

Making India A Gas Based Economy

SubrataRay

Abstract—India's 154000 MW installed coal fired power stations need 750 million tonnes (MT) of coal to run at optimum capacity and only two-thirds of the required fuel is available to the sector right now, leading to a surge in imports.

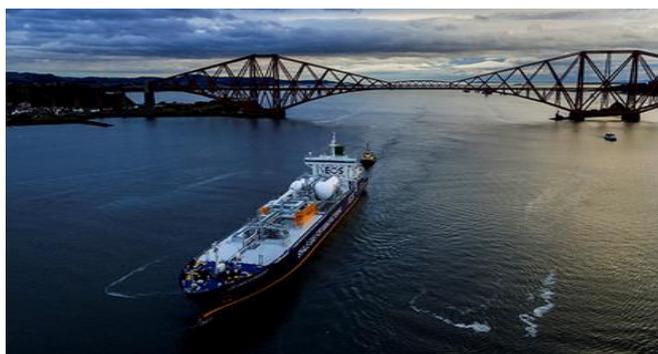
Given coal-based power capacity is projected to increase by 40% in another five years, the quantity of coal required to run all the power plants fired by the solid fuel is estimated at a billion tonnes, up a quarter from now. Yet the coal shortage in the country and, hence import dependence, will likely to come down by 2019 provided the output of Coal India enhances which are cast with doubts owing to sluggish implementation of Technology and digitization means.

This leaves the other fuel viz Natural gas and LNG to fuel ahead which is a lot more cleaner oil than coal. The challenge here is that the domestic production of Natural Gas (NG) is on a wane with a gas based installed capacity at 22,197 MW with a current average PLF at 22% which is very appalling owing to the Station Heat Rates going through the roof and detrimental to the specific fuel consumption in a scenario of dwindling domestic gas supplies. The calculation and estimation over the life cycle of KG-6 basin off the Rajamundry coast went topsyturvy coupled by a litigation stance by one of the major exploration companies with the Indian Government further making the issue complex.

Of late, there have been major changes in the policy outlook with a rational Gas pricing methodology for explorers within the Indian basin and suited for deep sea and ultra deep sea exploration aided by a slump in oil price around with a feeble chance to up the price per barrel above 45 USD as we go to press. Long term contracts with LNG exporters and with the Paris convention (COP-21) gaining acceptance worldwide, the Indian Government has decided to 'Gold plate' the Gas domain with continuous injection of innovative policies through slugs of time period as we poise for a cleaner economy in the months and years to come by.

This paper will throw light on various modes in the journey towards fuelling the Gas based economy of India in the time to come by.

Index Terms— GAIL: Gas Authority of India Limited, KG : Krishna Godavari, LNG : Liquefied natural Gas, MMSCMD : Metric Million Standard cubic metre per day, MMBTU : Metric Million British Thermal Units, RGPPL: Ratnagiri Gas Power Private Limited



SubrataRay, Chief Project Coordinator, Calcutta Electric Supply Corpn, India

I. INTRODUCTION

How the journey had begun:

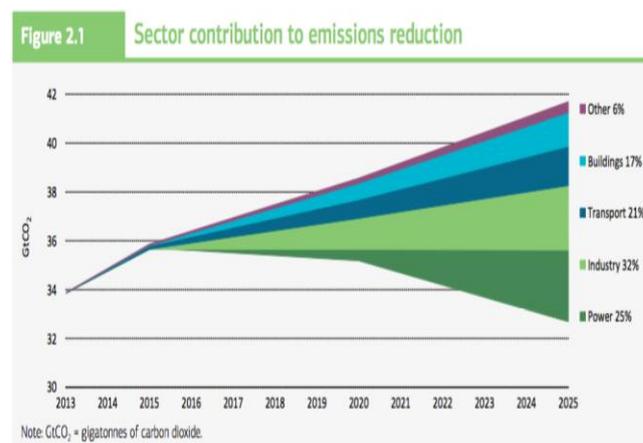
The fuel prognosis clearly indicates that with the current domestic gas availability for power sector stands at 18.2 MMSCMD which is too little to fuel the 22,197 MW countrywide.

It is also estimated that with a capacity of 27,000 MW growing by 2019, a gas requirement will be around 117 MMSCMD.

To tide over the challenge, Government had adopted a three pronged approach viz

- 1) Innovation in policy to allow more benefits towards pricing oil and Gas discovery from unfriendly terrain in Indian maritime boundary and in ultra deep exploration activity which was hitherto elusive as there was no consideration on pricing of discovery which was treated at par with shallow exploration pursuits.
- 2) Contracting large volumes of LNG in futuristic mode at a very attractive price prevailing today with an innovative funds flow scheme with the seller. Increasing LNG storage and regasification infrastructure with rampant addition of LNG storage along the coastline. It will be interesting to note here that Spain has more number of LNG storage and regasification facilities as compared to the present Indian scenario which has a coastline eleven times that of Spain alone.
- 3) Strengthening of gas grid and charting newer routes and linking to the developing LNG and regasification facilities.

