues. Hence, it is strongly recommended to extend PSCs on same fiscal terms (Profit petroleum, Royalty & Cess).

Incentivize Enhanced Oil Recovery (EOR) projects to maximize India's resource potential

EOR represents a unique opportunity for India to maximize resource potential. This is particularly important given that India is short on hydrocarbons & the Hon'ble Prime Minister has envisioned reduction in imports through higher domestic production.

With sustained low oil prices, going forward it would be challenging to monetize expensive projects such as deepwater, difficult reservoir projects, amongst others. Focus now is increasing on production from conventional plays. EOR projects thus can be an ideal, bridge choice in sustained low oil price era. In India, potential exists

M R Pasrija
Former CMD, (OIL)

Mr. M R Pasrija was Chairman & Managing Director of "OIL India Limited" (OIL) and was Managing Director of Prize Petroleum Company Ltd. He is with rich experience of more than 35 years in the Hydrocarbon Industry. During his tenure with OIL as CMD, he gave highest growth & also got Navratna status for OIL.

He obtained Government approval for OIL's maiden IPO to issue 11% new issue equity shares. He laid very strong base for IPO, which led to over subscribing 31times of IPO. It was most successful Government IPO's in India. He was Independent Director in Konkan Railway Corporation Ltd. and Mecon Ltd., He was also member of Board of Governors of Sri Sharda Institute of Indian Management.

He was also member of the Task Force on Petroleum Sector PSU's. He won various prestigious awards during his tenure as Director Finance & CMD of OIL. He won Enterprises Excellence award during 2005-06 from the Indian Institution of Industrial Engineering and was also awarded Amity Leadership Award 2008 for sectoral excellence in Petroleum and Natural Gas for outstanding contribution to the growth of Indian business and bringing glory to the Country through pioneering leadership.

to ramp up production through EOR projects. However, EOR projects have very high cost structure vis-à-vis conventional production. In addition to costs associated with conventional production, an EOR project entails cost of chemicals / gas (in case of gas injection) and associated infrastructural facilities. EOR projects require significant ongoing investment to sustain output. These results in higher project costs, lower returns and hence acts as a disincentive for investors to undertake large-scale EOR projects.

Many countries thus provide targeted incentive to maximize economic recovery of hydrocarbons through EOR projects. India can draw useful lessons from these countries. It is heartening to learn that the GOI recognizes the role incentives can play in the India context. It has already initiated public consultations for a policy framework. In the past, GOI notifications had provisions for a reduced rate of royalty for production from fields under EOR / IOR. Similarly, some PSCs also provide for fiscal incentives for an EOR project.

Against this larger backdrop & GOI's liberalization drive, it is strongly recommended that Government of India should:

i. Abolish Cess for production from EOR
ii. Attract reduced rate of royalty on production from EOR

Open Acreage Policy

This is a significant step taken by Govt. of India and it is going to be a game-changer. First of all, instead of the govt. specifying to the E&P companies where to explore and exploit hydrocarbons, the companies will now be able to carve out their own blocks. This policy reiterates Govt. of India's commitment to reduce administrative and regulatory burden, thus will facilitate enhancing ease of doing business in the country. The backbone of this policy – the National Data Repository – has already been launched. This contains a huge database including processed seismic data, well logs and reports on India's hydrocarbon basins. Further, ONGC and OIL have been assigned the task of coordinating the acquisition of seismic data in unexplored areas, which would further become a part of repository. Secondly the open acreage bidding round is based on revenue sharing instead of erstwhile production sharing model. Since it ensures less interference by govt., revenue sharing is going to be far more investor friendly as compared to the production sharing model.

