FIPI

THE JOURNAL OF
FEDERATION OF INDIAN PETROLEUM INDUSTRY

Voice of Indian Oil & Gas Industry

Challenges & Opportunities for Upstream operators in a Volatile Oil Price Regime

April-June 2018 | Vol.17 Issue 2

ऑयल इंडिया लिमिटेड
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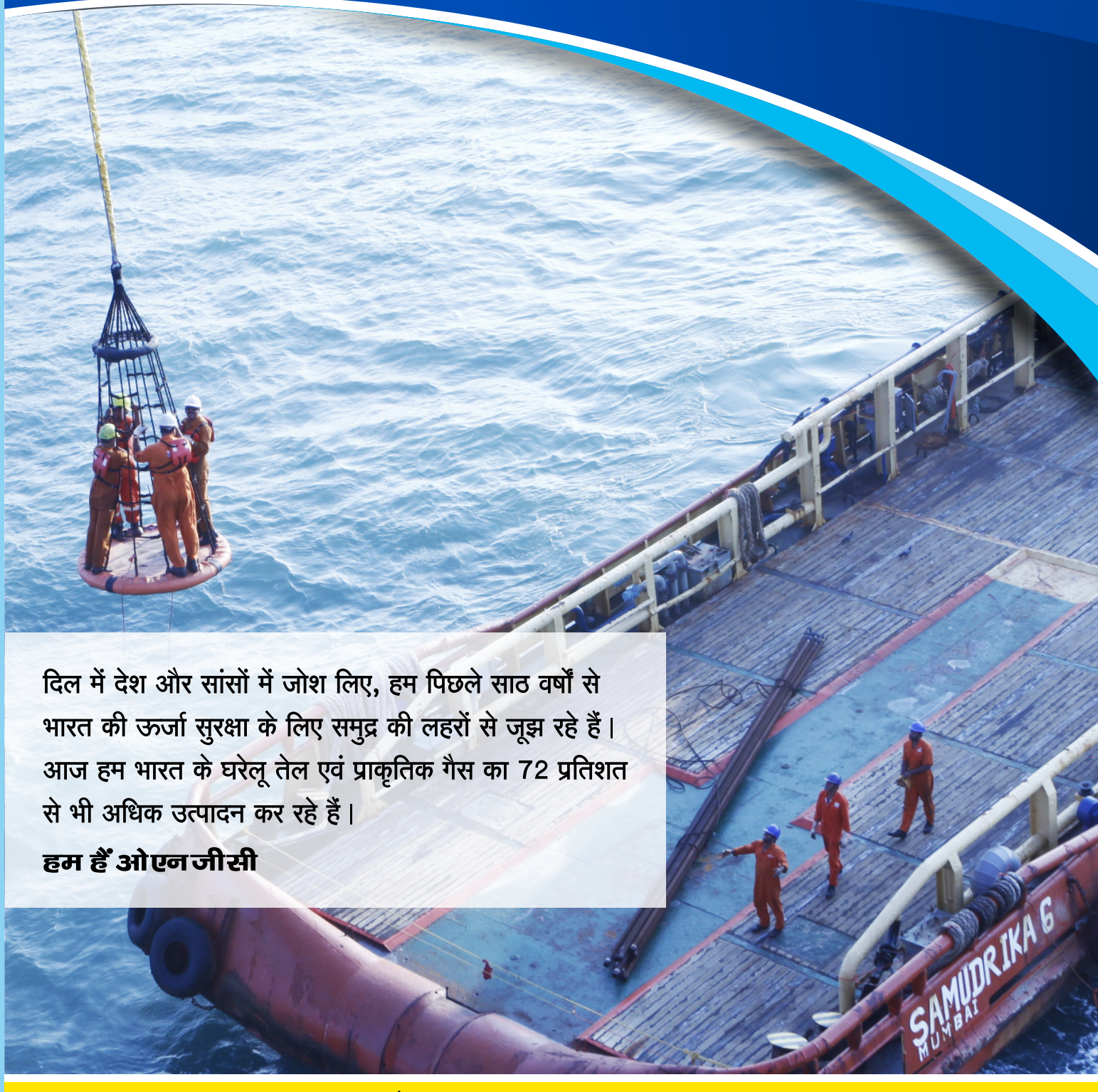
ऊर्जा के संचालक



दिल में देश और सांसों में जोश लिए, हम पिछले साठ वर्षों से भारत की ऊर्जा सुरक्षा के लिए समुद्र की लहरों से जूझ रहे हैं। आज हम भारत के घरेलू तेल एवं प्राकृतिक गैस का 72 प्रतिशत से भी अधिक उत्पादन कर रहे हैं।

हम हैं ओएनजीसी

नई दिशाएं, नई खोज, नई ऊँचाई एवं नई सोच के साथ आगे बढ़ते हुए - ओएनजीसी

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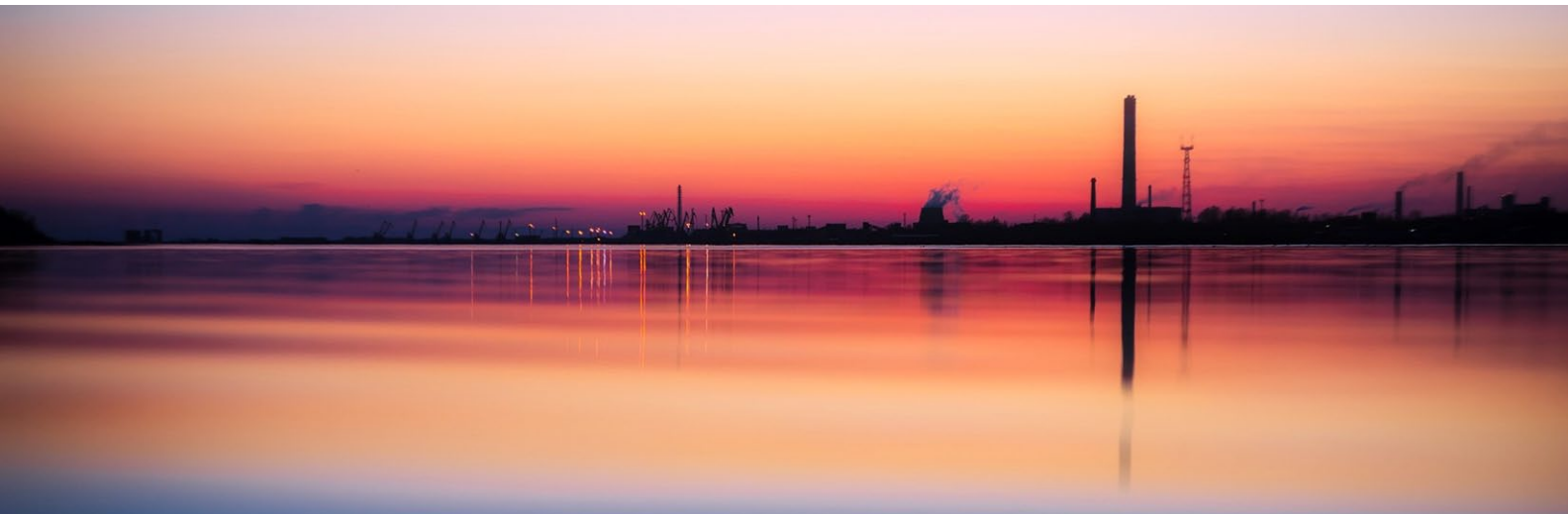

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From the Desk of the

Director General

Greetings from the Federation of Indian Petroleum Industry (FIPI)!

According to a recent report released by the World Bank, the Indian economy has moved past the disruptions caused by the implementation of GST and expected to re-gain its pace in the current fiscal and once again become the fastest growing emerging economy. The World Bank projects that India will see its GDP grow at a rate of 7.3% during the on-going fiscal and at 7.5% in the two succeeding fiscals. However, the higher crude oil prices continue to be a matter of concern.

Crude oil prices are also creating stress throughout global economy which already has threats from trade wars and geo-political events. During the recent OPEC meeting, our Petroleum Minister mentioned that the already fragile world economic growth will be under threat if oil prices persist at these levels and expressed the fear that this may lead to energy poverty in many parts of the world. Thus, causing undue hardships particularly to those at the bottom of the pyramid in developing and least-developed countries.

FIPI was privileged to be associated with the organization of the 16th International Energy Forum Ministerial Meet which was hosted by India and inaugurated by the Hon'ble Prime Minister, Shri Narendra Modi on April 10, 2018. Sharing his thoughts, Hon'ble Prime Minister mentioned that the world needs to move from roller coaster prices to stable and responsible pricing that balances the interests of both the producer and consumer who need to have supportive relationship between them. He added that the neutral platform of the IEF is the perfect place to build a global consensus on energy-related issues.

The Hon'ble Minister for Petroleum & Natural Gas during the above event stated that the hydrocarbon industry needs continuous investment in terms of technology, resources and manpower to realize its true potential. He reiterated that the Indian hydrocarbon sector is open for investment and we invite and welcome investors to invest in India's upstream, midstream and downstream sectors as well as for technological, R&D and academic collaborations.

During the month of April, 2018 FIPI had also organized a workshop in association with Stratas Advisors on 'Changing Oil & Gas Landscape'. This workshop covered diversified subjects related to growth and shift in demand & supply. It deliberated on the new-found hydrocarbon potential in US which will result in flow of oil from the US towards Asia as the demand shifts from the Atlantic basin to Pacific basin. The workshop also discussed the factors influencing the global oil & gas markets, pricing, market dynamics, impact of geo-political ties and technology related issues.

The last three months have seen several policy developments.

The Union Cabinet has approved establishment of additional 6.5 Million Metric Tonne (MMT) Strategic Petroleum Reserve (SPR) facilities at two locations, i.e. Chandikhol in Odisha and Padur in Karnataka. The facilities at Chandikhol and Padur will be underground rock caverns and will have capacities of 4 MMT and 2.5 MMT respectively. Cabinet's approval for establishing additional 6.5 MMT Strategic Petroleum Reserve facilities will provide an additional supply of about 12 days and is expected to augment India's energy security.

In order to make it easier for E&P companies to find and produce more oil and gas, the Government has allowed companies to go beyond their allocated block boundaries if a discovery were to extend outside their contracted area. In a "Policy Framework for Streamlining the Operations, Relaxation of Timelines", the MoP&NG also delegated powers to upstream regulatory body, DGH for approval of excusable delays and excess cost recovery.

Natural Gas is the fuel for the future and the need is to increase share of Gas in India's primary energy

basket from current 6.5% to 15%. In this context, FIPI undertook a study where all stakeholders were brought to a single platform to set a long-term vision and develop a roadmap to work towards achieving such vision. The report of this study has been released and shared with all the study partners and the MoP&NG as well. Further, the FIPI's ongoing study related to use of LNG as a fuel for heavy duty truck applications is nearing completion and we shall be able to list-out the actions required to be taken by various stakeholders.

Till 2014, India had City Gas networks in 47 Geographical Areas across 73 districts. Through the 9th Bidding round, PNGRB plans to roll out City Gas networks in another 86 GAs (Geographical Areas) covering 174 districts. After this round, India shall have CGD coverage in nearly 50% of the total 640 districts in the country and about 50% (61 Crore) of the population of the country. Speaking at the ninth CGD Bid Round, Shri Dharmendra Pradhan Minister for Petroleum and Natural Gas & Skill Development & Entrepreneurship said that this is the largest ever round which covers 20 states and 2 UTs of the country.

To increase the gas availability in the country, Government has granted relaxation under the PNG Rules, 1959 to Coal India Limited (CIL) and its subsidiaries for not applying for grant of license/ lease for extraction of Coal Bed Methane (CBM) under their Coal Bearing Areas.

Saudi Aramco and ADNOC recently signed an MoU to jointly develop and build an integrated refinery and petrochemicals complex at Ratnagiri in Maharashtra. The project will be implemented by Ratnagiri Refinery & Petrochemicals Ltd. (RRPCL). Earlier, Saudi Aramco had joined the project by signing a MoU with the Indian consortium on 11th April 2018 on the side-lines of the 16th International Energy Forum Ministerial. Saudi Aramco also sought to include another strategic partner to co-invest in the project as an overseas investor. RRPCL which is promoted by a consortium of India PSUs consisting of IOCL, BPCL and HPCL will now have Saudi Aramco & ADNOC as overseas strategic partners. The project will be set up as a 50:50 joint partnership (50:50) between the consortium from India and Saudi Aramco and ADNOC. This will be single largest overseas investment in the Indian refining sector.

The mega refinery will be capable of processing 1.2 million barrels of crude oil per day (60 million metric tonnes per annum). It will produce a range of refined petroleum products, including petrol and diesel meeting BS-VI fuel efficiency norms. The Refinery will also provide feedstock for the integrated petrochemicals complex, which will have the capacity of producing approx. 18 million tonnes per annum of petrochemical products. RRPCL will rank among the world's largest refining & petrochemicals projects and will be designed to meet India's fast-growing fuels and petrochemicals demand. The project cost is estimated at around Rs.3 lakh crore (USD 44 billion).

The Union Cabinet has approved National Policy on Biofuels – 2018 which categorizes biofuels as "Basic Biofuels" viz. First Generation (1G) bioethanol & biodiesel and "Advanced Biofuels" - Second Generation (2G) ethanol, Municipal Solid Waste (MSW) to drop-in fuels, Third Generation (3G) biofuels, bio-CNG etc. to enable extension of appropriate financial and fiscal incentives under each category. The Policy expands the scope of raw material for ethanol production by allowing use of Sugarcane Juice, Sugar containing materials like Sugar Beet, Sweet Sorghum, Starch containing materials like Corn, Cassava, Damaged food grains like wheat, broken rice, Rotten Potatoes, unfit for human consumption for ethanol production. Further, in another meeting Cabinet Committee on Economic Affairs has revised the ex-mill price of ethanol derived from C heavy molasses from Rs. 40.85 per litre to Rs. 43.70 per litre. In case of B-heavy molasses and sugarcane juice the price shall be Rs. 47.49 per litre.

FIPI has been continuing with its efforts to resolve the policy issues of concern to our industry. While our major concern related to GST is yet to be resolved, we have brought to the notice of the Government the issues related to OID Cess currently@20% to be brought down to 8-10%, Market & Pricing Freedom for Domestic Gas production in line with Deepwater & HPHT to promote new investments, Incentives for production through EOR Projects, Tariff protection for Domestic Refineries, Windfall Tax (as reported in Media) and Ease for Setting up of new Retail Outlets which as per current procedure requires up to 19 approvals from Central, State and local agencies and take more than 2 years' time.

We have planned to hold the annual FIPI Awards ceremony on August 8, 2018. The Awards Committee headed by Shri G. C. Chaturvedi, former Petroleum Secretary met a couple of times and the final meeting of the Jury headed by Dr. R. A. Mashelkar and Dr. Anil Kakodkar will finalize the award winners on July 13, 2018.

At FIPI we are committed to work towards the cause of the oil & gas industry and look forward to various suggestion and inputs from all the stakeholders.

Dr. R. K. Malhotra

Director General

UPSTREAM

CHALLENGES & OPPORTUNITIES FOR UPSTREAM OPERATORS IN A VOLATILE OIL PRICE REGIME

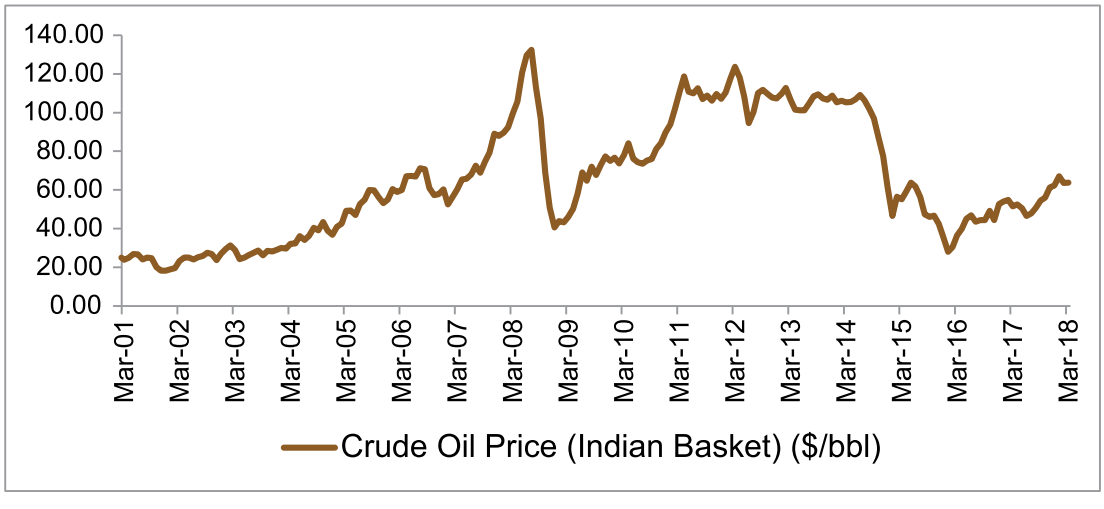
T. K. Sengupta
Director (E&P), FIPI

BACKGROUND

The E&P industry has been haunted by a volatile oil price regime for some time now.

Since April 2014, oil price has witnessed a downslide to fall below $30/barrel from a range of $130-$140/barrel. It was last in 2008 when such a low oil price regime had hit the industry. But it only took about 3 years for the price to bounce back.

