PetroFed

THE JOURNAL OF PETROLEUM FEDERATION OF INDIA

PETROFED

APRIL - JUNE 2016 | Voice of Indian Oil & Gas Industry | VOL.15 ISSUE 2

Transition to a Gas based economy (Cover story)

Interview with Mr. Prabhat Singh, MD and CEO of Petronet LNG

Energy Diplomacy Initiatives by India- An Overview

Also See Inside:

Special issue on

Gas

India's energy anchor

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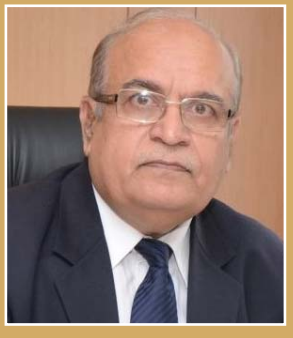
From the Director General



In a bid to boost domestic oil and gas production, Ministry of Petroleum and Natural Gas recently announced the commencement of the 'Discovered Small Fields Bid Round-2016' in New Delhi when Shri Dharmendra Pradhan, Hon'ble Minister of State (I/C) for Petroleum and Natural Gas launched the new bidding round along with technical information portal and e-bidding portal. Discovered Small Fields i.e. oil and gas blocks which have so far remained commercially undeveloped, are now in focus as the central government seeks to boost domestic hydrocarbon production. Under the announced 'Discovered Small Fields Bid Round-2016', 46 Contract Areas consisting of 67 different small fields are being offered to investors the world over, for exploration and production. Bids are being invited for developing and monetizing these contract areas having 625 Million Barrels of Oil and Oil Equivalent Gas (O+OEG) in-place volumes spread over 1500 square kilometers in Onland, Shallow water and Deepwater areas. Directorate General of Hydrocarbons (DGH), the technical arm of the Ministry is anchoring the entire bidding process.

India is now moving towards a new era of hydrocarbon production, driven by a forward looking Hydrocarbon Exploration and Licensing Policy (HELP); and a new fiscal model based on Revenue Sharing Contract. This new phase is a move ahead from the earlier NELP; and Production Sharing Contract regime and addresses various industry concerns that led to slowdown in investment over the last few years. Single license for exploring all forms of hydrocarbons, graded system of royalty rates, pricing and marketing freedom for crude oil and natural gas, are some of the highlights of HELP. Government is following principles of Enhancing Production, Attracting Investment, Generating Employment, Transparency, and Minimizing administrative discretion.

We hope the above initiatives of the Government of India will repose confidence in the investors who have been looking forward to positive policy changes. Thus should lead to enhanced exploration and production activity leading to increased domestic oil and gas production in coming years.

As India is moving towards simpler and transparent administrative and fiscal systems, PetroFed jointly with EyeOn decided to conduct a market survey on 'India's Hydrocarbon Sector Investor Index & Market Survey'. The idea is to get the feedback on how the investors perceive the business environment related to Oil and Gas sector. The results of this survey may be presented during the annual awards function of PetroFed.

In this dynamic and complex world, the quest for affordable and sustainable energy supply to the millions of world inhabitants while meeting environmental commitments will continue to be a challenge. India, the third largest global energy consumer in its Intended Nationally Determined Contribution (INDC), submitted to the United Nations Framework Convention on Climate Change (UNFCCC) at Paris, agreed to curb its greenhouse gas emissions by up to 35% from the 2005 level. To achieve this target in terms of CO2 mitigation, switch to gaseous and renewable fuels, recycling and improving energy efficiency seem to be low hanging fruits. In the total energy mix of India, gas has a share of only 7% as against global average of 24%, hence these seems large potential to increase gas share in total energy mix of India.

To increase the natural gas share, there is an urgent need to harness the domestic gas sources and expansion of infrastructure for LNG import terminals, floating storage, re-gasification facilities and gas transportation etc. for catering to the growing demand of existing and new demand centers (viz. green corridors, smart cites). On the policy front, a few initiatives have already been taken by the government to improvise and incentivize the domestic gas production. We also need to improve CNG & Piped Natural Gas (PNG) supply chain. The increased penetration of piped natural gas (PNG) in cities will also free up subsidized LPG which can be diverted to rural consumers, thus helping achieve government mission of providing clean cooking fuel to rural India.

With the growing emphasis on gas based economy, the dynamics in the commodity markets are bending towards LNG (liquefied natural gas), which can stimulate the trade and investments in global energy assets. India as a country should be well prepared to seize this opportunity. Thus, it is important to complement the domestic supply by setting up LNG import terminals, floating storage, re-gasification facilities, gas transportation and distribution, etc.

I am happy to share that in this direction PetroFed along with IHS and ICF International has initiated a study for 'Accelerating India's transition to gas by enabling increased market access'. The study is focused on creating markets and connecting the last mile access to the gas consumer while learning from international best practices and for an effective policy implementation in the country to boost the gas markets. In the coming months, we will reach out to you to update on the project developments.

This issue of PetroFed journal is focused on gas theme and brings the nuggets of wisdom from industry experts on the challenges and opportunities in the domain of gas markets. With Indian's vision to slash import dependency by 10% by 2022, a transition to natural gas besides unlocking the huge gas resource potential will help to combat climate issues.

I am sure you will enjoy this special issue of PetroFed as our nation gears up for a future of Equitable Clean Energy Access.

Dr. R. K. Malhotra
Director General

Petroleum Federation of India

Core Purpose Statement

- To be the credible voice of Indian hydrocarbon industry enabling its sustained growth and global competitiveness.

Shared Vision

- A progressive and credible energy advisory body stimulating growth of Indian hydrocarbons sector with global linkages.
- A healthy and strong interface with Government, legislative agencies and regulatory bodies.
- Create value for stake holders in all our actions.
- Enablers of collaborative research and technology adoption in the domain of energy and environment.
- A vibrant, adaptive and trustworthy team of professionals with domain expertise.
- A financially self-sustaining, not-for- profit organization.

For more details, kindly visit our website: www.petrofed.org

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BREXIT – Has the Sun set on the Empire?

INTERNATIONAL AFFAIRS

Kaushiki Sinha Ray
Senior Assistant Director,
(Economic Research),
PetroFed

June 24, 2016 6:25 am Sterling plunged six cents against the dollar as EU vote counts hints at Brexit

The first discernible news flash of the day, while I was still forcing my senses to awaken. At a time when a better half of the world was still yawning itself into dawn, Britain was changing the course of economic and political history. The momentum had been building for quite some time with the past couple of days showing markets reacting and preparing in advance to either possibility. As I reached for my first cuppa, I glanced at my buzzing phone-

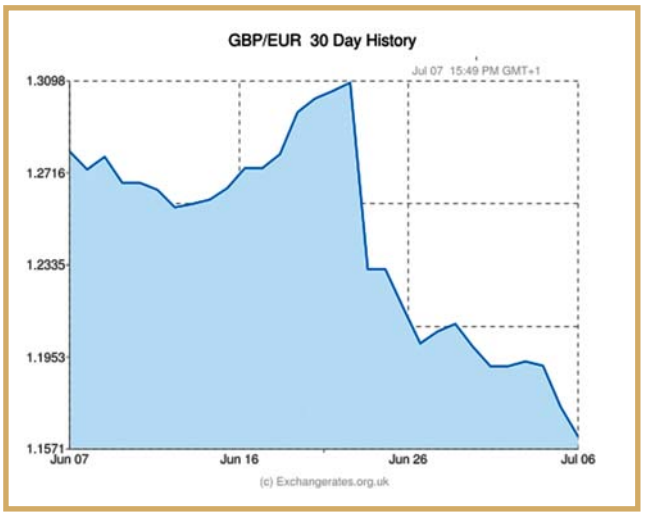
7:21 am Sterling is getting smackdoodled

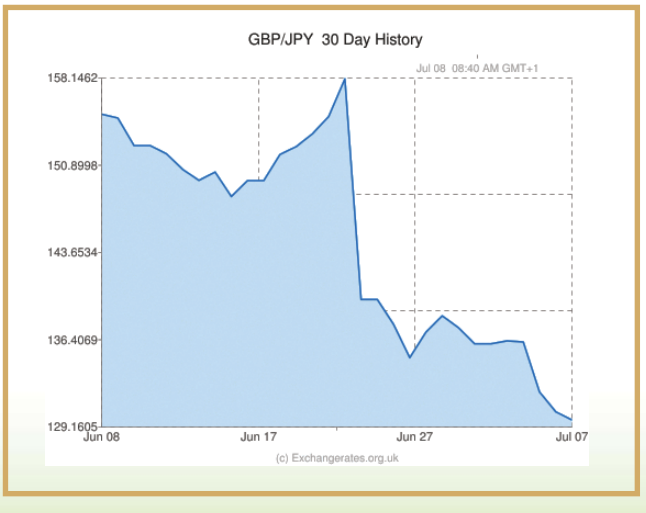
It seemed as if the entire world was waiting with breath that was bated. A highly suggestive statement, I could imagine it creating havoc in boardrooms across the globe. As the day got more pronounced, so did the gravity of the situation. With lots of theories raking up the groggy mind, each one taking precedence over the previous one, one thing seemed certain - the world was going to be as we had never known it to be - it was the end of an era.

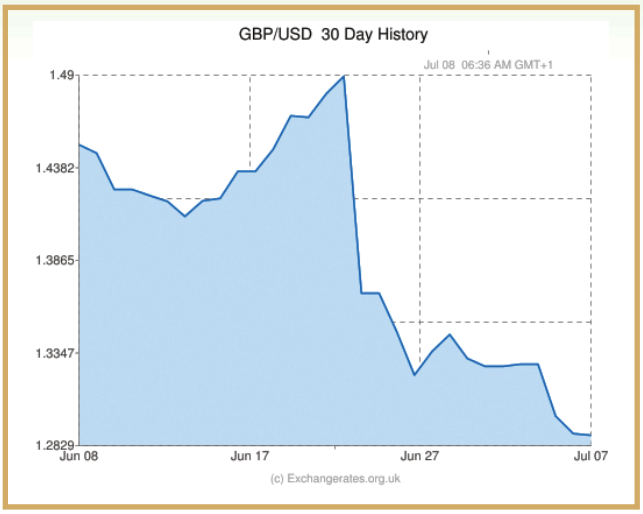
9:57 am Global turmoil on the cards as Brits nod to Brexit

The Great Oak has fallen. Britain was redefining the map of the world. The largest periphery of market transactions - Europe was now being chalked anew. After 43 years of union, it was a divorce for Britain. With a staggering 51.8% of Britain voting to leave this had to be the biggest blow to the unity of European Union since World War II.

Motivated, seemingly more by sovereign concerns, this departure did have some, if not completely relevant, economic interests. Propelled by the compulsion of weekly payments towards the European budget to the tune of millions and the detrimental effect on the British exporters due to the hostile nature of the European parliament, the Leave Commission gained steady ground towards this consequential eventuality. This development picked further momentum with the increasing dent in the welfare schemes of the UK government which were being caused by the constant migration from European Union. Statistics claim that approximately 2.15 million EU workers have filed for 2.2 million jobs in Britain since 2005. That Britain's gains are much more than its contributions and an exit will not result in the complete restriction of immigrants, no longer holds water after Friday's decision.







Source: www.exchangerates.org.uk

Trotting around the Globe

The end of this tumultuous relationship is not one without repercussions. The heaviest alimony seems to have been paid by pound which saw its worst ever beating in about 31 years. Pivoting from an open economy to a relatively lesser one would definitely nick Britain's long term development plan which is something they can hardly desire since their latest productivity growth averaged around zero. While there is no doubt that immigrants have commanded around 2.2 million jobs since 2005, it also contributes to half of UK's growth. IMF estimates Britain's economy to be 5% smaller by 2019 due to Brexit. The country's GDP is expected to take a hit by 3.6% 2 years down the line, with inflation rising by 2.3% than the current levels. Unemployment rate is expected to increase by 160 basis points with average real wages contracting by 2.8% and house prices deflating by 10 per cent.

Source:www.123rf.com

Declining pound and euro would push capital flows into dollar, strengthening it and causing a depressing effect on the existential declining oil prices. The possible ripple effects of Brexit would be felt most by US, a long time strategic alliance of UK. Jolting US economy and driving up the dollar, it would weaken US diplomatic leverage in Europe and disrupt the corporate strategies of US companies based in London. As panicky investors pull out of UK and start pouring into US assets, an already surging dollar would be further boosted, thereby suppressing demand for American exports. If an economical back slash was not enough, political fallout with UK would also be a natural outcome, since it would no longer be a part of the European Union and would have no say when it makes difficult decisions. A fair warning by President Obama states that a Brexit would take 10 years for Britain to negotiate a new trade deal with the US.

With world markets going haywire in panic, investors are bound to turn to safe haven, the most lucrative of which after US appear to be Japan. This refuge in Japan would boost the value of Japanese Yen thereby accentuating trouble for the government which has maintained a weaker currency to propel exports and economic growth.

Global Oil & Gas Impact

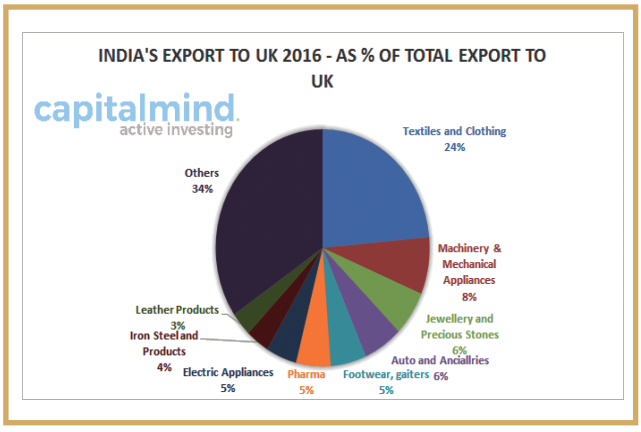
European energy would see a transformation in that the challenges being mostly to barriers to trade. The possible loss of free travel between UK and EU would mean an increase in bureaucracy in gaining a non EU citizen status and therefore costs of the employers - an outcome the oil and gas industry would want to avoid at any cost. Another unintended outcome of this unfavorable exit would be loss of competitive edge gained by the companies operating in North Sea due to its close association with the research centers in both UK and EU. Barriers to movement would hamper the potential value gained from association with resource rich countries and education centers. While UK's 64m people consume a relatively less significant 1.6m barrels a day as compared to 19.6m b/d in the US, the world's largest oil consumer, the pertinent point here is that the total EU bloc covers more than 500m people and this accounts for almost 15 percent of global oil demand (12.5m b/d). Along with the much expected uncertainty, Brexit will hamper growth in an area where oil demand has already been declining for much of the past decade. In fact, driving down of oil prices from $50 a barrel is well under way.

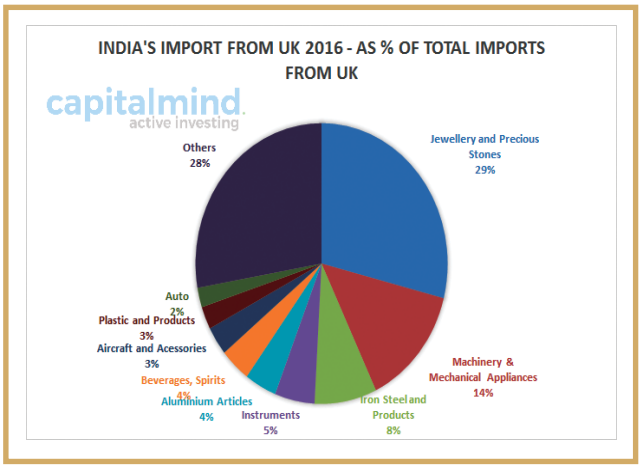
With Brexit, EU would lose a very important ally. This would change the bloc's energy policy which in turn would impact the climate policy. This development will give London a free reign to pursue its nuclear policy. Further to this, resource rich countries

like Canada, Australia and Nigeria could provide an outlet for the highly trained UK workers to take their rich experience to foreign locations and create new strategic partnerships. This could hold true for India as well who are much more geared up for growth as compared to the mature UK and EU markets.

The Great India Story

Closer to home, the near term would predict volatility for India with capital flows being impacted. The multiplier effect of outflow of foreign funds with a dollar rise will result in rupee depreciation resulting in the export market to be very competitive in nature. A strong dollar could push rupee towards 70 levels.





Source:capitalmind.in/2016/06/brexit-need-know-impact-india

With an established trading corridor with EU, depreciation in Euro/ Pound is bound to create a sluggish export environment for India. Guardian states that there are more than 800 Indian-owned businesses in UK and Europe with over 110,000 employees. This material presence is expected to be impacted with Brexit. Due to its historical and cultural ties with UK, India is its third largest source of FDI with 122 projects in the last financial year, a 65% rise from the previous year resulting in the creation of 7730 jobs and protection of 1620 jobs. The key sectors encompassed in this investment are healthcare, agritech, food and drink. Further, UK is India's largest G20 investor. With Britain ranking 12 in India's bilateral trade with individual countries and being among the seven of 25 countries with which India enjoys a trade surplus, India invests more in UK than rest of Europe combined. India's bilateral trade with Britain stood at $14.02 billion in 2015-16, out of which $8.83 billion was in exports and $5.19 was in imports. The trade balance was a positive $3.64 billion. Any opportunity lesser than the existing will have a bearing on future investment decisions of India. On a positive note, India could expect a deregulated and freer market for itself, since the lack of these in the EU seemed to have driven Brexit.

The Indian Scenario

History has always borne witness to the fact that a dollar rise has always been complemented with fall in oil prices which in turn has been accompanied by an increase in gold prices. The Indian oil and gas scenario is expected to be very much in tandem with the movements of the rest of the world. Further fall to already declined oil prices will definitely prove to be an impetus to the Indian economy due to its heavy reliability on crude oil imports. On the other hand, lower crude oil prices are definitely expected to be a snag for the oil producers.

From a long term perspective, it would seem that companies with huge exposure in the UK would have a lot to frown about. Mammoth entities like Tata Motors (JLR), Tata Steel Europe & Motherson Sumi would need to take due steps to hedge themselves against impending debacles. With expected sales drops and elevated operation costs, JLR and Tata Steel need to find alternative markets.

It would seem that the brunt of Brexit would fall most unfavorably on Tata Motors since it uses UK as a base for EU. In recent time, Jaguar Land Rover has accounted for almost 90% of company's operational profit whereas its Indian counterpart has plummeted miserably. For Jaguar Land Rover, not only is the market in doldrums, but with nearly 40% of its components being sourced from the EU region, its sourcing requirements are bound to be hampered. To quantify the impact, company reports suggest that Jaguar Land Rover could lose as much as an estimated one billion pounds by 2020.

Britain's exit from EU would mean that they no longer would be able to influence policy decisions and with JLR selling 25% of its products to rest of Europe and being in the process of setting up an additional plant in Slovakia, this could spell trouble.

So far as the IT sector is concerned, it seems to be a mitigated impact. While it is true that depreciation of the pound would have an immediate effect in the next couple of quarters, this impact would be steadily contained through currency hedges.

On the upside, Indian companies could expect some sort of tax breaks and other incentives from the UK government to contain their losses. Possibly one of the most beneficial and significant outcome of this scenario could be for the local companies who have availed loans in British currency. With the pound falling by 10%, the liability of these companies would have instantly reduced by 10% as well. The world just got better for them.

The rising head of populism

Britain seems to have become the latest victim of populism after Greece, Spain and probably even Germany. Energized by advocates who benefit principally from anxiety about migration rather than economic concern and propelled by an anguish to tear down existing institutions and defy anything that is established and ratified, be it politicians or economists. In fact the demographic profile of the Brexit voters is distinctively similar to that of American supporters of Donald Trump!! A constitution analysis of the voters states that the wide margin of the "Leave campaign" have not completed high school, are over 60 and have blue collar occupations as compared to the "Remain" campaign supporters who are university graduates, voters under 40 and members of professional classes and most importantly the actual legatee of Brexit. These populist tendencies could very well trigger similar referendum in other countries such as France, Netherlands and Sweden threatening the foundation of 28 country block.

Concludere

While quantification of the impact is definitely a mean task, it is certain that Brexit is a path towards making Britain poorer. Facing the dual challenges of inflation due to weakening of the pound which is down about 11% since Brexit and recession due to lower expectations of growth, it is going to be quite a task for UK to grapple and emerge relatively intact. While the above are certainly worrisome but not extraordinary in today's ever changing economic world, a more disturbing phenomenon that seems to be gaining momentum is the protectionist tendency of economies. The withdrawal of a country perceived to be liberal and free trading may as well be the commencement of a new regime, a market order encouraged by neo-nationalism and protectionism and this could separate the global economy further instead of a much desired integration. The WTO recently stated that the protectionist trade measure of the G20 countries were multiplying at their fastest rate since 2008. It would bode well to a take a ready reckoning to this warning and work towards a market wherein the benefits of a global economic system are enjoyed by everyone. A process of reversal from the otherwise could exhaust generations.

Towards Energy Security: Energy Diplomacy Initiatives by India-An Overview

ENERGY

Raghunath Mishra
Deputy Chief Economist (BD)
OIL India Limited

Meeting the energy needs for achieving economic growth of 8 % plus at affordable prices while addressing the very real threat of climate change presents a major challenge for India. Being an energy deficit country and heavy dependence on import of hydrocarbons, energy security further adds to this challenge.

India recognised this fact early in the process of development and took steps necessary to efficiently deliver energy in its various forms for the benefits of its economy and citizens. The state has played an active role in this sector via public sector enterprises in coal, oil, gas and power. Gradually the rules were relaxed to allow the entry of Private sector and Foreign Direct Investment into the energy sector. While these reforms played a significant role in enhancing the energy security of India, deficit status continued. Projections indicate that deficit will increase in future with economic growth if the scenario continue.

India is the third largest consumer of energy in the world after China and USA (Global Energy Statistical Yearbook 2015) but it is not endowed with abundant energy resources. Unlike developed economies, India faces an immediate challenge to address its energy security concerns. It challenges India's ability to create a modern economy that lifts hundreds of millions of Indians out of poverty and address its environmental concerns. India still has massive energy deficits. India needs to import large portions of its fuel supplies. About 80 percent of oil and 30 % of its natural gas consumption come from import sources besides some amount of coal. Large portions of the capital and equipment required for renewable and nuclear power are from external sources. India's energy status, therefore, has clear international dimensions.

Energy Diplomacy: A tool for Enhancing Energy Security.

India's fresh impetus on economic growth and development accords high priority to energy security in its own foreign policy. Energy matters to India's foreign policy for three fundamental reasons.

First, appropriate mode of energy is essential for power generation and manages our environment. India, therefore has an interest in having access to new technologies and sources of energy - especially including renewable, Nuclear energy etc- to reduce pollution, to improve energy efficiency, to diversify the global energy supply, and to address the very real threat of climate change.

Prime Minister of India Shri Narendra Modi with King Salman Bin Abdul Aziz of Saudi Arabia.

Second, energy is the key to India's economic development. Providing secure, reliable, affordable, and sustainable access to energy to its population is key to lift people out of poverty and improve their overall standard of life. By providing reliable, affordable access to power, people will have better chances of contributing to development educate their children, and increase their incomes - all of which is good for them and for the economy.

And third, it rests at the core of geopolitics, because fundamentally, energy is an issue of wealth and power, which means it can be both a source of conflict and cooperation. In the past Indian economy faced challenges thrown by unaffordable high oil prices caused mainly by geo-political factors. Conflicts and international sanctions have also affected India's sourcing options and business interests in many countries.

In recent years, several innovative measures have been taken to overcome the major bottlenecks being faced by the energy sector. Giving greater attention to energy diplomacy in India's foreign policy is one such move.In the last one and half year of the new Government, India's energy diplomacy has received a major boost. During foreign visits of government functionaries including the Prime Minister, energy security has received a focussed attention. Several bilateral and multilateral level discussions have been held and agreements signed.

A multi pronged approach

To begin with, the Government has reached out to its immediate neighbours through bilateral and regional mechanisms. During the PM's visit to Bangladesh, the two countries agreed to cooperate on a broad range of energy issues covering different sectors.India and Bhutan have agreed to jointly achieve a target of 10 GW. In two visits of PM to Nepal, agreements were signed for the Upper Karnali and the 900-MW Arun III hydropower projects. India also started supplying an additional 70 Mw to Nepal on the government's request. In a recent visit to Afghanistan, PM of India and Afghanistan President formally inaugurated the $290-million Salma Dam (Afghan-India Friendship Dam) which will provide up to 42 MW power to the country's rapidly growing industrial hub and also irrigate region devastated by drought.

At a regional level, the first major step in energy integration was the signing of the SAARC energy agreement on electricity cooperation in November 2014. The underlying idea behind such agreements is two-fold. Firstly, to help out smaller South Asian neighbours overcome their energy crisis at home. Second, by bringing South Asian countries under a common regional energy framework, stage is set for ushering greater political stability and economic integration in South Asia.

Another feature of India's energy diplomacy is renewing older relationships. Thus one can see India renewing its old ties with France, Australia and Canada, who had earlier boycotted export of nuclear technology and essential materials to the country. As per the joint statement during PM's visit, Canada has agreed to supply 3,000 metric tonnes of Uranium to India. Similarly, France has also agreed to supply components to help India build nuclear reactors. Recently, India and Iran have signed 12 agreements ranging that includes a pact to develop the strategic Chahabar port that can be leveraged subsequently for India's Energy requirement.

One of the important dimensions of India's energy diplomacy is to cultivate new relationships with willing partners with the intention to expand and diversify the sources of energy supplies, to the extent possible. Thrust on bilateral relations with Turkey, Tazikistan, Kazakhstan, Kyrgizstan, Uzbekistan and South Korea are testimony to this initiative.

So far, much focus has been on nuclear power, hydropower and renewable energy. Key nuclear breakthroughs included understanding on liability with the United States; a civil nuclear agreement with Australia; calls in France for expediting the Jaitapur plant and manufacture of nuclear plant components in India; deal with Canada to purchase uranium; and Russia agreeing to build 10 more reactors. The recent diplomatic initiatives by India have earned India the backing of Switzerland, USA and Mexico for India's bid to become a member of the Nuclear Suppliers Group (NSG).

Shri Dharmendra Pradhan, Minister of State (I/C) for Petroleum & Natural Gas meeting the US Secretary of Energy Dr. Ernest Moniz in Washington. The two Ministers reviewed bilateral energy cooperation, especially in oil and gas sector between the two countries.

Renewables and sustainable development have also attracted attention in India's Energy Diplomacy.In the renewable energy sector, in his three major bilateral foreign policy visits - Japan, USA and Germany, - the Prime Minister has made investment, technological assistance, and financial help in solar energy, a core part of thejoint statement. It formed a key part of US president's visit to India in January 2015. The government has also massively upped the target for solar power to an improbable 100,000 Megawatts by 2022. In addition, the govt has ambitious plans for off-grid solar, using that as the electricity gateway for the 300 million Indians who are without power. Renewable energy is also integrated into Govt's plans for smart cities, reviving manufacturing and addressing climate change in general.

The Japanese are to conduct feasibility studies for a 10-Mw canal-top solar photovoltaic plant in Gujarat. The United States will partner India in developing smart cities in Ajmer, Visakhapatnam and Allahabad, in addition to strengthening the Partnership to Advance Clean Energy, launching a Clean Energy Finance Forum, and supporting off-grid clean energy. Germany committed to support India's aggressive target of 175 Mw of renewable energy by 2022, particularly for solar rooftop and green energy corridor projects.

In his recent visit to India, after inaugurating the interim Secretariat of the International Solar Alliance at Gurgaon, French President Francois Hollande committed •300 million (around $325 million or Rs. 2,200 crore) over the next five years for the global development of solar energy.

The International Solar Alliance, envisaged to bring together 122 countries that are located wholly or partly between the Tropic of Cancer and the Tropic of Capricorn, is an initiative announced by the Indian Prime Minister at the COP 21 Summit in Paris in November. Countries those enjoy 300 or more days in a year of bright sunlight will be the members of this alliance.The French President said, "Through this solar alliance, he would like to open a new chapter to help give countries with no resources other than the sun an opportunity to produce electricity for meeting the needs of most of their people".

India has joined hands with United States and China in expanding the utilisation of clean energy technologies. In the coal sector

too, the Government has adopted a more practical policy. Realising that reducing the contribution of coal in India's energy mix would take longer time than originally anticipated, the Government has decided to build more efficient coal fired power plants with Japanese cooperation.

Four Fronts of Oil diplomacy

While outlining various aspects of India's energy diplomacy, adequacy attention has also been given to oiland gas. In an interview with the press, Minister of Petroleum and Natural Gas has said, " India's new oil diplomacy aims to further its interests on four fronts: to buy oil and gas acreage; source imports on better terms; increase investment in sectors such as pipelines and refining; and get business for engineering and construction companies with jobs for skilled Indian labour".The government has a set a target of reducing the total import requirement by 10 % by 2022 and in that direction, the government has put more focuson 'oil diplomacy' and leverage its position as a big-time oil importer while brokering new oil deals abroad.

The renegotiation of contracts with Ras Gas, Quatar for import of LNG brought substantial savings for the country. India was buying gas $14 per MMBtu from Qatar, which after negotiations came down to $6 per MMBtu. As a friendly gesture, Ras Gas has also waived a penalty of $1.5 billion to Petronet LNG Limited for not lifting committed amount of gas under the 'take or pay' clause. India's growing geopolitical influence globally and tumbling oil prices and a global gas glut are compelling exporters to offer better deals to retain their share in the global energy trade, benefiting Indian energy firms.