Maximizing the domestic production of oil and gas and supplementing the energy requirement of the country from other resources

By D N Awasthi

Government of India has declared its intention of cutting down its expenditure on the import of oil and gas by stepping up action in respect of locating and economically exploiting its existing and new discovered oil/gas fields. The steps to implement policy in this regard were discussed by the Minister of State Shri Dharmendra Pradhan with the members of newly formed Integrated Monitoring and Advisory Council (IMAC). In this meeting it was decided to update and initiate actions needed in respect of Resource re-assessment, Open acreage licensing policy (OALP), Hydrocarbon exploration licensing policy (HELP), Discovered small field policy, exploiting Unconventional Sources like Coal bed methane (CBM), Shale gas, and Biofuels. The main objective of IMAC is to prepare a roadmap for realizing an objective of cutting down the import of oil and gas by 10% by 2022 A.D. Some of the features of such a roadmap could be

1. Enhanced oil recovery from the existing oil fields
2. Production from small and proximate oil pools
3. Search for new small hydrocarbon pools
4. Biomass resources and bio fuels
5. Extensive and vigorous use of renewable energy resources
6. Coal based energy resources and systems

Enhanced oil recovery from the existing oil fields

Normal production from the oil reservoirs usually does not exceed 60% of the reservoir content, even after employing EOR. For enhancing the oil recovery from an oil field, the EOR technique appropriate to the conditions of an oil reservoir needs to be applied.

In normal EOR in an oil field, the pressure of injected water breaks down the continuity of the oil in the reservoir, resulting in progressively increased water production and reduced oil production. Disconnected oil globules cling to the reservoir rock or shale in an ion chain, holding them in place within the reservoir rock/shale. By incorporating appropriate chemistry of the injection fluid, this ion chain can be broken, leading to enhanced hydrocarbon recovery.

In sandy reservoirs, hardened due to very high geological pressure at the time of their formation, as well as in very low permeability limestone reservoirs, use of high intensity acoustic waves through well bore creates micro fractures in the reservoir rock, increasing its permeability. Thereafter, the micro- fractured reservoir may be subjected to cycles of low and high pressure. During low-pressure

D N Awasthi
Former Member, ONGC

D N Avasthi has over five decades of experience of exploring and discovering petroleum resources, out of which 36 years were spent in the domestic and foreign operations of ONGC in various capacities. He is credited with introduction of new technologies in petroleum exploration, including introduction of computers for different applications in ONGC. He is credited for the discoveries of hydrocarbon fields in Cambay, Cauvery and Krishna Godavari basins. His expertise encompasses Exploration for petroleum, Associated research, Corporate planning, Managing major exploration projects and Human Resource Management at the board level. Mr. Avasthi retired from ONGC as a Member of the board.

Mr. Avasthi has published over 50 scientific and technical papers in reputed journals and over 50 Technical Reports. He has been honoured by awards from Geol. Survey of India, Indian Geophysical Union, Assn. of Expln. Geoscientists, Society of Petroleum Geophysicists and Geol. Soc. of India.

Mr. Avasthi has his academic degree Master of Science in Physics from Allahabad University, a Certificate in Geophysics from L'Institut Francais du Petrole, Rueil Malmaison in Paris and a Certificate in Computer Science from I.I.T. Kanpur.

cycles, the trapped oil globules would burst into vapour within the pore. The pressure differential then enables the hydrocarbons to flow towards the well, where they can be drawn out of the ground.

There are also examples of the use of appropriate chemical feed for the microbes living around the globules of oil trapped in the reservoir, which leads to the rapid multiplication of their numbers. The microbes break the oil globules into micro oil droplets, making it more mobile and easy to recover.

Production from small and proximate oil pools

Production from small and proximate oil pools can be achieved at low cost by accessing the nearby small pools in sequence from one of the rig located at the main oil field and using "Plug & Play" to drill inclined or horizontal wells reaching the oil reservoirs of the nearby small pools. If such pools are located at distances making it technically unsound to drill from one location of a rig, a portable rig can be mounted on a suitable truck or boat (if the pools are in the offshore) and located over the proximate pools in sequence to drill wells. After completing the wells, a production system may be installed at each of the drilled well and the drilling rig moved to the next location.