However, this time the recovery has taken significantly longer. Almost three years into the volatility, oil price which was hovering around $50/barrel has seen the price rise to a level of $70- $75/barrel in the wake of the looming sanction by US against Iran. Although price has started upward trend from mid-2017 onwards, analysts are sure of one thing: that even if price recovers, it will not reach the erstwhile range of $130-$140/barrel.



This long period of medium to low oil price and the related uncertainty about its stability is a huge concern for oil & gas players across the chain and across the world. With days of easy oil gone, and cost of production increasing even for the matured fields (where outcomes are pretty unknown), not to talk of the producing from the deep waters and challenging frontiers, profitability remains a huge concern and so remains the sustainability of business and operations.

*"With **days of easy oil gone** and cost of production increasing even for the matured fields, not to talk of the producing from the deep waters and challenging frontiers, profitability & sustainability of business and operations remain a **huge concern**"*

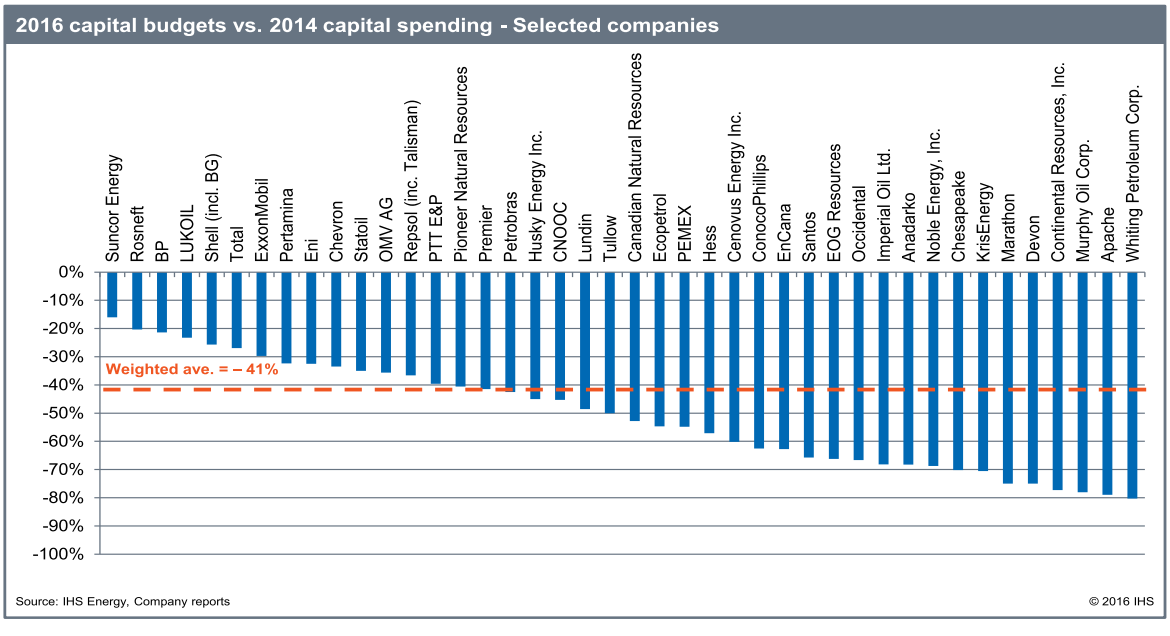
CHALLENGES: THE CAPEX CUT & ITS EFFECT

E&P companies have taken a hit. Numerous surveys and financial analysis have predicted lower spending by E&P players and rearranging of their oil & gas portfolios to remain profitable and competitive. Numbers may vary as per different studies but they all are agree that companies have been quite cautious on the spending front and trying everything under their belt to minimise the impact on their bottom-line. While some reports suggest that global upstream spending has been down by 38% since peak in 2014, many others report a decline in spending by 45% against the forecast during this period. Basis these trends, we are looking at a decline of 44% till 2022 against the earlier forecast.

In a spending outlook survey of 225 companies by Barclays, Upstream oil & gas companies had reduced spending by 15% globally in 2016, following a steep 23% decline already made in 2015. As a matter of fact, after 1986-87, it is only the second time that spending has fallen in consecutive years and predicted to follow the downtrend next few years as well. With this cut in spending, all the stakeholders are getting the hit and will continue to feel the hit for considerable time in future.

Having said so, whether companies will cut the spending or not, the reaction is mixed.

It depends on the capacity of the company and the nation. The majors and IOCs like BP, Shell, Total, Exxon Mobil, Chevron Corporation, Conoco Phillip etc have already cut their budget heavily – shelving-off many cost intensive projects. Latin America companies (Petrobras and YPF) had cut spending by 18% in 2016. On the other hand, NOCs of Middle East are increasing their spending. While the response to the low oil price regime seems to vary, on an average - capex in 2016 has been reduced by around 41% compared to 2014. The chart (courtesy: IHS), reflects the cut in spending by some major companies in 2016 as compared to in 2014.



The effect of this curtail in spending is huge. Accordingly, the world forecast of O+OEG for 2022 which was originally 182 Million bbl has recalculated and the new forecast is 161 Million bbl (after adjusting the capex cut).

The Global crude oil & condensate production was 82 Million bbl/day in 2017 and up from 78 Million bbl/day in 2014. The major contributor is shale oil in USA which has converted the country from being a net importer to becoming a net exporter, with the increase of 4-5 Million bbl/day in the Global oil production contributed by US shale oil alone. US shale has the advantage of lower and shorter investment cycles compared with conventional oil, which makes US shale more responsive to oil prices. Taken together with the lower break-even point for shale resources—& thanks to cost reductions and productivity enhancements—the United States has in effect become the global swing producer.

But if the price again falls below $40/bbl, the impact will be the most on shale oil production which will be economically non-viable. Further fall in price the areas of oil production will affect Brazil Pre salt, Conventional Deep Water, Argentinian shale & Canadian Oil Sands alike.

The major Oil PSUs in India, i.e. ONGC & OIL are in catch-22 situation in this current volatility regime. As a largest contributor to country's Oil & Gas Sector (contributing around 59% of country's oil & gas output), import-dependent nation wants ONGC to produce more – this strengthened by the fact that India's internal dynamics, projected growth and developmental objectives necessitates this goal. The country is still importing around 80% of its energy needs and forks-out huge import bills year after year.

Nonetheless the Prime Minister of the Country in April 2015 at Urja Sangam has spelt out the objective for us: "Nation should make sufficient efforts for 10% reduction in import dependence of oil & petroleum products to reduce the oil import bill burden by 2021-22."

Bigger onus for this lies with ONGC.

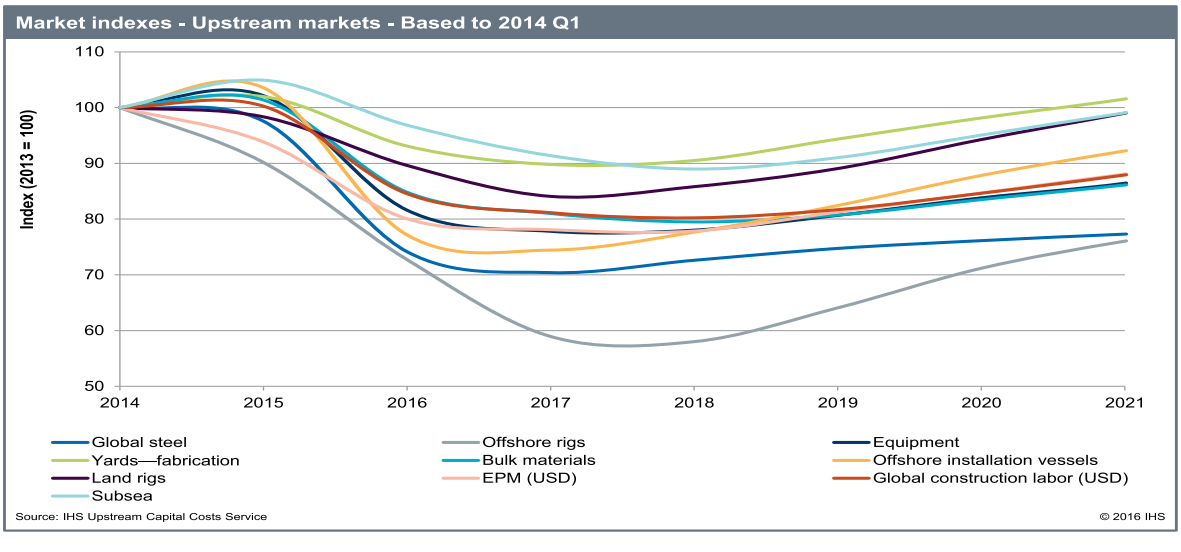
OPPORTUNITIES

The silver lining is that India has a huge E&P potential and the country can come closer to what our Hon'ble Prime Minister outlined for us. We still have the conventional reserves waiting to be put on production. Our matured field still have good potential left to be exploited. Deep and ultra-deep water of India holds huge promise. On the unconventional front like shale gas, CBM and Gas Hydrate, India has good possibilities of growth. The unconventional volumes available can be a game changer for India, if pursued in right earnest. Opportunities are abundant in oil & gas sector in India.

The recent policy changes like HELP (Hydrocarbon Exploration Licensing Policy), OALP (Open Acreage Licensing Programme), Revenue Sharing Mechanism in place of Profit Sharing, Discovered Small Field Policy (DSF), National Data Repository, Hydrocarbon Resource Reassessment Study 2017 by Govt of India are all steps towards attracting investments in E&P Upstream sector for more Exploration, Development and Production to harness these opportunities.

When we look at other side of the coin, this slump in the oil & gas market because of low oil price regime has created a huge opportunity for the operators in India - especially for NOCs like ONGC & private players like Vedanta and Cairn. As most of the Multi-National Companies have put many projects on hold and re-arranged their priorities, the resources are lying idle leading to huge redundancy with service provider companies and they now are available at much reduced cost. Rig prices have almost come down to 20-30% across all categories. Cost of vessels and marine spreads have also come down significantly to the tune of 25-30%. The cost of directional drilling, cost of logging services, cost of stimulation services, and cost of many ancillary services related to oil and gas activities have come down drastically. Even the companies are experiencing that the bidding amount getting comparatively lower for the development/ redevelopment projects.

Better participation is seen in the number of good and serious players who are participating in high value tenders across the industry. The time is ripe to plan and execute many brownfield & greenfield projects to bring in additional volumes. Prices of almost every inputs have fallen down sharply with upward trend starting only after 2019 and expected to reach pre-2014 level only by around 2021 & beyond (Ref below, courtesy IHS).



Therefore, in these times of low input costs - it is a blessing in disguise for companies like ONGC, CAIRN, RIL & OIL to fast pace its exploration and development efforts.

In the E&P sector, all investments are made with long term perspective. Since any development project is conceived with a profile of 10-15 years or more in case of large fields, investment decision is not very much dependent upon prevailing prices, but on a long term basis.

CHALLENGES: MANPOWER

Beyond the usual "impacting balance sheet" notion arising out of continuous low oil price regime, the other challenge which will have significant effect once situation rolls back to normal.

One most visible turbulence is the "lay-offs" company resorts to during low oil-price regime to trim down their expenses. Though it's business and company prerogative to do so, I personally feel that losing an expert and specialist manpower is a bigger loss than incurring small financial losses on this account. E&P industry, to a large extent, depends on the capabilities, capacities and wisdom of its workforce. Prognosis, analysis and concluding "the results" form a crucial pillar in this industry. Tools, tackles and technology apart, industry's success depend to a large extent on individual skills that gets accrued to them on account of their continuous engagement with the field and given assignments.

"How to handle the issue of 'lay-offs' that usually follows in low oil-price regime is a huge concern. But ***loosing experts*** *and specialist manpower will definitely* ***slow down the E&P business*** *further and when sun gets brighter, it will be a bit* ***difficult to deploy*** *similar or advance level of mastery &* ***expertise to kick-start & fast-pace your efforts."***

But the travesty of the industry is such that whenever bottom-line of the company gets hit on account of any reasons, the easiest way for them is to lay-off significant number of employees to cut on the spending. This time too, industry has resorted to that. As per the information available in public domain, one service company has reduced approximately 9,000 jobs globally in response to falling oil prices; another has reduced 1,000 jobs; the third has laid off 7,000 employees. Many other operators have also followed the similar patterns.

This is where the industry is erring. It is a well-known fact that producing from aging & matured fields is a difficult job while steering ongoing projects in technology driven areas like Deepwater in absence of the right kind of manpower can prove disastrous. When the bottom-line improves, it becomes very difficult to re-hire manpower for their specialized fields or to mobilise the requisite-experience-laden workforce at right time.

The end result: company fails to kick-start the pace that is required and fail to accelerate their efforts further when remunerative prices of oil/gas become favourable. This is one under-current that gets dominant when economic-situations get tough, leading to business turbulences in more ways than one.

"One way to survive in this volatile oil price regime is to offset the upward cost trend by **improving the efficiencies of operations & systems.** Increased sophistication of science & technology, increased digitisation, increased innovations & forging and pursuing creative strategic partnerships can help in cost reduction. **Technology, creativity & innovation** can play a significant role in helping Oil & Gas companies accomplish more with less

CHALLENGES: RISING OPERATING COST

Another challenge is how to contain the rising cost of production, operations and business. What I am talking of is the technical cost only; while there are other costs involved like royalty, cess, taxes and other statutory charges. Sum total of all these expenditures on per barrel basis are normally quite high and do not commensurate with the returns, particularly in India. The saying that days of easy oil gone is true. It is costing more now to find oil and gas, to develop oil and gas. It is taking more time to drill owing to deeper depths and challenging subsurface condition. The new volume which is coming to the market is complex and driving the cost upward.

OPPORTUNITY: IMPROVING EFFICIENCY

In this phase of low to medium oil price regime, to remain profitable, it is important that the operating companies keep sustained focus on "Efficiency" and "Effectiveness" of every activity which they are pursuing or intended to pursue in future.

Improving operational efficiency is foremost and paramount because the results are easily & immediately visible here. Improved data quality and in-depth data-analytics is much more relevant in this situation because industry cannot afford to commit resources based on poor or wrong data analytics. Companies require better & quality forecasting to

plan the resources better, and for better decision making. The operators thus cannot afford longer shutdown hours, afford overrun of scheduled & planned activities like overhaul, repairs and maintenance, afford "delays" or "waiting" because right capabilities and requisite resources are not available at point of action.

Efficient supply chain management and efficient logistics is the need of the hour. Operators must ensure continuous communications with the vendor/parties and ensure their participations at all the time & at all stages of "actions" to appreciate each other's concern better. Developing Trust and a 'joint-vision' will help to a great extent in reducing delays & down-time.

This is also very important while pursuing drilling efficiency by reducing waiting-on-material time and by reducing other factors that contributes to non-productive-time. The operating companies need to collaborate with the service providers to improve upon drilling efficiency parameters like cyclic speed and commercial speed. Leveraging vendors experience and knowledge will help in this tough time. The companies need to find out new technologies or new concepts or new way-of-doing-things that improves the well-productivity. Sometimes a slight up gradation and manoeuvrability in existing technology can fetch higher results. So, they must indulge in these kinds of improving efficiency exercises if they wish to move ahead with their business plan profitably.

The industry has taken cognizance of this. The formation of "Efficiency Task Force (ETF)" by Oil & Gas, UK, that intends to plan, execute & supervise pan-organisation efficiency improvement plans is an example of how world is falling back on "efficiency" paradigm to remain profitable. In my considered view, we in this part of the world also require such an efficiency task force.

How these networks create value within the oil and gas context is by enabling better and faster operational decisions, leading to greater asset utilization, reduced operating costs and increasing efficiency. Today's digital technology makes this feasible by enabling what EY has coined as "process compression." Process compression brings together three foundational digital capabilities, all of which exist in the marketplace today: smart assets, paperless processes and data analytics — all in a secure environment. When applied across the oil and gas supply chain, digital technology can simplify and synchronize processes and accelerate integrated decision-making. This is not a new idea. Process compression has been deployed successfully in other manufacturing-based industries — namely automobile and aerospace manufacturing.

OPPORTUNITY: INNOVATION & CREATIVITY

I am of the firm view, and history is witness to the fact, that "creativity" and "innovation" gets a shape only when the situation is tight, un-conducive and un-favourable. After all it is only when the going gets tough, only tough gets going.

To keep floating in rough water, we need to come out of our laid-back attitude and have to be more alert, more sensible and must have the ability to reciprocate. "This-too-shall-pass" attitude will not help. Its human tendency that when things are easy and going smooth, they enter into a comfort zone and it becomes a bit relaxed. It takes time to come out of that "comfort zone" and formulate commensurate new actions and directions when things start drifting apart. Unusual situation leads to unusual thinking and in response to those chaotic situation, some out of box idea do emerges. We must be sensible enough to capture those ideas. We must pilot-test those emerging ideas with clear focus on whether it serves our purpose or not. We should be at our "judgemental" best to see whether ideas worked or not. So tough times rather require all of us to be more pro-active and more creative to bring out some solutions that fetches us desired results in the challenging times like the one which we are witnessing since some time back.

"Two things are crucial if we wish to remain **profitable in this volatile oil price regime:"**

Improve **Efficiency & Effectiveness** of every activity which is pursued or intended to pursue in the future.

Focus on Innovation & Creativity. It is during such tough & challenging times that the best innovations emerge.

Optimism appears to be rising for a rebound in oil prices in 2018, yet the industry will continue facing challenges, thanks to OPEC agreement to production cut by 1.2 million barrels a day, geo political environment, seasonal swing etc.