Sector contributing to emission reduction globally



The above pictorial representation is amply clear about the part played by Power sector in de carbonating the economy which stands at a share as high as 25% starting from 2015 until 2025. Although the sector is divided between Gas power

plant/ Hydro power plant and Renewable energy, it may be understood that renewable energy though at a rapid stride now is solely dependent on Wind energy available in specific location and any spot which has an average wind velocity less than 5 m/sec is deemed to have a low wind power generating units annually.

While in case of solar system which is predominantly land intensive and have to track high insolation level (i.e the solar energy available per meter square of earth surface in a year round.).

Hence Gas power plants have to do much more within this family of clean energy to meet the expected target scenario as depicted above and which is only dependent on availability of fuel (NG/LNG) which has an inherent advantage of getting the required fuel through extensive storage and transportation which is feasible all across given the narrow tract of land to be made available in the gas pipeline route.

The only issue to tackle with , is the methane leakage while exploration and transportation coupled with a tricky situation of regulating gas flaring at the exploration site which is unavoidable given the Technology options.

The Hydrocarbon Policy: What is in it for Investors: The Government announced a slew of measures in the Hydrocarbon sector very recently and is expected to have a positive impact on the Indian energy sector in the long run.. Importantly there will be a uniform licensing system will cover all hydrocarbon like oil, gas, coal bed methane etc. which should help companies to explore under ONE LICENSE. The blocks under sale will be awarded through an open- acreage policy, which will enable E&P (Exploration and Production) companies choose the blocks from the designated area .

One of the key announcements made is allowing freedom for natural gas production from difficult terrain in terms of depth and reach especially in the offshore locations.. This will be applicable for deep water / ultra-deep water /high Temperature and high Pressure areas which were yet to attain commercial production as on 01 January 2016.

Ultradeepwater refers to the offshore oil and gas exploration and production activities that take place or are about to take place at depths of more than 1500 meters. It is a part of offshore drilling process and thus considered to be a relative term with respect to deep water drilling. However, deep water drilling activities takes place at depths of 500 meters and above and sometimes because of the challenges that drilling organizations have to face at such depths, deep water drilling is treated same as ultra deep water drilling. Deep water drilling is a process of oil and gas exploration and production business. Any offshore activities that take place beyond 500 meters are considered to be deep water drilling activities.

In order to perform E&P operations on ultra-deep water or deep water, special type of offshore rigs are used. These are completely different from Jackup rigs, barge rigs, or any other type of offshore rig which are used for below 500 meter water depths. These are:

- Semi-Submersible Anchored / Moored rigs – These rigs are floating rigs that have pontoons and columns. They are submerged in water to certain depths and can be anchored into a position or can

utilize dynamic positioning (DP) systems to keep the rig over the well. These rigs are useful for operations of up to 3000 m water depths.

- Drill Ships – These are Dynamically Positioned Vessels for deep water drilling. They are self-propelled offshore drilling rigs and can work beyond the depths of 3000 m.

However, there is a price ceiling , which means that prices are no longer soft and flexible. According to various analysts, the ceiling price based on the new guidelines, starting April 01 (the price discovery is made every six months) works out to \$6-6.5 per MMBTU (Metric million British Thermal Units). Compared to this the domestic price for already operational fields works out to \$3.82 per MMBTU currently.

However, with the time band expiring and starting a fresh one on October 01 domestic price cut to **\$2.5** per million British thermal units.

Gas price cut may hurt cash flows with major players like ONGC, Reliance Industries. India has cut the price of locally-produced natural gas for the fourth consecutive time, tracking a global decline in rates of the fuel. The determination of price is done by The Petroleum Planning and Analysis Cell under Ministry of Petroleum and Natural Gas, Government of India.

Secondly, the state of the macro environment and commodity (crude/ NG/ FO) prices would also be crucial for above mentioned developments as policy itself is not a sufficient condition to facilitate investment.

Another startling point made by the Government of India is that the above New regulation will be applicable to those players who would have withdrawn the pending litigation with the government . It may be noted here that as this report goes to publication, one of the major players RIL (Reliance Industries Limited) is having a litigation on pricing issues with the Government.

Recorded gas reserves in difficult areas are currently pegged at 6.75 Trillion cubic feet (tcf) including state-run ONGC's 4.5 tcf and GSPC's 1 tcf . This estimate excludes RIL's untapped KG-D6 assets and some 10 other notified discoveries whose potentials are yet to be established. The above price arrival is based on a formula devised by the Modi Government in October 2014, which is linked to select Global indices.

Along with these incentives for investors, the revenue sharing regime where the Government's remuneration over the life cycle of an asset is directly linked to the output levels and price could also be brought in.

In a recent form the Finance Minister proposed to 'incentivise gas production from deep water, ultra- deep water, high temperature, high pressure areas which are due to be exploited'.

The Exploration companies are eagerly awaiting for the promised "calibrated marketing-freedom" and discovering a

pre-determined ceiling price on the principal of landed price of alternative fuels as declared by the Finance Minister.