Search for new small hydrocarbon pools

Using a novel technique of geochemical cum geophysical exploration, search for undiscovered small pools at low cost can also be carried out. In this process, geochemical soil gas surveys are carried out and methane samples collected. Stable isotope analysis of carbon in methane can differentiate between biogenic and thermogenic dry gas. As biogenic gas is unrelated to the processes that form oil, the existence of a petroleum system at deeper depths may be discounted. However, if isotope analysis shows the gas to be mixed biogenic and thermogenic, there is the need for exploration for oil reservoir beneath a biogenic reservoir. The surface geochemical soil gas survey over the area limited by the surface gas presence shown by the geochemical gas survey, needs to be subjected to close grid seismic survey. A test drill based upon the interpretation of seismic data will assess whether an active petroleum system exists at depth and locate the areal extent of such reservoirs.

Geochemical soil gas survey anomalies when correlated with seismic, can tell before drilling whether a target formation contains oil, condensates or gas.

Biomass resources and bio fuels

Solid biomass and agricultural, forest, urban, and other wastes can be used as feedstock to produce bio fuel like ethanol, which is blended with petroleum in refineries. Bio fu-

els have the potential to reduce the greenhouse gas emissions from the transportation sector.

India needs to deploy technologies that are able to convert the wastes generated in the country to transportation fuels, as also to chemicals and materials. Agricultural wastes are required to be converted into bio fuels using proper technology in the extensive agricultural belts of different states. By selling these bio fuels to refineries, farmers can get additional income from their field products. Minister of State of Petroleum has emphasised on the states setting up bio fuel projects in villages extensively. He has said that if bio fuel projects are taken up on large scale in the country, savings on import bills on petroleum fuels can be made by about Rs. 1 lakh crore.

Given the complexity of these 'waste' feedstocks, the desired bio fuels cannot be produced by any well-defined chemical catalysis. Involvement of one or more biological conversion methods is essential in all cases. India needs to invest smartly in bio fuel technology development and deployment. Diverse technologies are required to be used to set up projects on fast track to produce (i) Ethanol (gas and liquid fermentation from biomass and Municipal Solid Waste MSW). (ii) Biodiesel (from algae grown on sunlight and carbon dioxide). (iii) Hydrocarbon/s (including terpenes and methane by fermentation of biomass and MSW). (iv) Hydrogen (solar or fermentation of biomass and MSW; catalytic conversions of biomass and MSW).

A number of start-up companies have shown interest in setting up projects based upon conversion of wastes into conveniently usable fuel for commercial cooking, transport and back-op power generation. One of the very successful start–up venture in this aspect has been Carbon Masters of Bengaluru, whose bottled branded product Carbonalites has been replacing LPG in hotels, CNG in auto-rickshaws and diesel in back-up power generation systems.

Shell Technology Centre (STCB) at Bengaluru has developed a technology called IH2 to convert municipal and agricultural wastes into a bio fuel, which is rated more efficient than ethanol for blending with petroleum refinery products like petrol and diesel. In IH2 process, agricultural, forest and municipal wastes (including plastic bottles) are heated with hydrogen and some added catalysts. The product is palletized in specially designed kilns after separating water generated in the process, to produce naphtha, which is refined to produce the bio fuel.

It is good national policy to develop such gas resources to reduce environmental footprint.

Extensive and vigorous use of renewable energy resources

Besides the fluidic resources of energy, the government has been stressing on the generation of energy from the renewable sources like wind and solar power.

One of the major steps being taken by the government is to encourage and support the generation and usage of solar energy. It has set a target of having 100 gigawatt (100,000 megawatt) of solar power installed by 2022. For the promotion of solar energy use, it has set up Solar Energy Corporation of India.