But to maintain production and the price for long term, exploration has to play a very important role in medium to long term strategy. In 2035, there will be a short fall of 20 million bbl per day in the world oil

production and that needs to be balanced by more exploration, more reserve accretion, more production and also through new energy initiatives. Even in India, where Upstream industries are hardly contributing to around 20% of the demand of oil consumption - the task is herculean & calls for extensive aggressive exploration. One hopes that the HELP, OALP etc, the policies introduced by Government will help the investor to take up more exploration work and add new reserves and production to offset the shortage.

In a nutshell it can be said that,

- Most oil & gas operators have utilised the past three years to reduce costs, but there is more work to do.
- More work need to be done on data analytics, reduce operational losses and improve efficiency
- Upstream companies should plan on low oil prices and create nothing less than a high performing efficient organisation
- Oil field service companies to focus on more innovative low-cost technology to reduce cost and improve quality.
- Operating companies to plan greener field and brown field work at this oil price regime to boost up the industry.

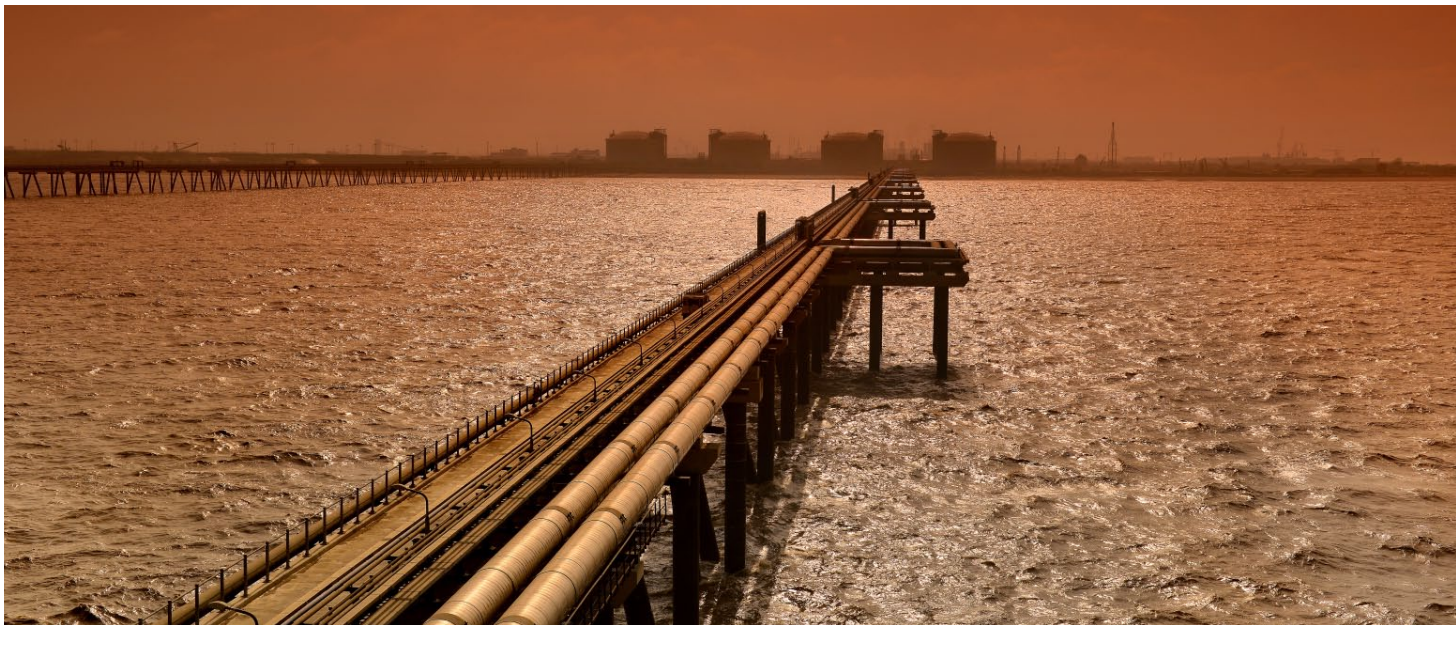
CONCLUSION

As the name of the topic suggests, both challenges & opportunity exists in today's volatile oil price scenario for upstream industry players. When we don't have much control on Geo Political affairs, no control on OPEC Production cut, cannot increase the production substantially as is done by US Shale oil, we do need to concentrate & focus on our own work. We need to work on extensive exploration, produce effectively from matured fields and use technology to the fullest.

The challenges are manifold as it is said that the "Days of Easy Oil has gone" and we have to explore & exploit from challenging environment like Deeper plays, HPHT (High pressure -High temperature environment), Deep water, Ultra shallow water, Tight sands, Oil sands and other Geographically and Geologically difficult areas.

But opportunities are also huge in this volatile environment. The service cost has come down and will be competitive in future, the major contractors/ investors started showing their interest in this country due to the enormous new positive Govt policies, more opportunities, ease of business etc and the disruptive intervention of digital technology. Technologies are now easily available. As artificial intelligence, cloud computing, automation and the Internet of Things (IoT) become more readily usable and the distributed ledger technology which is known as blockchain which the future backbone of the data infrastructure may be – the possibilities are endless & the future is exciting. All of these together will help E&P company to create an efficient organisation which can operate as a high-performance organisation even during a lower oil price regime.

Sources: 1 – IHS Energy, Company Reports. 2 – IHS Upstream Capital Costs Service
(Above data & analysis and interpretation is solely of the author only)



OIL MARKETS

OPEC – REVERSE MOVE TO BALANCE MARKET

N.K. Bansal
Director (Oil Refining & Marketing), FIPI

12 OPEC and 10 Non-OPEC countries decided to adjust (reduce) oil production by 1.8 million barrels per day (mbpd) from 1st January 2017 to control the oil glut situation since 2014. After a year , the sharp rise in crude price due to deficit in supply and rising demand caused global concern and these countries reviewed their earlier decision afresh . While they have agreed to balance the market through increase in the supply by about 1.0 mbpd from July 2018 , geopolitical risks like Trade Conflicts and Sanctions along with expected higher stress on few countries like Saudi Arabia and Russia may play dampening effect. The fall in price may not be in the immediate vicinity and later on not to the extent as expected by the global economies.

JUNE 2018 REVIEW BY OPEC

OPEC on 22nd June 2018 at Vienna reviewed its earlier resolution of October 2016 to adjust (read adjust) its production w.e.f. 1st January 2017 by approximate 1.2 million barrels per day (mbpd). The objective was to balance the market which was experiencing oil glut. Later a group of ten non OPEC oil exporting countries also joined the agreement to make the volume of adjustment to 1.8 mbpd. OPEC discussed the update with non OPEC members as well on 23rd June 2018 at Vienna.

Press release from OPEC on both the days mention that all the partners in production adjustment agreement (termed as 'Declaration of Co-operation' – DOC by OPEC) decided to trim down excess adjustment which reached a level of 152 % in May 2018 to comply with adjustment resolution only to 100 % as per DOC. No specific numbers were given in the press release or elsewhere but it is may be assumed that all included in 2016 agreement will remain as it is. Media reports suggest that this will increase the crude production by 1.0 mbpd.

FIPI has been tracking the oil market and OPEC to balance it. In our article in January- March 2018 , Volume 17, issue 1 edition of FIPI journal, we mentioned that after the adjustment and with increase in demand in 2018, the increase in production by some oil producing countries may be choice strategy.

To understand the current situation and its short term outlook, let refresh the production adjustment agreement by 22 countries first (12 OPEC and 10 non OPEC).

DECLARATION OF CO-OPERATION (DOC)

OPEC member countries, on 30th November, 2016 decided to implement a production adjustment of 1.2 mbpd. While targets were set for 12 countries, Iran was allowed to increase its oil production and Nigeria and Libya were exempted. On December 10, 2016, ten non-OPEC oil exporting countries joined the agreement to reduce 0.6 mbpd. Together it makes the reduction in oil production by around 1.8 mbpd by 22 countries. Effective January 1, 2017, the agreement was for six months extendable by another six months if market conditions compel to do so. All participating countries, decided on May 25, 2017, to extend the co-operative approach by nine months w.e.f. July 1, 2017 that is up to March 2018 which subsequently was extended for 2018 with a review in June 2018. A summary of adjusted numbers (in mbpd) given below in table 1(source: IEA OMRs)

Table 1

Member Country	Supply Baseline	Agreed Cut	Desired Production level
OPEC	31.11	-1.18	29.920
Non-OPEC	18.86	-0.55	18.295
Total Adjustment	**49.97**	**-1.73**	**48.24**

POST DOC SCENARIO

DEMAND- SUPPLY BALANCE

Data available from IEA OMR May 2018 (Table 2) indicate that the impact of production adjustment started showing deficit supply in 2nd quarter of 2017 but its real impact on ground level was felt in 4th quarter when prices also started moving north ward. The data in fact reveal that

Table 2

Figs. in mbpd						
	1Q17	**2Q17**	**3Q17**	**4Q17**	**2017**	**1Q18**
Demand						
OECD	46.90	47.00	47.60	48.00	47.40	47.60
Non OECD	49.30	50.90	50.70	50.50	50.30	50.50
Total	**96.20**	**97.90**	**98.30**	**98.50**	**97.70**	**98.10**
Supply						
OPEC -Crude	32.10	32.30	32.70	32.30	32.30	32.00
NGL	6.8	6.9	6.9	6.9	6.9	6.9
Non OPEC	57.70	57.70	58.30	59.00	58.20	59.20
Total	**96.60**	**96.90**	**97.90**	**98.20**	**97.40**	**98.10**
Gap (Supply-Demand)	0.40	-1.00	-0.40	-0.30	-0.30	0.00

COMPLIANCE TO PRODUCTION ADJUSTMENT

Demand – supply gap which was 1.0 mbpd in 2Q17, reduced to Nil by 1Q18. This was in spite of higher compliance by OPEC 12 during this period. Table 3 provides status of compliance by OPEC and Non - OPEC countries of DOC.

Table 3

Figs. in mbpd					
	Target After Cut	**4Q17**	**2017**	**1Q18**	**Apr-18**
OPEC 12	29.92	29.72	30.00	29.31	29.20
% Compliance		100.7	99.7	102.1	102.5
Non OPEC 10	18.29	18.66	18.74	18.74	18.71
% Compliance		98.0	97.6	97.6	97.8
Total	**48.21**	**48.38**	**48.74**	**48.05**	**47.91**

While OPEC 12 compliance crossed 100 % in 4Q17 and reached higher level of 102.5 % in April 2018, it remained at around 98 % for Non OPEC 10 throughout. The compliance in both the categories got an indirect major support from Latin American countries, Venezuela in OPEC and Mexico in Non – OPEC countries.

For their own issues, primarily geopolitical in nature, Venezuela compliance is 128 % whereas that of Mexico is 107 %. It may be noted that if these two countries would have complied with 100 %, overall compliance would have been closure to 100 % as now desired by these 22 countries. It is worth mentioning that 'compliance' here is with respect to actual physical material available for use and not in terms of 'cut' which is shown as 152 % by OPEC.

GAINERS & LOSERS

Supply position would have been worse but for higher production by some of the oil major countries. Oil production from US increased by about 2.0 mbpd from average of 12.53 mbpd in 2016 to 14.59 mbpd in April 2018. Nigeria and Libya also maintained higher productions compared to 2016 levels.

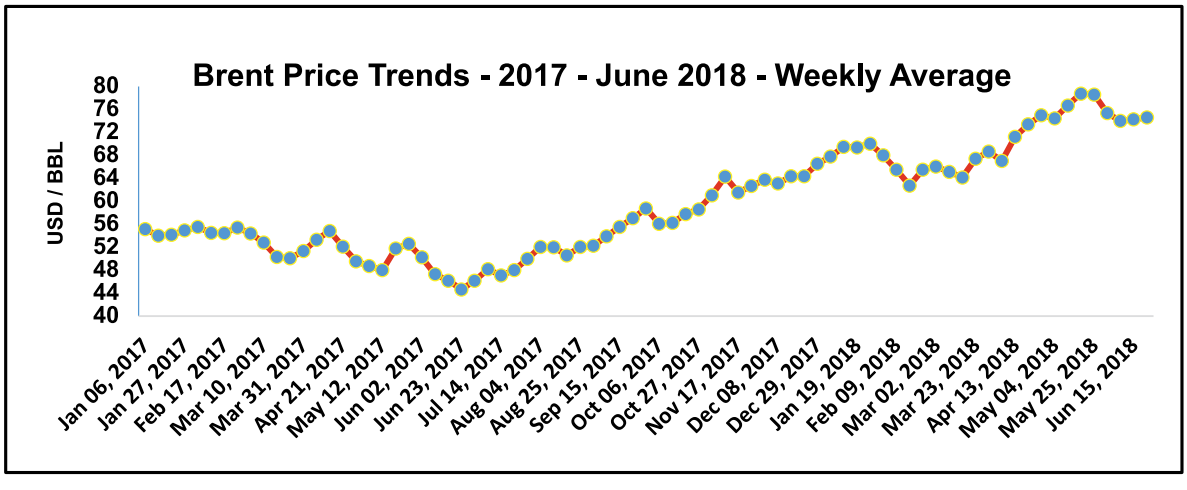
Table 4

Figs. in mbpd				
Country	**2016**	**4Q17**	**1Q18**	**April 2018**
Mexico	2.47	2.13	2.15	2.10
Venezuela	2.24	1.75	1.54	1.42
USA	12.53	14.01	14.29	14.59
Nigeria	1.47	1.60	1.55	1.59
Libya	0.39	1.00	1.01	0.98
Total	**19.37**	**20.49**	**20.54**	**20.68**

The maximum drop in production was from Venezuela where the reduction was about 0.8 mbpd during this period. Table 4 provides oil production (in mbpd) status with respect to some major producers. Overall production increased by about 1.3 mbpd from above five oil major exporters. This trend in fact is responsible for wiping out demand-supply gap in 1Q18.

CRUDE PRICE

Brent spot price crossed 60 $ / BBL by end October 2017, never to come back. It crossed 66 by end December 2017 only to touch peak of 80.42 $ per BBL on 22nd May 2018. Currently



It is hovering around 74.4 / BBL. In fact , international benchmark crude , Brent price shot after the declaration on 22nd June , Friday by about 3% in early afternoon trading in London, before falling back a bit, to around $74 a barrel . This knee jerk initial reaction was perhaps due to higher expectations from the OPEC conference. Sharp increase in price were causing concern all over the globe. From the above analysis, it is clear that global markets were not short of crude supplies in overall status but were on the verge of higher risk due to reduction of the flexibility and reaching squeeze position.

OUTLOOK FOR 2018 AND 2019

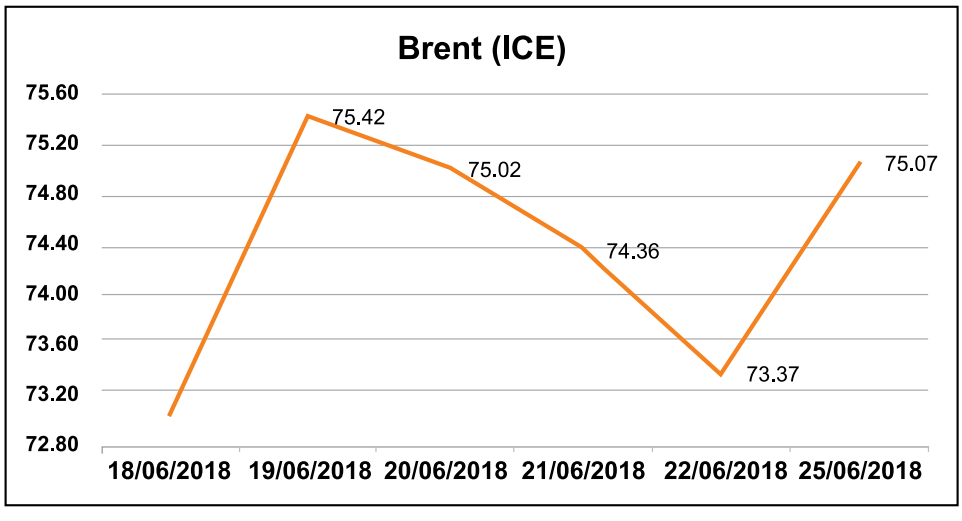
IEA OMR 13th May 2018 project total demand and supply from Non- OPEC countries. Derived desired production levels from OPEC to just meet the demand has been worked out and given in Table 5

Table 4

2018 (Figs. in mbpd)					
	1Q18	**2Q18**	**3Q18**	**4Q18**	**2018**
Demand	98.10	99.10	99.30	100.20	99.20
Supply					
OPEC	38.90				
Non OPEC	59.20	59.70	60.30	60.90	60.00
Total Supply	98.10				
Desirable from OPEC to meet demand		39.40	39.00	39.30	39.20
NGL		6.90	6.90	6.90	6.90
OPEC Crude		32.50	32.10	32.40	32.30
Production from Nigeria and Libya		2.50	2.50	2.50	2.50
Production desired from OPEC 10		30.00	29.60	29.9	29.80

The result clearly indicate that if OPEC 10 maintain 100 % compliance of producing 29.92 mbpd and Non- OPEC 10 maintain current levels of 18.70 mbpd , the supply situation will remain in reasonable flexible zone with manageable risks . In fact , actual increase required may be less than 1.0 mbpd (say in the range of 0.6-0.7 mbpd) if the current production status remains with Venezuela and Mexico. However, drop in Venezuela and Mexico production level and fluctuation in production from Nigeria as per past experience add to the risks . Sanctions on Iran also are the cause of concern in this direction and output is expected to decrease. In such scenario , Saudi Arabia and Russia will have to take major share in increasing their productions and maintaining compliance to 100% level.