The India-Africa Hydrocarbon Conference held during January 2016 at New Delhi was another initiative in the area of energy diplomacy. The conference aimed at greater cooperation between India and African continent towards 'Development Transmitting Partnership' in the field of Hydrocarbons. It is a continuation of the discussion revolving around synergies between India and Africa and will strengthen the ties between the two. The partnership would enable India to enhance its energy security while nurturing Africa's Hydrocarbon's sector growth on several fronts like capacity building, environmental sustainability, human resource development and employment generation.

During Russia President Vladimir Putin's visit, India signed agreements on long-term oil and gas cooperation, including liquefied natural gas (LNG) supplies and studying the viability of a pipeline connecting Russia and India. ONGC Videsh and PetroVietnam signed agreements for new projects, notwithstanding tensions in the South China Sea.OVL has recently concluded acquisition of 15% stake in Russia's Vankor oil field. Efforts are underway to acquire some more stakes in such fields in Russia.

Energy pipeline and diplomacy

India's energy pipeline diplomacy which was moving at a slow pace due to various geo-political factors such as, international sanctions against Iran, is back into play in the backdrop of subdued international energy prices, with producing countries seeking buyers as their respective economies are heavily dependent on exports for revenues.

As reported, the government of India is working on simultaneous plans for constructing transnational crude oil and gas pipelines to India from Turkmenistan, Russia and Kazakhstan. In addition, the lifting of sanctions on Iran will help the revival plans for a gas pipeline from Iran through Pakistan to India.

India's pipeline project plans come in the backdrop of the International North-South Transport Corridor that promises to cut the costs involved in transporting goods to Central Asia by 30%.

There are several projects in various stages of planning and discussions. The proposed pipeline projects include the Turkmenistan-Afghanistan-Pakistan-India (TAPI) gas pipeline, the Iran-Pakistan-India pipeline, and crude and gas pipelines from Russia and Kazakhstan.All these gas pipelines are very important from the viewpoint of India's growing demand for energy and also energy security.

During the visit of Kazakhstan's energy minister in 2015, a joint working group was set up to examine the possibilities of such a pipeline from Kazakhstan. Similar efforts are being made with Russia for transportation of both oil and gas to India.

A pipeline from Turkmenistan is under discussion. As par the proposal, State-owned TurkmenGaz is to lead the multinational consortium with a majority investment in the $9 billion, 1,814km pipeline project, which is expected to have a capacity of 90 mmscmd of gas from Turkmenistan's Gunorta Yoloten-Osman fields. Of this, 38 mmscmd is planned for supply to India.

A step in the right direction...

Energy Diplomacy helps create a favourable international operating environment for energy enterprises, and strongly encourages other enterprises to develop international markets, increase sales of commodities, undertake engineering projects and promote the advancement of technology and joint Research and Development. The effort of government of India to pay full attention to deepening political exchanges, as well as strengthening economic and commercial linkages with countries having energy resources and enablers is likely to help India in enhancing its energy security. Sustained diplomatic intervention and follow-up with foreign governments with regard to efforts by our corporates both in the public sector and private sector, to acquire energy assets overseas will be a step forward in the right direction.

The Base Erosion and Profit Shifting: India's response so far…..

FINANCE

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The Base Erosion and Profit Shifting (BEPS) refers to tax planning strategies that exploit the gaps and mismatches in the tax rules across the globe to artificially shift profits of an enterprise to low or no-tax locations where there is little or no economic activity, resulting in little or no overall corporate tax being paid. This practice affects the developing countries negatively due to heavy loss of tax revenue.

G20 countries worked with OECD to design action plans to tackle the challenges in the taxation of cross border activities. The OECD launched the BEPS Plan in July 2013 and got the final action plans approved by the G20 leaders in the meeting held in Turkey in November 2015.Since India is a part of G20, the BEPS Action plans are important to India.

In line with the BEPS Action Plans and even independently, India has been introducing changes in its tax legislation and tax treaty framework to plug tax avoidance measures.

Equalization Levy

Foreign companies which operate in India through a website, the server of which is located outside India, were not taxable in India in the absence of physical presence. If such companies were located in low/ no tax jurisdiction, then such companies were escaping tax in both the countries i.e. country in which the income is sourced i.e. India and the country in which it is incorporated. To give an example, if a social networking site was doing advertisement for a business enterprise in India, the consideration received by it was not chargeable to tax in India in the absence of a physical presence. If such enterprise was situated in a no/ low tax jurisdiction, then the income was taxed at NIL/lower rate.

BEPS Action Plan 1 has suggested various options to tax the foreign companies on account of such digital presence. Out of these options, India has chosen to adopt the introduction of equalization levy in the Finance Act, 2016. As per these provisions, an Indian resident carrying on business or profession, or a Permanent Establishment of a foreign company in India, is required to withhold6% of the amount of consideration payable to non-residents for specified services provided by them. Specified services is defined to mean online advertisement, provision for digital advertising space, or any other facility or service for the purpose of online advertisement or any other service as maybe notified.

The Equalization levy is introduced as a separate levy in Chapter VIII to the Finance Act, 2016, outside the purview of the Income-tax Act, 1961 ('the Act'). Since equalization levy is not a part of the Act, a non-resident cannot claim beneficial provisions of the tax treaties to contend that such equalization levy should not be payable by them in the absence of a presence in India.

Equalization levy will impact businesses that engage foreign web-based portals for the purpose of advertisement. If such foreign companies seek to receive the consideration for services net of all taxes then the tax cost on such services shall be borne by the Indian recipient of such services. For example, if a lubricant company viz. X Ltd (incorporated in India) receives advertisement services from Y Ltd (Non-Resident) which is web based portal having no physical presence in India but only operates in India via a website. In this scenario, equalization levy shall be withheld by X Ltd. while making payment to Y Ltd at the rate of 6% of the entire consideration. However, if Y Ltd. seeks to receive its consideration net of all taxes in India, then the equalization shall be borne by X Ltd.

Thus, it can be said that through the introduction of the equalization levy, the income-tax department has taken a step to tax the entities which have a digital presence in India.

Country by Country Reporting ('CbC Reporting')

BEPS Action Plan 13- 'Transfer pricing documentation and country by country reporting' aims to have a framework to ensure complete transparency on the global economic activities undertaken, profits earned and taxes paid by the different entities under a multi-national group in different countries and use such information in the matters of transfer pricing and BEPS risks.

BEPS Action Plan 13 has recommended a three tier transfer pricing documentation as follows-

- Master file: requirement to provide an overview of the Multinational Enterprises (MNEs) business and explain the MNE's Transfer Pricing ('TP') policies in the context of its global economic, legal, financial and tax profile.
- Local file: to demonstrate that the taxpayer has complied with the arm's length principle in its material intra group transactions. Entities need to

  Demonstrate arm's length nature of transactions;

  Contain the comparable analysis.
- Country-by-Country (CbC) report: This report shall provide jurisdiction-wise information on global allocation of income, taxes paid/accrued, the stated capital, accumulated earnings, number of employees and tangible assets. This shall also provide entity-wise details of main business activities which will portray the value chain of inter-company transactions. This report shall be filed in one country and shall be exchanged between the revenue authorities of different countries when required.

In the Finance Act, 2016, one of the most important developments from TP regulations perspective was introduction of Country-by-Country (CbC) reporting norms for TP documentation. An international group is intended to comply with CbC reporting if the consolidated revenue of the group is above EUR 750 million i.e. Rs 5,632 crore approx. Three type of entities resident in India shall have to file the CbC report-

- The parent company of a multi-national group which is resident in India.
- The Indian resident constituent entity of a multi-national group which is designated by the multi-national group to file CbC on behalf of the parent company of the group.
- The constituent entity resident in India whose parent company is the resident of a country which does not have an agreement providing exchange of CbC with India and such a parent company files the CbC report for the group.

Regarding the master file, since no threshold has been prescribed, it may be deduced that it can be applicable to all multinationals operating in India whether headquartered in India or otherwise, unlike CbC reporting which is triggered only if groups' revenue exceeds EUR750 million.

The Transfer Pricing documentation will bring more transparency and will enable revenue authorities to examine the structure of the group and ask relevant questions to determine correct taxes in respect of overseas operations.

Amendment to tax treaties to adopt source based taxation

India has extensive tax treaty network with several countries. As per the beneficial capital gains article in the tax treaties, the entities resident in countries like Mauritius, Singapore and Cyprus were not liable to tax in India on gains arising on transfer of shares of an Indian company. This is because as per these tax treaties India did not have right to tax capital gains arising on sale of shares of an Indian company. Further, India- Netherlands treaty also provides similar benefit for sale of shares of an Indian company to another non-resident.

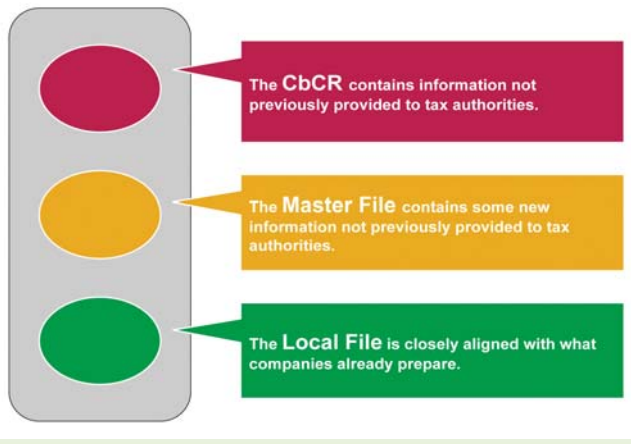
Because of such favorable capital gains article, Mauritius was considered to be most attractive destination to make investments in India. As these capital gains are also not taxable in Mauritius, many investors ended up avoiding taxes in both India and Mauritius. Over the years, the India-Mauritius tax treaty garnered severe criticism for serving as a loophole through which treaty shopping, round tipping and aggressive tax evasion strategies led to severe loss of tax revenue to the Indian government. With a view to address this issue, after many years of negotiations, India has signed the protocol to the India-Mauritius tax treaty in May 2016.As per the amendment India has been given right to tax capital gains earned on transfer of shares of an Indian company, which shares have been acquired on or after 1 April 2017.

Since the capital gains benefit in India-Singapore tax treaty is linked to India-Mauritius treaty, Singapore resident companies will also not be eligible to obtain the beneficial capital gains article and they will be liable to pay taxes on sale of shares of an Indian company.

Thus it can be seen that Indian tax authorities have started the process of renegotiation of tax treaties where India has been denied source based taxation on capital gains arising in India. This will result in avoiding double non-taxation, both in India and in the country of residence.

In view of the aforesaid, it can be seen that India has taken proactive steps to adopt suggestions in some of the BEPS action plans. It will be interesting to see what further changes will be made in the tax legislation. From the perspective of a taxpayer, it is important to study BEPS plans and the developments in tax laws so as to arrange its affairs on the right side of law.

Three tier documentation requirements



Perspectives on the Indian Discovered Small Fields Bid Round

UPSTREAM

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The Discovered Small Fields Bid Round was launched on 25 May 2016 at a ceremony held at Hotel Ashoka in Delhi. A portal was also established to provide technical information. The bid round promotion has since toured across India before moving on to London and Houston. Bids are accepted from 15 July 2016 and all bids will be opened on 31 October 2016.

A total of 46 contract areas are being offered, both onshore and shallow water with one deep water block in the Krishna-Godavari Basin. The contracts encompass 67 fields previously held by ONGC and Oil India Ltd. These contracts will be subject to the Revenue Sharing Model of the Discovered Small Field Policy announced on 2 September 2015. This differs from the previous Production Sharing Contract, changing key fiscal terms, pricing and allowing both conventional and unconventional production by local and international companies.

Small Field bid rounds have had mixed success in Asia Pacific, with Indonesian KSO contracts and Malaysian RSC contracts delivering both profitable and unprofitable results under contract terms set up during high oil prices. Under those terms, success was driven by resource upside, with risk mitigated by phase gated implementation. Prior small field experience was an advantage but not a guarantee.

The Indian opportunities are governed by administrative and fiscal systems designed to be a lot simpler and more transparent than in the past. This article introduces the scale of these opportunities and provides some perspectives on the direction of the upstream investment environment of India.

Outline of the Discovered Small Fields

According to Directorate General of Hydrocarbons (DGH) the 67 fields hold around 625 MMboe in place volumes which include around 360 MMbo and 1,500 Bcf of gas. This article provides IHS outside view of the prospectivity through the lens of its E&P database developed through sixty years of scouting upstream activities in India.

The 67 small size fieldsgrouped by contract in the table below include 31 onshore and 36 offshore fields (including two deep water), and hold around 625 MMboe in place volumes.

Most fields are offered from Mumbai Offshore, Krishna-Godavari, Assam Shelf / Assam-Arakan Fold Belt (AAFB) and Cambay basins, which are the most mature hydrocarbon producing regions in the country.

Mumbai Offshore:

The 27 fields in Mumbai Offshore region are grouped into 13 clusters or 'contract areas'. The discoveries hold 198 (million barrels of oil) MMbo and 990 Bcf(billion cubic feet) gas in place volumes. D-18 is the largest field offered in this bid round containing 108 MMbo and 73 Bcfin place gas. It was discovered by ONGC in 1985 and the discovery well, D-18-1, is reported to have tested 3,403 (barrels oil per day) bo/d and 0.72 MMcfg/d (million cubic feet gas per day) from Oligocene MuktaFormation limestone; reservoir lies at 2,987 meter depth and have pressure of 4,250 psi.

Source: Director General of Hydrocarbons (DGH) website

Contract Areas on Offer

S. No.	Basin	Field	Contract Area	Type of Discovery	Map Ref No.
1	Assam Shelf & Assam-Arakan Fold Belt	Hilara	HILARA-DSF-2016	Oil+Gas	1
2		Laxmijan	LAXMIJAN Cluster-DSF-2016	Oil+Gas	2
		Bihubar		Oil+Gas	
3		North Patharia	PATHARIA Cluster-DSF-2016	Gas	3
		Patharia			
4		Barsilla	BARSILLA-DSF-2016	Oil+Gas	4
5		Charaideo	CHARAIDEO-DSF-2016	Oil+Gas	5
6	Mumbai Offshore	CA	CA Cluster-DSF-2016	Oil+Gas	S-1
		SD-14		Gas	
		SD-4		Oil+Gas	
		TP		Gas	
		CD		Oil+Gas	
		ED-4		Oil	
7		B-37	B37 Cluster-DSF-2016	Oil+Gas	S-2
		B-51		Gas	
		B-174		Gas	
		B-183		Gas	
8		B-7	B9 Cluster-DSF-2016	Gas	S-3
		BRC		Oil	
		B-9		Gas	
9		C-37	C37 Cluster-DSF-2016	Gas	S-4
		C-43		Gas	
10		D-12	D31 Cluster-DSF-2016	Gas	S-5
		D-31		Oil+Gas	
11		B-15	B15 Cluster-DSF-2016	Oil+Gas	S-6
		B-15A		Oil+Gas	
12		B-127E	B127E Cluster-DSF-2016	Oil+Gas	S-7
		B-153		Oil+Gas	
13		B-14	B14-DSF-2016	Oil	S-8
14		B-163	B163-DSF-2016	Gas	S-9
15		PER	PER-DSF-2016	Oil+Gas	S-10
16		B-80	B80-DSF-2016	Oil+Gas	S-11
17		NMT	NMT-DSF-2016	Gas	S-12
18		D-18	D18-DSF-2016	Oil+Gas	S-13
19	Kutch Offshore	GK-39	GK39-DSF-2016	Gas	S-14
20		KD	KD-DSF-2016	Oil+Gas	S-15
21	Cambay	Elao	ELAO-DSF-2016	Gas	6
22		South Patan	SOUTH PATAN-DSF-2016	Oil+Gas	7

S. No.	Basin	Field	Contract Area	Type of Discovery	Map Ref No.
23	Cambay	Khambel	KHAMBEL-DSF-2016	Oil+Gas	8
24		Kamboi	KAMBOI-DSF-2016	Oil+Gas	9
25		West Bechraji	WEST BECHRAJI-DSF-2016	Oil+Gas	10
26	Cauvery	Neduvasal	NEDUVASAL-DSF-2016	Oil+Gas	11
27		Karaikal	KARAIKAL-MF-2016	Oil	12
28	Krishna-Godavari (Onland)	Palakollu	PALAKOLLU-DSF-2016	Gas	13
29		Achanta	ACHANTA-DSF-2016	Gas	14
30		Lankapalem	LANKAPALEM-DSF-2016	Gas	15
31		Uppidi	BHIMANAPALLI Cluster-DSF-2016	Gas	16
		Bhimanapalli		Gas	
32		Mummidivara	MUMMIDIVARAM-DSF-2016	Gas	17
33		Koravaka	KORAVAKA-DSF-2016	Oil+Gas	18
34		Sanarudravara	SANARUDRAVARAM-DSF-2016	Gas	19
35	Krishna-Godavari (Offshore -Shallow)	GS-KV-1	GSKV1 Cluster-DSF-2016	Gas	S-16
		GS-59		Oil+Gas	
36		YS-5	YS5-DSF-2016	Gas	S-17
37		GS-70	GS70-DSF-2016	Oil+Gas	S-18
38	Krishna-Godavari (Offshore -Deep)	GD-7	GD7 Cluster-DSF-2016	Gas	D-1
		GD-1		Gas	
39		KD-1	KD1-DSF-2016	Gas	D-2
40	Rajasthan	Bakhri Tibba	BAKHRI TIBBA-DSF-2016	Gas	20
41		Sadewala	SADEWALA-DSF-2016	Gas	21
42	Vindhya	Nohta	NOHTA-DSF-2016	Gas	22
43	Assam Shelf & Assam-Arakan Fold Belt	Kherem	KHEREM-DSF-2016	Oil	23
44		Dipling	DIPLING Cluster-DSF-2016	Oil	24
		Sarojini		Oil	
		Sapekhati		Oil+Gas	
45		Duarmara	DUARMARA-DSF-2016	Oil+Gas	25
46		Jeraipathar	JERAIPATHAR-DSF-2016	Oil	26

The CA Cluster DSF-2016 comprises six fields which is the highest number of fields offered in any cluster and it holds around 16 MMbo and 146 Bcf in place gas volumes. Among six fields, CA is the largest discovery containing around 14 MMbo and 124 Bcf gas.

NMT and B-9 are the two main gas fields in Mumbai offshore containing 193 Bcf and 158 Bcf in place gas volumes respectively. NMT-2 discovery well is reported to have flowed 3 MMcfg/d from Lower Oligocene Mahuva Formation sandstone at around 2,011 m depth. The reservoir pressure is reported as 2,777 psi. The B-9-1 discovery well is reported to have tested 10.5 MMcfg/d from Upper Oligocene Daman Formation sandstone at around 2,645 m depth with a reservoir pressure of 3,852 psi.

Northeast India:

There are 13 fields from north-eastern part of the country located in Assam Shelf and Assam-Arakan Foldbelt (AAFB) regions. They are grouped into nine contract areas, and hold 11.8 MMbo and 15.7 Bcf gas in place volumes. Dipling Cluster DSF-2016 contract area, which includes Dipling, Sarojini and Sapekhati fields, holds 52 MMbo and 72 Bcfof in place gas. The Dipling is the largest field containing 30 MMbo and 28 Bcf gas and the discovery well, Moran 98, is reported to have tested 82 bo/d from Oligocene Barail Group.

Laxmijan Cluster DSF-2016, containing Laxmijan and Bihubar hydrocarbon discoveries, holds 13 MMbo and 36.5 Bcf gas in place volumes. Laxmijan 1A discovery well is reported to have tested 63 bo/d from the Miocene Tipam sandstone at around 3,330 m depth with reservoir pressure of 5,290 psi.

Krishna-Godavari Basin:

There are 15 fields from Krsihna-Godavari basin, including eight onshore and seven offshore fields. Among the offshore fields, two(GD-1 and GD-7) are deep water located below 500 m water depth. Both are offered under single contract area, GD7 Cluster DSF-2016 and together contain around 2.6 Bcf in place gas volumes. GD-1 was reported to have tested 2.3 MMcfg/d from Pliocene sands, whereas GD-7 flowed 5.4 MMcfg/d during mini-DST.

Other five offshore fields in Krishna-Godavari basin are shallow water, containing 4 MMbo and 108 Bcf in place gas volumes. YS-5 with around 60 Bcf in place gas is the largest among eastern offshore fields. The discovery well, YS-5-1A, is reported to have tested 1.9 MMcfg/d from the Cretaceous Golapalli Formation sandstone.

The eight onshore fields offered from the basin hold 26 Bcf in place gas volumes with Palakollu and Lankapalem as the main discoveries - each holding more than 8 Bcf of in place gas. Cretaceous and Paleocene sandstones constitute main reservoirs for onshore fields.

Cambay Basin:

Five fields, categorised into five contract areas, have been offered for bidding including four oil and one gas field. These hold more than 10 MMbo of in place oil with Bechraji West containing around 5.4 MMbo and Patan South 3.2MMbo.Paleocene-Eocene sandstones are the main reservoirs in the area.

Patan South's discovery well, SP-5, is reported to have tested 94 bo/d from Eocene Cambay Shale's sandstone whereas West Bechraji West's discovery well, Bechraji 15, tested 9 bo/d after hydrofracturing in Eocene Kalol sandstone at around 733 m depth.

Apart from above mentioned four regions, two onshore fields are offered from Cauvery Basin, two from Rajasthan, one from Vindhyan basin, and two shallow water offshore fields are offered from Kutch offshore region.

Discovered Small Fields Bid Round						
No.	Field	Contract Area	Cluster No.	Hydrocarbon Type	Onshore / Offshore	Basin
1	Hilara	HILARA-DSF-2016	1	Oil & Gas	Onshore	AAFB and Assam Shelf
2	Laxmijan	LAXMIJAN Cluster DSF-2016	2	Oil & Gas		
3	Bihubar			Oil & Gas		
4	N.Patharia	PATHARIA Cluster DSF-2016	3	Gas		
5	Patharia			Gas		
6	Barsilla	BARSILLA-DSF-2016	4	Oil & Gas		
7	Charaideo	CHARAIDEO-DSF-2016	5	Oil & Gas		
8	CA	CA Cluster DSF-2016	6	Oil & Gas	Offshore	Bombay
9	CD			Oil & Gas		
10	SD-4			Oil & Gas		
11	SD-14			Gas		
12	TP			Gas		
13	ED-4			Oil		
14	B-37	B-37 Cluster DSF-2016	7	Oil & Gas		
15	B-51			Gas		
16	B-174			Gas		
17	B-183			Gas		
18	B-9	B-9 Cluster DSF-2016	8	Gas		
19	B-7-2			Gas		
20	BRC			Oil		
21	C-37	C-37 Cluster DSF-2016	9	Gas		
22	C-43			Gas		
23	D-12	D-31 Cluster DSF-2016	10	Gas		
24	D-31			Oil & Gas		
25	B-15	B-15 Cluster DSF-2016	11	Oil & Gas		
26	B-15A			Oil & Gas		
27	B-127E-1	B-127E Cluster DSF-2016	12	Oil & Gas		
28	B-153			Oil & Gas		
29	B-14	B-14 DSF-2016	13	Oil		
30	B-163	B-163 DSF-2016	14	Gas		
31	PER	PER DSF-2016	15	Oil & Gas		
32	B-80	B-80 DSF-2016	16	Oil & Gas		
33	NMT	NMT DSF-2016	17	Gas		
34	D-18	D-18 DSF-2016	18	Oil & Gas		
35	GK-39	GK-39 DSF-2016	19	Gas	Offshore	Kutch
36	KD	KD DSF-2016	20	Oil & Gas		
37	Elao	ELAO DSF-2016	21	Gas	Onshore	Cambay
38	South Patan	SOUTH PATAN DSF-2016	22	Oil		
39	Khambel	KHAMBEL DSF-2016	23	Oil		
40	Kamboi	KHAMBOI DSF-2016	24	Oil		
41	West Bechraji	WEST BECHRAJI DSF-2016	25	Oil		
42	Neduvasal	NEDUVASAL DSF-2016	26	Oil & Gas	Onshore	Cauvery
43	Karaikal	KARAIKAL DSF-2016	27	Oil		
44	Palakollu	PALAKOLLU DSF-2016	28	Gas	Onshore	Krishna-Godavari
45	Achanta	ACHANTA DSF-2016	29	Gas		
46	Lankapalem	LANKAPALEM DSF-2016	30	Gas		
47	Uppidi-1 (UPAA)	BHIMANAPALLI Cluster DSF-2016	31	Gas		
48	Bhimanapalli			Gas		
49	Mummidlvaram	MUMMIDIVARAM DSF-2016	32	Gas		
50	Koravaka	KORAVAKA DSF-2016	33	Oil & Gas		
51	Sanarudravaram	SANARUDRAVARAM DSF-2016	34	Gas		
52	GS-KV-1	GSKV1 Cluster DSF-2016	35	Gas	Offshore	
53	GS-59-1A			Oil & Gas		
54	YS-5-1A	YS5 DSF-2016	36	Gas		
55	GS-70-1	GS70 DSF-2016	37	Oil & Gas		
56	GD-7	GD-7 Cluster DSF-2016 (Deep Water)	38	Gas		
57	GD-1			Gas		
58	KD-1	KD1 DSF-2016	39	Gas		
59	Bakhri-Tibba	BAKHRI TIBBA DSF-2016	40	Gas	Onshore	Rajasthan
60	Sadewala	SADEWALA DSF-2016	41	Gas		
61	Nahota-2	NAHOTA DSF-2016	42	Gas	Onshore	Vindhyan
62	Kherem	KHEREM DSF-2016	43	Oil & Gas	Onshore	Assam Shelf
63	Dipling	DIPLING Cluster DSF-2016	44	Oil & Gas		
64	Sarojini			Oil & Gas		
65	Sapekhati			Oil & Gas		
66	Duarmara	DUARMARA DSF-2016	45	Oil & Gas		
67	Jeraipathar	JERAIPATHAR DSF-2016	46	Oil		

India's Changing Upstream Investment Environment

There have been significant reforms in India's upstream sector over the past two years, with the most notable developments stemming fromchanges introduced under:

1. the Discovered Small Field Policy (DSFP);
2. the Hydrocarbon Exploration Licensing Policy (HELP); and
3. the new pricing formula for deepwater, ultra-deepwater and high-temperature high-pressure fields.

Many of the provisions of the DSFP and HELP overlap, including uniform licensing for conventional and unconventional hydrocarbons, arms-length pricing and marketing freedoms, longer exploration periods, exploration throughout the contract period, and a shift from production sharing contracts (PSCs) to revenue sharing contracts (RSCs). The DSFP also incorporates unit development flexibility in the case of reservoirs extending beyond contract areas, and HELP includes offshore royalty reductions and introduces open acreage licensing.

The IHS Oil & Gas Risk Service (OGRS) provides a global view of upstream-specific above-ground risk analysis and forecasts, allowing clients to benchmark countries in a consistent and forward-looking manner by comparing 21 risk factors across 131 countries and regions. Recent upstream reforms in India have resulted in improvements to India's scores for two OGRS risk factors in the five-year outlook:

- Pricing and marketing freedoms, combined with offshore royalty reductions and open acreage, have resulted in an upgrade of the 2021 score for International Openness, as these policies, successfully implemented,could incentivize increased international oil company investment and, eventually, production.
- The removal of the administrative burden related to cost recovery that will come with the new RSCs, combined with uniform licensing and longer exploration periods, has resulted in an upgrade of the 2021 score for Regulatory Burden.

The OGRS is also monitoring three other risk factors that could change as implementation of the DSFP and HELP progresses. The execution of these policies is likely to impact the score for Government Take, once fiscal terms are clarified through the release of model RSCs. Given the removal of cost recovery, the fiscal terms of the new model RSCs are crucial to determining these policies' impact on project economics, as well as the extent and direction of any potential change to India's score for Government Take. The model RSC for the Discovered Small Field Bid Round has been released, with the following provisions for gross revenue sharing between the contractor and the government:

- When the revenue is at or below a Lower Revenue Point (defined as USD 10,000 per day), the government's revenue share is a fixed percentage of the revenue, which is one of the bid items.
- At or above a Higher Revenue Point (defined as USD 1 million per day), the government's revenue share is a higher fixed percentage, which again is a bid item.
- Between these two points, the government's revenue share is calculated on a sliding scale.

While the absence of minimum government revenue shares means that the impact of this model RSC on Government Take has yet to be clarified, it underlines the government's efforts to increase bid item flexibility to encourage bids.

Additionally, under HELP the government plans to create an Empowered Committee of Secretaries to streamline inter-ministerial coordination and resolve contract disputes with investors. If technical experts are appointed to the Committee and are empowered to resolve disputes without turning to the overburdened legal system, this would have a positive impact on India's score for Sanctity of Contract. Further, if the Committee is able to speed up the process for obtaining approvals and clearances from multiple government agencies, this could improve India's score for Expeditiousness of Contract.