However, India could add only 827 megawatt of solar power generation capacity in the first three months of the current financial year. This is about one third of the pace needed to achieve a 10,000-megawatt addition in solar power target for this year. To achieve the set target for the current year, the pace of solar energy panel installations has been formulated to be accelerated four times the rate of pace so far by extending solar panel installations from urban to rural areas and from open land to the space above selected stretches of trunk roads and canals

India has an abundance of sunshine, which is virtually free fuel! Technology for improved solar energy extraction, e, g. use of non-reflecting solar panel covers (enabling almost 100% absorption of solar energy by the solar cells), IoT software controlled multiple panel solar energy optimization system (recovering 80% of the energy lost by the system) can be used for all solar installations, specifically for rooftop ones. With the objective of incentivising people to use more and more solar energy, government has made appropriate concessions to solar power companies, making the energy from solar source available to public utilities at low tariffs. For example, SECI (Solar Energy Corporation of India) is providing solar energy to a select sector comprising of

- Schools
- Colleges
- Universities
- Hospitals
- Medical Institutes

at rates, which start at Rs. 3 per unit. NTPC is playing an important role in private solar developments by purchasing the electricity from solar energy companies.. Its strong balance sheet de-risks such private investment, helping to drive down the cost of solar energy.

With exponentially growing improvements in technology, India has the potential to leapfrog directly to a solar-based, cheap, sustainable and green energy economy. Padmashree Prof. Ashok Jhunjhunwala of IIT Madras has been assigned the task of transforming India to a self-sufficient, green energy country by 2025 A.D., by the Power Minister Shri Piyush Goel and the PM Modiji. According to his plans, 400 million vehicles, including cars,

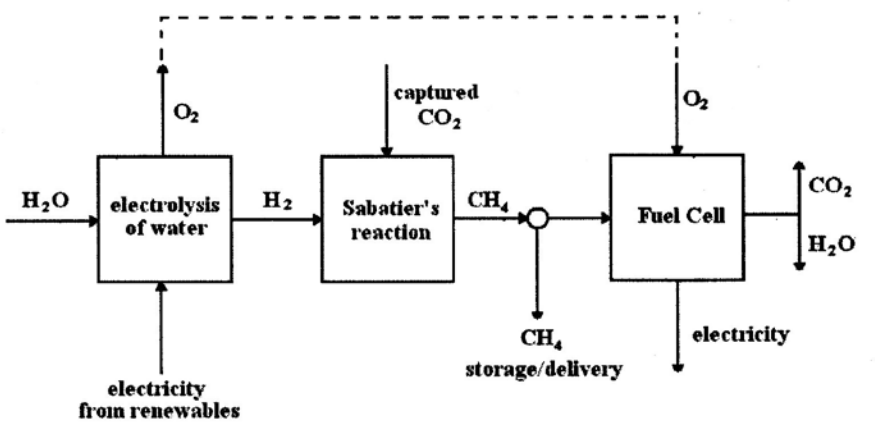
three-wheelers, two-wheelers, buses, trucks etc. will run using electric power – most of it generated by solar. It is also planned to use DC on the electricity grid instead of AC, which is the default everywhere in the world today. This would save a lot of power that is wasted in converting repeatedly from AC to DC and back (up to 50-60%) instead of staying with DC throughout. Prof. Jhunjhunwala has invented the design of a 48-volt DC electrical micro-grid, powered by solar energy, which is much better suited and safe for India.

As far as wind energy is concerned, it is being incorporated in the coastal areas, particularly in Tamil Nadu, for the present. There are plans to increase the wind power from installations in Rajasthan and Cambay regions, but the main concern to be attended to is the repair and maintenance of the wind fans.

Coal based energy resources and systems

Carbon di-oxide has been blamed for the climate change in the world. But carbon di-oxide is a necessary component of our atmosphere, which is the major feedstock for the plantations, forests and greeneries in which we live and which we admire. Besides, the plant vegetation of the world provides needed feedstock for the living beings on our planet. The blame lies with the humans and their civilizations, which have contributed to the excess carbon di-oxide in the atmosphere disturbing the healthy and genteel behaviour of climate of the earth. Scientists have been trying to find solutions to this problem and have been developing devices and techniques to capture the excess carbon di-oxide let out in the atmosphere by excessive use of carbon laden energy sources. One such method has been to develop new 'clean coal' technologies.