In any case the time of sub 60 $ per BBL crude price (Brent) are not likely to return . If supplies improve , possibly towards the mid of 3Q18 , price may come below 70 $ per BBL and may remain around 65-68 $ per BBL range. Trading community , however, well aware of geopolitical risks of sanctions and trade conflicts , stress on production systems in near futures and finding OPEC declaration of 22nd June 2018 short of expectations , is likely to maintain current trends of higher prices in 74 $ per BBL range in the immediate vicinity till actual situation on the ground changes. This is evident with rise in price immediately after the press release of OPEC on 22nd June and thereafter.



IEA predict a rise of 1.4 mbpd in oil demand in 2019 , making it to 100.6 mbpd in this year. This will further add to burden on supplies causing market squeeze in 2019 . Surplus capacity available (given below) shows the possibilities of further increase in production by OPEC but with higher stress on hardware. Much of the desired investments are not coming in upstream due to uncertain market situations both in short and long terms. Risk of price rise , therefore, looms large in 2019 unless geopolitical situation of trade wars and sanctions ease out and market driven demand- supply equilibrium is restored .

Table 6

OPEC Spare Capacity over April 18		
Figs. in mbpd		
Total	3.47	
Saudi Arabia	2.12	61.00 %
KUWAIT	0.22	
IRAQ	0.34	26.00 %
UAE	0.33	
Nigeria / Algeria/Angola (each)	**0.10**	

Above data and analysis is based on OMR of IEA in April 2018 and May 2018 (Highlights) and is entirely the interpretation of the author only.

OIL MARKETS

CRUDE OIL PRICES – GLOBAL TRENDS AND IMPACT ON INDIA

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ABSTRACT

The prices of the Crude oil have seen lot of turmoil globally in the past decade, specifically in the last 5 years - the price having touched a high of $147 per barrel (bbl) during 2008 and dropping down as the global economy was hit by recession and demand for oil dipped. The prices again continued to rise till 2012, kept steady for about 3 years around $100/bbl till 2014 and again fell to a low of an average $43/bbl in 2016 and now again observed to be going up - till recently to $80/bbl in 2018.

This paper examines the reasons of the volatility observed globally, the forecast in the next two decades and also the impact that it presently has w.r.t inflation and GDP etc. and the options that are available in the Indian context.

INTRODUCTION

There are two grades of crude oil that significantly serve as benchmarks for the oil prices - West Texas Intermediate (WTI) for imports into United States and Brent North Sea oil that originates from Northwest Europe.

Brent Crude oil, a classification of a blend of sweet light crude oils is the world's leading price benchmark for the oils. The price of Brent crude oil is influenced by the costs across all stages of the process of production and consequently alters the price of consumer goods as well. While WTI oil is lighter and sweeter than Brent oil, the price of a barrel of WTI oil is normally about $4/bbl lower than Brent oil prices. Historically, the price differences between Brent and other index crudes have been based on physical differences in crude oil specifications and short term variations due to supply and demand.

The prices of the Crude oil have seen lot of turmoil in the past decade, specifically in the last 5 years. The price touched a high of $147 per barrel during 2008 (an annual average $97), as panic about future supply shortages along with financial crisis had been experienced globally. Traders were afraid that China's demand for oil would overtake the supply, leading the investors to drive the oil prices up. These fears were unfounded, as the world soon plunged into recession and demand for oil dipped. The Brent prices have seen lots of lows and highs since then; an average $61/bbl in 2009, rise to an average $112/bbl in 2012, steady for about 3 years to around $100/bbl till 2014, again a fall to a a low of average $43/bbl in 2016. Of late, the prices have been going up to $80 till recently in 2018 (average $66/bbl).

In addition, Urals oil - a combination of heavy and light oils is used as a benchmark price for Russian export oil mixtures, also listed on the Russian Trading System stock exchange. The price of Urals crude oil was expected to rise from $78/bbl in 2010 to $116/bbl by 2017 based on a 2012 projection. However, this benchmark too followed the general trends of other benchmarks and had a daily oil price of $53/bbl in Jan 2017.

Ref: Forecast by the US Energy Information Administration's (EIA) Short Term Energy Outlook

ANALAYSIS OF CRUDE OIL PRICES AND FORECAST

OPEC's agreement wherein the members of the oil cartel agreed to keep production cuts through 2018 alongwith the decreasing US crude oil inventories gave rise to the oil prices during the second half of 2017, and by late September, Brent crude price had reached $60/bbl. The Oil prices were almost triple the

thirteen year low of $26/bbl in Jan. 2016. Incidentally, 6 months earlier, the prices had been $60/bbl and just a year earlier in June 2014, they stood at $100/bbl. In April 2018, global oil prices averaged $72/bbl i.e. $6 higher than in March. Currently too, the volatility in the crude prices is being observed globally due to changes in production levels by Russia, Saudi Arabia etc.

The forecast of prices of Oil primarily depends on the interaction between supply and demand for oil in the international markets. The most important supply side factors weighing on pricing expectations are US Shale Oil production, US Crude oil stocks and OPEC oil supply. It has been observed that the crude oil prices worldwide have averaged $68/bbl so far in 2018 which is almost a dollar higher than the previous month's Short Term Energy Outlook published by US Energy Information Administration.

With several fluctuating factors, the oil prices are influenced on daily basis. It is expected that Brent crude oil prices may x average $63/bbl in 2018 and 2019. The activity of recovery of US Shale oil is expected to be vigorous in the year and is broadly expected to limit price gains in the future. As regards the demand of oil, OPEC oil report suggests that it may increase by 1.3 million barrels per day (mb/d) in 2018, 0.1 mb/d more than the increase expected from non-OPEC oil supply.

WTI oil will average $71/b in 2018 and $66/b in 2019 as per the forecast by EIA. Commodities traders also predict that the price of WTI oil could be anywhere from $54/b to $84/b by August 2018 in their futures contracts. The World Bank too anticipates that all three major benchmark oil prices, Brent, WTI, and Dubai, will continue to increase after 2020 to reach $70 per barrel in 2030.

REASONS FOR VOLATILE OIL PRICES

The volatility of the prices of crude oils has been due to swings in the supplies. Oil prices used to have a predictable seasonal swing. Normally, these spikes are observed during the spring season as the traders anticipate high demand during summer vacations. Once the demand peak, the prices drop in the fall and winter.

However, based on the fundamentals, the pattern of predictability of the prices is as under:

- **Increasing Production of Shale Oil and Alternative Fuels**

  The production of shale oils such as ethanol began increasing in the US in 2015. While the fuel production was 10.4 mb/d in 2018, from the average 9.3 mb/d in 2017, EIA forecast that it will average 11.4 mb/d in 2019. The prices of oil have been low as the shale oil producers have become more efficient at extracting oil as they have found ways to keep wells open, saving them the cost of capping them. On the contrary, the oil wells in the Gulf began producing in large quantities and have not stopped the oil production regardless of low oil prices. As per IEA's prediction, US will become the world's largest oil producer by 2023. While the US industry is expected to grow to meet its own demand, the prices too must be kept reasonably high enough to pay for increasing production.

- **Reduced output by OPEC**

  Throughout its history, OPEC has controlled the production to maintain a target price of $70/b. Even though, OPEC abandoned its policy of controlled production in 2014, most OPEC members agreed to reduce the oil production

in Nov. 2016 by 1.2 mb/d which gave rise to increase in the prices. The production cuts continue through 2018, although Saudi Arabia continued to produce. As per EIA estimates, OPEC will produce 32.8 mb/d in 2018 which is still higher than the 2015 average of 32.32 mb/d.

OPEC's biggest contributor, Saudi Arabia lowered its price to its largest customers in 2014 as they did not want to lose market share to US shale oil producers as they expected to force many the shale producers out of business and reduce its competition. Its key rival Iran doubled the oil exports to 2.4 b/d in 2016 once the economic sanctions were lifted.

However, the shale producers found ways to keep the oil pumping due to increased supplies in US. Although the demand for OPEC oil fell from 30 million b/d in 2014 to 29 million b/d in 2015, but the strong dollar meant OPEC countries could remain profitable even at lower oil prices, thus maintaining the production target at 30 million b/d. The lower prices caused oil production in US to fall to 8.9 leading less efficient shale producers to reduce supply by around 10%, creating a recession in US shale industry.

- **Slow growth of global demand**

  According to EIA, the global demand grew more slowly than anticipated as it only rose to $93.3 mb/d in 2015 from 92.4 mb/d in 2014. The demand is expected to be slow as pace of economic reforms too has been slow. Most of the increase has been from China which consumes 12% of global oil production.

- **Manipulation of Oil markets**

  Oil is used as a weapon and a tool for politics, war and managing the economy. Investment banks are some of the largest short players on oil in the market. First, rumours are spread to send oil prices down, trying to convince the public that oil demand is crashing, or insinuating that OPEC's deal is about to collapse, having no relation with the underlying situation in the oil market. As long as people believe in it, prices go down. At this stage, the manipulators step in and start buying up oil as prices lie low. They tend to store the oil, preferably somewhere where that doesn't have to be reported. As this oil is withheld from the market and the rumors dissipate, oil prices start rising again. Once prices have recovered enough, the manipulators sell the "missing" oil that they had been hiding in storage at the new and higher price, thereby hedging the funds with big bets on increased oil prices.

  Such acts of hedging are not based on oil supply and demand scenario but on the hope that manipulating and playing with the oil prices will work. Unlike the equities where the companies are only indirectly affected by price swings in their stocks, the energy companies are directly affected due to the changes in energy prices as most not only derive their revenues from the "free" markets but also use them to hedge with banks that may themselves have a hand in setting the prices.

- **Increase in value of Dollar by traders**

  The foreign exchange traders increased the price of petroleum by 25% due to global uncertainty in 2014-15 that continued upto 2017. The strong dollar caused 70% decline in the price of petroleum for exporting countries, leading to drop in oil prices.

OIL PRICE FORECAST

As per the assumptions by EIA, the demand for petroleum shall flatten as utilities rely more on natural gas and renewable energy. It also assumes the economy growth to be around 2% annually, while increase in energy consumption by 0.4% annually. The average price Brent crude oil is expected to rise by 2025 to $85/bbl, to $92/bbl by 2030 owing to the demand globally, and to $106/bbl by 2040, by which time the cheap sources of oil would have been exhausted, making extraction of oil more expensive, and also as the shale oil market would have stabilised. US will become a net energy exporter by 2022, exporting more than it imports.

EFFECTS OF RISING CRUDE OIL PRICE ON INDIA'S GDP GROWTH, INFLATION ETC.

- The Economic Survey 2018 by the Government of India estimates that increase of every $10 per barrel in the price of oil reduces the growth by 0.2 to 0.3%. As per the Comprehensive annual document of Indian Economy issued by Ministry of Finance, country's economic growth is expected to grow between 7 and 7.5% in the fiscal year 2019, while flagging concerns over rising crude oil price. The survey envisages the growth in the oil price by an average 12% in FY19, WPI inflation by approximately 1.7%, and drop in current account deficit by about $9-10 billion. As per Morgan Stanley, the fiscal deficit is likely to increase to 3.5% of the GDP in the fiscal year 2018-19. It is also expected that if the higher oil prices require tighter monetary policy to meet the inflation target, real interest rates could exert a drag on consumption.
- In the last three months, the Brent crude oil price has gone up by $18 per barrel, as it touched $80/bbl recently. The rise in crude oil prices since 2017 has put an end to the low oil price windfall since 2014 that allowed a cushion to the Government and the excise duty on petrol and diesel has been increased. This has led to petrol

price in Mumbai breaching Rs. 80 per litre mark, completely reversing the impact of excise duty cut announced by Government in Oct. 2017.

- The drop in oil prices in recent years has been favourable for India. Moreover, increased foreign capital inflows in recent years have helped India amass a large Foreign Exchange reserve position, making India balance of payments position comfortable. As per EIA, India's oil demand is expected to go up from the present 6mb/d to 9.8m b/d by 2040 which will give rise in oil imports – presently around 82% of the total oil demand. Despite the collapse in oil prices in the past four years, India still spent $70bn on the imports in 2016-17 i.e. about a fifth of its total import outlay.
- Although India as a major oil importer, it need not be worried by increase on the prices, specifically in view of substantial global oversupply. The availability of cheap shale oil from the US is tempting the Indian refiners, and even after factoring the shipping costs, the increasing US crude output will continue to make it more attractive and cost competitive for Indian importers. Thus, as options of exports from US open up, India's energy security is expected to improve by diversifying sources of supply. In addition, India has been complaining long about paying a premium for it's imported crude from OPEC members, compared to the European and US importers. Efforts are being made such that the producer group treats Asian buyers "as primary markets", and are not treated unfairly.
- Indian energy consumption has surged by around 6% per year over the past decade. With consistently high GDP growth of around 7% for the past few years, the country's energy demand is set to increase in the next few decades, possibly faster than any other major economy. As population grows, incomes rise and industries expand, coupled with booms in telecoms and automobile sectors, the demand for fuels is set to go up.
- With due consideration of keeping a watch on the India's energy security, the Energy Division of Niti Udyog has developed IESS 2047 (Indian Energy Security Scenarios), comprising of likely energy demand and supply scenarios. This dynamic energy scenario building tool has been developed to create multiple scenarios with different combinations of levels/ efficiencies of energy demand and supply sectors, with the capability to aggregate the choices of energy demand and supply and suggest measures to shift the energy pattern. The tool is capable of generating information as to what percentage of the total energy supply will be met by imports under different scenarios, by segregating the demand for energy by sectors and the supply numbers by sources.
- In addition, the developed and developing economies including India are gradually moving to 'alternative', renewable energy sources such as solar, wind and hydro power etc., besides use of natural gas as options in the energy basket.

GAS

US LNG EXPORTS AND TRADE SANCTIONS

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ABSTRACT

India has strategic ties with Iran and Russia. Both these countries are facing increasing trade sanctions from USA. Secondary sanctions could be imposed on India for specified dealings with these countries. While specific impacts are not yet clear, the threat of such sanctions exists.

India has signed LNG import contracts with US companies. The paper examines whether these LNG imports would be impacted due to these sanctions, if imposed on India.

Introduction

India has significant political and financial relationship with Iran and Russia. Both these countries have been targeted by USA through trade sanctions either with UN mandate or under US laws.

Recently USA announced its withdrawal from Joint Comprehensive Plan of Action (JCPOA), better known as the Iran nuclear deal and has threatened to impose toughest sanctions unless the deal is renegotiated to its satisfaction.

JCPOA is a multi-lateral agreement as P-5 of UN Security Council and Germany are also signatories of the agreement. The perceptions of the other signatories so far are not in sync with US approach. The developments in this regard, their effectiveness and implications on other countries will become clear as the days go by.

India has strategic stakes in Iran particularly investment in Chhabbar Port and import of crude oil.

Similarly US has imposed sanctions on Russia. India has long standing relationship with Russia and has been a buyer of defence equipment from them. Recent reports indicate that US may consider secondary sanctions against India with the primary aim to deter India from defence purchases from Russia.

India has signed several agreements for LNG imports from USA. The paper analyses the impact of trade sanctions on LNG exports from USA.

INDIA'S LNG IMPORT COMMITMENTS FROM USA

GAIL India has a deal to buy 3.5 million tonnes per annum of LNG for 20 years from Cheniere Energy and has also booked capacity for another 2.3 million tonnes at Dominion Energy's Cove Point liquefaction plant[1].

Indian Oil Corporation has also signed an agreement with Mitsubishi Corp of Japan for 0.7 million tonnes a year of LNG for 20 years from Cameron LNG project in USA [2]. The total LNG quantity is 6.5 MMTPA or approx. 315.9[3] Trillion Btu per year. Financial commitment to US companies exporting LNG is approx. $ 1.8 Billion per year based on current Henry Hub prices of $2.75/mmbtu and liquefaction fee of $3.0/mmbtu.

INCREASING CRUDE PRICES AND DESIRABILITY OF US LNG FOR INDIA

The fixed cost structure of US LNG, makes it competitive to oil indexed LNG imports in India when the crude prices are high. With the rising crude price (apprx $80/bbl) the DES price of US LNG at India's ports competes well with LNG purchased on spot basis (reported to be in $8.0 - $9.0/mmbtu range for May 2018).

If crude oil prices continue to rise further, US LNG will become more attractive for Indian market and Indian companies may re-seek the LNG deals which they

abandoned in 2015 end due to low crude oil prices.

Thus in the current crude oil scenario, US LNG will be best suited for price sensitive Indian market and the trade volume will rise further either in terms of spot cargo purchases or additional term deals by Indian companies.

US LEGAL SYSTEM

The US Constitution divides the Federal Government into three branches where a system of checks and balances prevents any one branch from obtaining too much power:

The legislative branch, which consists of a bicameral Congress - the Senate and the House of Representatives, with specific powers, most importantly the authority to enact statutes. However, legislation may only be passed for certain limited purposes defined by the US Constitution.

The executive branch is the President who is head of state, head of government, and commander-in-chief. The President appoints cabinet members and other high ranking officers, subject to Senate approval, to administer and enforce federal laws and policies. The President has the authority to sign treaties, but treaties also require Senate ratification.