While reform efforts to date have resulted in improvements to two OGRS 2021 scores, attractive fiscal terms and the implementation of the benefits offered by the DSFP and HELP will be crucial to recognizing upgrades to the scores for additional risk factors. Nonetheless, progress thus far suggests that India's relative above-ground attractiveness as an upstream investment destination within Asia is likely to improve over the next few years.

NeoPentyl Glycol (NPG): A Unique Multi Purpose Chemical

TECHNOLOGY

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BPCL

Introduction

Consumer durable products are essential part of our modern life. These products are produced from many important chemicals. Among these important chemicals, oxygen containing organic compounds such as alcohol (R-OH); ethers (R-O-R); ketones (R-CO-R); aldehydes (R-CO-H); carboxylic acids (R-COOH); esters (R-COO-R); acid anhydrides (R-CO-O-CO-R); amides (R-C(O)-NR2). (Where "R" is an organic group) are widely used as raw material in the synthesis of many advanced synthetic polymers and chemical substances.

Polyols (compounds with multiple hydroxylfunctional groups such diol (with two hydroxyl groups), triol (three hydroxyl groups) and tetrol (with four hydroxyl groups) are important class of oxygen containing organic compounds, widely used in the synthesis of various synthetic polymeric materials such as polyether polyols, polyurethanes and polyesters etc.

Neopentyl glycol (NPG): A Unique Chemical

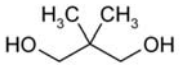
Neopentyl Glycol (NPG), IUPAC name 2,2-dimethyl-1,3-propanediol, CAS [126-30-7]) is an important diol which features unique chemical structure. NPG has two hydroxyl groups located in the 1, 3-position on the primary carbon atom. Additionally, it has two methyl groups instead of the usual two hydrogen atoms on the ?-carbon atom. This unique combination in the structure of NPG enablesrapid esterification, high chemical and thermal stability as well as high crystallinity and weatherability.

NPG: Properties and Applications

NPG is a white crystalline solid and partially soluble in water. It is soluble in oxygenated solvents and completely soluble in alcohols. A detailed chemical and physical property of NPG is provided in Table 1.

Neopentyl glycol is increasingly being used as an important chemical intermediate particularly in the manufacture of various synthetic resins, alkyd resins, polycarbonate resins, polyesters, paints, plasticizers, adhesives and synthetic lubricants. It is utilized by automotive industry, original equipment manufacturers (OEM), synthetic resin manufacturers and other plastic and polymer manufacturers. NPG is employed to enhance the stability of the polyester resin and increase its resistance against light, water, heat and chemicals to provide a longer product life. Synthetic lubricating esters produced through the esterification of NPG with fatty or carboxylic acids are found to be superior with respect to reduced potential for oxidation or hydrolysis, as compared to natural esters.

Table 1: Physical and Chemical properties of NPG (Source: Mitsubishi Gas Chemical)

Properties	Description
Appearance / Molecular weight	White solid,104.15 g/mol
Chemical Formula/ IUPAC Name	(CH3)2C(CH2OH)2/2,2-Dimethyl-1,3-propanediol
Chemical structure	
Melting point/Boiling point/Flash point	127 °C/208 °C
Solubility	Soluble in benzene, chloroform, highly soluble in ethanol, diethyl ether
Water Solubility	190g/100 ml at 20 0C (65%)
Thermal Stability	Pure NPG is thermally stable upto the boiling point. However, in the presence of alkali salts or bases, NPG decomposes above 140 0C. Thermal decomposition products: methanol, isobutanol, isobutyl aldehyde, formaldehyde etc.
Toxicity	Non-toxic to fish, Daphnids and Algae.
Stability & Reactivity	Stable. Incompatible with strong oxidizing agents, Acetic anhydride, Acid chlorides, Moisture. Combustible
Flash point/Ignition Temperature (°C)	129^{0}C /399^{0}C

NPG and its derivatives have the applications in the fields including water based coatings, magnetic coatings, gel coats, powder coatings, high solid systems, coil coatings, multilayer coatings (on alkyds, epoxy, polyester and poly urethane resins). It is also used as an intermediate for the synthesis of lubricants, plasticizers, adhesives, mortar or cement systems, photographic materials, pharmaceuticals, pesticides, fragrances, fibre lubricants antistatic agents, fabric softeners, vibration dampeners etc. A detailed sector wise application of NPG is provided in Fig 1.

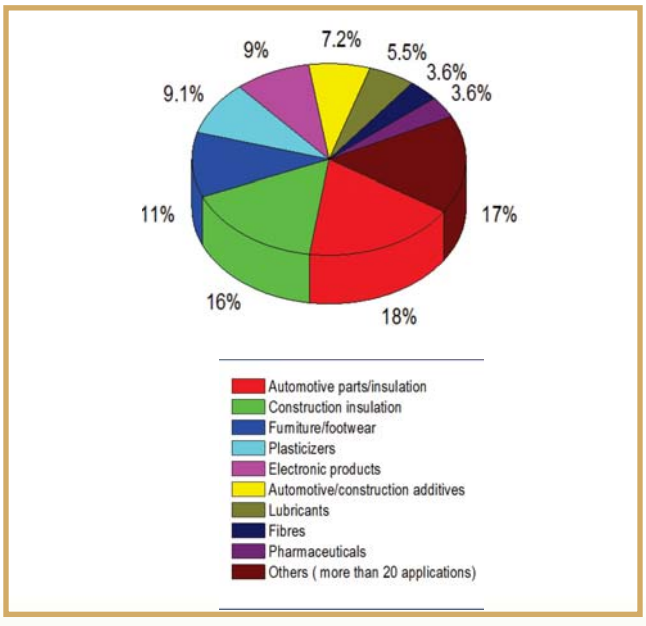


Fig1. Sector wise applications of NPG(Source: ICIS chemical Business report)

NPG has wide applications in coatings areas such as powder coatings based on NPG has improved impact and scratch resistance and high gloss. Synthetic lubricants made from NPG provide good lubricity and reduced corrosivity. It is also employed in enhancing the stability of the polyester resin and increases its resistance against light, water, heat and chemicals to provide a longer a product life.

The neopentyl glycol market is driven by its demand from polyester resins industry for a variety of coatings solutions. However, substitutability of neopentyl glycol(NPG) with ethylene glycol, a cheaper alternative, is expected to be the major restraining factor for the NPG market. New product applications in the pharmaceutical formulations could be a prospective market opportunity.

NPG: Worldwide Supply/Demand Scenario

Demand for NPG is rising steadily as market is driven by its demand from polyester resins industry for a variety of coating solution. The polyester resins manufactured from neopentyl glycol (NPG) find wide range of application is the automotive, construction, furniture, electronic, lubricants and plasticizer industries. According to consultancy firm TranTech report, global capacity of NPG was 485,000 tpa in 2005 while in 2015 it was around 800,000 tpa. Asper LGChem's, forecast, NPG production capacity in the world would be around 890,000 tpa by 2019 (Fig.2).

As per the forecast, production capacity of NPG in North America is expected to remain stable during the period of 2012-2019 while demand will increase marginally while in Europe during the same period, the supply will stood nearly steady. China will be the major drivers for NPG demand and supply (Fig.3). The projected installed capacity for NPG in China will increase by double during 2012-2019. While in rest of the Asia, the capacity will increase from 170,000 tpa to 220,000tpa during the same period. China's NPG demand growth rate to be 10% per annum during 2012-2019, while in Europe and America' demand it would remain around 4.0 % per annum. The Africa, Oceania and Middle East are also going to use more NPG in coming years and will see around 6.6% growth rate for NPG uses.

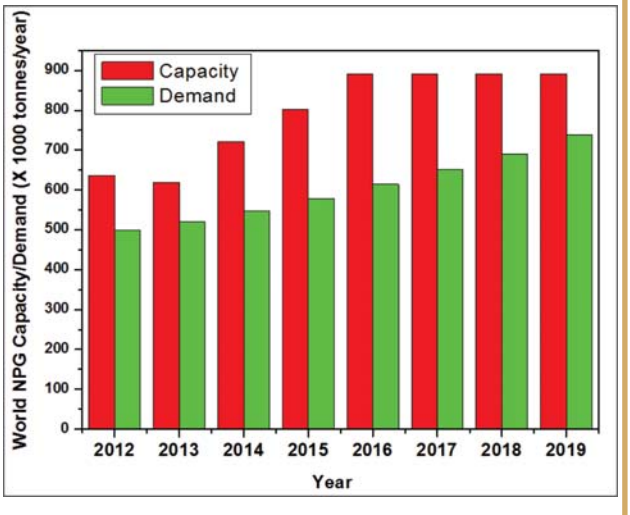


Fig 2. Worldwide current and future installed production capacity and demand of NPG in different regions (Source: LG Chem)

China and India, world's two most populous countries, will drive demand for consumer goods such as furniture, footwear, electronic products, automotives, pharmaceuticals, etc., which in turn will lead to further demand for NPG used in these products. Europe is the second largest consumer of neopentyl glycol (NPG), especially in the automotive and OEM sector. The demand for NPG is also driven by high use of polyester resins in powder coatings. North America is another major consumer for neopentyl glycol (NPG) due to its demand for synthetic lubricants and plasticizer industry. In Rest of the World, Brazil, Argentina and South Africa contribute to major demand for the market.

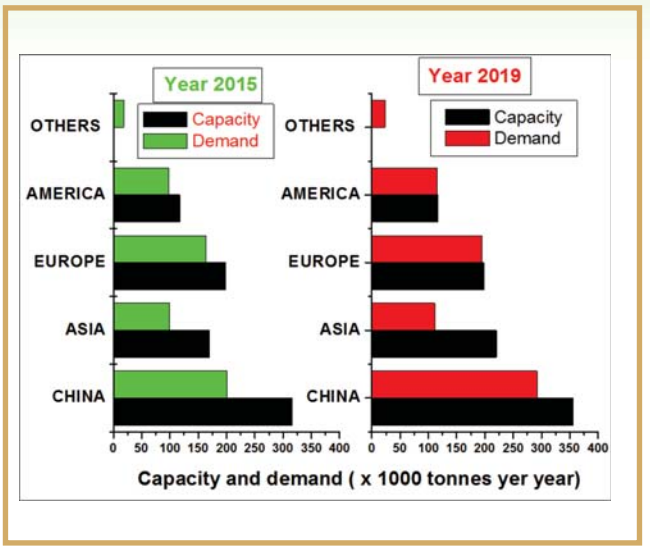


Fig 3. Region wise capacity and demand for NPG(Source: LG Chem)

Chemistry of NPG ProductionProcess

NPG is synthesized from formaldehyde and isobutyraldehyde. There are two main industrial production technologies: (1)Cannizzaro process technology and (2) Aldol condensation followed by hydrogenation technology. The advanced NPG production process is based on aldol condensation followed by hydrogenation, which is discussed in more details in the following section.

Production by Cannizzaro Reaction

A significant portion of the NPG produced commercially is synthesized by the combination of aldol condensation and a crossed Cannizzaro reaction (named after its discoverer Stanislao Cannizzaro) with either NaOH or Ca(OH)2 catalyst (Fig.4).

In aforementioned process, advantage is being taken of the fact that all -hydrogen atoms of the aldehyde i.e isobutyraldehyde react with formaldehyde in an aldol condensation. In a subsequent crossed-Cannizzaro reaction, the aldehyde group in the intermediate product hydroxypivaldehyde, CAS [597-31-9], is then reduced to alcohol with excess formaldehyde. The major benefits of the process arises from the fact that self-aldol of isobutyraldehyde requires a base stronger than OH- ions to occur to a significant extent, a relatively small excess of formaldehyde is sufficient for high conversion and a selectivity greater than 90% is achieved.

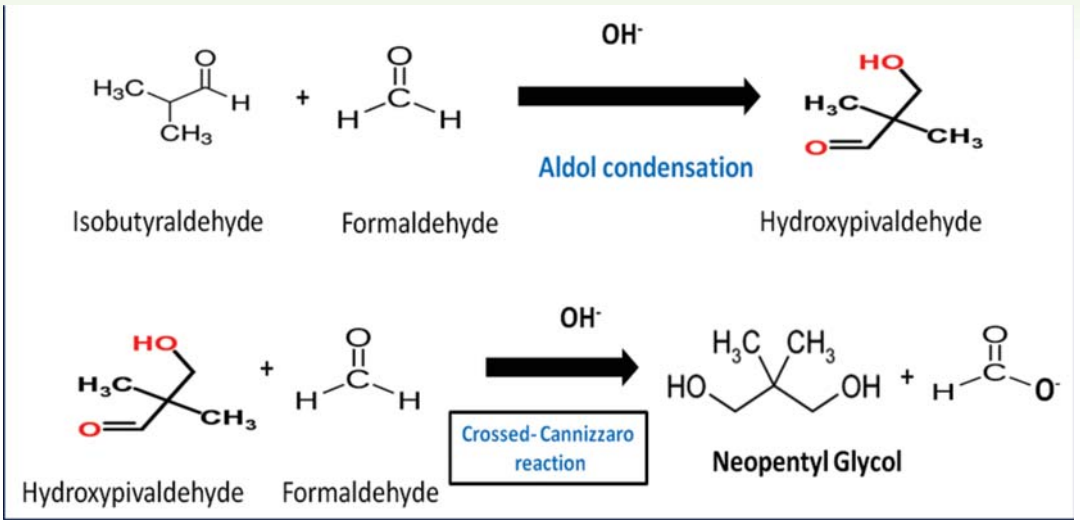


Fig 4: Reaction scheme for the synthesis of NPG through aldol condensation and crossed-Cannizzaro reaction

Production by Catalytic Hydrogenation

This process usually is performed in two stages. The type of catalysts used for the aldol addition has significant effect on the technical requirements of the hydrogenation and purification stages. Since OH- assisted aldol reaction produces significant amount of by-products, tertiary amine is being used as catalysts for the aldol addition. Hydroxypivaldehyde is formed rapidly by the reaction of isobutyraldehyde (up to 10% excess) with formaldehyde in presence of trialkyl amine as catalyst. Hydroxypivaldehyde is separated from salts by extraction with dibutylether and hydrogenated on copper chromite catalyst between 175-220 0C (Source: Ullmann's Fine Chemicals).

In a variant of this process, hydrogenation and hydrogenolysis are performed stepwise at different temperatures 120-1600C and 175-1900C. At the higher temperature, esters by products also are hydrogenated to the corresponding alcohols.

The state-of-the-art NPG plants are now use a tertiary amine catalyst in place hydroxide catalysts. Hydroxypivaldehyde is formed rapidly by the reaction of isobutyraldehyde (upto 10% excess), formaldehyde and trialkylamine (Fig.5). The complete conversion of formaldehyde occurs with a slight excess of isobutyraldehyde. The excess aldehyde is distilled with amine and the two are recycled together. The reaction is quite selective and most of the acidic by-products produced by formaldehyde reduction are absent. Hydroxypivaldehyde is separated from salts between extractions with dibutyl ether and hydrogenated with Cu, Cu/Cr, Co or Ni catalysts at 80-2000C and greater than 3.5 MPa pressure.

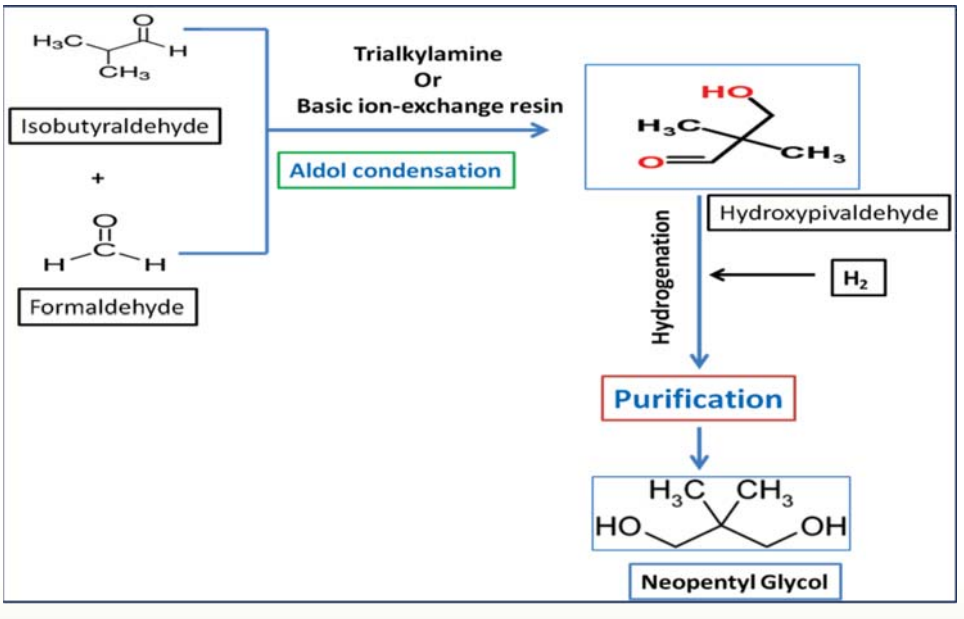


Fig 5: Reaction scheme for the synthesis of NPG through aldol condensation and catalytic hydrogenation reaction

Further advancement in the process has been achieved by using weakly basic ion-exchange resins as catalysts. Use of solid catalyst, instead of liquid catalyst, has significantly enabled easy separation of the product steams making the process even simpler. The reactions run with high selectively and therefore most of the side products which are typical of the production based on the Cannizzaro reactions, are formed only in negligible amounts (Source : Handbook of Industrial Chemistry and Biotechnology, Edited by James A Kent)

Industrial Journey of NPG productions

The first commercial production of NPG (based on process scheme of Fig 4) wasstarted by BASF in Ludwigshafen, Germany in 1959 with a capacity of below 100 metric tons per annum and was stepped up steadily. A new NPG facility with an annual capacity of 12,000 metric tons went on stream just 16 years later. This plant employed a new, environmentally more compatible BASF process that is still in use today. In order to meet the growing demand for NPG in North America as well, BASF started up another NPG plant in Freeport, Texas, in 1980, which has meanwhile been replaced with a world-scale facility. NPG demand has increased considerably in Asia, too, in recent years. BASF JCIC Neopentylglycol Co., Ltd., a 60/40 joint venture company of BASF and Jilin Chemical Industrial Co., Ltd., responded by putting into operation another NPG plant in Jilin, North East China, in 1998. As the global market leader, BASF has NPG production facilities in Ludwigshafen, Germany; Freeport, USA and Jilin, China.

Eastman invented Eastman NPG™ glycol in the 1950s, and its market share continues to grow to this day. Eastman NPG™ is available in two forms: as white, waxy platelets or molten. Slurry of 90 percent by weight with water is available and designated Eastman NPG™ 90.

Mitsubishi Gas chemical (MGC) started production of NPG at the Mizushima Plant, Japan in the year 1966. Currently, MGC produce 50,000 metric tons of NPG from this plant.

South Korea based LG Chem, started project on NPG in 1996 and within less than 3 years it started commercial product of 18000 metric tons of NPG by self-developed manufacturing process from its Yeosu Plant The capacity of this plant successively increased in 2003 to 30,000 metric tons and then in 2008 to 65,000 metric tons and then 2011 to 100,000 metric tons. At present, LG Chem is the second largest producer of NPG in the world only behind BASF. LG Chem first entered the NPG business in 1998 by becoming the world's 4th company to develop its own NPG production technology (Source: LG Chem).

Table 3: Leading Global NPG producers

Rank	Company	Locations	Capacity (1000 tonne/year)
1.	BASF	• Ludwigshafen (Germany) • Freeport, Texas, (USA) • Jilin (China)	165
2.	LG-CHEM		100
3.	EASTMAN Chemical	Yeosu, South Korea	87
4.	Perstorp	Perstorp, Sweden	50
5.	Mitsubishi Gas Chemical	Mizushima, Japan	45
6.	OXEA	Oberhausen, Germany	45
7.	BASF-YPC (A 50-50 JV of BASF and Sinopec)	Nanjing, China	40
8.	Shandong Fufeng Perstorp Chemical Co.,	Zibo, Shandong province, China	40
9.	Polioli	Vercelli, Italy	23

Very recently, BASF-YPC, JV of BASF and Sinopec JV starts neopentylglycol production at their Verbund site, BASF-YPC in Nanjing, China. The plant has annual production capacity of 40,000 metric tonnes. With this new plant, BASF-YPC are responding to growing demand for high-quality NPG especially in the Asia Pacific region, and at the same time strengthening the position as the global leading supplier of NPG (Source : BASF-YPC)

NPG scenario in India

As rising disposable income of Indian middle class in improving, the demand for consumer durable products is rising. As a result, demand for NPG is steadily growing in India. However, all of the NPG demand is met through imports and most of the NPG is imported from Sweden, South Korea and Japan.In the year 2015 around 24578 metric tonnes of NPG has been imported in India ((source: https://www.zauba.com).

Very recently, Swedish specialty chemicals group Perstorp, a leading manufacturer of polyol based products such as NPG, Pentaerythritol etc has signed a memorandum of understanding (MoU) with the Maharashtra Industrial Development Corporation (MIDC) to evaluate the opportunity to invest in a new production plant for pentaerythritol (penta) in India. The MoU was signed at the 'Make in India' event, organised by the Government of India as part of an initiative to drive investments in the country (Source:http://www.chemicals-technology.com/news).

Summary

Due to its unique properties, NPGis increasingly being used in environmentally friendly powder coatings for architectural applications, domesticappliances, transportation and automotive applications and general industrial applications.

The current NPG production process although highly optimised, the environmental footprints of NPG production can be improved ifpropylene and formaldehyde, the main feedstocks for NPG production can be produced from the renewable methanol. Propylene can be produced from methanol via the methanol to olefin (MTO) process while renewable methanol could be produced by converting syngas,derived from biomass/municipal solid waste (MSW)to methanol or through chemical recycling of CO2 into methanol (Fig 6).

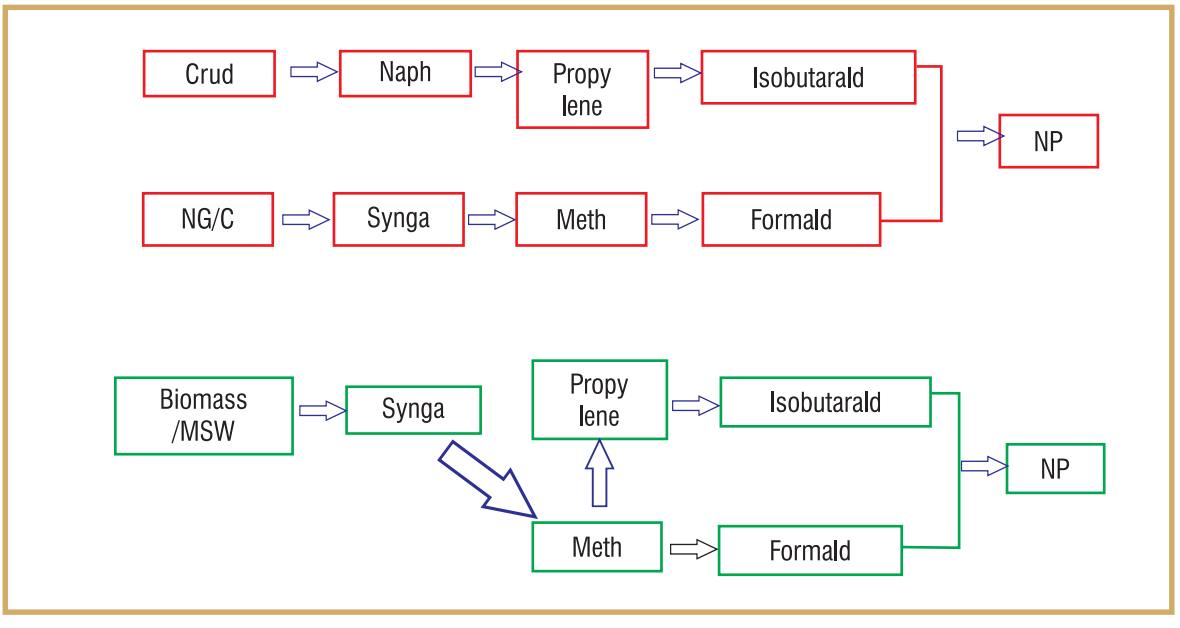


Fig 6 : Greener approach of NPG production through renewable methanol route

Further improvement in the process economics would be possible by developing more advanced dual catalyst system to make the process even simpler by conducting two reactions in a single reactor. Significant research efforts are being made in finding a suitable metal/solid base bi-functional catalyst by loading hydrogenation active metal on a solid base which would be able to catalyze the aldol-condensation of formaldehyde and isobutyraldehyde and the subsequent hydrogenation of aldol adduct in a single-reactor.

NPG will find new application particularly in the areas of like powder coatings curing at lower temperatures, thus giving good opportunities for the future. The Indian market will grow rapidly due to an increased awareness of the environmental benefits of powder coatings and VOC free paints which will drive growth for NPG.

EIL-IIP's Wax Technology: Opportunity for Import Substitution

TECHNOLOGY

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The recently commissioned Wax Plant at Numaligarh Refinery Ltd. is the maiden plant in India with indigenous technology (developed by EIL-IIP), implementation of which is a classic example of Concept to commissioning services being offered by EIL. Indigenous technology developed by EIL-IIP and commissioned successfully at NRL is a step towards 'Make in India'. The project has many "first" in India which has been mentioned in the article. To begin with, it is currently the largest such plant in Asia.

Engineers India Ltd (EIL) was entrusted by NRL to carry out Engineering, Procurement, Construction and Project Management (EPCM) Consultancy services for the project. The desired products to be extracted from the VGO were Paraffin Wax, Semi Micro Crystalline Wax (MCW).

Sl.No.	Process Units and Facilities	Capacity	Licensor/ Design
1	Solvent Deoiling Unit	50 KTPA	EIL-IIP
2	Wax Hydro Finishing Unit		AXENS
3	Associated Utilities & Offsites	-	EIL

Salient Features of EIL-IIP Wax Technology:

- Process flow scheme has been designed in a way to optimize the maximum of "Cold & Hot" recovery in order minimize the utility requirements.
- EIL design of solvent Deoiling unit ensures the absence of High Pressure & Temperature conditions making it an inherently safe process unit.
- Flow scheme includes special attention to minimum solvent losses thereby reducing the operational cost by substantially reducing solvent make-up compared existing technologies.

Technological Highlights:

- Largely automated unit with low manual intervention in steady state operation.
- Solvent management techniques - To ensure low solvent make - up as compared with competing technology.
- Solvent recovery section - Designed with maximum heat integration.

- Solvent to Feed ratio - Lower due to prudent filtrate cycles.
- Optimum Solvent Dilution Scheme - Combination of delay dilution, incremental dilution and cold dilution techniques for maximum gains
- Controlled Crystallization - For large crystals with narrow crystal size distribution.
- Balanced filter cycle - Two stage filtration.
- High wash efficiency - Energy efficient process with built in operational flexibility and continuous process back - up.
- Automated Slabbing & Packing machine - 1st in India installation.

The Govt. of India is aggressively focused upon the "MAKE IN INDIA" campaign. It is noteworthy that through this project, EIL has played a vital role in development of indigenous vendors who could manufacture equipments at a cost substancially lesser than the cost of similar equipment in case sourced from the global market. Some of them are as mentioned below:

- Rotary Drum filter :-M/s Eimco KCP (Make in India)
- Nitrogen Plant: M/s BHPV (Make in India).
- Refrigeration Package: M/s Voltas (Make in India)

The paper attempts to study the potential & the possibility of new wax installations using indigenous EIL-IIP Wax Technology that would suffice to meet the domestic requirements and in turn help in reduction of import bill.

A Brief About Wax in Crudes

In an oil refinery, wax is one of the important chemical materials. It is white to pale-yellow in color, gelatinous, crystalline and water-insoluble substance. Its main content consists of n-paraffin.