The reform agenda is hotly debated within Government with a view to fork out the best and plausible solution. There have been a proposal by the Petroleum Ministry to allow the Firms to sell half the produce from difficult terrain at the market determined price. It seems that the Finance Ministry is not too keen to accede to this proposal citing absence of sufficient competition among Gas producers, tepid demand, impracticality of freezing input gas price when output prices (Power and Fertiliser) are not market oriented, potential grave implications for the exchequer (as higher gas prices may inflate power and Fertiliser subsidies) and, finally its assumption that a higher price might not result in a surge in investments by the gas producers at this juncture.

The Provisions: In the revenue sharing regimes, the bidders will have to indicate the quantity of oil and gas they will share with the government at various stages of production along with the rates. Hence the Government's remuneration is delinked from the quantum of investment made in developing the block and extracting the hydrocarbons. Under the existing production sharing (PSC) applicable for previous NELP (New Exploration Licensing Policy) earlier, the explorer gets to recover costs incurred during the exploration cycle before sharing profits with the Government.

Such Profit sharing contract have been inducted in bids for the 69 marginal producing oilfields which remained to be tapped. Moreover, the bidders are given the right to sell gas to customers of their choice unencumbered by the Government's allocation policy.

The 'Gold Plating issue: It is definitely hard to believe how a dispute between the Government and a major player in exploration could lead a country as in India to change a fiscal regime that had been in existence for last 35 years. The dispute in reference arose from the 'Gold Plating' issue as explained ahead. As explained above how a Product sharing Contract changed into Revenue sharing contract. Experts are labelling this as a massive failure on the part of Government Machinery. It may be noted that Profit sharing contract exists in about 90% of oil exploration countries. It had been pointed out by the CAG (Comptroller and Auditing General) first brought out the issue of 'Gold Plating' by companies to inflate costs through overspending on projects. Companies go in for 'Gold Plating' when the fiscal regime gives them an incentive to spend more on Capital investment to claim a greater share on Project revenues. Gold Plating therefore needs to be distinguished from over-invoicing, transfer pricing and other means of misappropriation to evade the tax. The plausible way forward is that the Government must have a mechanism to have certain critical approval in place and above all DGH (Directorate of Hydrocarbons) must equip its elite staff to understand and tackle any ticklish issues arising during the project life cycle. It is imperative that Government and the Party (Particularly Private Party) must work in tandem towards growth economy vehicle for the country with the very limited oil and gas reserves discovered till now.

The Hopes ahead: Oil and gas companies will invest about Rs 2.5-3 trillion in India over the next few years to produce

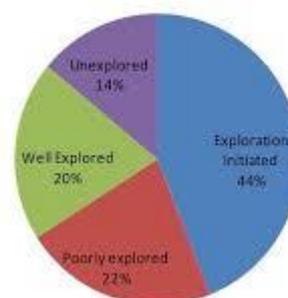
around 10-15 trillion cubic feet of natural gas and help build a gas based economy says a report.

Private sector gas producers signalled their willingness to make fresh investments after the Union Cabinet on 10 March 2016 approved a liberal pricing as cited above. The proposed investments will help raise the share of gas in the country's primary energy mix (Comprising of crude oil, gas and coal) from 6% to now about 15% by 2030. The intent is to boost gas production by intensifying exploration, accelerating production from existing fields, enhancing hydrocarbon recovery and forging partnerships. If successful, it will generate investments of Rs 2.5-3 trillion in the upstream sector, revenues of Rs 2.5 trillion and replace almost Rs 10 trillion of imports.

The current low price of natural gas comes as a blessing in disguise to make fresh investments in the energy starved country as procuring equipment and services for gas field development has become cheaper.

A lot of investments were made in existing oilfields where price was \$20-30 a barrel. The gas consumption in India is significantly low at 6.55 of India's energy basket down from 12% a few years ago primarily when the production in KG-6 basin operated by Reliance Industries limited slumped from the projected 60 MMSCMD at the time of commencement in 2009 to a present day rate at less than 10 MMSCMD.

Level of Exploration for Natural Gas in India



Getting Creative on Gas: The first major steps were taken by the private sector player in the form of Shell who could envision Indian gas economy way back in 2006 although by that time Petronet and RGPPL at Dabhol had some presence from the GoI side. Shell had to grapple with \$ 700 Million to decide whether herding of customers came first or development of infrastructure came first a huge risk on the table though. Finally Shell opted for the latter. 'Take or pay' which was thrust on the Customer when GAIL had a monopolistic view of gas transmission and distribution. But for long now it has been proved that this notion of 'Take and Pay' is not going to work as the Indian consumer has another option of cheap coal. The regasification units which saw the first phase of development is enumerated below:

- RGPPL LNG Terminal, Maharashtra, 5 MMTPA (Integrated with its own Power Plant)^[17]
- Dahej Terminal, Petronet LNG Ltd., Gujarat - 10 MMTPA^[18] 15 MMPTA by Sep 2016
- Hazira Terminal, Shell Ltd, Gujarat - 3.6 MMTPA^[18]
- Petronet LNG, Kochi - 5 MMTPA^[18]

The future of regasification Terminals which are at the various stages of development is enumerated below.