New 'clean coal' technologies enable utilisation of world's enormous resources of for future generations without contributing to global warming. Much of the challenge is in commercialising the technology so that coal use remains economically competitive despite the cost of achieving low (eventually 'near-zero') emissions. The technologies are both costly and energy-intensive.



$$CO_2 + 4\,H_2 == CH_4 + 2\,H_2O \qquad \Delta H = -164.9\ KJ/mol$$

While Coal cleaning by 'washing' has been standard practice to reduces emissions of ash and sulphur dioxide when the coal is burned, electrostatic precipitators and fabric filters are also used to remove 99% of the fly ash from the flue gases, new technologies are being additionally introduced. Advanced technologies such as Integrated Gasification Combined Cycle (IGCC) and Pressurised Fluidised Bed Combustion (PFBC) enable higher thermal efficiencies up to 50% in the future. Gasification technologies, including underground coal gasification (UCG) in situ, use steam and oxygen to turn the coal into carbon monoxide and hydrogen. Captured CO_2 is liquefied and sequestered into deep geological strata. This is called carbon capture and storage (CCS). CCS technologies are in the forefront of 'clean coal' fuel.

Captured CO_2 can also be injected in deep coalmines, where it gets adsorbed and displaces methane contained in coal seams. Thus, while CO_2 is sequestered in the deep coal seams, commercial production of coal bed methane is realised. In the CO_2 storage in coal seams, CO_2 is adsorbed in the coal matrix instead of being held within the pores of the rocks, as is the case in saline aquifers and oil-gas reservoirs. The properties of the coal do influence its absorption capability of CO_2. With the application of improved technology in the sequestration of CO_2 the cost of production of coal bed methane can be matched to the cost of production of hydrocarbons in a petroleum reservoir using CO_2 for EOR.

Adoption of clean coal technologies would require either a well thought out modification in the existing set-up of the coal based thermal power plants in use, or abandoning them and build new power plants designed to use new clean coal technologies, based upon the respective cost-benefit analysis. NTPC expects to progressively close end-of-life inefficient coal capacity. Pending remodelling of a few selected plants and building up new plants using clean coal technologies, it is thinking of maximising its power sales by building solar PV panels around its existing plants. This will enable NTPC to continue 24X7 power supply as needed — solar in the day and coal as the balance.

Coal firing in oxygen rather than in air, is called Oxyfuel combustion.

The flue gas in Oxyfuel combustion is mostly CO_2, which can readily be captured at about half the cost of capture from conventional plants. The Integrated Gasification Combined Cycle (IGCC) plant is a means of using coal and steam to produce hydrogen and carbon monoxide (CO) from the coal. These are then burned in a gas turbine with secondary steam turbine (i.e. combined cycle) to produce electricity. If the IGCC gasifier is fed with oxygen rather than air, the flue gas contains highly concentrated CO_2, which can readily be captured post-combustion as above. Captured CO2 can be used in EOR of oil wells as well as for making methanol or di-methyl ether through appropriate chemical interaction with hydrogen. Methanol is a good substitute of petrol/ gasoline and di-methyl ether is a good substitute of diesel.

Oxyfuel combustion requires producing large amounts of oxygen. While producing oxygen from liquefied air is quite costly, use of ion transport membrane (ITM) process for separating oxygen from air and oxygen produced by electrolytic dissociation of water are relatively cheaper. ITM technology uses a ceramic material, which under pressure and temperature, ionizes and separates oxygen molecules from air. No external source of electrical power is required.