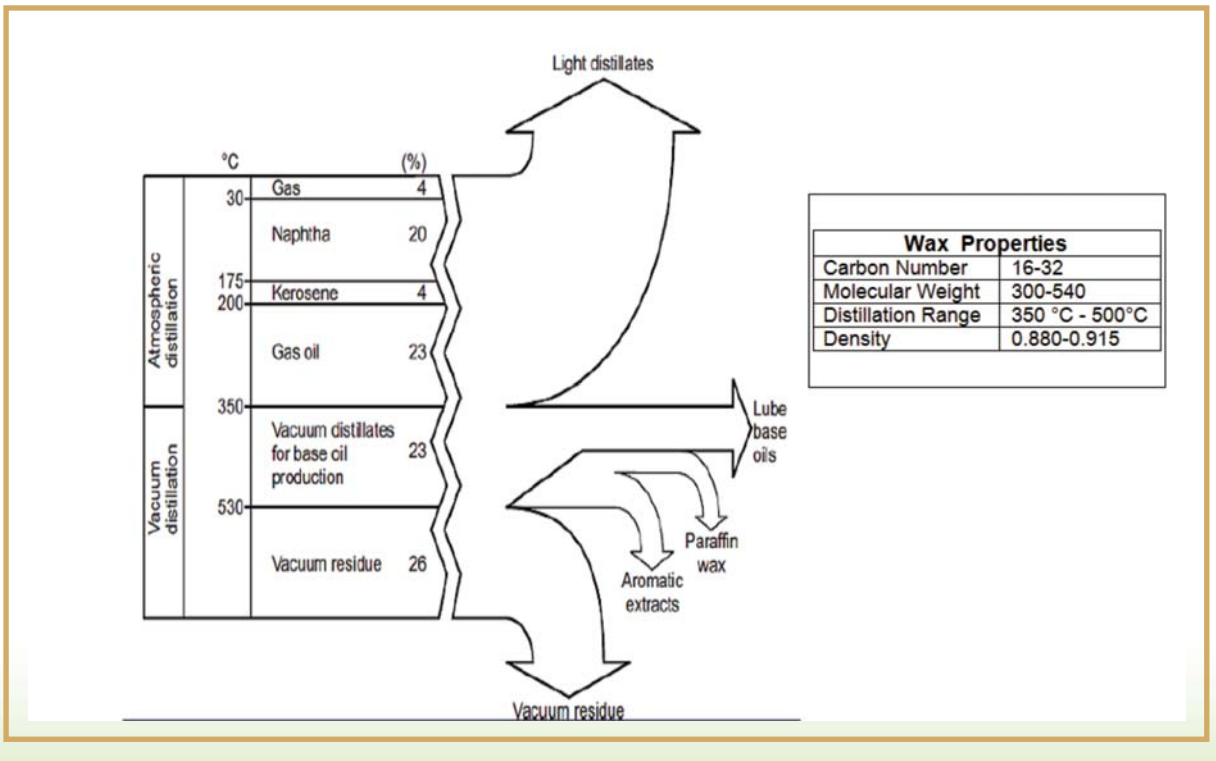
- Hydrocarbon waxes derived from petroleum having a melting point generally ranging from 50-98°C.
- Largely consist of long chain saturated hydrocarbons (normal paraffins, iso-paraffins, iso-paraffins and alkylated cycloparaffins), generally having carbon number between C22 -C65.
- Small quantity of alkylated aromatics may also be present in them.
- Based on the production method, properties, composition and crystal structure, these waxes are divided into two groups namely:

i. Paraffin wax - made of long-chain alkane hydrocarbons

ii. Microcrystalline wax - with very fine crystalline structure

iii. Petroleum jelly

FIGURE - 1: TYPICAL WAX RICH CUT IN A CRUDE



Wax Properties	
Carbon Number	16-32
Molecular Weight	300-540
Distillation Range	350 °C - 500°C
Density	0.880-0.915

Why is wax removal from crude & its products required?

TABLE - 1: EFFECT OF WAX IN CRUDE & ITS PRODUCTS

Crude oil	Jet fuel	Diesel fuels	Lubricating oils & residuals fuels
High pour point	High freezing point	High pour point	High pour point
High yield stress (Requiring high restart pressure on cooling)		Poor filterability	Poor pump ability
High plastic viscosity (Related to throughput capacity)		Wax separation	
Wax deposition in pipelines - Reduction in pipeline capacity		Cold start problems	
Wax deposition in storage tanks - Removal and disposal			

GLOBAL MARKET SCENARIO

Total Global Consumption - 3025 kT

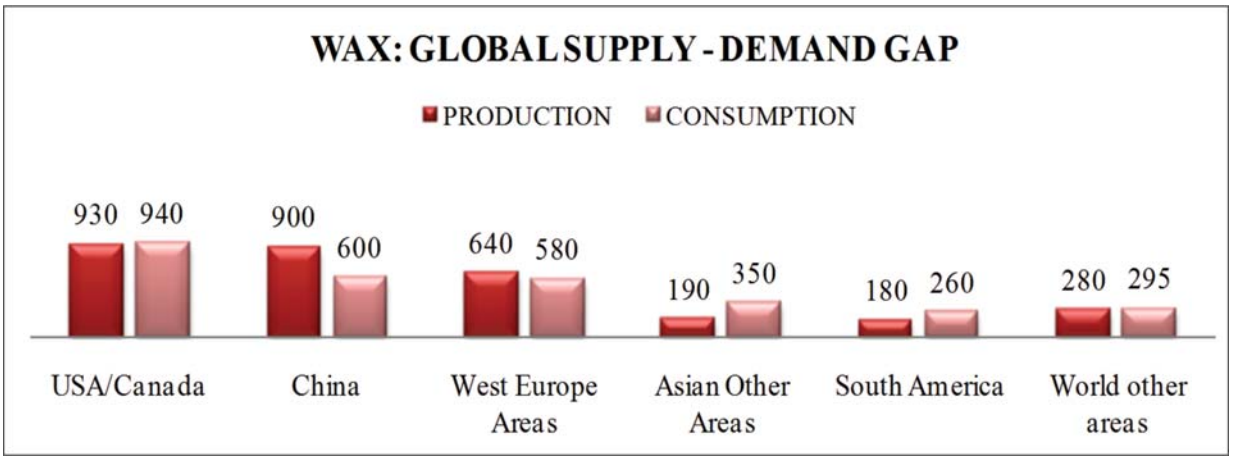
TABLE - 2: GLOBAL WAX CONSUMPTION (END - USE)

CONSUMPTION OF WAX AROUND THE WORLD (kt)

Products	America and Canada	China	West	Asian Europe	South other areas	Other America	Total areas	(%)
Candle	130	450	290	210	180	210	1470	48.6
Packaging	410	22	75	64	30	35	636	21
Synthetic Wood	110	15	70	17	30	15	257	8.5
Hot-melt adhesive	54	8	36	12	2	2	114	3.7
Rubber	36	8	30	12	6	10	102	3.4
Antirust additive	45	6	35	14	1	1	102	3.4
Soap Wax		70					70	2.3
Man made wood	54		3				57	1.9
Make up	27	1	6	1	1	2	38	1.3
Others	74	20	35	20	10	20	179	5.9
Total	**940**	**600**	**580**	**350**	**260**	**295**	**3025**	

Reference: Eur. Chem. Bull. 2012, 1(7), 266-268

FIGURE - 2: GLOBAL SUPPLY - DEMAND GAP OF WAX



As can be seen, China exports ~ 300 KTPA of Wax/ year. Also the excess amount of wax around the world was 95 kt per year.

Indian Scenario: An Opportunity for Import Substitution

- In 2013-14, India produced around 56 KTPA of Wax.
- Post Jan'15, NRL's 50 KTPA Wax plant based on EIL-IIP's technology was commissioned.

TABLE - 3: REFINERYWISE PRODUCTION OF WAX (FY 2014-15)

REFINERY-WISE PRODUCTION 2014-15	(FIGURES IN TMT)
REFINERY	**WAX**
IOCL, Digboi	29
CPCL (MRL), Manali	25
Total	**54**
Note: Capacity of NRL's Wax Plant (50KTPA) has not been accounted here as the data is for FY 2014-15	

Source: Indian Petroleum & Natural Gas Statistics (2014-15)

Referring to the MOP&NG statistics, the estimated consumption of wax was 361 TMT (FY2014-15) while the production is approx. 54 TMT. Deficit of around 307 TMT

With commissioning of NRL Wax Plant, additional capacity of 50 TMT can be added. A demand-supply gap of approx 257 TMT still remains thereafter.

Wax Prices & Import Reduction Potential

Last 1 year basis, the price of Paraffinic Wax is around 80,000 INR, while that of micro-crystalline wax is around 1, 20,000 INR. Thus, manufacturing of wax in a refinery provides very good premium vis-à-vis transportation fuel which converts to a higher refining margin.

TABLE - 4: IMPORT OF PETROLEUM PRODUCTS (CR INR)

Imports	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
Product						
LPG	8,329	15,888	27,019	31,696	37,425	36,652
Petrol	1,264	6,427	3,311	891	1,481	2,301
Naptha	4,942	6,853	9,827	9,791	6,067	4,102
Kerosene	2,909	4,939	2,710	0	0	172
Diesel	6,390	6,969	5,039	3,219	503	679
Lubes	3,518	4,093	8,314	9,259	10,664	10,951
Fuel Oil	1,935	2,455	4,392	4,546	5,537	3,876
Bitumin	138	210	197	235	773	1,507
Others $	4,262	8,164	7,282	8,727	12,156	12,538
Total Product Import	33,687	55,998	68,091	68,364	74,605	72,778
Note: $ Others include Paraffin wax, Petroleum Jelly LSWR, Aviation Gas, Pet Coke etc., Source: PPAC						

A look at the Indian Petroleum and Natural Gas Statistics (PPAC), 2013-14 shows:

- Total import cost for Petroleum Products under the category "Others" (that comprises Paraffin wax, Petroleum Jelly, LSWR, Aviation Gas, Pet Coke etc.) is 12538 Crore INR in 2014-15. (Refer Table: 4)
- During the financial year 2013-14, the demand supply gap of wax was around 307TMT(source: MOP&NG, GOI)
- The total cost on account of wax import is calculated to be approximately 2763 Crore INR. This would amount to approx. 22% of total import under the Category "Others".

Wax Potential in Indian Crude Basket

As indicated earlier, India was expected to import ~ 307KTPA of wax amounting to ~ 2763 Crore INR in 2014-15. Even after 50 KTPA NRL Wax unit start up, a deficit of 257 KTPA of wax amounting to ~ 2313 Crore INR would still exist.

With a view of import substitution, 3 crudes were studied to estimate wax potential in refineries. Crudes being:

1. Assam crude
2. South Gujarat Crude
3. North Gujarat Crude

TABLE - 5: CHARACTERISTICS OF CRUDE OIL-TYPICAL DATA

Charecteristics	South Gujarat	Bombay High	Arab Mix	Kuwait	North Gujarat	Rajasthan Crude
Density, gm/ml	0.7906	0.82	0.8664	0.8741	0.8932	0.8934
API gravity	47.3	41	31.6	30.3	26.8	26.9
Pour Point, °C	12	21	-24	-27	27	42
Kinematic Viscosity						
@ 40 °C	1.7	3.4	10.0	11.1	65.6	-
@50 °C	1.5	-	8.9	8.5	31.4	-
Water content, % wt	nil	nil	nil	nil	4.1	-
Salt content, % wt	50	-	L20	2.0	200	-
Sulphur, % wt	0.02	0.09	2.7	2.8	0.08	0.08
TAN, mgKOH/gm	0.018	0.1	0.14	0.14	1.93	-
RCR, % wt	0.39	1.1	6.4	5.4	2.5	4.6
Wax, % wt	10.0	12.7	2.5	6	5.9	32
Asphaltene, % wt	0.07	0.25	2.3	2.5	0.05	-
ASTM Distillation						
cracking point, °C	340	372	322	335	367	-
Metal content, ppm						
Nickel / Vanadium	0.3/-	-	4/23	4/33	61/L10	98/2

Source: Industry -Academia Workshop On "Refining & Petrochemicals, IOCL Haldia-2010

4.1 Assam crude used at X Refinery in North East

On basis of 3 MMTPA refinery crude throughput, MVGO (350 - 4850 C) generation of 105.5 TPH (28.15 wt% yield), has potential to generate ~ 24.6-30 wt% of wax, which is equivalent to 23.3 TPH. Considering 300 days of operation, only MVGO has the potential to generate 165 KTPA wax.

Recently, a 50 KTPA Solvent Dewaxing & De-Oiling unit based on EIL-IIP's technology was set up. Keeping in mind the need for import substitution, and the need to cut down project life cycle by almost 20%, the refinery has potential to set up 2 more plants of same capacity which may just be a replication of the recently commissioned unit.

TABLE - 6: ASSAM CRUDE ASSAY

CRUDE ASSAY OF ASSAM CRUDE AT NRL											
S.NO	CUT TEMP, DEG C	WT% YIELD	CUMUL WT%	Sp. Gr.	Aromatics Vol%	Saturates Vol%	Sulphur wt%	Kin. Viscosity at 200°C	Kin. Viscosity at 250°C	Pour point °C	Wax content (EH) %wt
IBP	20	0.9	0.9								
20	50	0.9	1.8	0.6428		100	0.00023				
50	75	2.5	4.3	0.6976	10.4	89.6	0.0007				
75	100	4.4	8.7	0.7434	15.5	84.5	0.00184				
100	125	3.8	12.5	0.762	21.1	78.9	0.00231				
125	150	3.9	16.4	0.7856	25.6	74.4	0.00396	0.284	0.239		
150	175	3.7	20.1	0.8006	27.5	72.5	0.00758	0.289	0.238		
175	200	3.3	23.4	0.8154	28	72	0.01482	0.324	0.266		
200	225	4	27.4	0.843	31.8	68.2	0.02278	0.436	0.344	-30	
225	250	4.8	32.2	0.8643	38.1	61.9	0.04028	0.472	0.365	-30	
250	275	6.7	38.9	0.8824	38	62	0.08758	0.464	0.347	-30	
275	300	5	43.9	0.891	28.5	71.5	0.15189	0.529	0.385	-18	
300	325	5.5	49.4	0.8799			0.174	0.6	0.429	-3	
325	350	4.7	54.1	0.9102			0.287	0.721	0.506	9	
350	370	4	58.1	0.9162			0.357	0.827	0.572	21	
370	400	6.4	64.5	0.9237			0.3	1.267	0.847	39	26.8
400	425	5.8	70.3	0.9247			0.29	1.4	0.923	45	31.3
425	450	4.8	75.1	0.9224			0.28	1.634	1.067	48	31.8
450	**475**	**5.3**	**80.4**	**0.9187**			**0.29**	**1.79**	**1.14**	**54**	**32.5**
475	**500**	**3.7**	**84.1**	**0.9294**			**0.36**	**2.19**	**1.36**	**57**	**31.5**
500	**525**	**2.2**	**86.3**	**0.9465**			**0.45**	**2.69**	**1.58**	**57**	**25**
525	**550**	**2.2**	**88.5**	**0.9614**			**0.54**	**3.71**	**2.05**	**63**	**22.5**
550	565	1.11	89.61	1.0451			0.76	52.49	13.94	78	
565	790	10.39	100								

4.2 North & South Gujarat Crude being used at one of the refineries in India (XX)

Potential shall be checked for the existing refinery with respect to usage of South and North Gujarat crude, and also for the proposed refinery expansion case.

4.2.1 Checking Wax generation potential in existing refinery (13.7 mmtpa)

4.2.1.1 South Gujarat crude being used = 2.3 MMTPA

This has a wax potential ~ 205 KTPA.

4.2.1.2 North Gujarat crude being used = 3.5 MMTPA

This has a wax potential ~ 185KTPA

TABLE - 7: CHARACTERISTICS OF NORTH GUJARAT CRUDE / VACUUM GAS OIL

BHANDARI *et al.* : STUDIES ON VACUUM GAS OILS FROM NORTH GUJARAT CRUDES 11

Table 1—Characteristics of crude oils

Crude	Aszole	Bakrola	Indrola	Dholka
Properties				
Density Kg/l at 15°C	0.9514	0.8710	0.8395	0.8190
Specific Gravity 60/60°F	0.9519	0.8715	0.8402	0.8194
Gravity API	17.15	30.87	36.92	41.19
RVP Kg/cm^2 at 38°C	-	0.052	0.14	0.07
Kinematic Viscosity at, cSt				
40°C	952.19	43.47	-	17.2
50°C	431.46	24.63	9.42	12.5
Salt Content%wt	0.086	0.0739	0.00292	0.0006
(Ptb)	287	246	9.7	2
S%wt	0.17	008	0.09	0.06
Pour Point °C	-9	+36	+39	+39
CCR (Conradson)%wt	7.9	3.16	1.75	1.35
Wax Content EG%wt	1.0	17.7	17.8	18.3
Asphaltene%wt	0.4	0.17	1.4	0.13
BS & W%Vol	11.6	8.5	4.1	4.3
Trace Metal, ppm				
Vanadium	0.3	< 0.1	< 0.1	< 0.1
Nickel	170	22.0	23.0	10.5
Iron	120	14.5	17.0	19.0
Copper	0.23	0.06	0.08	0.22

Table 2 — Characteristics of vacuum gas oils (370-530°C)

VGOs Characteristics	Aszole	Bakrola	Indrola	Dholka
Yield%wt	30.3	35.8	30.8	27.3
Density at 15°C	0.9348	0.8601	0.8545	0.8613
Kinematic Viscosity at				
100°C, cSt	10.8	4.8	4.7	3.9
Wax Content EH%wt	5.12	39.6	42.1	48.5
Mol. wt	427	391	390	378
Sulphur%wt	0.13	0.1	0.06	0.04
CCR%wt	0.26	0.13	0.22	0.14
H%wt	13.14	13.24	13.21	13.25
C%wt	86.71	86.60	86.64	86.61
H/C	1.81	1.83	1.83	1.84
Trace Metal, ppm				
Vanadium	0.1	< 0.1	< 0.1	< 0.1
Nickel	1.1	0.3	0.8	0.2
Iron	3.1	0.1	0.3	0.4
Copper	<0.01	< 0.01	< 0.01	<0.01

Source: Indian Inst. Of Petroleum, Indian Journal of Chemical Technology, vol.7, May 2000. IIP-Dehradun is being approached to vet the numbers worked out for South & North Gujarat crude wrt Wax generation in EIL's study.

TABLE 8: FEED- EXISTING REFINERY

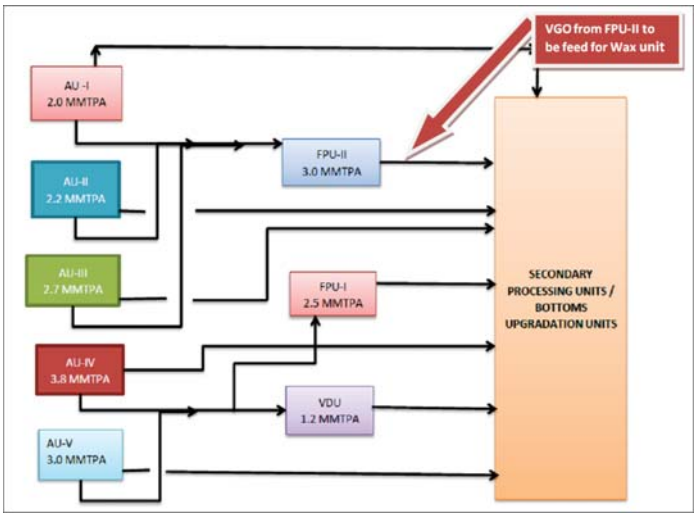
FEED SLATE (MMTPA)	
North Gujarat	3.5
South Gujarat	2.3
Rajasthan (Mangla)	-
Basra Lt.	-
Kuwait	7.9
RLNG	0.2
Methanol	0.012
Benzene	-
TOTAL	**13.912**

TABLE 9: CRUDE PROCESSING IN EXISTING CDU/VDU

Process Unit	Existing Unit Capacity, MMTPA	Remarks / Type of Crude
AU-I	2.0	• 100% South Gujarat (Ankaleshwar) • South Gujarat & North Gujarat (70:30)
AU-II	2.2	• 100% North Gujarat ,
		• South Gujarat, North Gujarat & Bombay High in any proportion
AU-III	2.7	• Case I: NG 55% + Imp LS 45% • Case II: NG55% + BH45% • and Case III: NG100%
AU-IV	3.8	• South Gujarat • IMP (HS & LS) & BH
AU-V	3	50:50 by weight of Light and Heavy Arab Crude
FPU-1	2.5	Feed Preparation Unit For FCCU
FPU-II	3	Feed Preparation Unit For HCU
VDU	1.2	

FIGURE 3: INDICATIVE SKETCH FOR WAX UNIT FEED AT XX REFINERY

4.2.2 Checking Wax generation potential in Future



In 2013, the refiner entrusted M/s Engineers India Limited to carry out the job of configuration study and preparation of feasibility report for capacity expansion from current 13.7 MMTPA to 18.0 MMTPA. In the event of refinery expansion, owing to the future crude mix, the total wax potential in refinery would be around 151KTPA and 195 KTPA for South and North Gujarat crude respectively.

Conclusion

As inferred from above, the potential & the opportunity both exist in the Indian Refining sector for setting up a Wax unit. Needless to say, when added to a refinery's configuration, wax products yield better margin vis-à-vis transportation fuel.

The nation still has an appetite for ~ 257 KTPA of wax production. EIL-IIP's experience of setting up the 50 KTPA unit at NRL would definitely come handy with respect to shortening of the project cycle, and utilization of the indegenously developed vendor base.

Further, under the on going "Make in India" campaign, it becomes imperative to fully exploit this opportunity, thereby not only yielding better refining margins to the owner but also a significant reduction in import bill amounting to around Rs. 2313 Crore per annum.

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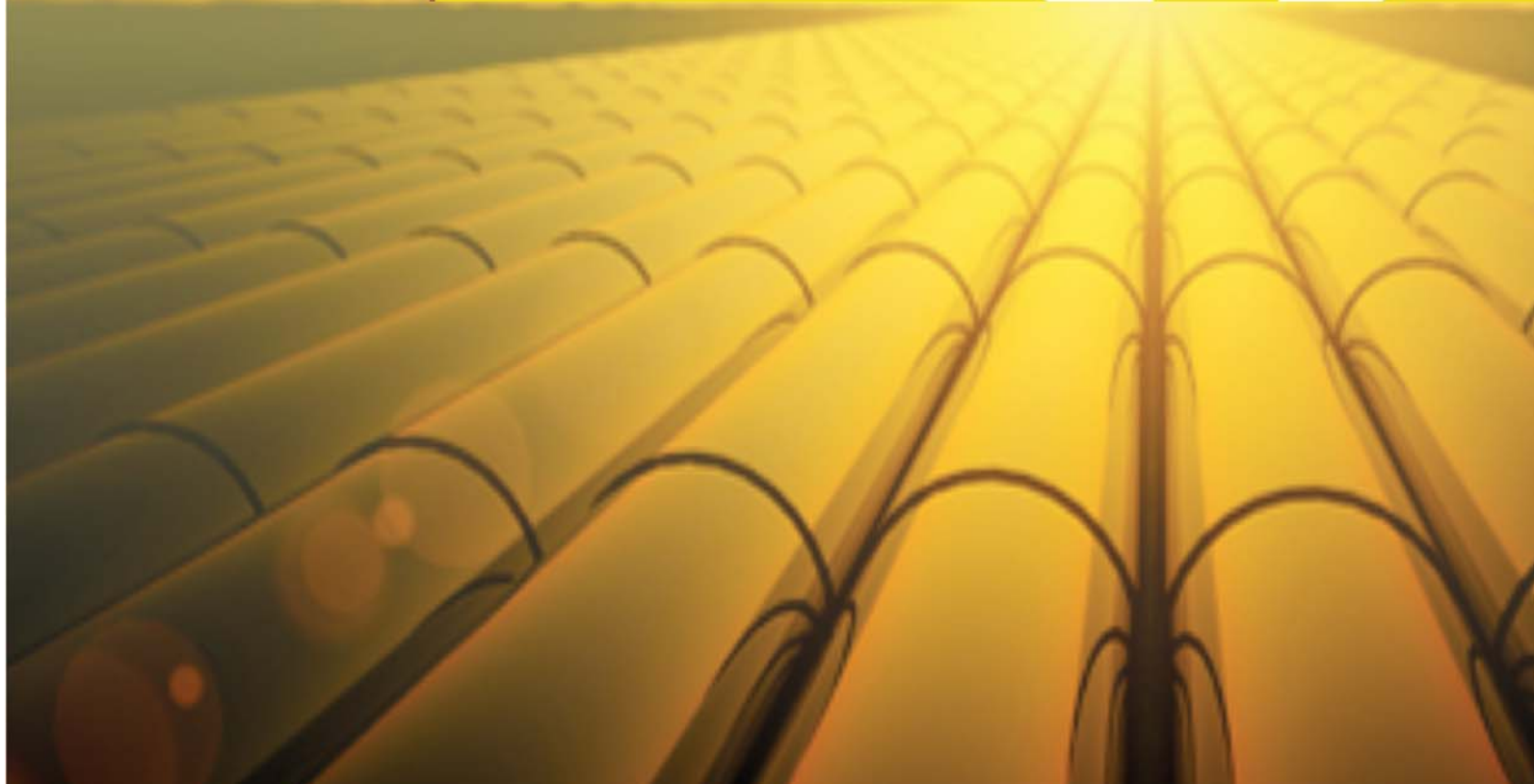


International Cooperation: Promotion of sub-regional Cooperation in Oil and Gas within the neighboring region

❖ Shantanil Bagchi, Sarupa Debnath & Soumyajit Ghosh ❖
GAIL (India) Limited

Introduction

Oil and gas are considered as the most strategic resources in the contemporary world, because almost all the countries in the world need them for their socio-economic development. Natural gas is termed as the fuel of the 21st century. Accordingly its consumption is following the fastest trend compared with other primarily energy carriers. Asia and Pacific are going to be driving the natural gas market with consumption expected to increase from 30% in 2013 to 44% in 2035. But due to the complex underlying characteristics of each country, geopolitical issues and geographic constraints for pipeline connection, the Asian market is undergoing major changes.

The Asian market comprises of already established major players like Japan, Korea and Taiwan, emerging energy markets like India and China, and relative newcomers such as South East Asian Countries. Countries like Australia, Brunei, Indonesia, Malaysia and Papua New Guinea are exporting a large amount. In the foreseeable future, imported LNG is still going to be the main source of energy trading as many more countries are either planning or building receiving terminals.

- Due to a lot of pressure on environmental regulation and curbing the emissions, countries have started to change their outlook towards energy usage. China is looking at ways to increase natural gas consumption to displace coal consumption to improve air quality. A major governing decision from the Chinese government will be whether to use the gas received for power generation as gas is relatively expensive or use it to produce lucrative petrochemical products.
- With the advent of new government in India, several reforms are taking place that will shape the future of natural gas market. The east west corridor pipeline is a major step towards bringing the whole nation under one common gas grid. Moreover talks with Iran, Bangladesh, Myanmar and several other nations over pipeline gas transportation are underway. Various FSRU projects are also proposed that may play an important role in the market economics.
- Japanese economy is already well established with a lot of energy hungry industries and it is also environment conscious. The Japanese market had been considerably influenced by the Fukushima incident as it was expected to decreases its dependence on LNG import. But after the incident, demand has increased further to around 65% in 2011.
- With Indonesia and Malaysia, the decision that needs to be taken is whether to sell or use their gas supplies. Because of a number of islands in Indonesia transporting the gas is a costly affair. So exporting the gas and reinvesting the profits directly into infrastructure is a lucrative proposition. But according to trend, it seems that both the nations are going to export their supplies in the long term.

Ten new regasification terminals started operations in 2013. In Indonesia, Israel, Malaysia, and Singapore, four new LNG importing markets emerged. A regasification terminal is being built to cater to Vietnami's internal demand. Some of the nuclear plants in Japan have come online and this has freed up some spare LNG capacity.

India's energy consumption has almost doubled since 2000 but is using only 6% of world energy. India's economy, already the world's third-largest, is growing rapidly and policies are in place to press ahead with the country's modernization and an expansion of its manufacturing. Policy-makers at national and state levels are intensifying their efforts to ensure that energy is not a barrier to India's advancement, looking to remove obstacles in energy supply investment while also focusing on energy efficiency and pricing reform.

-The material in this chapter is an excerpt from "Nigel Lucas, P. 2014. Energy Security in Asia: Prospects for regional cooperation, Asian Development Bank".

Principles for Subregional Cooperation

The idea that trade can be an important force for creating and maintaining peaceful relations between countries as trade means greater economic interdependence between the countries involved. This increases the stake each country has in the welfare of its neighbor and makes war more costly.

Regional cooperation can strengthen national policies on energy security by:-

- Sharing information and knowledge to create knowledge base
- Agree on common policies using the shared knowledge and information, and
- Develop sub regional markets in energy by genuine interconnection of national grids, and agreement on competitive sub regional markets.

■ Creation of Knowledge Centre

There is considerable sharing of knowledge and information around the region and sub regions, but it is generally unstructured. There is no systematic procedure for validation, storage, and access.

It is proposed that each sub region should create a knowledge center for energy policy not aimed at general statistical data but at qualitative material. Modern software can be used to make it searchable, and access should be permitted to all interested parties. Some parts of the knowledge base might be password protected.

The costs of maintaining the knowledge base should be borne by the economies in the sub region, but the costs of designing the structure of the information system, writing the software, and initial training might be funded by donors as part of regional cooperation.

Collecting data is not enough; it must be analyzed and converted in to information and knowledge, then shared widely within and between countries and stakeholders to focus attention to natural resources problems across all scales for it to be meaningful

Commercial competitions, political issues, protection of reputation, no adherence to international protocols and lack of research activities focusing on resources assessment are some of the reasons for lack of information as well as withholding information.

◆ Developing Sub regional Markets in Energy

Having regional networks will allow the full deployment of energy resources, the optimal dispatch of plant, the reduction of reserve margins, optimal scheduling of a diverse set of sources of natural gas, and the best interface between the gas networks.