- Pipavav LNG Terminal (APM Terminals)
- Mundra LNG Terminal (GSPC/Adani) - 5 mt/year
- Ennore LNG Terminal Ltd (IOCL/TIDCO)
- Mangalore LNG Terminal Ltd
- Paradip LNG Terminal (GAIL) - 4.8 mt/year
- Kochi LNG Terminal (Puthuvype)

It is very surprising that Spain which has a coastline one seventh that of India has two times more the regasification infrastructure as of today. A poor insight of not having such facility and subsequent piping infrastructure increased woes with the stalled Gas generating sets around the country totalling to over 24000 MW, a colossal challenge to the economy.

The next tasks are as under:

A) The Government must plan for a National gas grid with regasification infrastructure now building up momentum and the Regional gas grid concept now must be kept as a backburner. It should then get all the states to read from the same script on issues like land acquisition, right of ways, environmental approvals, tariff structures and taxation rates.

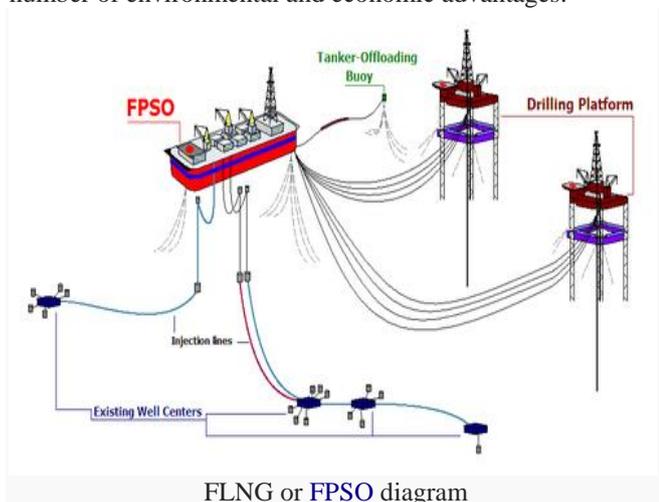
B) Making of a National Gas grid must squarely lie on a separate SPV and the funding should be initiated from the Government's balance sheet, the viability gap funding is a strong case here. The newly formed SPV must receive a fixed post tax return on equity with maybe upside incentive for efficient and safe operation and it should not have any direct links with the existing Public sector companies. Then there should be a clear demarcation of position and responsibilities between the new Company and GAIL for a better Management practice.

C) Gas prices are now linked to the prices in Russia, the US and Canada. The gas prices in Asia Pacific must also to be considered while arriving at a fair price. The best point is that the price of Gas is competitive with the imported coal price.

Making of the first Floating LNG terminal in India:

Floating LNG has become the order of the day.

Among fossil fuels, natural gas is relatively clean burning.¹ It is also abundant and affordable¹ and may be able to meet world energy needs by realising the potential of otherwise unviable gas reserves (several of which can be found offshore North West Australia). FLNG technology also provides a number of environmental and economic advantages:



- **Environmental** - Because all processing is done at the gas field, there is no need to lay long pipelines all the way to the shore. There is also no requirement for compression units to pump the gas to shore, dredging and jetty construction or the onshore construction of an LNG processing plant, all of which significantly reduce the project's environmental footprint. Avoiding construction also helps preserve marine and coastal environments. Additionally, environmental disturbance would be minimised during the later decommissioning of the facility, because it could be disconnected easily and removed before being refurbished and re-deployed elsewhere.

- **Economic** - Where pumping gas to shore can be prohibitively expensive, FLNG makes development economically viable. As a result, it will open up new business opportunities for countries to develop offshore gas fields that would otherwise remain stranded, such as those off the coast of East Africa. FLNG is also conducive to side stepping complexities involving neighboring countries where disputes would make pipelines vulnerable or impractical such as in Cyprus and Israel. Moreover, LNG is slowly gaining its role as direct use fuel without regasification with operational cost and least pollution benefits in road, rail, air and marine transport.

II. OPERATION

The FLNG facility will be moored directly above the natural gas field. It will route gas from the field to the facility via risers. When the gas reaches the facility, it will be processed to produce natural gas, LPG, and natural gas condensate. The processed feed gas will be treated to remove impurities, and liquefied through freezing, before being stored in the hull. Ocean-going carriers will offload the LNG, as well as the other liquid by-products, for delivery to markets worldwide. The conventional alternative to this would be to pump gas through pipelines to a shore-based facility for liquefaction, before transferring the gas for delivery.

In the Indian context:

The offshore project, as a concept, is a novelty for the Eastern Indian market, the shorter gestation period for developing the floating storage and regasification unit (FSRU) project along with the strategic location has intrigued stakeholders throughout the gas value chain. The proposed FSRU terminal is set to be the gateway for natural gas to Eastern India which would not only support the industrial growth of the states of West Bengal and Odisha but will also provide an economical and environmentally friendly energy solution across various customer segments. The project is likely to cater to the needs of fertilizer units, refineries, petrochemical plants and industrial units in the Eastern India region. In addition, the project is also expected to be a catalyst for city gas distribution in the cities of West Bengal and Odisha, facilitating natural gas availability to domestic customers and the transportation segment. The concept of an offshore FSRU will set an example for LNG infrastructure creation in various parts of India which are still undeveloped due to lack of proper port infrastructure and limitation of draft at smaller ports.