There are many advocates for the use of natural gas as an alternative to coal for electricity generation, on the grounds that it emits much less CO_2 per kWh generated Among the processes devised by scientists in this respect is Sabatier's reaction, by which carbon di-oxide generated in burning coal based fuels, can be converted into reusable energy source methane as shown below:

Methane (natural gas), when burned, gives CO_2 and water. It can be used in a number of ways for power generation. For example, Central Heat and Power (CHP) process involves burning natural gas in a combined cycle gas turbine (CCGT) for generating electricity, and using exhaust gas to heat steam boiler to make more electricity, and finally using "the exhaust stream to heat buildings or other purposes. Thermodynamic efficiency reported for this process is 80%. This is more than the reported highest efficiency of Combined cycle gas turbine, which is. 60% and of Direct gas turbine, which is 30's%, or straight steam boiler with about 40% efficiency (now obsolete). All of these have potential for CCS. With high efficiency methane combustion, the nitrogen proportion is much less than that with low efficiency combustion of coal.

Latest Policy Initiatives by the GoI

44 Discovered Small Oil & Gas Fields Awarded

The Government of India awarded 44 Discovered Small Oil & Gas Fields to 22 companies in February 2017. The government had put 67 fields discovered by ONGC and Oil India but not developed so far. The response from the investors was overwhelming with 134 bids. However, 23 fields could not be awarded that include 20 offshore fields for which no bids were received and three onshore fields for which no bids were found valid. The Government is likely to come out with the next round of auction of some more discovered fields soon. The discovered fields are estimated to hold together over 650 Million Barrels of Oil and Oil Equivalent Gas in-place reserves and likely to add 2% to the country's oil production.

Open Acreage Licensing Opens Almost Entire Sedimentary Areas for Oil Hunt

On July 1, 2017, the Government of India placedaround 90% of the country'stotal sedimentary areas for a pick by the investors under the Open Acreage Licensing Program (OALP). OALP is a clear departure from the current licensing policy of the government's role in identifying and putting the blocks on auction. Considering that half of sedimentary basins have remained unexplored and oil and gas production in India is only from 7 sedimentary basins, the Government has come out with the present offer for 2.7 million square km, almost 90% of India's total sedimentary area of 3.14 million square kilometers spread over 26 sedimentary basins. This comprises of 1.5 million square km of onshore and 1.2 million square km of offshore area.Under the OALP, a prospective bidder can submit an Expression of Interest (EoI) for anyarea. The block then will be put on auction. The prospective bidder will, however,have to compete with other bidders in the auction though it gets 5% additional weight vis-à-vis competitors during the technical evaluation process. The bidder company must have one-year operatorship experience in exploration, development or production of Oil, Gas or CBM plus the required financial net worth. The financial bids will be evaluated on the basis of revenue share offered to the Government and committed biddable Minimum Work Program, both caring equal weights. The auction of oil and gas blocks will be conducted twice a year, with the first round likely to be held in December this year.

Investors get access to National Data Repository

On July 1, 2017, the Government of India launched National Data Repository (NDR) which offers 160 terabytes of data on India's 26 sedimentary basins; the vast data collected over last six decades by E&P companies and other agencies. The sedimentary basins gridded into sectors (10'x10') and divided into zones with corresponding data are made available. The NDR contains seismic and well data, and investors can identify areas with potential through studying the data available online, offline and near online. This enables investors to select the most prospective sectors after studying the geological data and submit the Expression of Interest (EoI) for the sectors.The auction of oil and gas blocks will be conducted twice a year.

NELP Replaced by HELP: a Liberalized Licensing Policy

Replacing NELP, the earlier licensing policy, by the new Hydrocarbon Exploration Licensing Policy (HELP) is a major reform in the Oil Sector. The contractors get a uniform license for exploration and production of all forms of hydrocarbon during the entire contract period. The uniform license enables the contractor to explore and exploit the conventional as well as unconventional oil and gas resources such as CBM, shale gas/oil, tight gas, and gas hydrates under a single license. This makes a departure from the NELP wherein separate licenses were required for different types of hydrocarbons. As a result, contractors could not exploit the unconventional hydrocarbons even if found within the block, for want of the specific license. Second, the contractors get full right to continue exploration during entire contract period; earlier it was limited to exploration phase only. This will enable full exploitation of the block through further exploration and discovery.The third paradigm shift is from the complex cost profit- model to a simple revenue sharing with the Government In past, the profit sharing led to delays and disputes with the government scrutinizing cost details of private participants. In the revenue sharing contract, the contractor will not have to obtain the government approvals for incurring expenses. It will reduce administrative burden and ensure faster decision making and speedy project implementation. Fourth, the operators will have the freedom to sell oil and gas at arm's length market prices. Fifth, other incentives include no cess on the oil production, customs duty exemptions and also reduced royalty structure for offshore blocks. The new model replacesthe NELP under which 254 exploration blocks were awarded in nine rounds since 1997. The new Hydrocarbon Exploration Licensing Policy (HELP) has been successfully tested in the recent auction of Discovered Small Fields.