Creating a regional market is not simple; among the issues to be considered are the following-

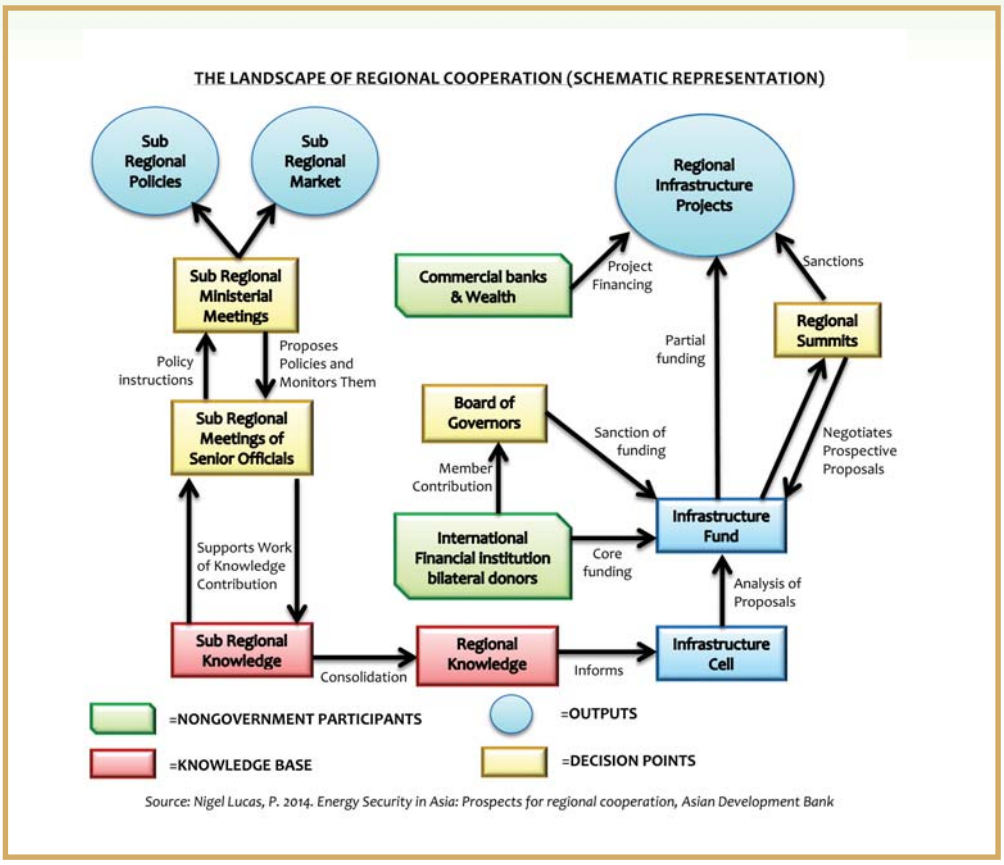
- Legislative and regulatory framework. This includes clarifying the governmenti¦s role in the industry, policies on adequate competition, and provision for private participation.
- Financial viability of the industries. A market cannot function unless prices are correct and the entities are profitable. This requires attention to tariff reform and to the elimination of subsidies.
- Technical and commercial rules and agreements. These include grid codes, using system agreements, and technical standards.
- Market arrangements. This includes term and spot contractual arrangements, financial settlements, and provisions for balancing services.
- Infrastructure requirements. There need to be agreed plans for the transmission system and the interconnectors, and also for the metering and communication systems.
- Imports and exports. National rules on imports and exports and on the use of the interconnectors with neighboring systems must allow trading by third parties.

Much of what is required needs to be done by national governments but in a coordinated and harmonized fashion.

Proposition of Opportunities

In spite of tariff reductions, financial information exchange, discussions at ministerial level, the process of regional cooperation has not been up to the mark. This failure can be attributed to lack of willingness towards regional cooperation mainly because of engagement in inter and intra-state conflicts.

Regional cooperation not only brings economic gains for the member states but also helps in advocating peace and security, cultural amalgamation and religious integrity. A shift in Indian policy could be observed from the project talks that were discussed to reduce energy shortage through gas pipelines.



Source: Nigel Lucas, P. 2014. Energy Security in Asia: Prospects for regional cooperation, Asian Development Bank

- Iran-Pakistan-India gas pipeline was conceived in 1989; a lot discussion on technical, price and economic issues had been done on it. The project was a win-win situation for both India and Pakistan as India could have fulfilled its energy needs while Pakistan could have got energy from Iran and transit fees from India.
- In 2005, Myanmar-Bangladesh-India gas pipeline project was signed but later no progress has been made as Bangladesh tried to include bilateral issues with India in the discussion. But after the election of new government in Bangladesh some hope can be expected with the project.
- India, Sri Lanka and Nepal have started to move forward in energy cooperation. Sri Lanka and Indiai¦s joint venture in electricity and India-Nepal joint venture on gas pipeline are the example that could be cited in this regard (The Hindu 2009; Business Line 2011).
- Further talk of Iran-India Deep Water Pipeline is also underway which can be a milestone achievement with respect to regional cooperation.
- Another pipeline that has been approved and is already underway is the TAPI (Turkmenistan-Afghanistan-Pakistan-India) pipeline which has paved the way for newer sources of natural gas and long term relationship and confidence in the member countries.
- Win-Win Situation Creation for Regional Cooperation

  India and Bangladesh are neighbors but have different strengths with respect to energy sources. Whereas Myanmar, Bhutan and Nepal can fulfill a part of energy requirements. Bangladesh being in a strategic location can bridge the gap between Myanmar and India for importing natural gas. India in return is in a position to reduce power crisis of Bangladesh to some extent by importing hydropower from Bhutan and Nepal. Their huge hydro potential can provide gains for all the three states and develop their economic conditions.

- ***Myanmar:***

  Burma is today primarily a natural gas producer. According to the US Energy Information Administration, Burma had proven gas reserves of 10 trillion cubic feet in 2012, with an annual production capacity of 416 BcF and oil reserves at 50 million barrels, with a production capacity of 21,000 bbl/d. Gas comprises 90 percent of total products and Burma is the 10th largest producer of natural gas globally iV the bulk of which is exported to China and Thailand.

MPE announced in July that it is seeking a foreign partner to launch a joint venture in a bid to privatize an oil refinery iV no further information has been publicly disclosed. Nonetheless, the opportunity for a foreign firm to benefit from the sale of petroleum products for the first time is an indication that Burma is embarking on a new phase of managing its oil and gas resources.

Opportunities for India:

The cost of establishing an office in Rangoon is relatively affordable and having a permanent presence will demonstrate a commitment to the customers and the Government of Burma. Media reports have stated that MPE is seeking out businesses that have experience owning and operating refineries, and also with experience in importing and distributing crude oil and petroleum products.

As Burmai¦s oil and gas sector grows there will be supply chain opportunities for Indian companies in many different areas. This is for three main reasons:

1. At present, there is a lack of local capacity in terms of skilled personnel.
2. Burmai¦s government and business community is keen to diversify their commercial partners.
3. Many international energy companies with a presence in Burma wish to work with trusted partners.

- **Brunei:**

  Brunei produced 426 billion cubic feet (Bcf) of dry natural gas in 2012. Brunei exports on average more than three-quarters of its output. Brunei has been a stable and long-term LNG exporter to Japan and South Korea. But in 2013, Japan reduced its contracted volumes. This drop in contracted LNG amounts has prompted Brunei to sell LNG to other regional buyers and seek short-term contracts or spot cargo sales. Brunei LNG signed a 10-year contract with PETRONAS of Malaysia starting in 2013 and began sending out spot cargoes to other Asian consumers. French-based oil company, Total, made significant gas and condensate discoveries in Block B in 2010 which could bolster Bruneii¦s natural gas reserve base and sustain its production levels and support LNG exports.

  India can acquire LNG from Brunei, given existing good relation between Brunei and India.

- ***Policy Reform towards Foreign Acquisition:***

Now one must agree that India is lacking behind China, Japan, Korea etc. as far as winning the exploration block or JV acquisition in abroad are concerned.

One of the drawbacks behind this reason may be attributed as-

Although all oil and gas PSUs are under the same roof of Indian govt. and private companies are obliged to the same, all these companies become aggressive competitors when there is a call for bid for exploration block. This strategy may go fine in domestic environment but is highly detrimental in broader aspect specially winning a bid abroad. It not only increases the competition but also reduces the chance of winning.

The suggested framework:

- For any bidding outside of India, a committee or board can be formed with top officers from the companies, specialized in that field with central minister or secretary heading the committee.
- The committee's objective will be deciding the key player (who has the maximum chance of success in that particular bid) among several companies. This decision will be taken based on the opinion of the members and assessing the past record or extent of specialization, ability on that field.
- As one company is chosen, other companies will support this company to win the bid. This help may be technological, financial or of any kind.
- The govt. must have strong control over the companies to spread its wings over the international domain, specifically in Asia pacific region.

This will increase the chance of winning. The same can be applied for setting up JVs in abroad.

Conclusion

An assessment of the 25-year performance of the South Asian Association for Regional Cooperation (SAARC) reveals the dominant influence of interstate power relationships and the impact of internal political forces. Several SAARC members perceive India as a risk to their security and a source of possible economic domination. Such perceptions are aggravated by a lack of trust and poor interstate relations, particularly between India and Pakistan. These regional dynamics have stunted trade and cooperation by

(i) Pushing members to restrict trade and economic exchanges with India in order to moderate the risk of economic domination; and

(ii) Making the progress of regional cooperation dependent upon the status of relations among member states, rather than on economic opportunities, thereby introducing uncertainty and arbitrary factors into the cooperation process.

As the preeminent member state, India needs to take the initiative in building better relations in the region by allaying other members' security concerns and fears of domination. Other members, in turn, need to recognize that integration with the Indian economy could help them overcome the constraints of market size and geography. In this context, South Asia Sub-regional Economic Cooperation program (SASEC) that was started in 1996 between Bhutan, Bangladesh, India and Nepal for sustainable economic development, under the banner of Asian Development Bank (ADB) could be extended to other areas of cooperation and states of the region.

A preeminent method to enhance regional cooperation in the region could be the creation of regional fund or regional Bank to finance aid projects, crisis prevention and to provide finance to the private sector. South Asia could take lessons from the experience of ASEAN states trying to attract intra-regional investments with the help of ASEAN investment area. Mobilizing foreign exchange reserves for development projects and crisis prevention could play an important role.

Secondly, initiating regional bodies to manage could be an effective dose to boost regional cooperation in South Asia. Regional institutions are not only outcome of negotiation processes but also drivers of negotiation processes.

Although, the practical problems of implementing regional cooperation could not be overstated yet these are not the problems that could not be overcome. Regional cooperation can offer substantial benefits to all the small states of South Asia. Not only in the areas of trade and investment but also in the areas of cross- border project specific coordination, macro-economic policy harmonization and people to people contacts must be encouraged. This coordination of efforts would assist in mobilizing scarce economic and natural resources.

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Role of Natural Gas in Meeting INDC Targets through 2030

❖ Praveen Gautam, K M Thilagarbabu & Ranjit Deka ❖
GAIL (India) Limited

Summary

India submitted its Intended Nationally Determined Contributions (INDCs) to United Nations Framework Convention on Climate Change (UNFCCC) with an attempt to work towards a low carbon emission pathway which lists out eight goals - Sustainable Lifestyles, Cleaner Economic Development, Reducing Emission Intensity of GDP, Increasing the share of non-fossil fuel based electricity, Enhancing Carbon Sink, Adaptation and Mobilizing Finance, Technology Transfer and Capacity Building. Under INDC, India's target towards carbon emission reduction is - "Reduction in the emissions intensity of its GDP by 33 to 35 per cent by 2030 from 2005 level"'

On the basis of India Energy Security Scenario (IESS), 2047, developed by NITI Ayog, GHG emissions through 2047 were analyzed keeping in mind the INDC targets of India. The Scenario where high thrust is put on renewables including solar, wind, small hydro and others reveals that India needs to make further efforts to meet INDC target of reducing emissions intensity of its GDP by 33 to 35 per cent by 2030 from 2005. As per the analysis, even with high thrust on renewables, India may achieve around 19% reduction in emissions intensity of its GDP by 2030.

Under such scenario, India has to seriously consider coupling of renewable energy sources with lesser harmful alternative such as natural gas. Natural Gas is the least GHG emitting fuel among all fossil fuels. With effective utilization of existing infrastructure, minimal further investments, and favorable policy support, gas can actively contribute in reduction of carbon emissions. This paper intends to elaborate on increasing role of natural gas in the primary energy mix with reduced CO2 emissions to achieve INDC targets.

Introduction

According to various studies, India's energy consumption is expected to rise 132 per cent by 2035. India's economy is currently heavily reliant on coal, and that's unlikely to change any time soon. As on date, almost 60 per cent of India's installed power plants were coal-based and government aim to double India's coal production to one billion tons by 2019 with an ambition of ending coal imports in the next two to three years can put a serious question mark on India's ability to cut down its emission level.

NITI Aayog has undertaken an 'Energy Scenario Building' exercise called the India Energy Security Scenario (IESS), 2047 where efforts have been made to see the entire energy sector in an integrated space, by putting together all the energy demand sectors of the economy together, and analyzing in light of the domestic supply, and extrapolate this exercise in medium to long term.

Due to large demand of energy requirement of the economy, and adequate availability of coal reserves, the share of coal in the energy mix is set to rise from 47 % in 2012 to 51 % in 2030. This will have a significant negative impact on emissions which are set to rise from 1.7 tons /capita in 2012 to 3.7 tons / capita in the year 2030.

India's Intended Nationally Determined Contributions (INDCs) goals

The INDCs, which lay out the blueprint for tackling climate change has includes the following two goals to show commitment towards curbing emissions.

1. To reduce the emissions intensity of its GDP by 33-35 per cent by 2030 from 2005 level (GDP by 20-25 % over 2005 levels by 2020)
2. To adopt a climate friendly and a cleaner path than the one followed hitherto by others at corresponding level of economic development.

Considering the above two goals, adaptation to new avenues is inevitable for India. India has already adopted several ambitious measures for accomplishment its target for clean and low carbon energy including renewable energy, implementation of higher energy efficiency benchmark in various sectors of industries etc.

Working of Carbon Emission of GDP

In INDC targets, India aims at reduction of Carbon Intensity of GDP by 33-35% by 2030. The Carbon Intensity of GDP (CIG) is arrived at in the following manner:

$$\frac{CO_2}{GDP}(Carbon\ Intensity) = \frac{Energy}{GDP}(Energy\ Intensity) \times \frac{CO_2}{Energy}(Fuel\ Mix)$$

Carbon Intensity to GDP for the base year i.e. 2005 is worked out in Table 1. It shows that India's carbon intensity of GDP was 197.42 Ton CO2e /Rs. Crore implying that India added 197.42 tons of CO2e in environment for every Rs. Crore of GDP in 2005. This level will be considered as the base for meeting the future emission targets of India.

Table 1

Working of Carbon Intensity of GDP:

	Factors	Units	2005
A	GDP on basis of 2011-2 series and constant prices (Source: World Bank)	Rs. Crores	5555422.99
B	Energy Consumption -Including Biomass (Source: IEA)	MTOE	517.66
C	Actual CO2 Emissions (Source: IEA)	Million Tons CO2e	1096.77
D	Energy Intensity (Energy / GDP) [B/A]	MTOE/ Rs. Crores	0.000093
E	Fuel Mix (CO2 / Energy) [C/B]	Million Ton CO2e/MTOE	2.1187
F	Carbon Intensity of GDP (CO2 by GDP) [D*E]	Ton CO2e/	Rs. Crore 197.42

Projections have been made till 2035 under various scenarios using India Energy Security Scenario (IESS), 2047 (See on Table 2) considering various factors determining Carbon Intensity of GDP. It emerges that even with a scenario of high thrust on renewables including Solar PV and CSP, Wind Power, Small Hydro and other non-fossil sources, GHG emissions will be of the order 5390 Ton CO2e in 2030 and the Carbon Intensity of GDP will only decrease by 19% from 2005 level against a target of 33-35%.

In order to meet the INDC targets, a further reduction of 926-1060 million ton of CO2e by 2030 needs to be achieved over and above that achieved by laying high thrust on renewables.

Trade-off between Renewables vs. Natural Gas

As per the IESS scenario projection with high thrust in renewables, solar capacity will reach 191 GW by 2032 (171GW in solar PV and 20 GW in solar CSP) from existing 4.88 GW with a CAGR of over 24% while wind will reach 139 GW (127 GW onshore and 12 GW offshore) from existing 25 GW with a CAGR of around 11% which is high enough considering the potential.

Since targets of renewables (including solar, wind other hydro) are already stretched and highly ambitious, next alternative is to switch from high carbon emitting fossil fuels to lower ones.

As per data on GHG emissions and primary energy consumption by fuel type, natural gas results in around 60% lesser emission of CO2e for the same level of energy consumption as compared to coal (Figure 2).

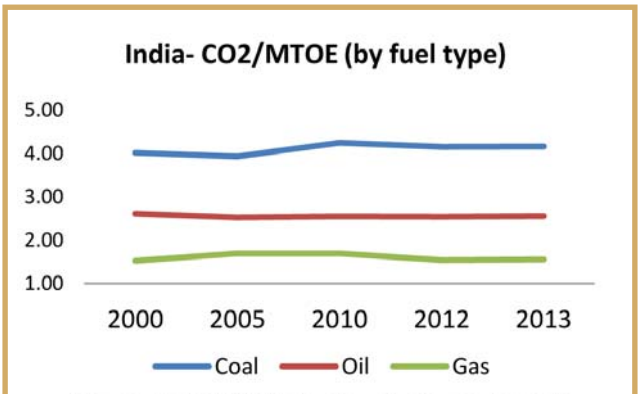

Figure 2: CO2 EMission by Fuel type in India

In simple mathematical terms, for carbon emission curtailment of 1%, an approx. 1.6% of capacities need to be switched from coal to gas. From the India Energy Security Scenario (IESS), 2047 and carbon emissions of fuels as given in graph above, it is observed that reduction of 926-1060 million ton of CO2e by 2030 to meet the INDC targets, can be achieved by cutting down coal based power generation and producing commensurate power through gas based plants. Currently gas based power generation has a PLF of 22% only and there is ample scope for improved utilization without additional investment. In such a scenario when

natural gas industry is rightly placed to serve as an alternative fuel in reducing GHG emissions, it requires certain favorable policy changes too.

Table 3 shows that increasing PLF of gas based power units form the current figure of 22% to 70% (i.e. around 17 GW increase) results in curtailment of 239-270 MTCO2e of carbon emissions.

Policy Changes in favor of gas

For increased usage of gas, we need a favorable policy environment in India. Some of the immediate possible policy interventions are given below.

1. Promotion of natural gas for fuel purpose replacing coal and optimal utilization of domestic coal for non-fuel applications like Coal Gasification, Coal to Liquids, and other Value Added Products
2. Operationalizing stranded gas based power generation and increasing PLF of operational plants from existing 22% to 60%.
3. Minimum Purchase Obligation (MPO) for power produced from gas based power plants i.e. ensuring a minimum percentage of gas based power in the total power generation in country. This percentage may vary from 15-20%.
4. Peaking power regulations for gas based power generation as a support mechanism for renewables power generation.
5. Promoting CNG in the transport sector to replace diesel.
6. Imposing Carbon cess on coal based electricity production: to gradually increase carbon tax from the current rate of Rs. 400/MT on annual basis.

Conclusion

In order to meet the INDC targets, a further reduction of 926-1060 million ton of CO2e by 2030 needs to be achieved over and above that achieved by laying high thrust on renewables. So India needs to make additional efforts to reduce carbon intensity and meeting the INDC targets.

- As a lower carbon form of energy, natural gas can bring immediate carbon savings in the near term and will be a key component of the future energy mix.
- It is found that if 15-17% of coal based power generation is curtailed and commensurate generation is obtained from gas based units, the PLF of total gas based power generation has to just increase from 22% to 70% and no additional capital investment would be required.
- Curtailment of coal based power generation does not mean rendering coal unused, but it is proposed to use this amount of coal in producing Value Added Products like coal to liquid hydrocarbons, petrochemicals etc. rather than fuel, and generating commensurate power from gas based capacities, India can move towards achievement of further carbon curtailment.
- Natural gas sector needs favorable policy changes in order to extract the maximum benefit out of it and meet the INDC targets by 2030.

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Table 2: Projections Carbon Intensity of GDP and Shortfall from Targets:

2	Projections	Units	2015	2020	2025	2030	2035
A	GDP at Constant Prices (Source: IESS 2047) (Base Year 2012 and projected based on GDP Growth)	Rs. Crores	11,305,748.22	16,289,917.95	24,247,006.64	33,742,223.58	44,730,323.32
B	Energy Consumption (Source: IESS 2047)	MTOE	713.31	902.04	1,110.50	1,334.13	1,589.34
C	Carbon Emissions (Source: IESS 2047)	Million Tons CO2e	2,508.86	3,346.16	4,314.65	5,389.95	6,495.82
D	Energy Intensity (Energy / GDP) [B/A]	MTOE/Rs. Crores	0.000063	0.000055	0.000046	0.000040	0.000036
E	Fuel Mix (CO2 / Energy) [C/B]	Million Ton CO2e/MTOE	3.5172	3.7096	3.8853	4.0401	4.0871
F	Carbon Intensity of GDP (CO2 by GDP) [D*E]	Ton CO2e/Rs. Crore	221.91	205.41	177.95	159.74	145.22
G	% Decrease from 2005 Levels	%	-12.40%	-4.05%	9.87%	19.09%	26.44%
3	**INDC Targets**						
A	% Decrease in Carbon Intensity of GDP from 2005 Level	%				33-35%	
B	Carbon Intensity of GDP	Ton CO2e/Rs. Crore				128-132	
C	Carbon Emissions	Million Tons CO2e				4330-4463	
4	Additional Carbon emissions to be captured [2.C-3.B]	Million Tons CO2e				926-1060	

Table 3: Impact on Generation (GW) and Carbon reduction with every % switching of Coal Generation Capacity

% to GW of Generation					
%	2017	2022	2027	2030	2032
1%	1	1	1	2	2
3%	3	4	4	5	6
5%	5	6	7	9	10
7%	8	9	10	12	14
9%	10	11	13	16	18
11%	12	14	16	20	22
13%	14	16	18	23	26
15%	16	19	21	27	30
17%	19	21	24	30	34
19%	21	24	27	34	38
21%	23	27	30	37	43
23%	25	29	32	41	47
25%	27	32	35	44	51
27%	30	34	38	48	55
29%	32	37	41	52	59
31%	34	39	44	55	63
33%	36	42	47	59	67

% to Carbon ($MTCO_2e$) Reduction					
%	2017	2022	2027	2030	2032
1%	16	21	27	32	35
3%	48	62	81	95	104
5%	80	104	135	158	173
7%	111	145	189	221	243
9%	143	187	243	285	312
11%	175	229	297	348	382
13%	207	270	351	411	451
15%	239	312	405	474	520
17%	270	353	459	538	590
19%	302	395	513	601	659
21%	334	436	567	664	728
23%	366	478	621	727	798
25%	398	520	675	790	867
27%	430	561	729	854	937
29%	461	603	783	917	1006
31%	493	644	837	980	1075
33%	525	686	891	1043	1145

Creating Infrastructure specially to connect consumers is the main challenge-

Interview with Shri Prabhat Singh, MD and CEO of Petronet LNG Limited

Petronet LNG Limited (PLL), with rise in revenue from 1102 million USD in 2006-07 to 6583 million USD in 2014-15, is one of the fastest growing world-class companies in the Indian energy sector. Company has to its credit the setup of country's first LNG receiving and regasification terminal at Dahej, Gujarat. Capacity of this terminal is 10.0 MMTPA, up from 5.0 MMTPA in 2004. This is further set to reach 15.0 MMTPA in the current year. Another terminal at Kochi, Kerala with capacity of 5 MMTPA is also operational since 2013. The company is in the process to build a third terminal of 10 MMTPA capacity potential at Gangavaram, Andhra Pradesh which is expected to be in operation in 2017. Beside operation of LNG terminals, PLL also has linked business channels in its portfolio; road and costal supplies of LNG and LNG services & bunkering at Kochi port.

Sh. Prabhat Singh, Managing Director and CEO of PLL took over charge in September 2015

An Engineering graduate from IIT, Kanpur, he has around 35 years of relevant experience in the Hydrocarbon Industry both in MNC (British Gas) and Maharatna PSUs (GAIL, NTPC, EIL) etc. He is a vastly experienced professional having worked his way up in diverse areas including Project Planning, Execution & Management, Exploration & Production, Training & Organizational Reforms and Business Development & Marketing.

He has been instrumental in putting the country on the world gas map, India being one of the first countries to have sourced LNG (based on Henry Hub) from the US. During his brief tenure in PLL, the company successfully re-negotiated price for the long-term gas contract with Qatar's RasGas to take advantage of low price of gas in the international markets

Today, he is recognized as a visionary professional in the Industry for having a great business sense with a human touch & communication skill.

In an interview with the Editor in Chief, N. K. Bansal of Petrofed Journal, Sh. Singh shared his thoughts on different aspects of Gas business at national and company's level.

What is your perspective for the Gas economy and usage of Gas in the future in the Global scenario?

Natural gas constitutes around 24% of the primary energy consumption in the World. Natural gas is a clean and environmentally safer fuel. The usage of natural gas has been growing for the past few years. Due to the advances in the production of gas from un-conventional sources like Shale, natural gas is expected to penetrate into newer areas. Besides the conventional sectors of the economy like generation of power, urea manufacturing, refineries and petrochemical plants, natural gas is expected to make deeper in roads into transport sector as well.

How do you rate the current investment conditions in India's LNG infrastructure market?

Investment for setting up LNG infrastructure in India is open to all players without any embargo. 100% FDI is permissible in this sector. Currently, there are four operating LNG terminals in India - all on in the west coast of India - with a combined import capacity of about 30 MTPA. Two more terminals - one at Mundra in Gujarat and another at Ennore in Tamil Nadu are under construction. Many new terminals are being planned both on the west coast and east coast of India. I believe the LNG terminals are well planned to take care of the India's import requirements. What is lacking is investment into pipeline infrastructure to connect the more users of gas.

What strategy you follow to maintain the trust and highest standards of business ethics and values in your brand among consumers and shareholders?

Petronet is a very ethical organization and keeps its business dealings with all the stakeholders above board and uniform. The values which Petronet adhere to are as follows:

- Integrity
- Excellence
- Sustainability
- Trust & Care
- Team

As you are, aware most of the transactions carried out by Petronet are with related party, however, each of these transactions are done on an arms lengths basis and highest integrity is maintained.

How is the partnership with Ras Gas Company Limited, Qatar shaping up for your organization?

Petronet and RasGas have grown together since we signed our long term agreement in the year 1999, even today our long term contract of 7.50 MMTPA is the single largest LNG contract in the World. There is an excellent relationship between our two Companies both at the highest level as well as at the operating level.

With the sharp fall in the crude prices in the past two years, the long term contract between Petronet and RasGas was put to a test. Both the organizations, had rounds of discussions and arrived at a sound commercial understanding maintaining the integrity of the contract. Both the Companies also agreed for sale purchase of an additional one MMTPA of LNG which went on to cement this relationship further.

What steps Petronet LNG Limited is taking for maximizing the value creation for the stakeholders?

Petronet has been conscious of the fact that creation of infrastructure is necessary for the progress of the nation and also for maximizing the value creation for all the stakeholders. With this perspective in mind, the initial 5 MMTPA terminal commissioned in the year 2004 at Dahej in Gujarat was expanded to capacity of 10 MMTPA within 5 years of its operations. Companies subsequently added second jetty at the terminal to handle large LNG vessels and to have more flexibility in its operations. Petronet is further expanding the terminal to handle 15 MMTPA of LNG. This expansion is likely to be commissioned before the end of the current year.

The Company also commissioned its LNG terminal at Kochi in the state of Kerala in the year 2013. As per the current market price, the paid up capital of Rs.750 crore has reached to a market capitalization of Rs.21000 crore within a span of 12 years period.

The Kochi Terminal's infrastructure was developed in the shortest possible time and at a benchmark cost which has been commissioned in August, 2013. What is the current status of the Terminal and the steps taken by the company to overcome the hurdles?

Setting up at the LNG terminal at Kochi had its challenges which the highly dedicated team at Petronet was able to surmount and complete the project as per the scheduled cost and time. You are aware, that the terminal is running at a very low capacity utilization primarily due to the non availability of gas evacuation pipeline. Efforts are on by GAIL (India) Ltd to set up the relevant gas pipeline. Petronet has come out with innovative services to enhance the utilization of the Kochi terminal. Some of these are relating to providing storage and re-load services, gassing up and cool down, bunker fuel for vessels etc. Due to the softening of the LNG prices in recent time M/s. FACT, one of the fertilizer Companies in Kochi, has started consuming LNG in its plant. We are quite hopeful for early completion of stranded pipeline project.

Take us through the main bottleneck and key challenges of Indian market for your organization?

Having been in this sector for the past 30 years I believe the main challenge is creation of infrastructure. As a Country, we have to facilitate creation of all channels of infrastructure and remove bottlenecks so that the consumer has option to maximize

Overview of Kochi Terminal

his output. Petronet was formed to import LNG and to set up LNG import terminals in India. While the import infrastructure is currently robust, the consumers in many parts of the Country are not connected to the Natural Gas pipeline thereby making it difficult to reach natural gas to all the beneficiaries. It is, therefore, important that gas pipelines reach all the major parts of the Country so that the transmission and distribution network is beefed up.

What is the company's expansion plan into the Gas sector for our country?

Petronet is also looking at creating more demand for usage of natural gas in unconventional sectors of the economy including long haul trucks and bunker barges replacing diesel so as to make transport sector more environment friendly.

The answer to climate change, is change.