The judicial branch is in the form of the Supreme Court and those inferior federal courts created by Congress. Federal courts are competent to hear the cases that arise under the US Constitution, federal laws and regulations and treaties. Other cases may be heard in federal courts depending on the parties to the case.

LEGAL FRAMEWORK FOR TRADE SANCTIONS[4]

Sanctions policy may originate in either the executive or legislative branches. Presidents typically launch the process by issuing an executive order (EO) that declares a national emergency in response to an "unusual and extraordinary" foreign threat, such as "the proliferation of nuclear, biological, and chemical weapons.

President has special powers pursuant to the International Emergency Economic Powers Act (IPPEA) to regulate commerce with regard to that threat for a period of one year, unless extended by him/her or terminated by a joint resolution of Congress.

Congress, for its part, may pass legislation imposing new sanctions or modifying existing ones. Congressional and executive action may be required to alter or lift the restrictions.

For the most part, US sanctions programs are administered by the Treasury Department's Office of Foreign Assets Control (OFAC), while other departments, including State, Commerce, Homeland Security, and Justice, may also play an integral role.

Several laws delegate embargo power to the President[5]

- Trading with the Enemy Act of 1917
- Foreign Assistance Act of 1961
- International Emergency Economic Powers Act of 1977
- Export Administration Act of 1979

Several laws specifically prohibit trade with certain countries:

- Cuban Assets Control Regulations of 1963
- Cuban Democracy Act of 1992
- Helms–Burton Act of 1996 (Cuba)
- Iran and Libya Sanctions Act of 1996
- Trade Sanctions Reform and Export Enhancement Act of 2000 (Cuba)
- Iran Freedom and Support Act of 2006
- Comprehensive Iran Sanctions, Accountability and Divestment Act of 2010

The most potent of these Acts was passed by the Congress and signed by President Trump in July 2017. The act is called "Countering America's Adversaries Through Sanctions Act" (CAATSA). This Act is in three sections, one each dealing with Iran, Russia and North Korea. The Act provides for mandatory sanctions and restricts Presidents ability to dilute the sanctions or waive them. The Act also has the provision for secondary sanctions on states or non-US persons having significant transactions with the Russian defense and intelligence sectors.

SECONDARY SANCTIONS ON INDIA

Considering India's dependence on Russia for defense supplies including spare parts for maintenance, it will be difficult for India to completely dissociate itself from Russia's defense sector. Technically, India could come under secondary sanctions unless same are waived by President Trump.

LNG EXPORT AUTHORIZATION PROCESS AND CONDITIONS[6]

For exporting LNG, a project proponent has to obtain an authorization from the Office of Fossil Energy of the Department of Energy (DOE/FE) under section 3(a) of the Natural Gas Act (NGA). The entity seeks long-term, multi-contract authorization to export domestically produced liquefied natural gas (LNG) by vessel to nations with which the United States has not entered a free trade agreement (FTA) providing for national treatment for trade in natural gas (non-FTA countries). The entity can export this LNG on its own behalf and as an agent for other entities that hold title to the LNG, after registering each such entity with DOE/FE.

Section 3(a) of the NGA sets the standard for review Export Authorization Application:

"…[N]o person shall export any natural gas from the United States to a foreign country or import any natural gas from a foreign country without first having secured an order of the [Secretary of Energy46] authorizing it to do so. The [Secretary] shall issue such order upon application, unless after opportunity for hearing, [he] finds that the proposed exportation or importation will not be

consistent with the public interest. The [Secretary] may by [the Secretary's] order grant such application, in whole or part, with such modification and upon **terms and conditions** as the [Secretary] may find necessary or appropriate …"

Two things stand out from the above provisions:

- DOE/FE must certify that export of LNG from the project is consistent with public interest
- Authorizations are conditional to project complying with all terms and conditions of the authorization.

While public interest is not defined, DOE/FE has identified the factors like economic impacts, international impacts, security of natural gas supply, and environmental impacts amongst others as key determinants. The international impacts identified are :

- Beneficial impact for the United States on its balance of payments
- Diversification of global supply
- Promote the liberalization of contract structures in global LNG markets by lowering the cost of energy in foreign nations, thereby fostering economic growth abroad and creating demand for U.S.-sourced goods and services
- Promote greater national security by expanding American influence in international energy markets while enabling greater production in domestic petroleum basins
- Increase economic trade and ties with foreign trading partners and hemispheric allies,.

LNG exports from US therefore not only are based on commercial considerations but also have many policy implications for extending US influence and leverage in energy markets. The export authorizations are issued with large number of conditions on reporting operations etc etc. The focus in this article is on the conditions which may facilitate bringing such authorization under trade sanctions regime.

In the DOE/FE order no. 3638, May 12, 2015 granting LNG export authorization to Corpus Christi Liquefaction Project following conditions are included:

"….F. This LNG may be exported to any country with which the United States does not have a FTA requiring the national treatment for trade in natural gas, which currently has or in the future develops the capacity to import LNG, and with which **trade is not prohibited by United States law or policy.**

G. CMI shall ensure that all transactions authorized by this Order are permitted and lawful under United States laws and policies, including the rules, regulations, orders, policies, and other determinations of the **Office of Foreign Assets Control (OFAC) of the United States** Department of the Treasury and FERC. Failure to comply with this requirement could result in rescission of this authorization and/or other civil or criminal remedies. …"

It may be noted OFAC is one of the prime agency for implementing trade sanctions. It may therefore be concluded that legal framework exists to bring LNG export Authorization under Trade Sanctions.

LIKELIHOOD OF SECONDARY SANCTIONS AGAINST INDIA

There is still time for USA to impose secondary sanctions. The matter is under discussions at highest level between Govt. of India and Govt. of USA. The final outcome of these discussions will be known in due course. However, several articles on the subject opine that secondary sanctions may not be imposed on India. Some of the reasons cited are:

- India is a strategic partner of USA and CAATSA objective is to impose sanctions on Russia and not on India.
- India is important in US strategy to counter China's influence in the region.
- The sanctions would have a negative impact on development of Chabbar Port in Iran by India. This is targeted as the main supply line to Afghanistan from India.
- India's defense procurements from USA are increasing. Post sanctions US defence industry would therefore loose out.
- India has historical dependence on Russia for defense supplies. India needs to procure the spares to keep the defense systems operational. Sanctions on India would push India more towards Russia for defense supplies.
- EU countries are dependent on Russia for oil and gas supplies and thus it would hurt EU's interest if sanctions are imposed on them. The support of EU for these sanctions may be difficult to obtain.

The effectiveness of the sanctions would largely depend on the support US is able to garner from other countries.

IMPLEMENTATION OF TRADE SANCTIONS ON LNG EXPORT

Secondary trade sanctions are imposed on States and individual entities. It is likely that even if India comes under secondary sanctions, Indian LNG Buyers may not be put on the list.

Indian companies have bought LNG from US either as a primary buyer from the project like GAIL in Sabine Pass and Dominion Cove Point LNG Projects or as a secondary buyer like IndianOil from Cameron project.

In case the sanctions are extended to Indian companies, GAIL as a direct buyer may have higher consequences in terms of cancellation of registration etc. IndianOil in all probability will not be a registered buyer with DOE/FE and thus the transaction between IndianOil and Diamond Gas may continue unaffected. This is based on assumption that a non US company would not come under secondary sanctions for dealing with a company belonging to secondary sanctioned country.

Another issue in implementation of these sanctions is the authorization itself. Single authorization is given to project proponent and the same is not split amongst buyers. Rescission of authorization would therefore be difficult.

In addition to above, there may be commercial implications which will have to be settled with in framework of individual agreement.

From Indian standpoint, even if LNG exports to India are stopped, India may get LNG supplies from alternate sources. India is an emerging market for LNG imports and is actively pursued by LNG producers and suppliers. Further India has a growing unease to buy on Henry Hub basis as domestic market was not willing to take the align index risk. With crude prices moving up and shipping rates being low, the LNG from US may be accepted by Indian market. In low crude ricing scenario there will be no takers for this LNG. Trade sanctions, if these lead to termination of agreements, may even be welcomed by Indian companies.

CONCLUSION

India has considerable exposure to US LNG. In high crude oil price scenario, the US LNG can compete with LNG from other locations in terms of the price. Technically the LNG exports from US could come under trade sanctions if secondary sanctions are imposed on India under CAATSA. It is debatable if such sanctions will be imposed and will they be effective and serve US interests or be detrimental to them.

If trade sanctions are applied to LNG exports to India, it may not be a worrisome for India, both in terms of availability of alternate LNG and more acceptable crude oil linked price index which is more acceptable to Indian consumers.

1 GAIL seeks reworking of US LNG contract - PTI | Dec 20, 2017, 17:27 IST

2 IOC signs agreement to buy 0.7 MT LNG a year from US - Press Trust of India | New Delhi Last Updated at May 29, 2015 22:13 IST

3 https://www.qp.com.qa/en/Pages/ConversionFactor.aspx

4 https://www.cfr.org/backgrounder/what-are-economic-sanctions

5 United States embargoes- Wikipedia

6 FINAL OPINION AND ORDER GRANTING LONG-TERM, MULTI-CONTRACT AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS BY VESSEL FROM THE PROPOSED CORPUS CHRISTI LIQUEFACTION PROJECT TO BE LOCATED IN CORPUS CHRISTI, TEXAS,TO NON-FREE TRADE AGREEMENT NATIONS - DOE/FE ORDER NO. 3638, May 12, 2015

TECHNOLOGY

BLOCKCHAIN: THE FUTURE IS HERE

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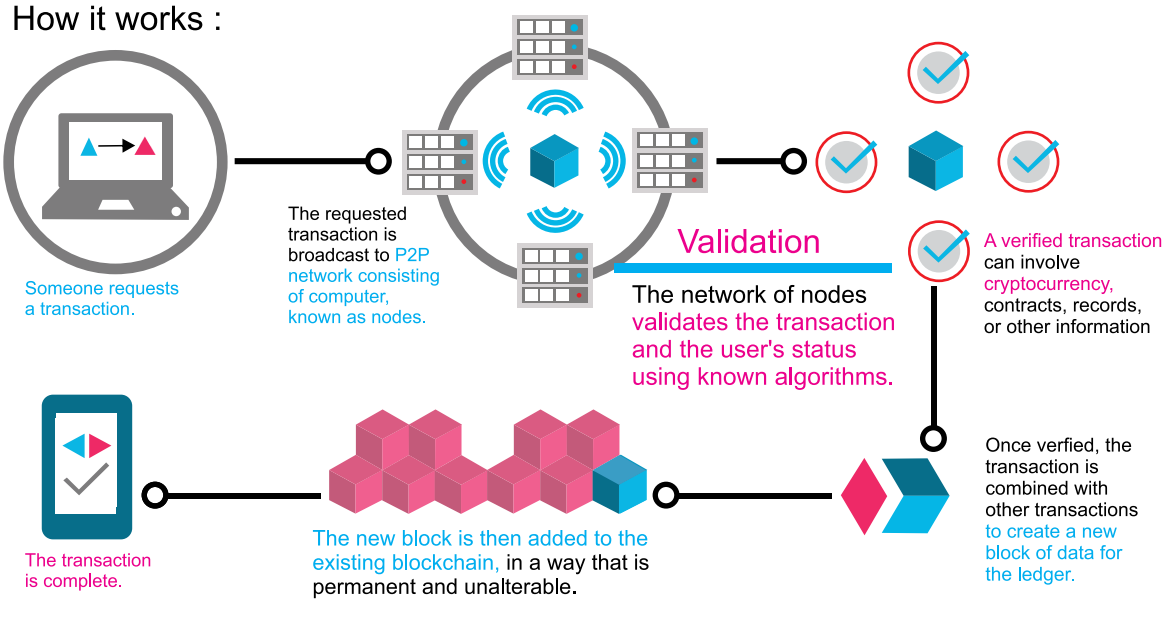
INTRODUCTION

The concept of blockchain was first introduced by "Satoshi Nakamoto" (whose true identity is still unknown) in a paper published in October 2008 titled "Bitcoin: A Peer-to-Peer Electronic Cash System", which further led to the release of first bitcoin software and the bitcoin crytocurrency in January 2009. Blockchain was initially introduced as the backbone of a peer to peer electronic cash transaction system, but now owing to its widespread applicability across various sectors, it is being touted as the next biggest invention after the internet.

Blockchain is a distributed secure ledger or database of records of all public transactions that have been executed and shared among participating parties over a network. The blockchain contains verifiable records of all transactions ever done, and each transaction in the public ledger is verified by a majority of participants in the system itself, without needing a third party authentication. Over the course of time, blockchain has found its application in various sectors such as supply chain, energy healthcare, insurance, transportation, voting, contract management and more. The figure below shows a transaction over a blockchain network.



UNDERSTANDING THE BLOCKCHAIN TECHNOLOGY

In its simplest form, a blockchain acts like a shared, replicated, append-only database (record of all transactions carried out) where write access is shared among participants, but validation is performed by all or majority of participants in the system. Since the blockchain technology is still new and developing, standardization of elements of the technology is not possible, however the elements that are common to most blockchain systems are:

- A data store, usually containing financial transactions, but could contain any type of data
- Data replication across a number of systems in real-time
- Peer-to-peer network topology instead of hierarchical client-server models
- Usage of cryptography and digital signatures to prove identity, authenticity and enforce read/write access rights
- Mechanisms that make it hard to change historical records, and make it easy to detect when someone attempts to do so

UNDERSTANDING THE CONCEPT: ANALOGY OF BLOCK CHAIN AS GOOGLE DOCS

"The traditional way of sharing documents with collaboration is to send a Microsoft Word document to another recipient, and ask them to make revisions to it. The problem with that scenario is that you need to wait until receiving a return copy before you can see or make other changes because you are locked out of editing it until the other person is done with it. That's how databases work today. Two owners can't be messing with the same record at once. That's how banks maintain money balances and transfers; they briefly lock access (or decrease the balance) while they make a transfer, then update the other side, then re-open access (or update again). With Google Docs (or Google Sheets), both parties have access to the same document at the same time, and the single version of that document is always visible to both of them. It is like a shared ledger, but it is a shared document. The distributed part comes into play when sharing involves a number of people.

Imagine the number of legal documents that should be used that way. Instead of passing them to each other, losing track of versions, and not being in sync with the other version, why can't *all* business documents become shared instead of transferred back and forth? So many types of legal contracts would be ideal for that kind of workflow. You don't need a blockchain to share documents, but the shared documents analogy is a powerful one."

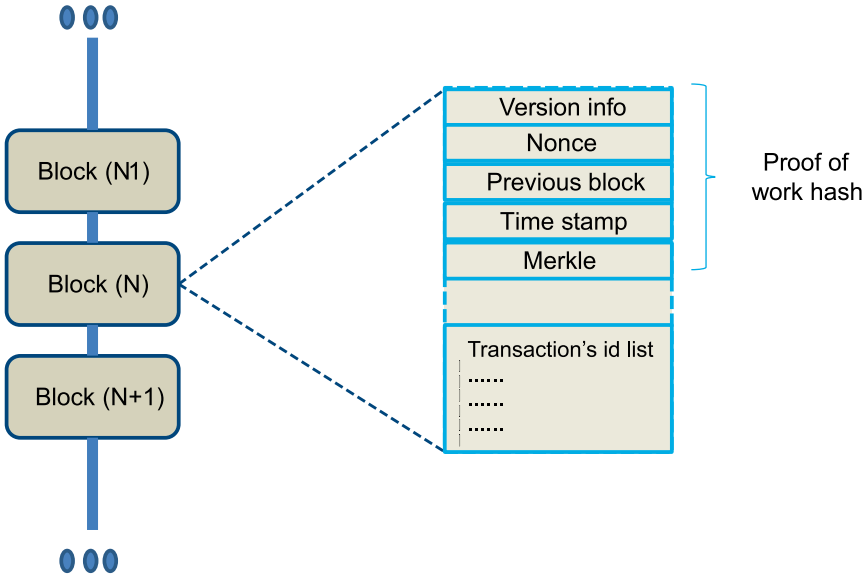
~ William Mougayar, Venture Advisor, Strategist & blockchain specialist

To further simplify, imagine a spreadsheet that is shared with millions of users on a network that are connected with each other over the internet. Every time any transaction happens, it gets recorded on a row in the spreadsheet. Anyone that is connected to this network can access the spreadsheet to view and add a transaction but the spreadsheet doesn't allow anyone to modify/edit the information that is already there.

BREAKING THE BLOCK

A blockchain consists of a series of blocks which contain details of all transactions records. Each block has components which gives the block its unique identity.

- **Genesis block:** The first block in the chain is called the genesis block or block 0. Every block in a blockchain can be traced back to the genesis block.
- **Hash:** Every block in a blockchain is linked to the previous block using a hash in the block header. Hashing is a way of encrypting the block by taking the hash of previous block as an input, running the hashing algorithm and generating a hash for the current block which acts as a digital fingerprint for the block.
- **Time Stamp:** Keeps track of the time of creation of the data. In a recent patent application by Xerox, it has indicated a desire to create a Blockchain-based timestamp protocol for data such as copies or pictures. The timestamp would be irrevocable, meaning that the data could then be admissible in courts as evidence.
- **Merkle tree root:** is a data structure to summarise the transactions in the block.
- **Nonce:** For each block there is a nonce, it is a number that is used once for a transaction. This means that the same encrypted value cannot be used for another transaction.