The 715 km Contai-Dattapulia-Jajpur-Dhamra-Paradip natural gas pipeline will connect all the major cities and towns of West Bengal and Odisha. The pipeline including proposed

interconnectivity with other pipelines planned in the region connecting the northern Indian region to Eastern India market will be a strong demand driver for the region. In total the pipeline is expected to unlock a demand of 5 - 6 million tpy initially and up to 10 million tpy in the medium to long-term.

The Zig Saw Puzzle: There are two types of contract predominantly executed between parties viz long term contract and a spot contract. While a long term contract is preferred by the customers having anticipated stable and sustainable demand in the long run 10-15 years whereas spot contracts are executed to satisfy a peak surge in demand. In the recent times with the market conditions prevailing, procurement of spot cargo is also a means of averaging the price differential of long term contracts and prevailing market prices.

If we follow the LNG market for the past 20 years it is evident that spot market has grown significantly, this is a favourable phenomenon since it increases the liquidity in the market. However, as we have seen time and again every time the spot prices are soft, the buyers keep increasing their spot portfolio cutting down on the signing of new long-term contracts, which is a dangerous practice. There is no alternative to long-term stable supply contracts and the spot and short-term purchases shall be only used as an optimisation tool and too much dependence on the volatile spot market needs to be avoided, the only change can be the duration of long-term contract from a period of 15 - 20 years to 10 - 15 years.

Presently natural gas contribution is around 6% in the Indian energy basket, this mainly comes from customer in Northern and Western India as Eastern India is yet to be connected to the national gas grid. At present, the customers in Eastern India are forced to use uneconomical and highly polluting liquid fuels, however the LNG terminal project and the natural gas pipeline will provide them with the option to use natural gas. After the commissioning of the proposed natural gas pipeline the share of natural gas is expected to rise significantly as the industrial belts in West Bengal and Odisha have immense potential in terms of natural gas consumption. The fertilizer units, refineries and petrochemical plants along the proposed route are likely to be the anchor customers replacing liquid fuels.

The government of India has already given mandate to all urea producing units to switch to natural gas, and has issued directives in 2015 for making available imported gas (RLNG) available to all urea producing units at uniform price. The city gas distribution sector has started assuming importance and policies are in place to incentivise new entities participating in this business so that energy needs of industrial, commercial, transport and household segments can be satisfied. The mentioned policy reforms are driven by a strong public sentiment and are a clear indication of the nation's willingness to promote the usage natural gas. The proposed pipeline will not only connect Eastern India to the gas grid but also strengthen nations commitment towards reducing emissions by promoting green fuels like natural gas.

Another startling practical example is that of NTPC (National Thermal Power Corporation Ltd) ltd refusing to honour a long term contract to fire its gas stations with 2 MMSCMD with the contract standing at \$11-12 MMBTU and with the spot

pricing falling rock bottom and with a considerable gap between these pricing had placed these two Giants in loggerheads with no solutions at sight. Under this circumstance, GAIL which sources the gas from a Third Party is in a spot. Consequently GAIL suffered a 66% drop in net profit and may even have to pay a penalty to its sourcing agency. While the contract (for imported LNG) allows a total deferment of 105 of volumes in any given year, higher volume shortfall in the coming two years will potentially expose GAIL to a take-or-pay with RasGas of Qatar amounting to a cumulative \$57 billion liability.

Asia's gigantic leap in trading LNG internationally: Singapore has recently developed into a hub popularly known as SILnG. There is a long way to go now as the spot market accounts for only 5% of traded volumes now traded in Asia.

Instead, the International market is dominated long term contracts linked to the price of oil both for gas delivered via pipeline or as LNG. Gas generates about 22% of electricity generated around the world and now rivals iron ore as the second largest commodity to be traded. At least \$130 billion of this investment in supply is in Australia which within a few years will overtake Qatar as the world's largest LNG producer.

Capital expenditure on LNG has risen substantially in recent years, due to the growth in the Global Economy which has been driving demand for natural gas. This trend is expected to continue with total spending on global LNG facilities expected to reach \$241 bn between 2016 and 2020. This represents a 34% increase as compared to the preceding five-year period.

Presently the landed price hovers around \$4 per MMBTU, However Asia need to build infrastructure fast. Secondly derivatives market are needed to allow producers to hedge against price swings when investing in expensive new capacity. Third end users need deregulated energy markets to encourage competition for the best source of supply.

Global Scenario: Global trade in LNG rose by 4.7 MT to reach 244.8 MT in 2015 and supplies will rise over the next 4 years as the 140 MTPA of liquefaction capacity is currently under construction. Simultaneously demand growth is slowing caused by economic weakness in China, recession in Brazil and increasing financial difficulties in emerging countries. Japan and South Korea, the world's largest consumers of LNG, reduced their imports by 7 MT in 2015. Japan's demand is uncertain depending on rate of nuclear restarts and renewable energy. Even South Korea expects 7-8 GW of new coal generation this year.