ओएनजीसी विदेश
ONGC VIDESH

राष्ट्र की परिकल्पना को इसकी सीमाओं तक नहीं बांधा जा सकता है।

चार महाद्वीपों में सत्रह देशों की अड़तीस परियोजनायें ओएनजीसी विदेश के अंतर्राष्ट्रीय समाकलन और सहयोग को दर्शाती हैं।

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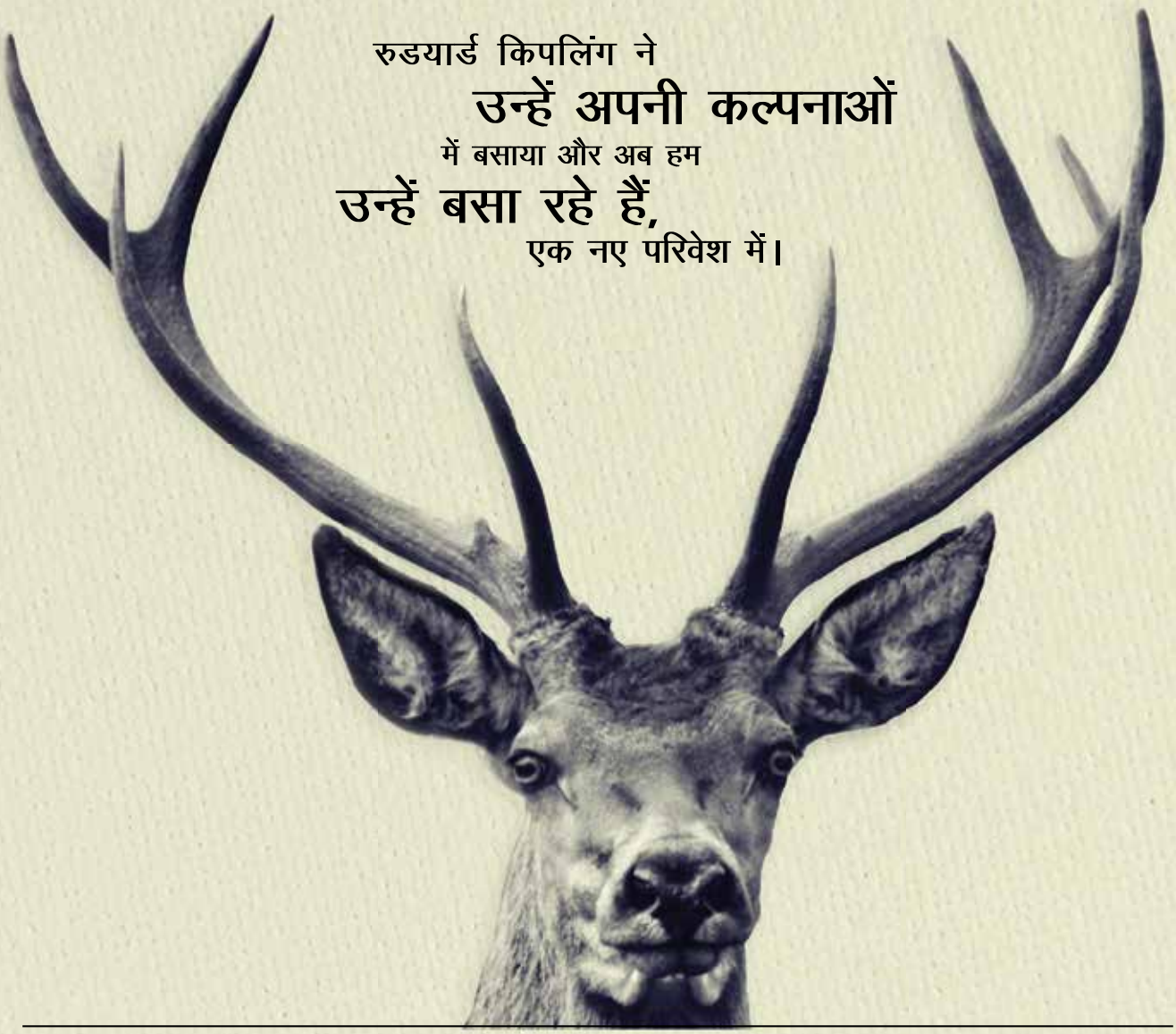
रुडयार्ड किपलिंग ने
उन्हें अपनी कल्पनाओं
में बसाया और अब हम
उन्हें बसा रहे हैं,
एक नए परिवेश में।