Change, from the way we now produce and consume energy to a greener mix of oil and coal powered energy coupled with the use of natural gas as an energy source. Natural gas emits an estimated 40-70% less carbon dioxide than other fuels, reducing the growing pressure on our ecosytem. Moreover, LNG results in virtually no atmospheric emissions of sulphur dioxide and particulate matter. Petronet LNG is leading this change for a better environment by continuously striving for doing things the greener way.

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Safety Challenges before Indian City Gas Distribution Industry - IGL shows the way

Introduction:

Indraprastha Gas Limited (IGL) is one of India's leading natural gas distribution companies. IGL was incorporated in 1998, to take over and operate the Delhi City Gas Distribution Project from GAIL (India) Limited (Formerly Gas Authority of India Limited). The project started to lay the network for the distribution of natural gas in the National Capital Territory of Delhi to consumers in the domestic, transport, and commercial sectors.

The two main business objectives of the company are -

- To provide safe, convenient and reliable natural gas supply to its customers in the domestic and commercial sectors.
- To provide a cleaner, environment-friendly alternative auto fuel to Delhi's residents. This has considerably reduced the alarmingly high levels of pollution.

The transport sector uses natural gas as Compressed Natural Gas (CNG), the domestic and commercial sectors use it as Piped Natural Gas (PNG).

I) Status of IGL after 17 years:-

- Largest CNG distribution Company in the country.
- Annual Sales Turnover ~ 4048 crores in FY 14-15
- Largest pipeline network (more than 10,000 kms) in a single city in the country.
- Total public transport system (100% buses & Autos) of more than 8.7 Lakhs vehicles of National Capital of the Country (including world's largest fleet of CNG buses in any single city) is operating on CNG supplied by IGL.
- Highest Natural Gas (CNG and PNG) supplying company in the country, Catering to ~ 6.5 lakh PNG customers including Industries, large & small commercials and domestic consumers and 418 CNG Outlets.

II) Major Health, Safety, Environment and Asset reliability issues before City Gas Distribution Industry:

Focussing on the Health, Safety, Environment and Asset reliability issues, there are two key elements that CGD industries needs to keep their eyes on:

A) Issues related to CNG sector

B) Issues related to PNG sector.

A) Issues Related to CNG Sector:

Since the major chunk of IGL's customers are the consumers of CNG viz. private cars, auto rickshaws, buses , taxis etc., there always exist an apprehension of installation of unapproved and unsafe cylinders in the vehicles which is hazardous to public life and safety. Some of the issues are as mentioned below:

i. Poor Maintenance Of Cng Vehicles And Kits:

CNG was introduced in NCR as an alternate fuel for environmental concerns, however general public prefers CNG vehicles because CNG is economical compared to other fuels and consumers generally do not spend on maintenance of kits and vehicles. Considering the fact that fitting of CNG kits, CNG cylinders, and parts in these vehicles are in the scope of retrofitters for conversion of vehicles at their assembling facility and installation of any unauthorized / spurious spare parts is a matter of serious concerns.

In addition, no periodic maintenance / checking schedule is defined for maintenance of CNG kits except for commercial & public transport vehicles and the very fact that CNG customers do not offer their CNG kits for checking and maintenance for its upkeep, any gas leak due to unsafe condition of the vehicle can lead to serious consequences as the vehicles are filled up to maximum pressure of 200 kg/cm^2.

ii) Validation of CNG Cylinders:

In 2014, third party study revealed that there was shortage of CNG cylinder testing stations in Delhi NCR. To address the issue, Indraprastha Gas Limited took the initiative for enhancement of CNG testing stations in Delhi NCR with support of PESO (Petroleum and Explosives Safety Organisation). An Expression of Interest (EOI) was called for setting up CNG Cylinder Testing Stations. Various meetings were conducted with interested parties and a workshop on enhancing CNG cylinder validation Infrastructure was organized in association with PESO. IGL acted as a facilitator for the interested parties to enhance the CNG cylinder validation infrastructure. Many new testing stations were added during the initiative increasing the number of testing stations more than the required.

Though at present there are sufficient numbers of CNG cylinder testing stations in Delhi NCR, however the testing procedures and quality control at these testing stations is questionable. During recent surprise inspection of testing stations in Delhi, PESO has suspended licenses of some of these testing stations for non-adherence to testing procedures and non-availability of required testing equipments. This is matter of great concern as these malpractices by testing stations are creating a pool of vehicles having unsafe cylinders but with valid certificate and compliance plate. The issue needs to be addressed by ensuring strict compliance by cylinder testing stations. Possibility of keeping photography/videography evidence of testing of each cylinder by testing stations should be explored by relevant Statutory Bodies.

B. Issues Related to PNG Sector (Third Party Damages to Pipeline Network Affecting Asset Integrity) :

Being the only gas distribution utility in DELHI & NCR, IGL has laid a very vast network of gas pipeline to cater gas to every nook and corner of Delhi & NCR. Due to rapid urbanisation in National Capital Region of Delhi, there exists a risk of damage to pipeline network by various construction activities of digging, piling and excavation by various civic bodies and other companies.

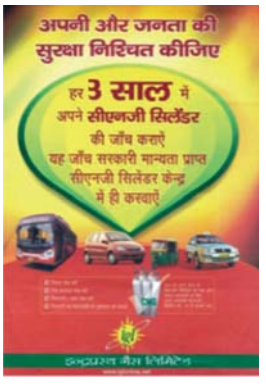
Lack of coordination/ poor planning of various utilities with gas distribution companies and unauthorized infrastructure development has damaged gas pipelines in past thereby disrupting the supply and more significantly has created havoc in terms of fires.

iii) Safety Initiatives & Best Practices:

a) Awareness among the customers:

IGL has taken various initiatives for keeping the general public aware /abreast with various safety measures through organizing various safety clinics at its all CNG outlets.

Besides Safety awareness information is regularly broadcasted through FM radio, by playing animated Films at CNG stations and distribution of pamphlet of safety instructions/information to consumers is a regular affair for customer safety awareness.



b) Mobile Training Van:

IGL has a very well designed Mobile training van to effectively address safety training needs for various target groups at their premises. Mobile training van is equipped with all latest training aids, portable fire fighting pan and training modules have been customized considering the needs of different types of consumers i.e., CNG filling station staff, domestic & commercial PNG consumers, drivers of public transport and school buses.

c) Strengthening of Emergency Response:

IGL has set up round the clock manned Emergency Control Centers (ECC) at various strategic locations of Delhi & NCR with trained, experienced and qualified personnel to respond to emergencies.

Additionally IGL has stationed Emergency Response Vehicles (ERV) having advanced rescue tools and equipments are at strategic locations to handle emergencies more efficiently.

Keeping in view all the above issues and concerns related to city gas distribution, it is the need of hour that the customers should have indubitable approach towards safety and should maintain the healthy condition of their CNG kits and fittings. Statutory bodies may make efforts to strict adherence to procedures by CNG cylinder testing stations and also to have better quantity control system by these stations. Co-operation between utilitily and

infrastructure companies is required to eliminate the chances of third party damages.

For the safe and optimum utilization of eco-friendly City Gas Distribution business, it is essential that each and every one from society, customers, utilitiy companies and all the stakeholders abide by the requirements of various statutory authorities and co-operate for the sake of safety of theirselves and general public at large.

Transition to a Gas Based Economy

Challenges of Infrastructure

❖ Soumik Biswas & Subhanjan De ❖

GAIL (India) Limited

COVER STORY

Introduction

The energy sector in India is poised to face an increasingly complex array of interlocking challenges – economic, geopolitical, technological, environmental in its transition to a gas based economy. As India's population continues to expand, the energy needs of billions of people in rural and urban areas will have to be met. Although we have gradually reduced the energy intensity of GDP, still for a GDP growth of 8 per cent, the primary energy demand would grow. Natural gas, being environmentally benign will contribute significantly as tight limits are placed on emission of greenhouse gases. The present text is on the existing challenges in natural gas sector – transportation and other technical infrastructures, current technologies, values and attitudes which will enable a smooth transition to a gas based economy.

Gas driven Economy, but what drives gas?

The overwhelming answer to the usage of gas is that it is environment friendly, involves lower capital costs and land usage for power plants and increased chemical and thermal efficiencies in applications vis-à-vis other substitutes. The table captures the myriad costs of electricity generation for society prepared by World Bank. The explicit costs signify the monetary cost paid by the owner of the project and the external costs are the costs not paid by the owner of the project but borne by society. This will be in the form of removing productive citizens from the work force for health issues and shift spending away from industries and education. Water pollution creates further health problems and makes agriculture more expensive, raising the cost of living and reducing international competitiveness.1

Table1: Social Cost of Electricity Generation: 2010 $/MWh

	PC	IGCC	Nuclear	Natural Gas	Wind	Solar	Biomass
Explicit Cost	41	77	41	53	70	154	78
External Cost	58	57	11	30	2	6	11
Total	99	134	52	83	72	160	89

Source: The Social Cost of Coal : Implications for the World Bank
Samuel Grausz , Oct 2011

Main Body

Contribution of natural gas in world energy basket was 23.7%2 (2015). Natural Gas consumption growth slowed in 2014-2015 was 0.4%, renewables the fastest growing form of energy and accounted for one-third of the increase in total primary energy use (3%). (3) The increase in Natural Gas piefrom8% to world average of >20% will depend on Availability, Affordability and Accessibility of Natural Gas vis-a-vis its substitutes.

Prima facie with a 7- 8% of GDP growth rate of Indian economy, the current per capita energy consumption of India is 0.434 toe as compared to the world average of 1.8toe signify substantial appetite for consumption exists which can be fulfilled by natural gas. Moving towards a Gas Based Economy depends on Availability, Affordability and Accessibility of Natural Gas in addition to societal will to move towards a cleaner fuel.

Availability

Availability of natural gas in a country primarily depends on resource endowment of the country. In India we observe there is a decline in natural gas production over past few years. GOI has already initiated a policy measure in the name of HELP in March 2016, where a more producer friendly pricing mechanism for capital intensive and complex exploration projects has been formulated.

We recommend that to increase domestic production and availability of Natural gas rapid technology absorption and exploration strategy for tapping potential Unconventional Gas sources in the country like shale gas may be adopted.

Countries mitigate issues of domestic non availability of Natural gas through Transnational pipelines and through Import of LNG. Plans for Transnational pipelines to bring Gas to India are still in

the drawing board due to geo political risk vis-à-vis huge capital expenditure required for the infrastructure. Import of LNG in India is rising as it has reached almost 40% of our gas consumption in the past year due to macro factors like easing of LNG price, policy impetus in the form of fertilizer pooling and power plant pooling. However, LNG regasification terminals like KOCHI and DABHOL are underutilized due to evacuation pipeline connectivity for the former and requirements of breakwater for the later.

Affordability

For development of Gas based economy affordability of Natural Gas also plays a vital role. Natural Gas is affordable vis a vis alternative fuels and substitutes in countries endowed with abundant Natural gas resource. Domestic gas is being priced with a weighted average pricing mechanism which makes the Natural gas affordable to end consumers in India.

Further developed countries, not endowed with Natural gas resource, can also afford to have a Natural Gas driven economy by importing Natural gas through Transnational Pipeline (Countries in Europe) or through LNG import (Japan , South Korea). However, for an emerging economy like India Imported Gas might not always be able to compete with alternative fuels and substitutes. Long-term and spot LNG prices are linked with global economic volatilities and competitive pressure from substitutes may turn Power and fertilizer production unviable with imported LNG. Producing power from LNG may become costlier than Coal based and renewable power generation. Similarly import of urea may be cheaper than producing from LNG.

We recommend that on comparing overall social cost and heavy investment already made in gas based power plants policy for generating power from a pool of Domestic + Imported gas may be formulated to increase share of Natural Gas in the energy basket.

Complementarity with renewables:

GOI has set up a steep target of RES of setting up Solar-PV and wind based power production facility. With decreasing solar PV installation cost, price of solar power is almost touching grid power parity. Growth of Solar generation will definitely decrease share in the country's gas pie. However both solar and wind capacities cannot provide uniform power in the National power grid. Beyond 15%, open cycle Natural gas based power production facilities can provide complementarities as combination of renewables & gas based facility will provide grid stability and discipline.

Accessibility:

Around 15000 Km of natural gas pipeline networks predominantly in Northern, Western and Southern part of the country connect almost all the major anchor load power and fertilizer consumers and existing and upcoming CGD networks. However the existing natural gas pipeline infrastructure is grossly underutilized due to poor availability of domestic gas and unaffordability of LNG.

We recommend that issues of availability and affordability of natural gas should be resolved before taking up the investment in natural gas pipeline network to cover NE/ Eastern/ South-Eastern states of the country. As we know without long-term supply agreement to anchor load consumers the pipeline infrastructure would not become financially viable.

From the above we derive that the major challenge today for gas infrastructure development is the evolution of anchor roadside power and fertilizers sectors in gas pipeline transportation and marketing. However both of these sectors are sensitive to price volatility. Power tariffs are either controlled or regulated within a price band and fertilizer units are provided a subsidy to assure a fixed unit-output price. There is a symbiotic relationship between anchor customers underpinning gas grid growth and our focus will be on power and fertilizer sectors for this purpose.

Sectoral Analysis of Natural Gas consumption

Gas Based Power Plants:

The present installed gas based power generation capacity is 27123 MW5 at a Plant Load factor (PLF) of 90% amounts to a demand of 110 MMSCMD of natural gas. Almost all the gas based power generation units are connected by gas pipeline network. The present gas consumption for power generation is at the tune of 10.5 billionSCM4or roughly 28.8 MMSCMD. Utilisation of already installed gas based power plants will definitely improve gas volumes. The average cost of power from gas is around 4.1-4.5 INR/ KWH (LNG price $6.5/MMBTU)6 For utilising the installed capacity of the "stranded " gas based power plants GOI has recently initiated subsidy scheme (PSDF) for generation of power from LNG,which have paid off. It has increased usage of natural gas and the latest round of subsidy-based auctions conducted by the Power Ministry to import and allocate gas for such plants saw nil claimants for the subsidy. The Ministry has ended up saving 1,600 crore earmarked for subsidy support in the third phase of R-LNG e-auctions, since none of the nine participants bid for subsidy support. This is encouraging as it signals that the plants are happy with the price and quantity of gas available and did not need PSDF support.

Recently GOI has reportedly sanctioned at least 200,000 MW of thermal power capacity, which translates to a capital investment of Rs 10 lakh crore over a decade. The capital costs of a thermal power plant are in the range of Rs 4-5 crore per megawatt. Witnessing the aggressive bidding for coal blocks allocation; it is safe to conclude that the cost of coal based generation will move northward from present 2.5-2.8 INR 7/ KWH.

The main contention for running gas based power plants is to use the already installed capacity to recover the operating costs effectively because the fixed costs are already "sunk". Moreover addition of coal based power plants will increase carbon emissions by a factor of 2 compared to gas8.

Besides there is a net difference of peak demand/ peak met at 3.2% amounting to 5 GU9. Gas is the energy source to bridge the peaking power gap given scalability, availability and time to construct. Hence there is also a strong case for peaking power tariff regulations so as to incentivize gas based power production.

Fertilizer Sector

The fertilizer scenario generally gravitates around urea production and hence this has been considered for the present study. The demand for urea is around 32.8 MMTPA against an indigenous production of 23 MMTPA6and import of around 9 MMTPA10. Because of restricted gas supply, the government has put a cap on supply of domestic gas to fertilizer plants. Urea units have for long been subject to cuts in supply of administered pricing mechanism (APM) gas affecting their working. Our study indicated that almost all major urea manufacturing units barring 2 (SPIC Tuticorin & MFL Chennai) are in gas pipeline grid (MCFL Mangalore on KKBMPL-II). The total gas demand from the fertilizer sector is around 55 MMSCMD. The new urea policy along with the pooled price mechanism already in place from July 2015 will contribute to the usage of gas. This will result in around 1.7 times usage of natural gas and establish the viability of transmission lines.

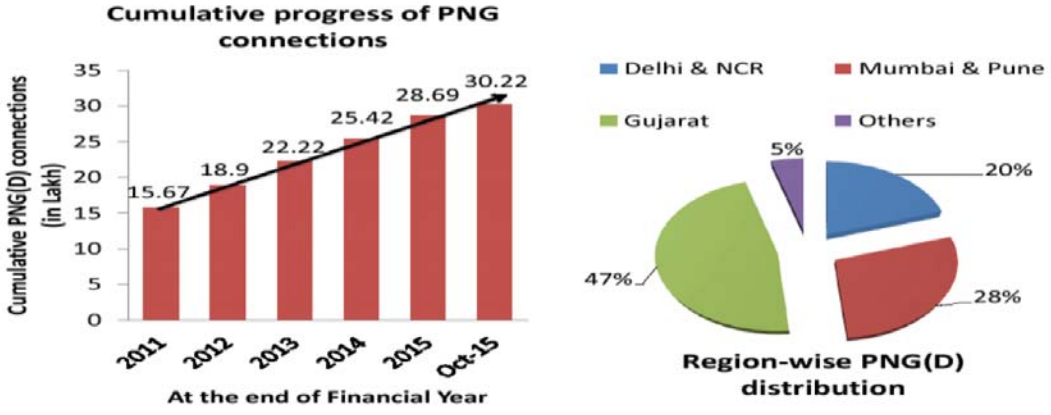
The revival of three fertilizer plants at Gorakhpur, Sindri and Barauni may further augment gas usage and reduce skewed gas consumption in Eastern side vis-s vis all India.11

CGD: The emerging urbanization trends and information society

Of the major uses of primary energy demand, namely electricity and transport both have tended to expand broadly in parallel with GDP. The per capita electricity consumption has increased steadily and is presently at 957 KWH12. The socio-economic changes are expected to lead changes in the mobility patterns and urbanization. The number of agglomerations (smart cities) will rise. Such evolutions will accelerate the development of City Gas Distribution network (CGD). The CGD business revolves around– Gas supplies, Infrastructure and Policies.

The CGD sector comprises of Compressed Natural Gas (CNG) and Piped Natural Gas (PNG) customers. There are a total of 101013 compressed natural gas (CNG) stations across the country and 30.22 lakh households PNG connections and 25.5 CNG vehicles. The consumption of gas in the CGD network during 2014-15 was around 16.3 MMSCMD, of which 9 MMSCMD was used for CNG (transport) & PNG (domestic) and 7.3 MMSCMD was used for Industrial & Commercial PNG. At present, there are 67 geographical areas (GAs) operating/under development. The PNGRB has envisaged a rollout plan of CGD network development in proposed smart cities in a phased manner depending upon the availability of natural gas and pipeline connectivity. GoI has a target to attain 1 crore PNG connections.

Trends of PNG (Domestic) Connections



Transport Sector : CNG/LNG:

To improve penetration of Natural gas in Transportation sector through CNG/LNG, following options may be taken up.

- Policy directives for conversion of diesel vehicles to CNG (as it was in Delhi) in other GAs
- LNG options may be explored for locomotives and other Heavy Duty Vehicles(HDVs)
- High-pressure Direct Injection (HPDI) injector system engines has been developed which substitutes 95% diesel
- LNG has a distinct cost advantage w.r.t diesel14

The gap areas looming large in CGD are:

- Zero tariff bids: PNGRB may review the existing methodologies of bidding considering practical volumes

- Marketing exclusivity: Presently a 5 year window is provided for the winning bidder or market penetration. However demand of a city with slow build up makes it difficult for increase in volumes
- At present, State/Municipal/Local Authorities are levying exorbitantly high permission charges from CGD network which is costing about Rs15000 to Rs 20000 per PNG15 connection. This should be addressed quickly.
- Opportunities for viability gap funding(VGF) to attain the steep target of PNG connections to be explored.
- Thoughts for policies to be mooted for i§LPG i§free zone on GAs. The LPG cylinders thus freed from PNG households to be diverted to millions of households where firewood is used as cooking fuel leading to CO/CO2 and tropospheric ozone emissions and associated health hazards.
- Policies restraining and eventually banning usage of Diesel Generating sets should be contemplated in GAs where PNG/ CNG is available. The same policy may be implemented in gas grid connected Smart Cities for Back Up power provision.

Conclusion and Recommendations

The study recommends the following:

1. Existing gas based power plants PLF to be increased from present 30% to 80% which will provide the following immediate benefits to the country:

   • Increase in Utilization of Stranded power plants infrastructure and return to investors

   • Lesser CO_2 emissions w.r.t equivalent coal consumption providing lesser societal cost.

   • Gas consumption to increase to 50-60 MMSCMD resulting in increased utilization of existing natural gas infrastructures.

2. Before committing on additional infrastructure development in the form of expansion of natural gas pipeline network, underutilization of existing natural pipeline networks should be mitigated so that the Natural Gas pipeline transporters generate sufficient cash flow from existing business for expanding natural gas pipeline networks and infrastructure.
3. Existing gas pooling mechanism to continue in fertilizer and plants may be incentivized to produce as per their maximum achievable capacities.
4. Complementarity of Natural Gas based power generation alongwith Renewables may be planned to instill greater GRID Stability, Discipline and providing for Peaking Power requirements.
5. Favorable policy directives for natural gas usage in city transportation and utilities and ensuring minimum ROI for operators.
6. Use of CNG /LNG in Heady Duty Vehicles by adopting evolving technologies may be implemented to steer bulk of transport sector towards cleaner fuel.
7. Policies restraining and eventually banning usage of Diesel Generating sets should be contemplated in smart cities and other GAs where PNG/ CNG is available.
8. The substituted coal in power generation may be used as a feedstock for producing, olefins, other chemical building blocks, fertilizer through coal gasification and syngas.
9. The substituted diesel can be exported to neighbouring countries that are short of refined petroleum products.

Lastly the key driver for long-term future of gas based energy economy is the growing awareness and consensus build up that cleaner energy may come at a premium and at times which cannot be compared with coal/oil based infrastructures on the same metric. The societal cost of coal based power generation which has already been depicted earlier far outstrips the explicit costs of generation. While China needed more than a decade to understand the pitfalls of coal based economy, India needs to act fast and change the trajectory towards gas.

Natural Gas : Smart Fuel for Smart India

❖ Vikram Anand, Shalini Surendra Prasad & Shaily Jain ❖
GAIL (India) Limited

Introduction

Nation needs to go smart on energy sources. To optimize India's energy mix for long-term environmental sustainability and to reduce greenhouse gas emission, it can be achieved by leveraging Natural Gas as a smart fuel for smart India. The case of alarming levels of pollution in the country with specific of National Capital Region the extent of the PM2.5 (Particulate Matter) emission impact on health has become an issue which no society can ignore. Natural gas plays very important role in furthering this objective. It is here promotion of Gas is required as in addition to CO2 or GHG emissions it also results in lower NOX, SOX, PM, Mercury and Mercury emissions.

Mankind and Environment

In the world today, to sustain healthy human lives of mankind clean air is the foremost requirement. According to the WHO, air pollution is currently the greatest environmental risk to public health and causes about 3 million premature deaths globally every year. Air quality has deteriorated in most large cities in India, a situation driven by population growth, industrialization and increased vehicle use. Indian cities today are among the most polluted areas in the world. Six Indian cities – Gwalior, Allahabad, Patna, Raipur, Ludhiana, and Delhi – rank among the most polluted cities in the world. WHO report suggests millions of people in India are at risk of serious cardiac and respiratory infections and diseases because of high pollution levels.

Ambient air pollution has been identified as the fifth biggest cause of mortality in India. According to a study conducted by University Of British Columbia more than 5.5 million people worldwide die prematurely every year due to household and outdoor air pollution, and India and China together account for 55% of these deaths, new research has found. About 1.4 million died in India in 2013 of air pollution. Reducing air pollution is an incredibly efficient way to improve the health of a population.

Urban air pollution is largely a result of combustion of fossil fuels that are used in transportation, power generation, industrial sector, and other economic activities. Almost all (95%) of the world's transportation energy comes from petroleum-based fuels, largely gasoline and diesel.

Household air pollution (HAP), also known as indoor air pollution (IAP), is a serious area of concern in rural spaces, as majority of this population continues to depend on traditional biomass for cooking and space heating and depend on kerosene or other liquid fuels for lighting, all of which are highly likely to lead to high levels of HAP. Buildings (6% of 2010 global greenhouse gas emissions) - Greenhouse gas emissions from this sector arise from on-site energy generation and burning fuels for heat in buildings or cooking in homes.

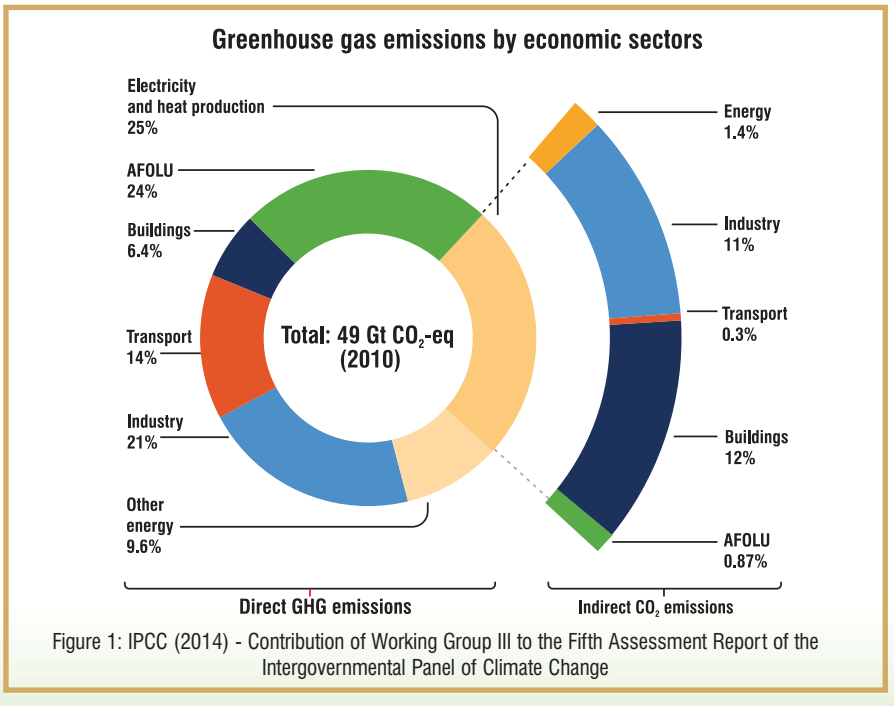


Figure 1: IPCC (2014) - Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel of Climate Change

Role of Cleaner Fuel for Tackling Air Pollution

There is urgent need to move to usage of cleaner fuels be it transportation, power generation, industrial sector, and other economic activities. For which Natural gas can act as saviour fuel. It is an extremely important source of energy for reducing pollution and maintaining a clean and healthy environment. Natural gas is the cleanest of all the fossil fuels. Composed primarily of methane, the main products of the combustion of natural gas are carbon dioxide and water vapour, the same compounds we exhale when we breathe.

The combustion of natural gas in comparison to other fossil fuels releases very small amounts of sulphur dioxide and nitrogen oxides, virtually no ash or particulate matter, and lower levels of carbon dioxide, carbon monoxide, and other reactive hydrocarbons.

Fossil Fuel Emission Levels – Pounds per Billion Btu of Energy Input

Pollutant	Natural Gas	Oil	Coal
Carbon Dioxide	117,000	164,000	208,000
Carbon Monoxide	40	33	208
Nitrogen Oxides	92	448	457
Sulfur Dioxide	1	1,122	2,591
Particulates	7	84	2,744
Mercury	0.000	0.007	0.016

Source: EIA

Natural Gas a Bridging Fuel

At present, India is the 4th largest CO2 emitter in the world contributing 6.5% after China (30%), US (15%), EU (10%). It is estimated that if India's CO2 emissions continue to grow at the same average rate of 7% as they have over the past 10 years, they will surpass the current EU-28 emissions by 2020. At a juncture, where India is a progressive partner in supporting global efforts on Climate Change agenda, natural gas offers promise of maintaining a desirable balance between growth and environment sustainability objectives.

Gas is playing important role in economic development of most of the countries. Most of the developed nation has transformed their economy into gas based economy. Even many countries which are natural gas deficit are having share of natural gas in total energy mix more than the global average which is ~24 due to many factors one of the main is that it is a cleaner fuel among all fossil fuels. Gas shall play an increasingly major role in India Economy as a cleaner fuel. Gas is cleaner for power, transport & Industry (e.g. China, US, Indonesia), for the same quantum of Energy Imports Natural Gas offers 27% to 30% FOREX savings as compared to Crude Oil and resultant reduction in Import Bill and consequent huge benefits to Indian Economy. Currently, oil products dominate the transportation sector, accounting for more than 90% of the energy that the sector consumes One area in which a very strong environmental argument could be made for substituting natural gas for oil products is with regard to the road transportation sub- sector, especially in large commercial and freight vehicles. Replacing diesel fuel with natural gas could reduce fuel life-cycle greenhouse-gas emissions from such heavy-duty vehicles by up to 29%.

India has NDC target of 35% reduction in emission intensity of GDP by 2030 from 2005 levels. To achieve the above NDC target, we have an option of going for balance mix of Coal, Renewable and Gas rather than mix of Renewable and Coal. Judicious mix of energy sources is essential in India's energy basket. Gas can be used to balance variability in renewable based capacity which is a cleaner generation option in comparison to Coal. The renewable source of energy which is the limelight today forming less than 7% of the energy mix is intermittent.