The Challenge of Regional Trade: Whilst LNG is traditionally seen as a global –trade, small-scale regional trades are emerging. For example, Alaskan LNG is destined for Hawaiian Islands and there are plans for regional LNG and bunkering hubs to be based in Jamaica, Trinidad and Puerto Rico

Educating Customers: Perhaps the greatest market challenge arises from overcoming the knowledge and expectations gap between experienced project developers and Government Customers. Educating customers to enable them to make optimal and timely decisions and create a business

friendly financial, regulatory and legal environment is a struggle.

Bringing back to life the stranded 24000 MW gas generating sets: In April 22, 2016 recently the Power Minister Mr Goyal was in New York to attend a round table discussion hosted by CII and USIBC, he called upon gas producers in US to explore investment opportunities in the Indian market. He had remarked that India is willing to take gas for its gas-based power projects and sign long-term contracts of 10-15 years but this can be done at a fixed price of \$5 per MMBTU as the power sector is a price sensitive sector in the country keeping view of the Baltic Index. Even the Minister was open to an earlier proposal of linking the debt to a basket of currencies including the US dollar, the Japanese Yen or even options like inflation-linked tariffs to cover hedging risk.

India aiming to double the LNG import capacity: India plans to more than double its annual LNG import capacity to 50 million tonnes as declared in October 2016. This is a positive indication of a gas based economy in the making. The nation presently has the capacity to import 21 million tonnes annually in ships. This facility is racing now to increase to 50 million tonnes in next few years. The Power Minister had exclaimed to increase the natural gas share in the energy basket to 15% in next 3-5 years which is currently now at 6%. Shell and GAIL is contemplating to build a floating LNG terminal at Kakinada with an initial capacity of 1.75 million tonnes. India's natural gas demand is slated to grow from 473 MMSCMD to 494 MMSCMD in 2017-18 and 523 MMSCMD in 2018-19.

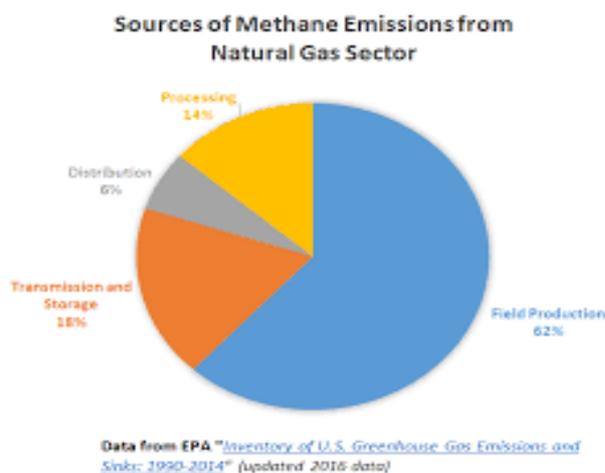
Capacity utilization: Globally re-gasification facilities are operating at 36-37% capacity and all such projects are running economically. The value of 'overhang capacity' i.e. the gap between supply and utilization stands at an impressive capacity which is less than 2 cents at \$/MMBTU reference. This is related to a good and reliable cargo. India has not been fortunate in this aspect. The repeated tendering to build LNG ships as a part of "Make in India" agenda did not get a single response to the global tender which was extended umpteenth times by GAIL. Even the newly readied facility at Kochi is not connected to the gas transmission network a poor visionary no doubt. The Dabhol facility does not have a backwater facility seriously hampering to tow in a large shipment.

India needs to also work towards safeguarding of interest for the first five years of inception. Like in Singapore, one of the LNG terminals is a 6 MTPA and is being expanded to 11 MTPA but the capacity utilisation is 3 MTPA. The bill for the gap of capacity utilisation is footed by the state Government. For attracting cargoes which are dollar sensitive, one has to give a few cents to the regasification and once the pipeline grid is in place, more and more entities would start gas utilisation.

The precautions: Moving briskly towards a gas based economy also entails other safety related issues mainly with respect to methane leakage which has become a part and parcel of the Gas Industry. Efforts are on to make it less and less through technological innovations. Methane is the most vulnerable Greenhouse gas. India must emulate the US way as enumerated below to mitigate such practices in future.

The US Bureau of Land Management issued a **final rule** aimed at reducing releases of natural gas into the atmosphere from oil and gas operations on onshore public and Indian tribal lands. Oil and gas associations were immediately critical. Two groups even sued in federal court, charging that the rule is a broad new air-quality regime that goes beyond authority that Congress grants BLM.

"We are proving that we can cut harmful methane emissions that contribute to climate change while putting in place standards that make good economic sense for the nation," US Interior Sec. Sally Jewell said in announcing the final rule on Nov. 15.



"Not only will we save more natural gas to power our nation, but we will modernize decades-old standards to keep pace with industry and to ensure a fair return to the American taxpayers for use of a valuable resource that belongs to all of us," she said.

The rule, which will be phased in, requires oil and gas producers to use currently available technologies and processes to cut flaring in half at oil wells on public and tribal lands, BLM said. Operators also must periodically inspect their operations for leaks, and replace outdated equipment that vents large quantities of gas into the air, it noted.

Other parts of the rule require operators to limit venting from storage tanks and to use best practices to limit gas losses when removing liquids from wells, the agency said. To ensure a fair return to taxpayers, it also clarifies when operators owe royalties on flared gas and restores the government's congressionally authorized flexibility to set royalty rates at or above 12.5% of the value of production.