TYPES OF BLOCKCHAIN NETWORKS

The idea of blockchain initially propounded through cryptocurrencies such Bitcoin, Ethereum etc. was of a public decentralized ledger. However with development of technology and its applications, blockchain networks have branched out into public, private and consortium Blockchains.

- **Public blockchain:** Public blockchains are open for all. Anyone can join them carry out transactions and to participate in the mining and consensus process of adding new block of transaction to the blockchain. These types of blockchain are open and transparent hence anyone can review anything at a given point of time. The decision making or consensus building in case of public blockchains is done by mechanisms such as Proof of Work or Proof of stake.

Proof of Work (PoW)

- It is a consensus algorithm that is used to confirm transactions and add new blocks to the chain. PoW requires large mathematical calculations to be carried out to facilitate transactions over the blockchain. Mining is a process of generating proof of work. The way it works is that all miners compete to find a number that, when added to the block of transactions, causes this block to hash to a code with certain rare properties. Miners validate the transactions within each block, by solving the "proof of work problem" for which they are rewarded.

Proof of Stake (PoS)

- Proof of stake protocol of block verification does not rely on excessive computations thus saving a lot of energy. Unlike the PoW, where the algorithm rewards miners who solve mathematical problems with the goal of validating transactions and creating new blocks, with the PoS, the creator of a new block is chosen in a deterministic way, depending on its wealth, also defined as stake. It is believed that a node with more currency would be less likely to attack the network.
- **Private Blockchain:** These types of blockchains are built by specific organizations where write permissions are kept to one organization whereas read permissions may be public or restricted to few participants. The private blockchains have much more flexibility as compared to public blockchains, as rules can be altered easily based on the requirements of the network; they also present more privacy and present opportunities for altering transactions.
- **Consortium or federated Blockchain:** This type of blockchain tries to remove the sole autonomy which gets vested in just one entity by using private blockchains. There may be a group of companies or representative individuals coming together and making decisions for the best benefit of the whole network.

IMPLEMENTATION OF BLOCKCHAIN TECHNOLOGY

The first implementation of blockchain technology was seen through its application in cryptocurrencies such as Bitcoin, Ethereum, altcoin etc., but the underlying architecture of the blockchain system does not limits its usage in payment transactions. It has found usage in many sectors such as supply chain, energy, healthcare, insurance, transportation, voting, contract management and many more. Few of the sectors that are gaining momentum with blockchain technology application are:

- **Asset Management; Trade processing and settlement:** Traditional trade processes within asset management (where parties trade and manage assets) can be expensive and risky, particularly when it comes to cross-border

transactions. Each party in the process, such as broker, custodian, or the settlement manager, keeps their own records which create significant inefficiencies and room for error. The blockchain ledger reduces error by encrypting the records. At the same time, the ledger simplifies the process, while canceling the need for intermediaries.

- **Digital Payments:** Blockchain technology has simplified the process of cross border payments. Issues such as money laundering, high transaction costs, and errors can be done away with the use of this technology. Financial institutions are deploying blockchain technology in areas such as KYC process, trade management, in capital markets etc. Its most prominent use is encountered in significantly reducing high transaction costs due to authentication required by third parties.
- **Smart Contracts:** These are computer codes running on blockchain consisting of set rules, under which the parties to that smart contract agree to interact with each other. If and when the pre-defined rules are met, the agreement is automatically enforced. Smart contracts can be used across sectors ranging from healthcare, insurance, traditional lending system, to mortgages.
- **Healthcare:** Blockchain can be used in drug traceability, where each transaction between drug manufacturers, wholesalers, pharmacists and patients can be tracked to verify and secure drug product information important for tackling issues such as counterfeit drug. It can be used for improvement and authentication of health records and precision medicine where patients, researchers and providers can collaborate to develop individualized care.
- **Supply chain & logistics:** Present supply chain networks are complex and lack transparency. Traceability and transparency are critical for efficient functioning of any supply chain. Blockchain offers shared ledger that is updated and validated in real time with each network participant. It enables equal visibility of activities and reveals where an asset is at any point in time, who owns it and what condition it's in.
- **Internet of Things (IoT):** The interaction of various smart devices can be recorded in the blockchain to increase efficiency and accuracy and reduce costs. Blockchain technology could provide a simple infrastructure for two devices to directly transfer a piece of property such as money or data between one another with a secured and reliable time-stamped contractual handshake. To enable message exchanges, IoT devices will leverage smart contracts which then model the agreement between the two parties. This feature enables the autonomous functioning of smart devices without the need for centralized authority.

APPLICATIONS IN ENERGY SECTOR

Along with applications mentioned above, blockchain technology is actively being pursued in energy sector. Its critical features such as digital public ledger, security, record verification and consensus building and smart contracts can be effectively applied in various use cases in energy sector. Few of such user applications of blockchain in energy sector are:

- **Grid management:** With renewable power generation, grid stability at local and national levels is a key concern. Direct peer to peer trading of power will strengthen the market role of small consumers and producers. This will also increase the share of renewables in power mix, thus shifting away from carbon sources.
- **Commodity and energy trading:** Natix, a company providing blockchain solutions, developed a commodity trade platform for US crude oil transactions. The platform helped in digitalization of crude oil transactions using blockchains, ensuring security, transparency and greater efficiency. Similarly there are other companies which have developed blockchain based energy trading networks. These networks allow for direct peer to peer trade, thereby doing away with exchanges, banks, brokers or other intermediaries, thus saving on transaction costs.
- **Supply chain in oil & gas:** Companies in the oil & gas sector rely on extensive supply chain networks to bring their products and services to market. Their industry network connects suppliers, partners, distributors and customers, and operates across geographies and regulatory boundaries. Adoption of blockchain technology will enable faster, permissioned, immutable, transparent and auditable business-to-business interactions between companies and their suppliers, distributors, financial institutions, or regulators. Such integration will reduce the risk of errors and make the contracts binding. Tracking of goods, pre-ordering, inventory management etc. when carried over a blockchain network will result in lower human interaction, cost and time savings.

Other application of Blockchain in energy and oil & gas industry exists in the areas of: Capital projects, Commercial trades/deals and service execution contracts, Supply chain/pipeline/logistics/shipping/procurement, Marketing and loyalty programs (for example gas points, movie tickets, upgrades and more), Trading in carbon emissions (Enabling oil commodities investment trading in carbon emissions), Cryptocurrency integration to existing gas stations, Joint-venture data/accounting, Transfer

pricing, Disputes/settlements, Divisional orders, Land royalties , Production sharing, Shareholder voting etc.

INVESTMENTS IN BLOCKCHAIN BY GOVERNMENTS

In a recent study carried out by IBM's Institute of Business value, entitled "Building trust in Government", revealed that the majority of public officials who participated in the survey are likely to pursue blockchain development in in future. The survey spanned 200 government leaders from 16 countries, suggesting that 90 percent of government organizations plan to invest in blockchain technology in the near future. It was indicated in the survey that government agencies are actively looking into the applicability of blockchain technology in the fields of financial transaction management, asset management, contract management and regulatory compliance. Few of the major announcements made by government agencies for investment in blockchain based applications are given in table below:

S.No.	Country/Investor	Type of investment	Amount of investment
1	China - Huobi Group	Building a public blockchain platform for the company's future operations, laying the infrastructure to allow millions of potential customers to access functions that rely blockchains	$100 million
2	China - The People's Bank of China	Plans to incorporate blockchain technology on a grand scale, using the platform's ability to verify transactions as a way to replace paper checking systems altogether	N.A.
3	China - Shenzhen, Guangdong	Established a new local government-backed fund focused on blockchain investments	$ 79.4 million
4	China – Hangzhou - The Xiong'An Global Blockchain Innovation Fund	Investments in blockchain startups	$ 1.6 billion
5	Australia - National Australia Bank	Investment in blockchains for foreign exchange payments	$ 24 million
6	United States	In various areas	$ 1.3 billion
7	U.K.'s Non- departmental Public Office	Projects which will result in new products or service in the fields of emerging and enabling technologies, including using distributed ledgers	$ 26.6 million
8	Innovate UK	New projects based on emerging technologies such as distributed ledgers	£ 19 million
9	U.K.'s Fintech Sector	Financial technology	£ 1.3 billion
10	Enterprise Ireland and SGI Innovate	Delivering aid to refugees camps	€ 1 million

Source: Industry reports

CONCLUSION

Blockchain has shown its potential for transforming traditional industry with its key characteristics: decentralization, persistency, anonymity and auditability. While blockchain's highest-impact application is Bitcoin and similar cryptocurrencies, the potential impact of the technology is much greater and wider than in cryptocurrencies. Newer areas of application are cropping up every day with the rising interest of Governments, investors and individuals in the subject. Significant investments are being made for development of blockchain based technologies across various sectors.

Companies across the globe have started evaluating cases where blockchain technology will bring benefits to their business. To keep up with the future and match the pace at which digital transformation is happening globally, especially in the field of blockchain based applications, it becomes vital for companies in India to plan for implementation of this technology in where it generates benefits. While the technology of blockchain is developing rapidly and its outreach is increasing every day among individuals, organizations & governments, the adoption of Blockchains will require effective policies, frameworks, and government support for breaking the barriers.

FINANCE

BUDGET 2018 – DIRECT TAX IMPACT ON OIL AND GAS SECTOR

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The Finance Minister introduced Budget 2018[1] in the backdrop of challenging economic environment coupled with decelerated Gross Domestic Product ('GDP') growth and increase in fiscal deficit. The Budget had to walk a tight rope to balance growth with prudent fiscal balance. The Budget sought to address these objectives through increased spending on infrastructure sector, support to agricultural sector, policy measures and through tax concessions to the Small and Medium Enterprises (SMEs).

The entities in the Oil and Gas sector in India operate through different business models and operate in a highly cost competitive scale. Thus, it would be worthwhile to examine tax effects which the amendments in the Budget may have on their operations. From direct tax perspective, we have discussed below key amendments which may impact the business, operating structures and direct tax cost associated with it.

I. CHANGE IN TAX RATES

To provide fillip to SMEs, the base tax rate for domestic companies having turnover upto INR 250 crores in Financial Year (FY) 2016-17 has been reduced to 25 per cent. The base tax rate of other domestic and foreign companies has been unchanged to 30 per cent and 40 per cent respectively. Tax on book profits, i.e. Minimum Alternate Tax ('MAT'), has also remained unchanged to 18.5 per cent. It has been clarified that MAT is not leviable on the income earned by foreign companies rendering services to entities undertaking exploration and production activities in India, if such foreign companies offer their income to tax on presumptive basis.

Existing cess of three per cent[2] has been increased to four per cent[3]. The revised tax rates are summarized in the table below.

Description	Tax rate[4]	MAT[4]
A) Domestic company		
i. Companies having turnover upto INR 250 crores in FY 2016-17		
ii. Manufacturing companies set up and registered after 1 March 2016[5]	29.12%	21.54%
iii. Other companies	34.94%	21.54%
B) Foreign company		
i. Taxable on net profits	43.68% on net profit	20.20%
ii. Taxable on gross receipts	4.368% on gross receipts	Not applicable

It would be worthwhile to note that application of rate of 25 per cent has not been specified for certain situations. For e.g. it has not been clarified whether reduced rate of taxes would apply to:

- a company incorporated after 31 March 2017, since such company would not have any turnover in FY 2016-17; or

- a company which was in existence in FY 2016-17 but business of which did not commence in FY 2016-17.

One may contend that the intent of the amendment was to provide benefit to domestic companies and hence the application of such reduced rate of taxation needs to be interpreted in liberal manner. However, one needs to be cautious of the fact that different factual pattern of the business may lead to different interpretation of applicability of such reduced rate. Accordingly, a thorough analysis needs to be undertaken to ascertain tax rates applicable to a particular company.

II. SIGNIFICANT ECONOMIC PRESENCE ('SEP')

As per the Income-tax Act ('the Act'), business income of a non-resident is taxable in India if it has physical nexus in India i.e. if the business is connected with operations of non-resident carried out in India or if the income is earned through an agent in India. The Act did not recognize economic nexus as a criterion for determination of tax liability of a non-resident, for e.g. if a foreign company sold applications on mobile device, such income was not taxable in India in the absence of physical presence of such foreign company in India. This difference created anomaly where the companies having physical presence were making payment of taxes, whereas companies doing business through digital mode were not paying taxes in India.

To address such situation, Budget has expanded the scope of taxation of non-residents and considered SEP as criterion to determine taxability of their income in India. As per the amendment a non-resident shall have a SEP in India if:

i) monetary value of any transaction/s for goods, services or property carried out by such non-resident in India[6] exceeds a prescribed amount; or

ii) the non-resident does systematic and continuous soliciting of its business activities or engages in interaction with prescribed number of users in India through digital means.

It is worthwhile to note that though the intention of introduction of SEP is to tax digital business, the definition of SEP is very wide and could cover any transaction of goods, services and property within its ambit as long as it exceeds specified user base[7] or revenue limit[7].

This amendment could have an impact on supplier of crude oil and gas in India whose supply exceed the prescribed revenue criteria, if the income tax authorities contend that such transaction has been carried out in India. In this case, profits earned by such suppliers could be considered as taxable in India. Other entities which could be impacted by the aforesaid amendment could be foreign companies who supply their products digitally (for e.g. companies providing digital solution products) in India.

It is important to note that the foreign companies from countries having tax treaties[8] with India can claim that since the taxing rules prescribed under tax treaties are not changed, SEP could not be a valid criteria for levy of taxes on the profits earned by such foreign companies. Accordingly, such companies may still not be taxable in India unless SEP as a taxing criteria is introduced in the tax treaties. However, this benefit is not available to foreign companies, whose home country do not have a tax treaty with India. If SEP of such foreign companies is considered to be in India then it could have a substantial tax exposure.

In view of the aforesaid discussions, foreign companies would be required to evaluate various aspects such as the quantum of revenue from India operations, the consumer base in India, availability of tax treaty benefit, contractual arrangement for supply of goods or services in India, etc. to ensure that the structure of its operations is tax optimum or there are no unintended tax leakages.

III. TAXABLE PRESENCE THROUGH AN AGENT

Before Budget, if an agent habitually exercised authority to conclude contracts in India on behalf of a non-resident, then such non-resident was considered as having a taxable presence in India through the presence of such agent. Now, it has been clarified that if an agent does not conclude contract but plays a principal role leading to the conclusion of contracts by non-resident, then such agent would also be considered for determining taxable presence of the non-resident. The term 'principal role' is not defined and hence a purposive interpretation needs to be made to determine role of the agent in India.

As explained in SEP above, this amendment would not impact companies which come from countries having tax treaty with India and the tax treaty do not contain the aforesaid amended rule. However, certain tax treaties would have the aforesaid rule in future on account of certain countries (like France, Japan) being signatory to Multilateral Instrument ('MLI')[9], in which case the aforesaid taxing rule would apply for tax treaty with these countries. Also, for companies coming from non-tax treaty jurisdiction, the aforesaid criteria would apply for determination of taxability of foreign company in India.

This amendment may have an impact on companies who undertake their activities

through agents/ subsidiaries in India, who provide marketing support activities. The role of such Indian subsidiaries or agents needs to be examined to ascertain if role played by them could lead to a taxable presence of their principal foreign companies in India.

IV. INCOME COMPUTATION AND DISCLOSURE STANDARDS (ICDS)

In India, taxable income a company was computed on the basis of audited financial statements prepared in accordance with Accounting Standards[10] (AS), provisions of the Act and as per the interpretation of provisions given by various judicial authorities.

To reduce litigation on account of the difference in interpretation of provisions and applicability of AS, ICDS were issued by the Central Board of Direct Taxes. It is now mandatory for a company to compute its taxable income as per ICDS. However, certain provisions of ICDS led to ambiguity as they were in conflict with settled judicial precedents and hence these provisions were stuck down by Delhi High Court as ultra-virus the Act. To give statutory backing to such provisions, a number of amendments have been made in the Budget.

Notable among such amendments is the provisions relating to treatment of foreign exchange loss. In a number of judicial pronouncements it has been held that foreign exchange difference on account of trading liability is revenue in nature and hence such foreign exchange gain or loss has to be considered while computing taxable income of a tax payer. On the other hand, foreign exchange difference on account of capital items were considered as capital in nature and hence were not to be considered for determination of taxable income. The amendment in ICDS now does not recognize the aforesaid difference[11]. Thus, it would be worthwhile analyzing what impact could arise on account of such amendment. One such example is whether foreign exchange loss on account of foreign currency borrowing made to build an Oil Refinery in India could be considered as revenue expenditure as per ICDS or be treated as capital expenditure as held by number of decisions of Apex Court.

Apart from above, there are number of amendments introduced to address situations like deductibility of mark to market gains or losses, determination of income of service companies, valuation of inventories, etc. It is pertinent to examine these amendments in detail and the impact it could have on the taxable income of a taxpayer.

V. EXEMPTION OF INCOME OF FOREIGN COMPANY FROM SALE OF LEFTOVER STOCK OF CRUDE OIL

In order to encourage participation of foreign private players to store their crude oil in India and to build up strategic oil reserves, following income of such foreign company were exempted:

(i) Income on account of storage of crude oil in a facility in India and sale of crude oil therefrom to any person resident in India, if the same is pursuant to agreement/ arrangement with the Central Government or;

(ii) Income from sale out of the leftover stock of crude after the expiry of said agreement or the arrangement[12].

As can be seen from (ii) above, the exemption was only available with respect to sale out of the leftover stock of crude after the expiry of the agreement. The benefit of exemption is now extended to even sale of the leftover stock of crude in case of termination of the said agreement/ arrangement in accordance with the terms mentioned therein.