Role of Gas with Renewables for Electricity

At present power sector has 62% reliance on coal as a fuel. To maintain fuel mix diversity in the power sector too much reliance on any one fuel can expose a utility, and the economy to the risks associated with commodity price volatility. The increased use of natural gas and renewable generation will increase the fuel diversity of the power sector.

In order to achieve 24/7 electricity in each household and clean India which are the main focus of present government gas based economy can act as an apt solution. Gas brings the reliability to intermittent renewables (e.g. Brazil & California.)

Natural gas based plants can quickly scale up or down their electricity production and can act as effective hedge against intermittency of renewables. India has INDC target of 35% reduction in emission intensity of GDP by 2030 from 2005 levels.

Share of each type of Renewable Energy

Renewable Energy Type	Target 2022 (MW)
Solar Power	100000
• Solar Roof Top	40,000
• Large & Medium Scale Grid Connected	60,000
Wind	60,000
SHP	5,000
Biomass Power	10,000
Total	**1,75,000**

Mix of Renewable and Coal

- In order to achieve above INDC target, 500 plus GW of renewable based installed power capacity will be needed which is highly unlikely due to following constraints:
  - Land availability,
  - Financing of projects,
  - Limited renewables equipment manufacturing capacity across the World. Currently, PV panel manufacturing capacity of around 50 GW is available across the World out of which major part is already tied-up for supplies in different countries and only 3-4 GW of capacity is available for India.
- 500 plus GW of renewables will result in very high variability in Power supply which cannot be catered by Coal.

Balance mix of Coal, Renewable and Gas

- Gas can be used to balance variability in renewable based capacity. Cleaner generation option compare to Coal.
- As per World Energy Outlook, feasible renewable which can be installed in India is around 250 GW by 2030.
- Now in order to meet above INDC target, required Gas based installed capacity would be around 100 GW for meeting for Mid-merit to Peak load req. in addition to Coal based capacity of 300 GW. Therefore, the installed Gas Based power capacity can be fully utilized to harness the environmental benefits.
- Government should promote Gas because in addition to CO2 or GHG emissions. It also results in lower NOX, SOX, PM, and Mercury emissions.

It translated to reduction in emission intensity of GDP to a level of 9.41 gm. of CO2/INR) from 2005 level of 14.48 gm. of CO2/INR for power sector.

Gas Power Pooling

Gas based power generation capacity is around 27,123 MW in the country out of which 24150 MW is connected to gas grid. Presently out of 54 of power plants, 31 are stranded and 23 part Gas supply. Time has come to emphasize on other reforms required in the gas based power generation such as mandatory purchase of gas based power (GPO) to make this model sustainable in long term. Gas pooling model can be implemented across all the sectors by creating pool of all available domestic and imported gas for greater price parity and demand realization.

In e-bidding process for supply of RLNG to power sector, all the stakeholders have sacrificed part of their short-term profitability for greater benefit of the country. Apart from ensuring clean power availability, this process is helping to prevent distressed gas based power assets turn into NPAs. In line with Hon'ble Supreme court's order on banning diesel cars, prohibition of diesel power generation should be considered for sustainable future.

Smart ways of using Natural Gas in Transportation Sector

At present CNG is majorly used for public transportation. Key support is required from State or Municipal authorities to promote its usage in school buses and trucks. Policy makers shall push to replicate the concept of 'Mega regions' as in USA, these are small green corridors which facilitate intercity goods movement on natural gas. Through this scheme small number of public CNG refuelling stations will serve a large number and percentage of the medium and heavy vehicle transportation segment. Further, more cities shall then be nominated for CGD bidding rounds by the PNGRB. Authorities have key contribution to make in this sector like rationalizing the differential taxes (i.e. VAT on natural gas) in adjoining states which leads to differential pricing of PNG and CNG in adjoining states; vehicle and fuel tax incentive and incentives to encourage investments in infrastructure and R&D to improve efficiency.

Liquefied Natural Gas is a very effective alternative for long-haul trucks which travel for great distances and pass through ecologically sensitive stretches.

Other sector of interest for natural gas is marine shipping and inland waterways. India is richly endowed with approx. 7,500 Km of coastline and 14,500Km navigable waterways, comprising rivers, canals, backwaters, creeks, etc. A green switch in inland water ways to reduce GHG emissions is by using LNG engines. GoI has recently announced its famous Sagar Mala Project, which provides a great opportunity for policy makers to pitch in use of such marine dual fuel engines using the fumigation technology in the defined coastal economic zones. This will immensely reduce the GHG emissions while travelling via environmentally sensitive regions. Established regulatory framework can provide a platform for key public and private partnership to promote LNG uptake for LNG based safe transportation.

Use of LNG in railways is also a very lucrative alternative when overall economics is concerned. LNG not only has higher calorific value per unit weight compared to high speed diesel, it is also cheaper per unit energy. Indian Railways have developed the technical specification for conversion of its diesel locomotive which will substitute up to 95% diesel with LNG.

Konkan Railways - 741 km line connecting Mumbai and Mangalore, along the Western Ghats can be considered as a pilot project as the entire corridor depends on diesel and consistent supply of LNG can be ensured through Dabhol terminal.

However, use of LNG in railways needs development of locos, refuelling stations and nearby source of LNG. Key role of authorities is to pitch in LNG as green fuel in railways by introduction of duel fuel engines. Policy makers can define routes near existing LNG terminals for infrastructure availability. Provide tax exemptions or incentives to industries for infrastructure development.

NG usage on Localised basis: Domestic and Commercial

India has almost doubled its energy generation in the past decade to 300 GW but its old and inefficient distribution and transmission (T&D) network lose more than 69 GW of this generated power. This is a huge wastage of a commodity which is one of the most environmentally unfriendly to produce, given India still produces 62% of electricity thermally using coal, and around 24 crore of Indian population, 93% of which live in rural area are still without access to electricity (IEA analysis). In this scenario, 369 GW T&D wastage translates into 0.58TWhr energy annually i.e. sufficient electricity for additional 29 lacs people without access to electricity per year.

Given this background, there is a definite case for deployment for Distributed Generation (DG) System in place of Centralised power generation. Now, considering benefits of Natural Gas as a fuel alternative both in terms of efficiency and environmental impact, gas fired Reciprocating Engines (RE) can be developed as an impactful option for providing clean and reliable power. Gas Fired reciprocating engine's efficiency goes as high as 90% if it is used for combined heating and power (CHP) purpose. Under CHP usage exhaust heat energy from the engine is used to produce low pressure steam, which in turn could be used for absorbent chilling units. Thus it is providing a more efficient temperature control option for large buildings and commercial complex. A typical commercial application for reciprocating engine CHP is a hospital or health-care facility with a 1 MW base-load electric demand. In such an application, multiple 200 to 300 kW natural gas engine-generator sets could be utilized to meet the electric demand. Approximately 1.6 MW thermal (MWth) of hot water would be recovered from engine exhaust and engine cooling systems to provide space heating and domestic hot water to the facility and to drive absorption chillers for space conditioning during summer months. Overall efficiency of this type of CHP system can approach 80%.

A second indirect, but relatively costly option for reducing toxic emission is to use natural gas based domestic appliances such as Cloth Dryers, water heaters, room heaters, Outdoor lighting etc. There is always an ever-growing and well commercialised market of PNG used for residential and commercial cooking.

To Summarize

- Natural gas's growing importance as a fuel has been recognised in draft version of issued National Energy Policy. It should be favoured within the fossil fuel basket over coal and oil owing to number of differentiators, including carbon content per unit of heat, more availability of gas and lower cost in calorific terms.
- To maintain fuel mix diversity in the power sector too much reliance on any one fuel can expose a utility, and the economy to the risks associated with commodity price volatility. The increased use of natural gas and renewable generation will increase the fuel diversity of the power sector. Gas brings the reliability to intermittent renewables.
- To emphasize on other reforms required in the gas based power generation such as mandatory purchase of gas based power (GPO) to make this model sustainable in long term. Gas pooling model can be implemented across all the sectors by creating pool of all available domestic and imported gas for greater price parity and demand realization.
- Natural gas usage in other sectors apart from industrial and domestic like transportation - small green corridors and for deployment in Distributed Generation (DG) System in power sector can be encouraged.

Increasing the share of natural gas in the energy basket is an imperative for India

❖ Anish De ❖
Partner with KPMG in India

India's energy demand is growing rapidly, bucking global trends. The latest BP Statistical Review indicates that India's primary energy consumption grew by 5.2 percent in 2015 over the previous year, the highest among all major economies. Yet this growth has been uneven when it comes to the distribution of resources. Oil has grown by an astounding 8.1 percent as compared to 4.4 percent in the previous year. Coal has grown by 4.8 percent. Renewable energy has grown by 13.7 percent and nuclear by 9.8 percent, albeit both over a very small bases. In contrast the main clean energy resources in the energy basket - natural gas and hydro - have actually shrunk. Natural gas has fallen below the previous year consumption, and hydro has dipped steeply by close to 5 percent.

This does not augur well for the country. The first challenge comes from an increasing oil addiction in the economy. Though growth of oil consumption in a fast developing economy is only to be expected, the quantum of growth in oil imports holds significant risks for the economy in a scenario where oil prices increase. Every fuel resource creates its legacies and if India becomes excessively reliant on oil and coal and creates capital stock reliant on these resources, the ability to react to global economic and environmental realities becomes that much more suspect. Under COP 21 India has voluntarily committed to reduce the emission intensity of its GDP by 33-35% by 2030 as compared to 2005 levels. A significant part of the gains will come from energy efficiency on the demand side and it is widely anticipated that the current momentum on energy efficiency will substantially help achieve this target. However the supply side needs to see significant changes in approach if the goals are to be achieved since India has also committed to generate 40% of its electricity generation from non-fossil fuels.

In reality it has to be a basket of solutions to meet the future needs of the growing sector. This combination requires active attention. Essentially it is a question of finding complements and diversity and not make rigid choices among technologies. A well-diversified fuel basket for India would perforce imply much higher contributions of natural gas. The contribution has dipped from a high of 12 percent five years ago to only 6.5 percent at present, and in contrast to the global average of 23.8 percent. India's gas sector is in relatively early stages of development and should be expected to grow strongly at this time. Apart from being substantially cleaner than coal and commercially available liquid fuels, natural gas is also more versatile as a resource. However, it is stuck somewhere in no-man's land. It is less economical than coal for power generation, less flexible at this time for transport as compared to oil and nominally less cleaner than renewables. From a sectoral definition standpoint it is seen

as an extension of oil and clubbed with it for fiscal policies. The unfortunate consequence of this has been its exclusion from the GST regime in India since states have been opposed to the inclusion of oil from which they derive very substantial tax revenues.

To emerge from shadows, the gas sector will need a few things going for it. The first is to get a vibrant gas market going to reduce the commercial inflexibilities that gas suffers from today. Unlike oil which has deep and completely flexible markets, gas is characterized by very rigid take or pay contracts through the delivery chain that pass down the risks. For example, in the case of long term LNG supplies (which forms the bulk of the overall LNG import basket), there are take or pay obligations to the tune of 90-95% of the annual contracted capacities, and with very limited ability to defer offtake or redirect the supplies to other markets. Similarly, in pipelines, there are take or pay obligations for capacities booked. The shippers of these supplies pass on the risks to the users through corresponding contracts. Users hate this and hence are slow to adopt or switch to gas.

The second is to create a robust delivery infrastructure. For various reasons related to legacy factors and a rather inelegant regulatory regime the development of gas infrastructure has been slow and inadequate. The infrastructure development and pricing framework could do with significant changes and simplification. In India, the authorization mechanism for pipelines by PNGRB requires the pipeline developer to substantially take the volume (throughput) risks. This loads massive market risks on the pipeline developers and is contrary to international practices wherein the pipeline operators rarely bear the market risks for the commodity and instead work on the basis of assured returns. This is particularly true for gas markets in early to middle stages of development, as is the case in India. Unless pipeline owners are insulated from such market risks financing of the assets would be very difficult to achieve and this would be to the detriment of the gas sector and to the economic interests of the country as a whole.

The third area that requires attention is innovation. Gas, especially in liquefied form, can become a viable substitute for diesel and other liquids for transport and industrial applications. Over time these technologies are witnessing accelerated adoption in the western world. Given that India has emerged as one of the largest hydrocarbon markets in the world, such innovation needs to be supported for the benefit of the country. It may require relook at the traditional approaches taken by regulatory authorities including by the Petroleum and Explosives Safety Organization (PESO) that regulates safety matters in the industry.

However, the biggest fillip for gas could come from the power sector which features approximately 25,000 MW of stranded or partially used gas based capacity. Any planning framework for the Indian energy sector must find ways to economically use this valuable capacity, much of which comprises state of the art assets. An appropriate framework to utilize these assets would not only help produce electricity, it would help in pipeline and LNG regasification infrastructure development basis these anchor loads, which in turn would help other sectors like transport, city gas and industrial applications that piggyback on such infrastructure. At the current low gas prices that are expected to sustain for the next five years at least India has a great opportunity to clean up, diversify and de-risk its energy economy. It would be a pity if this is let to go.

Views are personal. An abridged version of this article appeared in VC Circle in July 2016.

Oil & Gas in Media

Policy and Administrative Reforms

Government has been taking policy and administrative initiatives to facilitate oil and gas exploration in the country. Some of the policy decisions taken by the Government in recent years to enhance exploration and production activities are described here:

Hydrocarbon Exploration and Licensing Policy (HELP)

Government has approved Hydrocarbon and Exploration Licensing Policy (HELP) and same has been notified on 30th March 2016. This policy provides for a uniform licensing system to explore and produce all hydrocarbons such as oil, gas, coal bed methane, shale oil/gas, etc. under a single licensing framework Policy also provides many incentives such as reduced royalty rates for offshore blocks, marketing & pricing freedom and easy to administer revenue sharing model.

This replaced the National Exploration and Licensing Policy (NELP) which was 18 years old and has caused issues due to its features like separate licensing for different types of hydrocarbons, exploration limited to blocks put on tender and production sharing contracts.

Marketing and Pricing freedom for new gas production from Deepwater, Ultra Deepwater and High Pressure-High Temperature areas subject to certain conditions.

The Cabinet Committee on Economic Affairs approved a mechanism for pricing of domestically produced natural gas on 18.10.2014. Recognizing the need for incentivizing gas production from deep water, ultra deep water and High Pressure-High Temperature (HPHT) areas on account of higher costs and higher risks involved in exploitation of gas from such areas, in principle approval was also given for a premium on the gas price for the gas to be produced from new discoveries from such areas.

It was felt that rather than fixing a premium, it would be more appropriate to provide marketing and pricing freedom to the gas to be produced from the new HPHT discoveries as well as existing discoveries which are yet to commence production as on 1.1.2016. However, in order to protect user industries from market imperfections, this freedom would be accompanied by a price ceiling based on opportunity cost of imported fuels.

The ceiling price shall be calculated as, lowest of the (i) Landed price of imported fuel oil (ii) Weighted average import landed price of substitute fuels (namely coal, fuel oil and naphtha) (iii) Landed price of imported LNG. The weighted average import landed price of substitute fuels in (ii) above will be defined as: 0.3 x price of coal + 0.4 x price of fuel oil + 0.3 x price of naphtha.

Policy for grant of extension to the Production Sharing Contracts of 28 Small and medium sized discovered blocks.

28 small, medium sized fields discovered by National Oil Companies (ONGC and OIL) were awarded to Private Joint Ventures through Production Sharing Contract (PSC) between 1994-1998 for periods varying from 18 to 25 years. Out of 28

PSCs, two fields in which the duration of the PSC had expired in 2013 had been granted extension up to 2018. The remaining PSCs would start expiring from 2018.

For many of these fields the recoverable reserves are not likely to be produced within the remaining duration of contract. Further, in certain fields where additional recovery of hydrocarbons can be obtained only through capital intensive Enhanced Oil Recovery/ Improved Oil Recovery (EOR/IOR) Projects, the payback period would extend beyond the current duration of the contract.

The process and guidelines for extension of contracts for small and medium sized discovered fields includes time bound clearance from the Ministry. is being put in place:

The Government share of Profit Petroleum during the extended period of contract shall be 10% higher than the share as calculated using the normal PSC provisions in any year during the extended period. The royalty and cess shall be payable at prevailing rates and not at concessional rates stipulated in the contracts.

The extension of these PSCs would be considered for 10 years both for oil and gas fields or economic life of the Field, whichever is earlier.

The Discovered Small Field Policy

Discovered Small Field Bidding Round - 2016 was launched on 25th May, 2016 in New Delhi. Under the Discovered Small Field Policy, Government of India is offering 67 small fields, discovered by India's National oil companies, in 46 Contract areas spread over 9 sedimentary basins in on land, shallow water and deep water areas for bidding which have known hydrocarbon discoveries. .

More than 85MMT of in-place volume of reserves are there in these Contract areas. There will be a revised business model under Revenue Sharing Contract. Provisions under the policy have been framed to aim at 'Ease of Doing Business in India'.

Revised Policy on crude oil import for oil PSUs

The Union Cabinet approved a new policy on crude oil import by Oil PSUs and vest the oil PSUs with the power to evolve their own policies. This will provide a more efficient, flexible and dynamic policy for crude procurement, eventually benefiting the consumers. .

Oil PSUs of the Govt. of India shall be empowered to evolve their own policies for import of crude oil, consistent with CVC guidelines and get them approved by the respective Boards. This measure, which is in keeping with the principle of Minimum Government Maximum Governance, will increase the operational and commercial flexibility of the oil companies and enable them to adopt the most effective procurement practices for import of crude oil.

Pradhan Mantri Ujjwala Yojana

An ambitious social welfare scheme of the Government was launched by the Prime Minister on 1st May 2016 from Ballia in Uttar Pradesh. Under the PM Ujjwala Yojana, the government aims to provide LPG connections to BPL households in the country , replacing the unclean cooking fuels mostly used in the rural India with the clean and more efficient LPG (Liquefied Petroleum Gas).

A target of 5 Crore LPG connections in the name of women in BPL (Below Poverty Line) households across the country in the FY 2016-17, 2017-18 and 2018-19. has been set for this scheme.

The scheme aims at empowering women and protecting their health from the hazards associated with cooking based on fossil fuel. This will improve the quality of in India and will prevent young children from significant number of acute respiratory illnesses caused due to indoor air pollution by burning the fossil fuel.

The government has allocated Rs. 2000 crore for the Ujjwala Yojana implementation for the financial year 2016-17. A total budgetary allocation of Rs. 8000 Crore has been made by the government for the implementation of the scheme over three years. The scheme will be implemented using the money saved in LPG subsidy through the "Give-it-Up" campaign.

Pilot Programme to run two wheelers on CNG launched

In a major step to curb rising air pollution in Indian cities, Minister of State for Petroleum and Natural Gas (I/C) Shri Dharmendra Pradhan and Minister of State (I/C) for Environment, Forests & Climate Change Shri Prakash Javadekar launched first of its kind Pilot Programme in the country to run two wheelers on Compressed Natural Gas (CNG) in New Delhi on 23rd June 2016. The program aims at promoting the use of gas in the country,

S. No.	CNG Kit for two wheeler
1	Changeover Switch
2	Pressure Indicator
3	Cylinder Valve
4	Filling Valve
5	High Pressure Tube
6	Cylinder
7	First Stage Regulator
8	Low Pressure Tube
9	Second Stage Regulator
10	Air Gas Mixture to Carborator

thereby providing a better lifestyle to the people and also fulfilling the COP-21 commitments to curb pollution.

Being implemented by Indraprastha Gas Limited (IGL) and one of its parent company, GAIL (India) Limited, the Pilot Programme involves 50 CNG retrofitted two wheelers. Of these, the first batch of ten CNG retrofitted two wheelers were flagged off by the dignitaries today. The introduction of CNG in two wheeler segment has the capacity to revolutionize the fight against air pollution in the country and especially in the metros like Delhi, where two wheelers contribute a major portion in the vehicular emissions, according to several studies.

The performance of 50 CNG retrofitted two wheelers would be closely monitored in terms of efficiency, emissions, etc. during the pilot phase by all the stakeholders and the learning from this project would be used to develop the roadmap for introduction of CNG in two wheeler segment across the nation.

Statistics

INDIA: OIL 2015-16

Domestic Crude Oil Production (On Shore, Off Shore)

Crude Oil Import, (Volumes, Value - INR / USD)

Crude Oil Price (Marker, Indian Basket, Low and High Sulphur Crude Differential)

Domestic Oil Production
(Million MT)

		2013-14	2014-15	2015-16	2015-16 % of Total
On Shore	ONGC	6.71	6.07	5.82	15.75
	OIL	3.47	3.41	3.23	8.74
	Pvt./ JV (PSC)	9.41	9.06	8.81	23.84
	Sub Total	**19.59**	**18.54**	**17.86**	**48.34**
On Shore	ONGC	15.54	16.19	16.54	44.76
	OIL	0.00	0.00	0.00	0.00
	Pvt./ JV (PSC)	2.66	2.73	2.55	6.90
	Sub Total	**18.20**	**18.92**	**19.09**	**51.66**
Total Domestic Production		37.79	37.46	36.95	100.00
	ONGC	22.25	22.26	22.36	60.52
	OIL	3.47	3.41	3.23	8.74
	Pvt./ JV (PSC)	12.07	11.79	11.36	30.74
Total Domestic Production		**37.79**	**37.46**	**36.95**	**100.00**

Oil Import - Volume and Value

	2013-14	2014-15	% variation	2015-16	% variation
Quantity, Million Mt	189.20	189.40	0.11	202.10	6.71
Value, INR '000 cr.	864.88	687.42	-20.52	415.36	-39.58
Value, USD Billion	143.00	112.70	-21.19	64.40	-42.86
Average conversion Rate, INR per USD	60.48	61.00		64.50	

Oil Import - Price
USD / Barrel

	2013-14	2014-15	2015-16
Brent (Low Sulphur - LS- marker)	107.50	85.43	47.46
Dubai	104.58	83.77	45.63
Av. Dubai Oman prices (High Sulphur - HS- marker)	104.62	84.03	45.78
Low sulphur-High sulphur differential	2.88	1.40	1.68
Indian Crude Basket (ICB)	105.52	84.15	46.17
ICB High Sulphur share %	69.90	72.04	72.28
ICB Low Sulphur share %	30.10	27.96	27.72

INDIA: REFINING 2015-16

Refining Capacity
(Million MT on 1st April 2015)

Indian Oil Corporation Ltd.	
Digboi	0.650
Guwahati	10.00
Koyali	13.70
Barauni	6.00
Haldia	7.50
Mathura	8.00
Panipat	15.00
Bongaigaon	2.35
Total	54.20

Bharat Petroleum Corp. Ltd.	
Mumbai	12.00
Kochi	9.50
Total	21.50

Hindustan Petroleum Corp. Ltd.	
Mumbai	6.50
Visakhapattnam	8.30
Total	14.80
Other PSU Refineries	
NRL, Numaligarh	3.00
MRPL	15.00
ONGC, Tatipaka	0.066

Chennai Petroleum Corp. Ltd.	
Chennai	10.50
Narimanam	1.00
Total	11.50

Total PSU Refineries Capacity	**120.066**

JV Refineries

DBPC, BORL-Bina	6.00
HMEL,GGSR	9.00
JV Total	**15.00**

Private Refineries

RIL, Jamnagar	33.00
RIL , (SEZ), Jamnagar	27.00
Essar Oil Ltd. , Jamnagar	20.00
Pvt. Total	**80.00**

Total Refining Capacity of India	**215.066**
	4.319 million barrels per day

Refining Capacity
(Million MT on 1st April 2016)

Total Refining Capacity of India	230.66 ^
	4.62 million barrels per day

^ Include capacity of 15000 TMT of Paradip refinery of Indian Oil Corp. Ltd.

Crude Processing
(Million MT)

PSU Refineries	2013-14	2014-15	2015-16	CAPACITY UTILIZATION (2015-16), %
IOCL	53.13	53.59	57.19	103.67
HPCL	15.51	16.18	17.23	116.42
BPCL	22.97	23.18	24.09	112.05
CPCL	10.63	10.78	9.63	83.74
MRPL	14.65	14.68	15.60	104.00
NRL	2.61	2.78	2.52	84.00
SUB TOTAL	**119.50**	**121.19**	**126.26**	**105.16**

JV Refineries	2013-14	2014-15	2015-16	CAPACITY UTILIZATION (2015-16), %
HMEL	9.27	7.34	10.71	119.00
BORL	5.45	6.21	6.40	106.67
SUB TOTAL	14.72	13.55	17.11	114.07

Pvt. Refineries	2013-14	2014-15	2015-16	CAPACITY UTILIZATION (2015-16), %
ESSAR	20.20	20.49	19.11	95.55
RIL	68.03	68.04	69.44	115.73
SUB TOTAL	**88.23**	**88.53**	**88.55**	**110.69**

	2013-14	2014-15	2015-16	CAPACITY UTILIZATION (2015-16), %
All India Crude Processing	222.45	223.27	231.92	107.84

Crude Capacity vs. Processing - 2015-16

	Capacity On 01/04/2015 Million MT	% Share	Crude Processing Million MT	% Share in Total Cap.
PSU Ref	120.07	55.83	126.26	54.44
JV. Ref	15.00	06.97	17.11	07.38
Pvt. Ref	80.00	37.20	88.55	38.18
Total	**215.07**	**100.00**	**231.92**	**100.00**

POL PRODUCTION (Million MT)

	2013-14	2014-15	2015-16
From Refineries	216.44	217.08	227.90
From Fractionators	3.87	3.65	3.38
Total	**220.31**	**220.73**	**231.28**

DISTILLATE PRODUCTION (Million MT)

	2013-14	2014-15	2015-16
Light Distillates, MMT	58.81	59.54	63.60
Middle Distillates , MMT	112.85	113.41	118.31
Total Distillates, MMT	171.66	172.95	181.91
% Distillates production	77.17	77.46	78.43

INTERNATIONAL PRICE EX SINGAPORE, ($/bbl.)

	2013-14	2014-15	2015-16
Gasoline	114.31	95.45	61.72
Naphtha	100.22	82.22	48.54
Kero / Jet	121.23	66.62	58.17
Gas Oil (0.05% S)	121.99	99.44	57.63
Dubai crude	104.58	83.77	45.63
Indian crude basket	105.52	84.16	46.17

CRACKS SPREADS ($/ bbl.)

	2013-14	2014-15	2015-16
Gasoline crack			
Dubai crude based	9.73	11.68	16.09
Indian crude basket	8.79	11.29	15.55
Diesel crack			
Dubai crude based	17.41	15.67	12.00
Indian crude basket	16.47	15.28	11.46

News from Members

Shri Dharmendra Pradhan launched the website of IIPE

As per the Andhra Pradesh Reorganisation Act, 2014, Government of India had agreed to establish institutions of national importance in Andhra Pradesh, one of them being a Petroleum University. In pursuance of this, Indian Institute of Petroleum and Energy is being set up at Visakhapatnam, Andhra Pradesh. The institute will primarily focus on teaching and research in petroleum and energy. IIT Kharagpur will be the mentor institute for the establishment of IIPE.

HP Lubricants Launches next generation Synthetic Oil

HP Lubricants has recently launched next generation premium synthetic oil for motorcycles - HP Racer 4 Synth 10W 30. Racer 4 Synth 10W 30 will take HP Lubricants to the next level of Technology for high end motorcycles with existing and future designs thus covering the entire technology spectrum of motorcycle lubricants.

Shri M K Surana, takes over as Chairman and MD of HPCL

Government of India has appointed Shri Mukesh Kumar Surana as Chairman and Managing Director of Hindustan Petroleum Corporation Ltd., one of India's leading Fortune 500 companies. Shri Surana took over effective April 01, 2016 from Ms. Nishi Vasudeva who superannuated on 31st March 2016.

HPCL organised Program on 'Leading Teams & Building Organisation'

A two-day program on 'Leading Teams and Building Organizations' was organized on May 20-21, 2016 at HP Nagar East Auditorium, Mumbai. The program was conducted by internationally renowned faculty Dr. Henry Moon, Professor of Organizational Behaviour at CEIBS (China Europe International Business School) and earlier a tenured Professor of Organizational Behaviour in London Business School.

IOCL's Annual Press Conference

In its Annual Press Conference held on May 27, 2016, IndianOil declared a net profit of Rs. 10,399 crore for the financial year 2015-16. The income from operations for the financial year 2015-16 was Rs. 3,50,603. IndianOil sold 80.722 million tonnes of products, including exports, during 2015-16. The refining throughput for FY 2015-16 was 56.694 million tonnes and the throughput of the Corporation's countrywide pipelines network was 79.824 million tonnes during the same period. The gross refining margin (GRM) during the year 2015-16 was US$ 5.06 per bbl as compared to US$ 0.27 per bbl in 2014-15.

Definitive Agreement

An Indian Consortium, led by Indian Oil Corporation Limited (IndianOil), Oil India Limited (OIL) and Bharat PetroResources Limited (BPRL), a 100% subsidiary of Bharat Petroleum Corporation Limited (BPCL), signed the definitive agreement to acquire up to 23.9% shares from Rosneft Oil Company (Rosneft), NOC of Russia in JSC Vankorneft, a company organised under the law of the Russian Federation, which is the owner of Vankor and North Vankor Field licences.