BLM said the rule also makes an important contribution to the Obama administration's goal to cut methane emissions from US oil and gas operations by 40-45% from 2012 levels by 2025. This rule projects cutting methane emissions by as much as 35%, it indicated.

OGI (Optical Gas Imaging) is the latest technique to detect methane leakages from pipelines and in associated machinery. It can cut as high as 80% potential leakage spots and can visualise a leakage as small as 0.8 gm/hr. It is handy to even detect the same at a well level with much accuracy. It is way ahead than the traditional infra red camera with filter mechanism.



The Encouraging signs:

- As gas supply increases and distribution infrastructure (cross country pipelines and piped gas in cities) falls in place, India will transit from an oil-based economy to a gas-based one, says former head of Directorate of Hydrocarbons, Avinash Chandra. In his estimates India will find at least **200 trillion cubic feet of gas from the country's east coast alone.**
- Increased activity by players who have been active in this area like Reliance Industries Limited, ONGC, GSPC have already stepped up the exploration activities by moving the required rigs in that zone.
- Public transport in the form of LNG busses have started commercial plying in the state of Kerala
- The development of fuel cells have been taken seriously in the Indian context and a separate wing is becoming active under the aegis of MNRE primarily with a focus to drive down the cost.
- Piped gas in Indian cities are slowly becoming the norm of the day and Government plans to issue licenses for 74 cities in phases.
- CNG variants are already available in the Indian Automobile market.
- In Mumbai and in the cities of Gujarat, home geysers are available which runs on city gas. Thermax and Voltas make gas-fired vapour absorption chillers, used in malls, restaurants, theatres and offices. The smallest of these is of 15 tonnes of Refrigeration (TR) capacity, which can cool an area of 1900-2000 sq ft. The initial costs of Rs 12-13 lakh , for a 15 TR is though a deterrent at the moment , but it does cut operational energy costs by half.

Innovation which India must keep in mind: LNG swapping is unheard as on date. But on ground it has happened between Tokyo Gas Co and British Utility Centrica . **Japanese gas provider Tokyo Gas Co declared on Monday it has inked a memorandum of understanding with British utility Centrica for a location swap of liquefied natural gas (LNG) to reduce transportation costs.**

A location swap of LNG is still uncommon worldwide, but it is likely to increase in number in Japan as reducing procurement costs is vital for city gas suppliers ahead of the complete city gas retail market liberalisation from next April. Japan is the world's major LNG importer and user. Tokyo Gas will offer Centrica around 700,000-800,000 tonnes per annum (tpa) of U.S. shale LNG - from Cove Point project in Maryland - beginning probably from late 2018, when Cove Point production stabilises, said Tokyo Gas Executive Officer Kentaro Kimoto. In return, it will get the same volume of LNG acquired in Asia Pacific markets from the British company. Tokyo Gas, which has a contract to purchase 1.4 million tpa of LNG for 20 years from Cove Point, was thinking about using four ships to convey LNG from the U.S. shale gas project. Tokyo Gas is now envisaging to distribute one or two of the four ships to dedicate supplies to Centrica, according to Kimotos. The agreement will aid Tokyo Gas avoid passing the expensive Panama Canal and the two firms will benefit from lower transportation costs, as stated by Kimoto. The two firms will next target to reach a legally binding agreement, perhaps next year, Kimoto said.

Not always we have to fall for Russian Gas but some gas may be available next doors and it will be worthwhile to consider this option while a supply contract is on in some part of a farthest geographical location notwithstanding the salient points of the existing contractual obligations.

The Eye opener:

- 635 million metric Tonnes (MMT) of proven oil reserves (2P).
- 54 trillion cubic Feet of proven natural gas reserves and 96 trillion cubic Feet of estimated Shale gas reserves.
- Third largest consumer of crude oil and petroleum products in the world and second largest refiner in Asia.
- 60% of the prognosticated reserves of 28,000 MMT are yet to be harnessed
- Re-gasified Liquefied Natural Gas (RLNG) re-gasification facility is likely to increase from 47.5 MMTPA* by 2022 from a current level of 22 MMTPA. *million metric tonnes per annum

III. THE GROWTH DRIVERS(OIL AND GAS)

1. As part of International Energy Outlook 2016, EIA projects that India and China will account for about half of global energy demand growth through 2040, with India's energy demand growing at 3.2% per year. As per BP Energy Outlook 2016, India's energy consumption is projected to grow at 4.2% per annum upto 2035, faster than all major economies in the world.
2. Oil and gas sector plays a predominant role as over one third of the energy required is met by the hydrocarbons.
3. The country's natural gas pipeline network is spread over 14760.6 km in 2016. Another 15000 km is envisaged to complete national gas grid and move towards a gas based economy, which is under various stages of implementation
4. In order to promote use of natural gas, priority for allocation of domestic gas was accorded to PNG (Piped Natural Gas) / CNG (Compressed Natural Gas) segments for meeting 100% demand and faster roll out of PNG connections

and CNG stations. There are plans to connect 326 cities with city gas distribution network (CGD) by 2022.