VI. DIVIDEND DISTRIBUTION TAX ('DDT') ON DEEMED DIVIDENDS

Provisions of the Act considered certain type of loans and advances to related party as deemed dividend to the shareholders. These deemed dividend were till now taxable in the hands of the shareholder or the recipient at the applicable tax rate.

These provisions are now amended and these deemed dividends would now be taxable in the hands of the company providing loans and advances. The tax would be covered under the scope of DDT and would be levied at the rate of 30 per cent[13].

VII. FACILITATING INSOLVENCY RESOLUTION

The Insolvency and Bankruptcy Code, 2016 (IBC) has been introduced for consolidating and amending the existing laws relating to reorganization and insolvency resolution in a time bound manner. The Budget has provided following relief for facilitating insolvency resolution.

Relaxation in computation of book profits for MAT

MAT is an alternative tax on companies, whose tax liability on the book profits is more than the tax liability computed on the profits computed under the provisions of the Act.

As per existing MAT provisions, while computing book profits, a deduction to the extent of lower of the amount of loss brought forward or unabsorbed depreciation as per books of account,

is provided. Consequently, where either the loss brought forward or unabsorbed depreciation is Nil, the companies are not able to avail any deduction from book profits. This restriction is relaxed by the Budget for companies under the IBC. As per the amendment where a company's application for corporate insolvency resolution process under IBC has been admitted, the total amount of loss brought forward and unabsorbed depreciation would be reduced while computing book profits for computation of MAT.

Benefit of carry forward and set off of losses

Existing provisions of the Act restricted carry forward and set-off of losses applicable to closely held companies in case their shareholding changed by more than 49 per cent. Generally, shareholding of the companies under IBC changes beyond this limit. This restriction acted as a hurdle for restructuring and recuperation of such companies. Budget has now relaxed this restriction and accordingly if the resolution plan is approved, the said restriction shall not apply for such companies[14] and they would be eligible to carry forward losses.

VIII. TAXATION OF LONG-TERM CAPITAL GAINS ON SALE OF LISTED EQUITY SHARES ETC.

As per the amendment in Budget, long-term capital gains on transfer of listed equity shares or units of an equity oriented fund or a business trust would be taxed at concessional rate of 10 per cent.

The oil and gas industry is no stranger to strategic transactions, such as consolidations to joint ventures, carve-outs, strategic alliances, acquisitions, etc. Thus the impact of the amendment needs to be taken into consideration while evaluating business acquisitions, new investments, etc. which involves transfer of shares of a listed company.

As discussed above, Budget has brought cheer to tax payer by reducing tax rates, providing tax reliefs for entities undergoing insolvency proceedings, etc. However, certain amendments may have significant tax implications if structure of the business or transaction is not evaluated appropriately. Thus, it would be prudent for the tax payers to re-look at their operating and transaction structures to avoid any unintended tax leakages.

The information contained herein is of a general nature and is not intended to address the circumstances of any particular individual or entity. No one should act on such information without appropriate professional advice after a thorough examination of the particular situation.

[1]The Finance Bill, 2018 has received the President's assent on 29 March 2018 and the new Finance Act 2018 is effective. The amendments are applicable for Financial Year 2018-19.

[2]for primary and secondary education

[3]health and education cess

[4]Maximum marginal tax rates

[5]Subject to fulfillment of specified conditions

[6]including provision of download of data or software

[7]yet to be prescribed

[8]The tax treaty benefits could be obtained by a foreign company only if the foreign company has a valid Tax Residency Certificate and has commercial substance in the home country.

[9]MLI is an instrument signed by several countries to prevent treaty abuse, improve dispute resolution, prevent artificial avoidance of PE and neutralize the effects of hybrid mismatch arrangements. It shall operate alongside existing treaties.

[10]issued by the Indian Institute of Chartered Accountants of India

[11]except for exchange difference on the foreign assets purchased from foreign borrowing

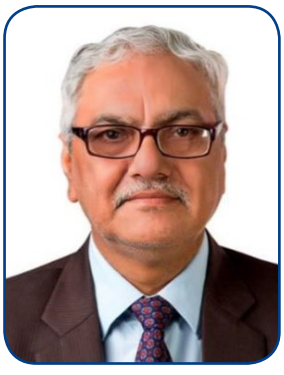
[12]subject to certain conditions

[13]plus applicable surcharge and cess

[14]subject to meeting certain conditions

HUMAN RESOURCES

ORGANIZATIONAL LEADERSHIP IS THE REFLECTION OF YOUR VALUES



Sanjay Gupta
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Human beings are endowed with enormous qualities. Sensitivity, action, guidance, dedication, reaction, love and sacrifice are all positive attributes, which contribute immensely towards the development of persona and the growth profile of an individual for enabling him or her, to undertake the rigours of life successfully or otherwise.

It actually starts a little early in life, particularly in the ***formative stages of an individual's profile, wherein the concept of life, wisdom, knowledge and values are ingrained in the hearts and minds of human beings.*** It is from here that the journey commences. Recalling the past can be a mixed feeling but the truth is, that the past is the precedence to future and actually, ***what unfolds in life is bound to be a reflection, somewhat to the basic tenets of life that we tend to pick up early in life.***

THE EARLY DAYS

The home and family is the first institution, which really begins to mould us in a manner that we would find ourselves finally evolving into. ***The basic values of life in terms of the message to spread love, kindness, truth and honesty are our first teachings.*** Irrespective of our background these values are essentially the ones which are perhaps, imparted to one and all, in early childhood. Certainly, ***all parents and family members, commence the process of preparing us for taking the cudgels from hereon, to launch ourselves in real life.***

Primary schooling and basic education is more of an extension of home, in a way, where the definition of the family begins to extend and expand. It is here, that the first brush with the external world commences. Children from different hues and backgrounds, and guides and teachers with different knowledge and experience base, begin the process of enlightening our minds. This is the time, when our minds are at their sharpest best. The receptiveness is high and the ability to react, question and decipher also is probably at its highest level. ***The first taste to mental Organisational build up therefore, commences from here***. On the one hand the knowledge lamps are lit up and the information flow begins to enhance and hone the mental faculties with real time exposure. On the other hand, the softer side of us begins the process of visiting and revisiting itself. ***It is in this phase of our life, that our beliefs and convictions begin to make home in our hearts so to say.*** It is here, that personality begins to accost us for the first time in its real form. The mind begins to draw distinction between what is right and not so right and queries of all kinds begin to take shape. ***The search begins, both in the real world to acquire the basic tenets of sustenance and on a more holistic level, silently the subconscious begins to perfect our basic values. Yes the exposure to real life begins early.***

The early influences of home, family, parents, upbringing, exposure to school, values and environment ***have a deep influence on us where the heart begins to soar with ambition, whereas, the mind sustains to control the momentum to enable channelizing the energies towards an objective goal linked closely with our lives.*** It is here and now that the agenda for the future begins to take shape in the haziest of forms deeply influenced by the external environment. The impressionable mind at this stage reacts predominantly to stimuli to adjust, adapt and evolve.

ADOLESCENCE

Childhood to adolescence is a transition. This is the time when the mind and heart is exposed to ***maximum pressures and conflicts.*** The mind though now developed, is still far too impressionable and is guided essentially, by the external influences. Education obviously is a priority in this stage, as the career concerns begin to take toll on the mind. ***This is the stage of life, where every individual learns conflict management. The heart soars to illimitable heights of softer intensities, whereas the mind binds itself to restrain the flight of the ambitious heart to pragmatic levels.*** Careers develop and flourish, while the mind achieves excellence, during adolescence. It is here that the life profile begins to take shape of a career, it is here that the first major steps to future course of life begin to unfold. This is also a stage, where the heart at its softest best, begins to bloom and evangelize. ***The path to college, higher education and career building opens up the fresh and productive minds to the myriad hues of life, to find for themselves a way, in a manner and method that they deem best for their future.***

PROFESSIONAL LIFE AND A BRUSH WITH ORGANIZATIONS

Entry into a college, particularly a professional college, opens up the inherent and latent corridors of personality. Suddenly a home away from home and becoming responsible for all major decisions pertaining to career, finance, growth trajectory, choice of companionship, vision for the future and igniting the ambitions for life become the essence of being. This is the time when a person evolves for entry into the real world. Yes this is also a time to test the values of upbringing and the sweet learnings of childhood. The transformation to manhood or womanhood is nearly complete.

The experience of life in hostel and in an alien atmosphere is the first true test of the basic tenets of life, which are nurtured and nourished in the early facets of life. This apparently, is the time where all the principles of early childhood and family virtues are put to test. ***The brush with life in a professional Institution, is the first experience that an individual is subjected to with respect to professionalism, personality traits, development of inclinations and clarity towards a mission in life.*** These are early days still but the mind is now sufficiently mature and developed ***to indulge in decision making*** linked with the prospects of career, life and livelihood for the times to follow.

The emotional quotient of individuals is now fully grown and the ability to decide for themselves on critical matters related to their basic virtues takes a centre stage. One learns to express himself or herself firmly and with conviction on issues. This is the time when one's own opinions on various issues pertaining to profession, life, social and political interface begin to take shape. This is also the time when one's own perspicacity orients one's persona as a loner and introvert, to a gregarious and outgoing individual. All in all, the basic wherewithal for the easing of an individual into real life takes place. In a way, ***the individuals are ready to launch themselves, with all their accumulated attributes evolved and perfected hitherto, to have themselves tested on the real life turf***

INTO THE PROFESSIONAL WORLD

Professional life in a job and an organization is the first major test of an individual. In actual sense, all that has been learnt and developed up to college is opened up to the rigours of real life. All of a sudden, ***the freedom to do at will is curbed and put to a serious method, heirarchial set up and protocol.*** Life begins to look that much more different and difficult. In the real sense the real exposure to practical life and contact with real teachers of life and practical wisdom are encountered for the first time. It is natural that one's own strengths will be subject to a tensile strength test. These are the times when the real race of life commences to lead one head-on into the professional rigours.

Experience reveals that the real personality development takes place during these stages. One's own inclination to learn and excel or to fade into obscurity commences in the true sense. The first Gurus in the professional life have a lasting impact. It is therefore, a matter of serious luck that one finds the right mentor who could help in leading the course of one's life into distinction. The teachers however, can only show a way, the essence lies in taking it upon ourselves to find our ways. In a way, the indomitable spirit and the desire to excel in professional life has to be strong. This is very important in the initial decade or so of the initial career growth where one gets exposed to various avenues of professional problems and conduct which enables a niche image to be developed for an individual. Careers of R&D could be led with Innovation. Careers of Engineering may be led by experience, wisdom and practical solutions. Careers of Commercial Orientation, Marketing, Project Control and Management, Human Resources and Financial management could be led by Horizontal Exposure and a subtle brush with the nuances of real life situations. All in all, the first decade or so of the professional exposure is a real builder of domain strengths and enables the articulation of one's personality.

These are also times when an individual enters into manhood or womanhood and has exposure to other responsibilities of life. These are testing times when the professional demands are high and so are the personal responsibilities towards one's own family. Establishing equilibrium therefore, is a major challenge. In fact the greatest exposure to Project management tests are encountered by an

individual at this stage where so many compromises and curtailments are necessary. These are also times where personal sacrifices and difficult decisions, such as separation from families also, at times, become necessary to fulfill professional obligations.

Experience reveals that in the formative stages of professional career development the most effective support, actually comes from the virtues of basic human development, that are so sincerely imbibed in us in the early stages of our life in the upbringing stages. Those of us who live with their attributes throughout their life with dedication and devotion, surely stand to gain by achieving poise, balance and equilibrium in all their endeavors. They are also the ones who notwithstanding the problems around them have the tenacity and the wisdom to excel in all situations. They are also the ones who acquire peace and intrinsic happiness a lot faster.

MANAGEMENT AND SCALING THE HEIGHTS

The first decade of exposure to the professional world is the real breeding ground for scaling heights. However the process of sustaining the momentum of unstinted growth is a continuous affair. It is important to ensure that the advantage is not frittered away as one scales the ladder of professional growth. The second decade into the professional life is the real building block for management positions. This is the time to consolidate experience and exposure. This is the time to also get a real life feel of managing smaller and bigger teams. The process of assessment and evaluation of professionals is a huge learning exercise. This is a great learning experience as exposure to managing human resource is perhaps, the greatest experience in the journey of one's own professional growth

A good idea at this stage of the professional career, would be to examine as to where we are and to try to summarize the attributes, that would help us catapult ourselves to leadership positions, in the times to come. The list has to be generic only as various professions could have their own specific nuances to be addressed as well. However, by and large, for technical professions some of the points listed herein would be common to a large extent

PERSONAL

- Moral Values
- Cultural upbringing
- Kindness
- Sharing
- Developing perfection
- Shedding conceit and desire
- Deriving pleasure in the success of others
- Courage
- Aptitude
- Communication Skills
- Obedience and following Instructions
- Facilitating Team Work
- Pride in work
- Commitment to family and work
- Honesty
- Dispassionate affection
- Humility and grace

PROFESSIONAL

- Problem resolution
- Domain Knowledge
- Conflict Management
- Boss Subordinate Relationships
- Sharing Experiences
- Sustained Learning
- Communication
- Innovation
- Minimizing Interfaces
- Creativity
- Timeliness
- Optimization
- Team Work
- Developing Vision
- Understanding Leadership
- Risks and safety factors

It is important, that a concerted attempt must be made to balance the personal and the professional attributes continuously, as one scales the heights in the professional careers. It is the essence of this equilibrium, that would enable one to prepare oneself, for leadership positions. A 20 year span in professional life is a fairly long one to realize, as to what really, one must eschew to gain wisdom, poise and strength to lead with aplomb and grace.

Deterrents to Leadership

- Extreme personal Likes and dislikes
- Bitterness and envy
- Inability to decide
- Connivance for undeserving gains
- Lack of Transparency
- Misalignment with the Company Objectives and Requirements
- Nepotism
- Arrogance & Conceit
- Poor objectives and goals
- Refusal to listen and accommodate
- Spreading Fear and apprehension
- Usage of unfair means to succeed
- Lack of appreciation of others potential
- One upman ship

While Leadership positions by virtue of the above matrix may appear to be a utopia, it is important that one must consciously try and cultivate many of these attributes, while eschewing the negatives, to find feet into leadership positions. The essence of experience at middle levels, is preparedness for larger leadership roles. Leadership brings with itself a larger sense of fairness and equity. This is simply not possible without cultivating the essentials.

TRAINING AND PROFICIENCY DEVELOPMENT

Training is an intrinsic part of professional development. It is a given that as one makes up for career growth in a profession the call is invariably there to develop multiple skills. Again, the distinction between line and staff functions, has to be rather critically nurtured in development of domain and Horizontal strengths. It is a given, that vertical growth in a singular dimension can be good only for certain specified functions. Largely there is need for developing multiple and multi dimensional skilling in preparedness of Managerial and leadership roles.

Specialist functions, such as technology and Engineering, have a rather vertical dimension attached to it, on account of which, the training profiles are rather limited in nature and are led more by Engineering and technical prowess enhancement. All other dimensions remain rather generic and personal attribute driven. However, even in these specialist domains, training of specialized nature would be required for gainful development of individuals. Nevertheless, the training requirements would remain specialized in nature, including exposure to construction and manufacturing.

For the staff function however, a wider variety of training expertise is warranted. Almost all the individuals serving the staff functions would have to be imparted training of the Commercial functions including contracting and legal, Financial, Estimation, Planning and Project Management expertise, in addition to the very essential construction experience. Those professions, which involve a horizontal expanse of an International growth trajectory may warrant, International Exposure of personnel as well. Developing all these proficiencies as part of planned career development is almost a pre requisite. All these skills serve as handy tools to develop the necessary base for preparing Managers and leaders of high quality.

LEADERSHIP EFFECTIVENESS

The essence of virtuous living, considered planning and career growth is essentially to enable one to indulge in effective discharge of a larger duty when the opportunity arises. Leadership positions are the intrinsic test of the toil and perseverance of the years. On the personal front, it is time for the Leader to rise to the occasion to deliver, as leadership brings with itself huge responsibility and expectation. The team and the Organization look upon the incumbent for direction, orientation and philosophy, which will create the growth culture of the organization.

All leaders by virtue of their background, upbringing, experience and vision have a personality and a distinct style of operation. Some leaders are aggressive with the intent of forcing issues with their own convictions and authority, some of them are soft and subtle, who unleash their vision without exuding power and force but with great impact and effectiveness. Either mode of leadership is effective and has its own fallout on the organization. It is often said and believed that the leader is as good as his team, but the fact remains, that the success of leadership and organization is always led by a vision, a philosophy, a desire for common good. Consequently, irrespective of the individual and the style of operation and implementation, there has to be a common streak of traits for the leadership to be successful, whichever way it is looked upon. The list for the traits could be long and generic. Also, it would be difficult to claim it as complete at any point of time, as the list of variables is large and the permutations and combinations could be factorial of infinite. Nevertheless, some of the powerful and more desirable attributes of successful leadership need elaboration.

1. Passion - Leadership has to be a combined result of many a personal and professional attribute, however, one of the most powerful attributes for unleashing leadership, in our opinion, is passion driven by clarity of goals, and passionate involvement in Organizational growth.