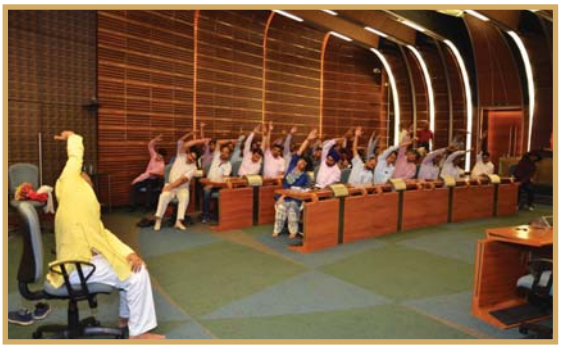
Aviation fuel to support the Indian Air Force

Responding to the call of duty and staying at the forefront during national exigencies, IndianOil rushed to provide aviation fuel to support the Indian Airforce douse the massive Uttarakhand forest fire that broke out in February 2016. IndianOil joined hands with the rescue teams to curb the Uttarakhand blaze.

Skill Development Institute in Bhubaneswar

Mr. Naveen Patnaik, Hon'ble Chief Minister of Odisha and Mr. Dharmendra Pradhan, Hon'ble MoS (I/c) for Petroleum & Natural Gas, Government of India, inaugurated the Skill Development Institute in Bhubaneswar on May 9, 2016. In line with the National Skill Development Mission of the Government of India, Ministry of Petroleum & Natural Gas (MoP&NG) has taken the lead in setting up Skill Development Institutes (SDIs) in different parts of the country, through the oil & gas PSUs under it.

IOCL observes the 2nd International Day of Yoga



IndianOil family across the nation observed the 2nd International Day of Yoga on June 21, 2016 by organising yoga sessions, workshops, talks, etc. on the benefits of yogic practices. Commemorating the day, a session on Yoga was organised at IndianOil's Corporate Office in Delhi. The session was conducted by Mr. Ganesh Avinash Mishra, a renowned practitioner of Kriya Yoga.

IOCL observes Swachh Bharat Pakhwada

IndianOil locations all over the country observed Swachh Bharat Pakhwada from June 16-30, 2016, undertaking a cluster of activities including cleanliness drives, walkathon, quiz contest, awareness campaign etc. to spread the message of keeping the surroundings clean and promoting Swachh Bharat Abhiyan.

Oil observes 2nd International Day of Yoga-2016

Oil India Limited celebrated the 2nd International Day of Yoga on 21st June, 2016 at its Corporate Office in Noida with a number of programmes, which included Yoga session and awareness session on Holistic Well-being.

Ms. Rupshikha Saikia Borah, Director (Finance) and Mr. Biswajit Roy, Director (Human Resources and Business Development) led the enthusiastic crowd of officers and employees of Oil India Limited who actively participated in large numbers under the able guidance of Instructors from Saksham Yoga Naturopathy Centre, Delhi as per the Common Yoga Protocol 2016, designed by Ministry of Ayush, Government of India. A session including talk and presentation on the topic 'Yoga: 'Science of well-being' was also organized to create and instill a sense of awareness among the Oilindians.

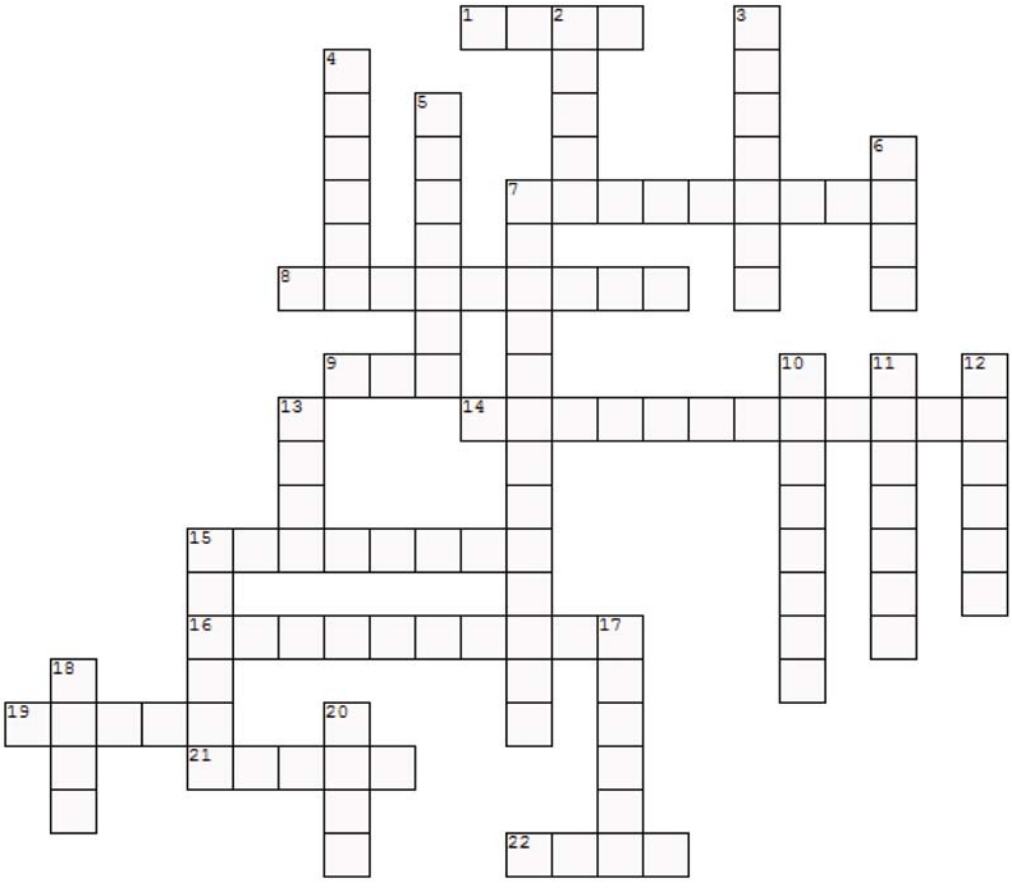
OIL Super 30 achieves landmark success

Under OIL Super 30, 74 students have cracked the IIT entrance examination this year. OIL Super 30, which is one of the most impactful CSR projects of Oil India Limited (OIL) under Education, witnessed 74 out of 150 students in the batch qualify the most prestigious IIT-Advance entrance examination in the country.

Observation of Swachh Bharat Pakhwada at OIL

As a part of observation of Swachh Bharat Pakhwada from 16th to 30th June, 2016 and creating awareness about the importance of cleanliness, various activities were undertaken by Oil India Limited (OIL) in and around its office premises, in different spheres across the country. Further, the initiative was also undertaken amongst school children in schools located in the operational areas of its Fields Headquarters in Assam.

Energy-Crossword



Across

1. The Greek word 'Petroleum' means--- oil
7. Name the state that leads in wind energy sector in India
8. BS&W means Bottom ---- and water
9. What is one way to harvest hydroelectric power?
14. The change by which any substance is converted from a gaseous state to liquid state is termed as -
15. Which fuel has the highest heating value?
16. Energy that is generated by natural process like hot rocks, magma, geysers is ----
19. The energy unit under the SI system is ---
21. Ignition is a slow process of burning fuel whereas combustion is --- process
22. -- Heat loss rate from a surface is expressed in---

Down

2. The country which has the largest share of coal reserve is ---
3. Common bio-fuel in transport sector
4. LPG is predominantly a mixture of propane and ---
5. The main element that is required to run a nuclear reactor
6. Air conditioner can also act as a heat ----
7. To drain condensate from a main steam line, this type of trap used
10. The motors where load will vary, shall be designed with--- speed drive motors
11. Solar cells are made of---
12. ---- can neither be created nor be destroyed
13. --- is not a fossil fuel
15. In a furnace, the lower the exhaust temperature ---- is the furnace efficiency
17. Melting ice releases ---- heat
18. In India, major energy is from ----
20. Energy saving equipments have max of --- stars

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PetroFed Events

Seminar on Smart Refineries

A day-long programme on "Smart Refineries" comprehensively covering all aspects of refining in three technical sessions was conducted by PetroFed. There were seven presentations covering the subject. The sessions were chaired Shri A.S. Basu, Head of Refinery, HMEL; Shri Prasad Panicker, ED (Kochi Refinery), BPCL and Shri K. Govindarajan, CEO-Projects, Essar Oil Ltd. The sessions witnessed extensive floor participation.

Dr. R.K.Malhotra, DG, PetroFed welcoming the participants.

Mr. James E. Rekoske, VP and Chief Technology Officer, UOP, USA delivering his Inaugural Address.

Technical Session I : (L-R) Mr. Steven C. Gimre, MD, UOP India Private Limited; Mr. A.S. Basu, Head of Refinery, HMEL and Mr. Rajeev Bhandari, Director HTS-HPS, UOP India Private Limited.

Mr. Manu Sehgal, Head - Strategy & Feedstock Supply Group, HMEL raising a query.

Industry Academia Interface on A-Z of Natural Gas & LNG

The Petroleum Federation of India organized the 5th Industry-Academia workshop on 'A-Z of Natural Gas & LNG' in association with the Petronet LNG Limited (PLL) from April 28 - 30, 2016 at Ernakulam, Kochi in Kerala.

The programme was conducted by experts from the industry and designed for the teaching faculty of Engineering Colleges, Universities and Industry members. Mr. Prabhat Singh, MD & CEO, PLL delivered the inaugural address. His inspiring futuristic talk on Oil & Gas industry was well received by the participants.

The feedback of participants was excellent.

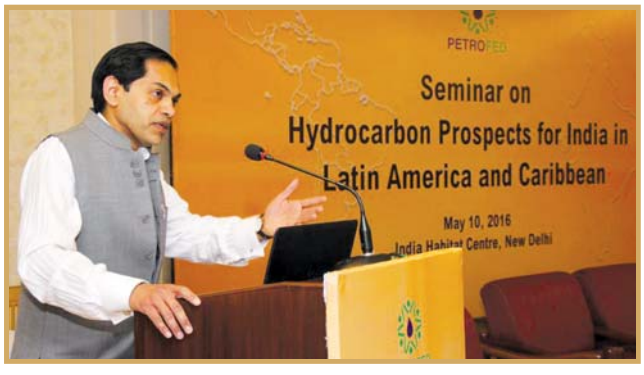
Seminar on Hydrocarbon Prospects for India in Latin America and Caribbean

PetroFed organized a seminar on Hydrocarbon Prospects for India in Latin America and Caribbean (LA&C) on May 10, 2016 at India Habitat Centre, New Delhi to deliberate on opportunities, challenges, political risks, policy framework etc. relating to hydrocarbon sector in LA&C region.

The seminar witnessed presence of Hon'ble Union Minister of State Sh. Dharmendra Pradhan, Ministry of Petroleum & Natural Gas, Government of India and senior officials from MoP&NG, MEA, Dept. of Commerce, IDSA, JNU as well as various oil & gas companies like ONGC, OVL, OIL, BPRL, RIL, Schlumberger, IOCL, EIL, GAIL, OVL, PLL, Prize Petroleum etc.

Shri K.D. Tripathi, Secretary, Ministry of Petroleum and Natural Gas delivering opening remarks.

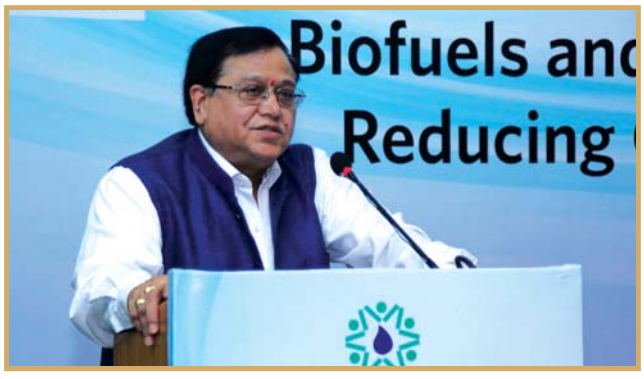
Shri Dharmendra Pradhan making the concluding remarks.



Shri Sunjay Sudhir, Joint Secretary (IC), Ministry of Petroleum and Natural Gas, Govt. of India delivering the Summary of the Proceedings.

Panel Discussion: (L-R) Shri Sujit Kumar, Managing Director, Schlumberger Asia Services Ltd; Shri Atul Chandra, Senior Advisor, Reliance Industries Limited; Professor Abdul Nafey, Centre for Canadian, US & Latin American Studies, JNU; Shri N. K. Verma, MD, ONGC Videsh Limited; Shri D. Rajkumar, Managing Director, BPRL; Shri Biswajit Roy, Director (HR&BD), Oil India Limited.

Symposium on Biofuels and Bioenergy: Enablers for Reducing Oil Import Dependence



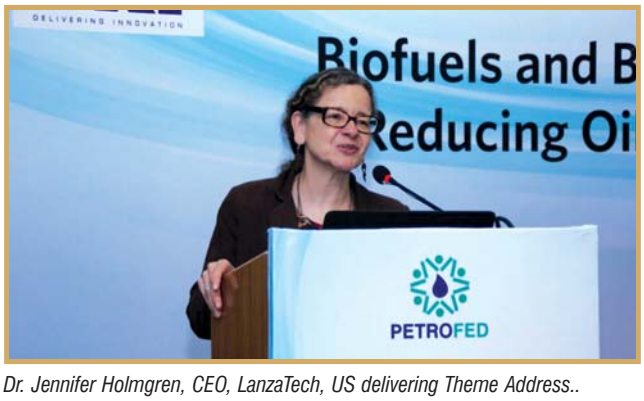
Dr. V. K. Saraswat, Member, NITI Aayog giving his Special Address.

Shri Dharmendra Pradhan addressing the delegates.

PetroFed organized a symposium on 'Biofuels and Bioenergy: Enablers for Reducing Oil Import Dependence' on May 11, 2016 at India Habitat Centre, New Delhi. The symposium had participation from senior government officials, technology developers, industry experts and academicians deliberating on enablers for enhancing the production of biofuels in the country.

Addressing the delegates the Hon'ble Minister of state Sh. Dharmendra Pradhan, Ministry of Petroleum and Natural Gas, Govt. of India accentuated on synergizing bioenergy to conventional energy market while developing India specific model so that biofuels can play an important role in India's inclusive growth story.

The conference saw participation of 14 national and international speakers in 4 technical sessions and more than 100 delegates.



Dr. Jennifer Holmgren, CEO, LanzaTech, US delivering Theme Address..

(L-R) Mr. Mahesh Kulkarni, Manager, Praj Industries Limited; Dr. Anjan Ray, UOP, Dr. Renu Swarup, Sr. Adviser, Dept. of Biotechnology, Ministry of Science & Technology, Govt. of India; Mr. Bas Melssen, Novozyme; Dr. C. S. Laxmi Narasimhan, Shell Technology Centre..

International Corrosion Impact Study: Learning for Oil & Gas Industry

Petrofed organized a Guest Lecture for the industry executives on 'International Corrosion Impact Study: Learning for Oil & Gas Industry' in collaboration with NACE International on April 25, 2016. Sh. M.A. Pathan chaired the session. Ms Elaine Bowmen, past President of NACE made presentation on the outcome of their global study on the Impact of Corrosion with specific reference to Asia Pacific and India.

Shri M. A. Pathan, former Chairman, Indian Oil and former Resident, Director Tata Group (6th from left) chairing the session.

Meeting with Operators/Non Operators in PSC Regime

Meeting in progress.

Hon'ble Minister presiding over the session along with other Govt. officials. (L-R) Shri U.P. Singh, CMD, Oil India; Shri K. D. Tripathy, Secreatary MoP&NG; Shri Dharmendra Pradhan, Hon'nle Minister of State(I/C), MoP&NG; Shri A. P. Sawhney, Additional Secretary, MoP&NG; Shri Atanu Chabraborty, Director General, Directorate General of Hydrocarbons.

PetroFed organized a meeting with Operators/Non Operators in PSC Regime under the aegis of MoP&NG on May 27, 2016 at New Delhi. The Hon'ble Minister has taken a number of path breaking initiatives to boost the growth of E&P sector. The latest was the launch of discovered small field bid round 2016 held on May 25, 2016 at New Delhi.

Under previous NELP regime, a number of issues arose while operationalizing the PSC contracts. In the meeting organized by PetroFed, the E&P operators/non-operators in India got an opportunity to interact with Hon'ble Minister, team from MoP&NG and DGH in a single platform on May 27, 2016.

Round table meeting on Way-forward for Enhancing Biofuels Availability

PetroFed organized a round table meeting on 'Way-forward for Enhancing Biofuels Availability' on May 11, 2016 at New Delhi for deliberating on the key takeaways of the symposium on 'Biofuels and Bioenergy : Enablers for Reducing Oil Import Dependence'. The roundtable aimed to develop the recommendation for enhancing biofuels availability in the country witnessed participation of leading Biofuels experts from India & Overseas.

Dr. Y.B. Ramakrishna, Chairman, Working Group on Bio Fuels, Ministry of Petroleum & Natural Gas, Govt. of India chairing the Roundtable Discussion

Dr. Preeti Jain (Joint Director, Economic Policy & Planning) presenting the summary of conference. Others Mr. R Bahl, Director, (Finance, Taxation & Legal), PetroFed.

Experts during the Roundtable Session.

Brainstorming and Kick-off Session for Gas Markets Project

The British High Commission has commissioned a project titled "Accelerating India's transition to gas by enabling increased market access" to a consortium of PetroFed, IHS and ICF. The purpose of this project is to catalyse a faster transition to a gas based economy in India.

A Brainstorming and kick-off meeting was organised by PetroFed on behalf of the project partners on June 1, 2016 at New Delhi. Shri Ashutosh Jindal, Joint Secretary (M&GP), Ministry of Petroleum & Natural Gas spearheaded the brainstorming session.

The immense interest of participants from the oil & gas sector was evident in the brainstorming session where the gas sector issues were deliberated for further study through survey, analysis and International best practices.

Ms. Frances Hooper, First Secretary (Energy & Climate), British High Commission (3rd from left) delivering the opening remarks. Others (L-R) Dr. B. Mohanty, Member, PNGRB; Dr. R.K. Malhotra, DG, PetroFed; Shri Ashutosh Jindal, Joint Secretary (M&GP), MoP&NG; Shri S. Rath, Director(E&P), PetroFed; Shri R. Bahl, Director (Finance, Taxation & Legal), PetroFed.

Meeting in progress.

Panel Discussion on: 'Policy Initiatives: Accelerating Exploration & Production in the Hydrocarbon Sector'

Shri S. Rath, Director(E&P), PetroFed welcoming the participants.

PetroFed alongwith Energy Think Tank (ETT) organized a panel discussion on 'Policy Initiatives: Accelerating Exploration & Production in the Hydrocarbon Sector' on June 14, 2016 at India Habitat Centre, New Delhi.

Shri S. Rath, Director (E&P), PetroFed welcomed the participants and briefly gave the objectives of the discussion.

A number of recommendations that the panelists and participants brought out during the discussions are: Strategic Focus of Govt., Data Acquisition, Gas Pricing, Fiscal and Infrastructure issues.

Panelists (L-R) Sh. S. K. Srivastava, Former CMD, Oil India Limited; Sh. Saurabh Chandra, Former Secretary, MoP&NG; Sh. T. N. R. Rao, Former Secretary, MoP&NG; Sh. Vivek Rae, Former Secretary, MoP&NG; Sh. R. S. Sharma, Former CMD, ONGC.

A section of the participants.

Seminar on Army's Fuelling Needs: Future Outlook

The dignitaries during the inaugural session. (L-R) Dr. R.K. Malhotra, Director General, PetroFed; Lt Gen RV Kanitkar AVSM, SM, VSM, QMG and Lt Gen Balbir Singh Sandhu, VSM, DGST

Dr. R.K. Malhotra, DG, PetroFed delivering the theme address

A seminar was organized on the topic 'Indian Army's Fuelling Needs: Future Outlook' on June 29, 2016 at Manekshaw Centre, Delhi Cantonment jointly by the Directorate General Supplies and Transport of Indian Army and Petroleum Federation of India. The seminar was inaugurated by Lt. Gen. R. V. Kanitkar, Quarter Master General of the Indian Army, and was attended by Defence officers, academia and oil industry representatives.

Presentations were made on the emerging trends in the use of energy resources in the background of energy efficiency improvement and environment considerations. Army officials also presented the need to change their current fuel consumption practices with ecofriendly sources of energy. Need to revise supply chain and logistics at army establishments specially in difficult terrain was also discussed.

Guest Lecture on 'Environmental & Health Benefits of LPG, the Clean Cooking fuel'

Prof. Kirk R. Smith addressing the gathering during his lecture on "Environmental & Health Benefits of LPG, the Clean Cooking Fuel".

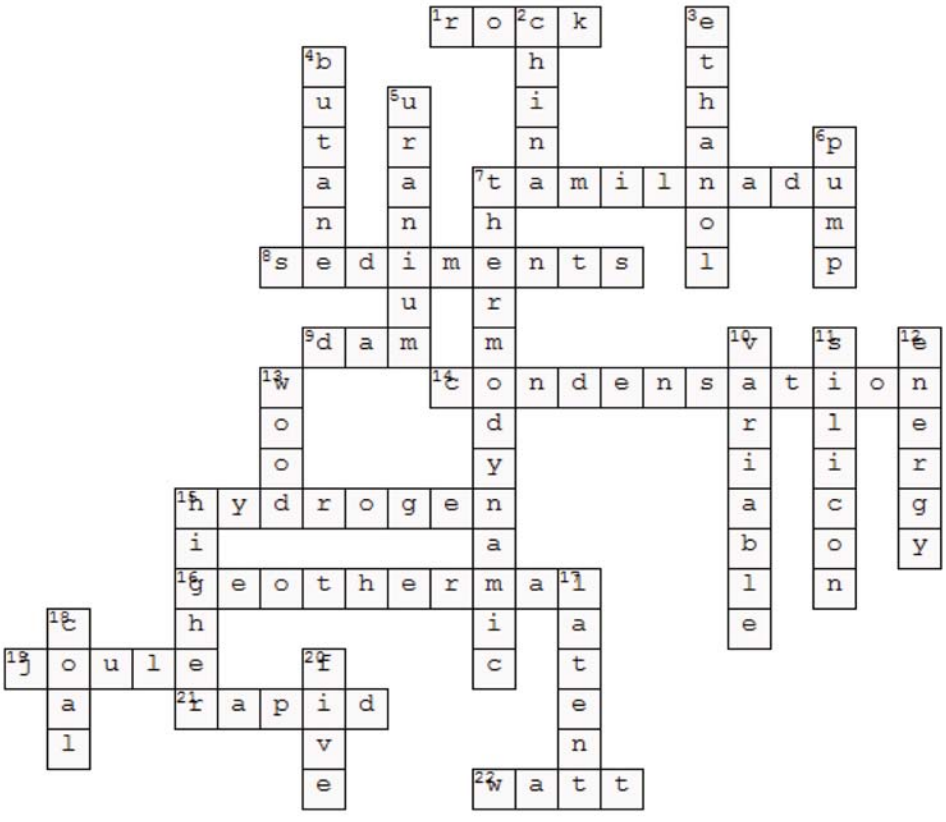
The dignitaries during the inaugural session (L-R) Prof. Kirk R. Smith, Mr. Ashutosh Jindal, Jt. Secretary (M&GP), Ministry of Petroleum & Natural Gas, Govt. of India and Dr. R.K. Malhotra, DG, PetroFed.

Petroleum Federation of India organised a guest lecture on "Environmental and Health Benefits of LPG, the Clean Cooking Fuel" by Prof. Kirk R. Smith, a Professor of Global Environmental Health, University of California.

Several eminent personalities and experts from Hydrocarbon Sector including Mr. Ashutosh Jindal, Jt. Secretary (M&GP), Ministry of Petroleum & Natural Gas, Govt. of India, amongst other distinguished participants attended the lecture. The talk emphasized the health benefits by switch over from biomass to LPG for cooking and gave a global perspective on the health of the world's poor.

Energy-Crossword

Solutions



Across

1. The Greek word 'Petroleum' means--- oil (rock)
7. Name the state that leads in wind energy sector in India (tamilnadu)
8. BS&W means Bottom ---- and water (sediments)
9. What is one way to harvest hydroelectric power? (dam)
14. The change by which any substance is converted from a gaseous state to liquid state is termed as - (condensation)
15. Which fuel has the highest heating value? (hydrogen)
16. Energy that is generated by natural process like hot rocks, magma, geysers is ---- (geothermal)
19. The energy unit under the SI system is --- (joule)
21. Ignition is a slow process of burning fuel whereas combustion is --- process (rapid)
22. -- Heat loss rate from a surface is expressed in--- (watt)

Down

2. The country which has the largest share of coal reserve is --- (china)
3. Common bio-fuel in transport sector (ethanol)
4. LPG is predominantly a mixture of propane and --- (butane)
5. The main element that is required to run a nuclear reactor (uranium)
6. Air conditioner can also act as a heat ---- (pump)
7. To drain condensate from a main steam line, this type of trap used (thermodynamic)
10. The motors where load will vary, shall be designed with--- speed drive motors (variable)
11. Solar cells are made of--- (silicon)
12. ---- can neither be created nor be destroyed (energy)
13. --- is not a fossil fuel (wood)
15. In a furnace, the lower the exhaust temperature ---- is the furnace efficiency (higher)
17. Melting ice releases ---- heat (latent)
18. In India, major energy is from ---- (coal)
20. Energy saving equipments have max of --- stars (five)

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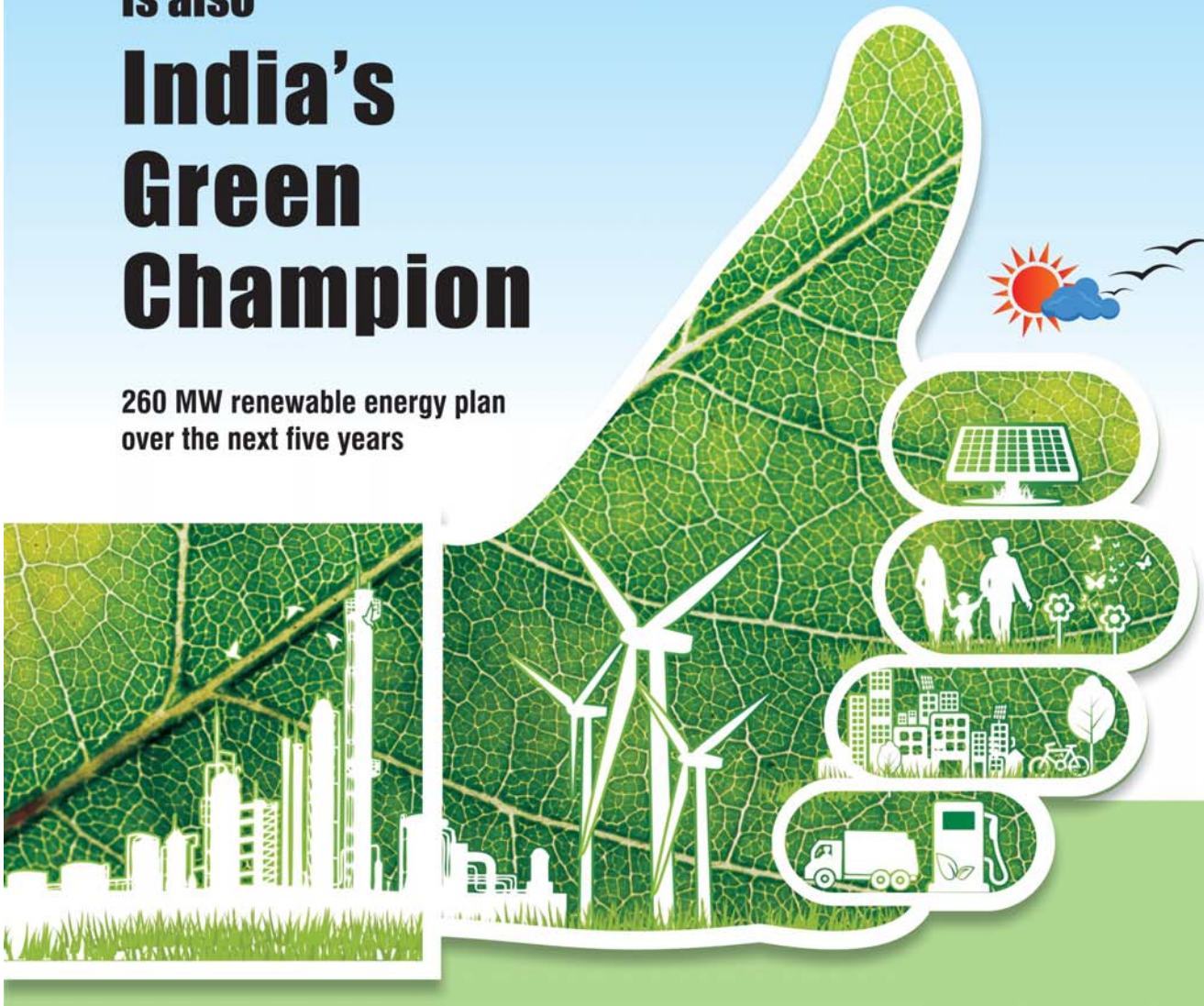
260 MW renewable energy plan over the next five years



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Nourishing earth.

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- Off-grid solar PV projects • Fuel stations solarisation • Solar lanterns
- LED lighting • Waste management system • Green belts
- Rainwater harvesting • Minimise carbon & water footprint

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