"ओएनजीसी बारासिंघा (ईस्टर्न स्वैम्प डीअर) संरक्षण परियोजना"

एक दुर्लभ प्रजाति को विलुप्त होने से बचाने के लिये ओएनजीसी की सीएसआर पहल।

असम में पाये जाने वाले बारासिंघा या ईस्टर्न स्वैम्प डीअर *(Rucervus duvaucelii ranjitsinhi)* आज विलुप्त होने की कगार पर है। प्रसिद्ध लेखक रुडयार्ड किपलिंग ने जिस से मंत्रमुग्ध हो कर उसकी सुन्दरता को अपनी दूसरी किताब 'द सेकंड जंगल बुक' में कैद किया हो, उस जीव के लिये यह काफी दुखद स्थिति है।

ओएनजीसी ने इस प्रजाति को विलुप्त होने से बचाने के लिये अपने कदम बढ़ाये, और वो भी बिल्कुल सही समय पर।

इसके पहले चरण के अन्तर्गत इनकी अनुमानित आबादी, अनुकूल पर्यावरण, पशु–चिकित्सा अंतःक्षेप एवं सामान्य अध्ययन और जागरूकता अभियान किया गया। इनके स्थानांतरण के लिये मानस राष्ट्रीय उद्यान को चुना गया, जो इनके रहने के लिये बिल्कुल उपयुक्त स्थान था।

काज़ीरंगा राष्ट्रीय उद्यान से 19 बारासिंघो को मानस में स्थानांतरित करना बहुत ही कठिन काम था। योजना के इस अत्यंत कठिन दूसरे चरण को दक्षिण अफ्रीका से बुलाये गये वन्यजीव विशेषज्ञों ने बहुत खास तरीके से अंजाम दिया। 19 बारासिंघो का स्थानांतरण खास तंबुओ में किया गया, जिनको अन्दर से उनके प्राकृतिक आवास जैसा ही बनाया गया था। कुछ ही महीनों में 6 नवजात बारासिंघो ने झुण्ड में जुड़कर, स्थानांतरण की खुशी को दुगना कर दिया।

इस योजना के विस्तार के तीसरे चरण के अन्तर्गत 20 अतिरिक्त बारासिंघो का स्थानांतरण किया जा रहा है।

यह परियोजना संतुलित पर्यावरण की ओर ओएनजीसी की एक शुरुआत है। लुप्तप्राय प्रजातियों का संरक्षण करने के लिये प्रेरित, हमारा संगठन प्रकृति की असली सुंदरता को बनाये रखने के लिये प्रतिबद्ध है।

ओएनजीसी
ONGC

ऑयल एण्ड नेचुरल गैस कॉरपोरेशन लिमिटेड

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