5. In a bid to enhance oil security and protect supply disruptions, crude oil strategic storage of 5.33 MMT capacity was built at three locations viz. Visakhapatnam (1.33 MMT), Mangalore (1.5 MMT) and Padur (2.5 MMT). The project at Visakhapatnam is already commissioned and Mangalore and Padur are under advanced stage of commissioning. A detailed project report has been prepared for additional strategic storage of crude oil for 12.5 MMT at 4 locations viz. Chandikol (3.75MMT) in Odisha, Padur (2.5 MMT) in Karnataka, Rajkot (2.5 MMT) in Gujarat & Bikaner (3.75MMT) in Rajasthan, which would be completed in Phase II.

6. New Domestic Gas Pricing guidelines, reforms in existing contracts, calibrated marketing freedom for difficult areas, clarity on testing requirements and addressing other concerns in the existing areas under exploration and production have resulted into unlocking of reserves valued at USD 53.84 Billion.

7. India's Refining capacity is estimated to reach 256.55 MMTPA by 2019-20 after completion of projects undertaken by a number of refineries which are currently under various stages of implementation.

8. E&P sector has undergone complete re-engineering to reinvigorate exploration and production of India's hydrocarbon reserves. A number of path breaking policies have been formulated to revolutionize Exploration & Production (E&P) sector including Hydrocarbon Exploration and Licensing Policy, Discovered Small Field Policy and Gas Pricing Reforms.

9. The price of diesel has been made market determined effective October 19, 2014, resulting into better service delivery due to increased competition in the auto fuel sector. The saving in subsidy is available for funding anti-poverty and social sector schemes.

10. The Government is focused on providing access to affordable, reliable, sustainable and modern energy to every citizen. In a bid to promote clean cooking fuel, the Government has planned to increase LPG coverage by providing 100 million new LPG connections in next 3 years till 2019.

11. The government has planned to roll out BS-IV auto-fuels throughout the country progressively by April 1, 2017 and leapfrog into BS-VI auto-fuels all over the country w.e.f. April 1, 2020, which would facilitate major investment in refinery upgradation, auto industry, related manufacturing and services sector.

12. Hydrocarbon Vision 2030 for North East India has been released. It envisages an investment of USD 20 Billion in upstream, downstream and midstream sector in Hydrocarbon Sector in North East India till 2030. To incentivize E&P (Exploration & Production) in the North East, 40 % subsidy on gas operation has been extended to private companies operating in the region.

Things to watch further: Keeping with the latest regulations all the ocean liners including those which ferry LNG / crude will have to cut down their sulphur emissions from presently average 3.5% down to 0.5%. The issue is that the new age

refineries do not have fuel oil as their residue as they are now converted to asphalt, a product which has high sulphur content. Hence usage of middle distillates as available in the old refineries will bear some solution. But the middle distillates are more expensive. Wood Mackenzie, a global consultant estimates that by 2020 the middle distillates margin could average as much as \$25 per barrel which is now pegged at \$9 per barrel. Hope GAIL in particular are keenly observing this notion.

IV. CONCLUSION:

With the appetite of Indian economy to grow faster and cleaner, India is embarking on a gas based economy sharing the turf somewhat with the Renewable energy segment. With the advent of developing 100 Smart cities, this drive becomes imperative. The Government, in my opinion must focus in the downstream side as well as it is faster to achieve in terms of multiplying products in this segment. Consumer awareness is the key and carefully and innovative schemes will be the key to success.

Easing of exploration norms and speedy clearances will attract Foreign established players as there is much more to explore especially in Eastern maritime locations as the current disbursement under NELP schemes appears to be inconsistent and inadequate. There is not much time to be allowed between establishing a credible and explorable mapping to the auctions thereof. Here national Data Repository (NDR) role becomes paramount. It needs to urgently consolidate and store all the Geoscientific data available in the country to create a base for Open Acreage Licensing Policy. Based on the Open acreage licensing policy will allow and empower the Government to view geo-scientific opinion regarding prospectivity of the blocks prior to bidding the block. This will enhance exploration activity in the country. Presently M/s Haliburton offshore Services inc is assisting DGH in this project.

With the facts above it can be concluded that the nation is moving in the right direction towards making of a Gas based economy and more importantly the above actions are in line with the Paris Convention or COP 21 memoranda and the INDC submitted by India and finally ratified very recently.

**** Views expressed above are personal.**

Bibliography

- [1] Darwin liquefied Natural Gas- Conoco Philips
- [2] FERC website
- [3] Neptune Energy(deep water port)
- [4] Handbook of Liquefied Natural Gas by David Wood, Saied Mokhatab
- [5] Energy for the 21st Century: Opportunities and Challenges for Liquefied by Susan L. Sakmar
- [6] LNG: A LEVEL-HEADED LOOK AT THE LIQUEFIED NATURAL GAS CONTROVERSY PAPERBACK – MARCH 1, 2007
- [7] www.maineharbors.com/sepbk07.htm
- [8] www.gazprom.com > About Gazprom > Production > Projects
- [9] *Ministry of New and Renewable Energy* mmre.gov.in/
- [10] *Ministry of Petroleum & Natural Gas* petroleum.nic.in/