   Passion is perhaps the biggest drive, which enables the adrenalin to be kept high at all points of time. Several other personality traits seem to appear as a subset of passion as it enables, the highest forms of energy, perseverance, courage and confidence to be demonstrated by the leader. It serves as one of the most powerful tools to serve as a strong and common connect with the Organizational mass. It is natural that different people will have different intensities and views on a variety of subjects, but it is also true that the passion of the leader has an infectious effect and enables one and all, to gradually align with the passion and the intensity of the leader. This is the power of passion. It is magnetic, intense, forceful and distinctly genuine. Passion of an inspiring leader ignites, maintains and sustains the enthusiasm of work force.

2. Domain Knowledge and Decision making – Difference of opinion and debate in an organization is an essential recipie for growth. No organization can survive for too long without encouraging consideration for a variety of views to take informed, logical and honed decisions. The critical part is however, the word decisions. Decisions could result as a part of the drift of the

debate or could be prompted out of a considered opinion. It is incumbent upon the leader to take a decision considering the various pros and cons linked with the issue. Sometimes what may appear apparently as logical, may not emerge as a final decision, given the various ramifications and the long term effects of a decision. This is where the Leader's knowledge, wisdom and visionary thinking has a critical role to play. This is where earthshaking and landmark decisions are undertaken by leaders, for their long term lasting impact.

3. Strategic Thinking – Leaders are invariably bound by strategy. They always have broad contours of a philosophy brewing in their minds, led by conviction and considered belief. Strong Leaders are bound to think strategically. They ought to have a great sense of their own resource, its optimal usage and a plan to unleash growth in horizontal and vertical directions. As a measure of their own philosophy they need to have a clear and a succinct view of their Organizational strengths and weaknesses. This helps them to chalk out a clear growth trajectory both, in the areas of their own strengths, as well as, newer Horizons that need to be explored.
4. The Leader must be an initiator of strategic debate. He must be capable of moderating, guiding and supervising the task of balancing opinion, to examine new opportunities for Business Development, consolidation and Implementation. Without this fervor, the leadership remains archaic, routine, mundane and involved in trouble shooting only. It soon fades into obscurity as freshness of the new is missing. This is highly demotivating for the Organizational mass, especially the millennials, who are always in search of exciting opportunities which, provide them an avenue to excel, exhibit and demonstrate. The strongest, motivation led organizations are essentially the ones, where strategic and Horizontal thinking is encouraged right from the top and individuals are allowed to excel. Leadership has to ensure that excitement of the new is kept alive in the company for catering to the motivational instincts of individuals.
5. Strong Financial Acumen - Alongside, every Leadership has to involve itself, in visionary financial planning for setting the growth agenda of the company. A strong financial acumen and a concrete plan for the future is almost a pre requisite. However, for the Plan to be pragmatic and realistic, a strong practical supplement to initiative is a near necessity. Strong leaders have always to keep the Financial goals in perspective, while balancing the several odds in the Organization for perfecting growth.
6. Communication – Leaders may be visionaries and exemplary. However their mission and work remains unaccomplished without the strength of strong, effective, forceful and regular articulation of their thoughts. No leader can be successful in dormancy. Since decision making itself is a complicated process, it is important to recognize, that the Organizational commitment towards a decision would be well nigh impossible, without alignment of the entire team with it. Consequently, dissemination of a decision for its ramification and its sanctity, is of paramount importance. Both Oral and written communication has to simply take precedence and priority, in the formal agenda of the leader.

   Communication of the thought process of the Leader to cement the Organization together, also enables the virtues of participation, engagement and togetherness in a team. This in the long run serves as one of the most important reasons for a company to succeed in its endeavors. Effective Communication has a far reaching impact on the psyche of the individuals in the company. It is infectious in nature. If the leader himself encourages communication and finds ways and means of acknowledging the same, the company in a way, begins to communicate effectively at large, as well. This spurs knowledge, action and experience collation. The sense of involvement and contribution in the company improves and the trajectory for enhanced activity is initiated.

   An intrinsic part of communication is maintaining contact with the Organizational mass, particularly the bottom of the pyramid. This enables the leader to get an insight of how the lowermost rungs of the company, accept the vision of the leadership and the difficulties that they encounter, in their routines to effect delivery. This feedback is vital for enforcing policy interventions through which, the performance and satisfaction levels of the employees can be enhanced. Practical experience suggests, that this is a powerful tool for improving the overall delivery quotient of the Organization.
7. Organization Structuring and Accountability – Organizations grow as a single mass or as subunits or task forces. Depending upon the nature of the company, its operations and its size, the organization structure of the company could be re visited from time to time. The critical issue to be contended with always, is the size of the company and the effectiveness of its existing delivery systems. Invariably, as the size of the company increases, it is important to organize it in smaller, focused and dedicated units with defined responsibilities, resources and targets and have the same closely monitored through corporate tools, such as well defined and structured MOUs

and Executive control processes. This certainly improves delivery, enhances client satisfaction and improves the quality of manpower. The individuals, in a respective subunit, get more and more Horizontal exposure and learning. Additionally, with focused objectives and financial targets the financial and the commercial acumen of the subunit and its employees get commercial orientation and focus on a regular basis. This serves as a great breeding ground for future leadership development.

The central advantage of a subunit concept in a large organization, is the direct accountability that can be fixed on the leadership of the subunit. Experience reveals, that this serves both as a huge incentive, as well as, a threat to the efficient performance of the subunit. This has significant all round benefits for the subunit in particular and the organization in general. The positive experience of this is perhaps, a huge management lesson to be emulated in the overall interest and security of the future of the organization.

One of the contentions of the subunit concept is that it warrants additional resources. Actually, surprisingly for many the answer is no. Obfuscation is the cardinal theme on which mediocre people thrive. People like to revel on centralization of power, multifarious interfaces and defense mechanisms. Many a person in organizations tend to create problems and then solve them, to take undue credit. Human nature perhaps! The cardinal issue is that the problem itself, should not have arisen in the first instance. The problem is actually a mirage, a potpurri of confusion. Some people see a huge advantage in deriving vicarious pleasure in the discomfort of others, at the expense of the Organization. They take refuge to jargon, apprehension and spreading of canard to serve their myopic objectives. Efforts to streamline the Organization therefore, will be met with a lot of resistance, as streamlined affairs leave no scope, or at least largely minimize machiavellian tendencies. This is where, the role of a strong and visionary leadership unfolds.

These are moments, where if required, the Iron hand has to be used to suppress dissent. This is also a time when the passion, conviction, courage and wisdom of the leader are tested. He has to be iron clad as well, when the moment so warrants. Yes pockets of dissent without logic, will continue to exist, but what matters is the larger interest of the Organization and its goals, against which false dissent will pale into insignificance as logic and reasoning, begin to acquire solid and well entrenched roots.

8. Monitoring Tools – Organizations thrive on performance and adhering to commitments. Large organizations in particular, are involved in significant activity for which, a proper resource and performance management system ought to be in position. In normal course, the Management and leadership is critically engaged in higher level activity, which could perhaps, not enable it enough time to exercise direct vigil on performance of the various subunits of the company. A system therefore, has to be in position, wherein, performance is monitored through a structured format, problems are highlighted in time, and management intervention related issues, are highlighted for corrective action. A shadow management comprising of senior and experienced personnel from the company need to be constituted to draw power from the Management for effective enforcement of monitoring the delivery agenda of the Organization .

   The Shadow group could effectively monitor the health of the delivery and throw up all system improvement programs to be taken up by the Company leadership, for review and system improvement. This therefore, establishes the vital connect between policy and implementation. The ground level feedback too, is acquired in the process for introspective analysis of the quality improvement program and bringing about further critical changes in the Organization as may be warranted!

9. Protecting the balance Sheet – As mentioned above, all the Companies are invariably engaged in a very pro active process of protecting the financials of the company. On the one hand, the Company has to engage in serious Business Development activity and on the other hand, it has to involve itself, in serious project implementation to ensure that the revenues of the company are assured. At the same time leadership has to focus actively, on the avenues to exercise expenditure control towards the expenses incurred by the Company, such that, profitability of the Organization is not strained. A complete vigil over the external and the internal factors therefore, have to be sustained by the Leadership, to maintain the financial health of the company.

   This aspect however, is easier stated than implemented. Financial control of the Organization invariably leads to situations, wherein, recourse to inconvenient decisions has to be undertaken. Some of these decisions are unpopular, as they end up affecting the perks and privileges for the company's personnel. This therefore, is an acid test for the leadership too. Strong leaders however maintain their focus and

aplomb and do not flinch in the moment of trial. The Organization and its success, has to be the sole motive for their actions. In case this warrants a few inconvenient decisions to be taken, be it so!

10. Enthusing the Young – Organizations succeed or wilt on the strength of how well they protect and enthuse their young, to gain experience and wisdom to set themselves, on an effective growth path. It is of essence to recognize early that the future of the Organization itself, rests critically on the effective development of the young, to have them prepared for shouldering responsibilities, to charter the course of the future of the Organization

    The motivation levels of the young have to be kept high and strong at all points of time. They need to be mentored to realize, that they have to acquire all the basic skills, which can enable their growth as a proficient engineer, an efficient manager and a subtle and strong leader.

11. In posterity – Every leader, young or old has to make way for posterity. It is therefore essential for the leader, to leave behind strong footprints of a defined path, a collection of knowledge and an atmosphere, full of vibrancy and creativity. It is also the job of the leader to enable development and encouragement for fostering a succession plan, not only at leadership level, but across the board. It is around this area, that most of the vulnerability in growing or large organizations is noticed. It is also an Achilles heel for those who do not plan their career as well keeping the future in mind.

    The second line of leadership must be on its toes all the time, to align with the priorities of the company. They must, at all points of time, look for consolidation and continuity, to take the philosophy of the company forward

    However, often the absence of a dynamic leader and his or her exit from the company becomes a problem. Experience reveals that at times, a vacuum is created in the company by the exit of a powerful leader. In case the succession plan is not effectively drawn up, for whatever reason, the company could be led into a variety of problems. Companies must guard against this and plan appropriately and preemptively to ensure the sustained success of organizations .

CONCLUSION

Organizational platform is probably the biggest playground of life, where a human being is tested for his or her entire span of career and trait profile. This is also the Citadel to demonstrate our wholesomeness as a human being and put to scrutiny our values and qualities to be assessed and rated by all.

Posterity will judge on the basis of how dispassionate your decisions were for the common good, how fair and transparent you were in your dealings, how humane and considerate you acted on employees' personal grievances and how your actions as a Leader benefitted the organization as a whole. Unpopular decisions may not be appreciated immediately, they may cause resentment and turbulence for a while but a time will come when they will be acknowledged and appreciated.

Posterity shall stand in judgement, as to how well, we evolved as human beings, not by our external looks and attitude, but through the sustained and demonstrable actions, that we would have undertaken in this battlefield, in the larger interest, common good and sustenance of others. In the Mahabharata of life, this is the only Chakravyuh, which can be unraveled by sustained and committed Karma alone! This is the only time to liberate and redeem ourselves towards the intrinsic essence of Living through Giving!

REFINING

HYDROPROCESSING AND HYDROCRACKING DAO

ACHIEVING UNLIMITED CYCLE LENGTHS WITH THE MOST DIFFICULT FEEDSTOCKS

David Schwalje **Eric Peer**

Axens

BACKGROUND

The refining landscape remains dynamic. In the last decade, the industry has gone from rampant dieselization to the tight oil and condensate boom, to king gasoline and unprecedented premiums on the octane-barrel. Today, we find the US as a major product exporter to Latin America, keeping utilization high independent of domestic demand. A simple truth remains: the refiner who remains the most flexible in terms of feed and product slates has remained the most profitable.

The focus of this paper is the impact to the US refiner as a result of U.S. policy decisions in conjunction with the reduction in marine fuel oil sulfur to < 0.5 wt% for ships lacking Exhaust Gas Scrubbers (EGS). Specifically, the potential approval and construction of pipelines to increase the availability of heavy, sour crudes to mid-continent and Gulf Coast refiners coupled with the widening spread between sweet and sour crudes resulting from the IMO regulation may create an environment that favors sour crude conversion.

The well-established routes for refiners processing residue-heavy crudes are Residue Hydrocracking (Axens H-Oil® process), Residue Hydrotreating followed by Residue Fluid Catalytic Cracking (Axens Hyvahl™ followed by R2R™), Coking, and Solvent Deasphalting (Axens Solvahl™). This paper will concentrate on Solvent Deasphalting (SDA) and downstream processing of Deasphalted Oil (DAO), as SDA is the least capital intensive of these options and has provided attractive returns for refiners with a viable outlet for the pitch. The attractiveness of SDA is evidenced by the 23 operating units in the US totaling approximately 500 MBPSD of residue throughput[1].

SDA Units are attractive because of their low capital requirements and relative ease of operation; however, the technology does not come without its challenges, as processing of the DAO significantly impacts the activity and cycle length in downstream units. Many refiners now process DAO in fixed-bed Cat Feed Hydrotreaters (CFHT) where its inherent metals and CCR content can be detrimental to catalyst activity and cycle lengths. CFHT and hydrocrackers processing feeds concentrated with DAO that were not originally designed for that operation can experience cycle lengths drastically lower than the preferred 30-36 months to better coincide with FCC I&T's. The increased downtime resulting from frequent catalyst changes challenges profitability and refinery storage logistics.

Axens technology portfolio includes two solutions for this "DAO Dilemma:"

- The patented Swing Reactor System (or Permutable Reactor System, PRS) to change-out catalyst in multi-reactor fixed-bed hydroprocessing units on-the-fly without shut-down of the operating unit. This technology is

applicable in low capital investment environments where gasoline production via the FCC or RFCC is the most profitable.

- The ebullated-bed, H-Oil$_{DC}$ process for high conversion hydrocracking of 100% DAO feed without any cycle limitations. This is the higher investment option that favors product slate flexibility, increased diesel production, and increased liquid fuel yields.

This paper will present commercial results and a case study to evaluate the benefits of these two technologies in an environment that favors heavy, sour crude processing.

DAO DILEMMA OPTION 1: DAO HYDROCRACKING IN H-OIL$_{DC}$

The ebullated-bed H-Oil® process is a well-established technology with 21 licensed units including 10 in operation and a total licensed capacity of over 1,000,000 BPSD since its commercialization in 1968. The key to the technology is the ebullated-bed reactor, which is a three-phase system utilizing back-mixing of both the reactor liquid and catalyst particles to provide excellent reactor temperature control coupled with low and constant pressure drop over several years of continuous operation. A critical technology component is the ability to add and withdraw fresh catalyst to control the level of catalyst activity in the reactor as required. This provides constant catalyst activity and eliminates the need to shut down the unit for catalyst change out. The fluidized bed and catalyst withdraw capability make H-Oil ideal for exothermic reactions and difficult feedstocks such a DAO concentrated in metals, asphaltenes, and other foulants/coke precursors.

The ebullated bed process therefore provides the following benefits compared to fixed-bed systems:

- Nearly isothermal operation throughout the run
- Unlimited reactor run lengths (shut-downs dictated by I&T schedules rather than catalyst activity)
- High conversion flexibility
- Unlimited metals processing capacity
- Lower gas circulation rates due to the use of cold feed as reactor quench

The most common feed to an H-Oil Plant is vacuum residue with relatively high CCR and contaminant metals. This mode of operation is referred to as H-Oil$_{RC}$ (for Residue Cracking) and has been commercially demonstrated for over 50 years. H-Oil$_{DC}$ (for Distillate or DAO Cracking) is an extension of the well-known H-Oil $_{RC}$ for processing non-residue feedstocks and began commercial operation in 2004. The DC technology is typically used to treat difficult feeds like heavy coker gas oil or DAO containing high levels of CCR and contaminant metals. 4 of the 21 licensed H-Oil units have been of the $_{DC}$ variety; additionally, 2 of the RC units have operated temporarily in $_{DC}$ mode to produce low sulfur FCC feed.

The H-Oil$_{DC}$ process has the following features, which distinguish from H-Oil$_{RC}$:

- Typically lower reactor operating pressure
- Typically lower catalyst addition rates
- No vacuum tower reacquired for product separation
- Typically reduced reactor volume

As a result of these features, internal Axens studies have shown that for conversion of feeds high in metals and CCR, ebullated-bed hydroprocessing has significantly better returns than fixed-bed hydroprocessing due to its unlimited cycle length and reduction in required reactor volume. The relative reactor volume for fixed bed units processing high metals feeds can be on the order of 50% higher than for the ebullated bed option.

The introduction of the H-Oil process for DAO conversion was the result of a deep knowledge of the interaction between SDA operations and downstream hydroprocessing units developed via intensive R&D projects coupling SDA and H-Oil piloting across a wide range of feedstocks and operating conditions. Specifically, the technology development focused on four key areas: catalyst selection, DAO quality, Unconverted Oil (FCC Feed) quality, and conversion selectivity.

CATALYST SELECTION

Even for DAO feeds low in asphaltenes, the use of heavier butane or pentane solvents results in DAO metals contents greater than 20 wppm for many crudes. Catalyst screening was performed on a C5 DAO derived from Cold Lake vacuum residue considering three different catalysts. The DAO contained 90 wppm of Ni + V and over 4 wt% sulfur. Catalyst 1 (with a unimodal pore size) was a high activity product developed to process heavy vacuum gas oil feedstocks. Catalysts 2 and 3 had bi-modal pore size containing adequate macropore volume for metals tolerance and were both developed for processing of feedstocks with significant metals content. The test results clearly show that processing of DAO requires a metals tolerant catalyst and that Catalyst 3 (Axens HTS-458) designed for ebullated-bed DAO processing had the best long term activity maintenance.

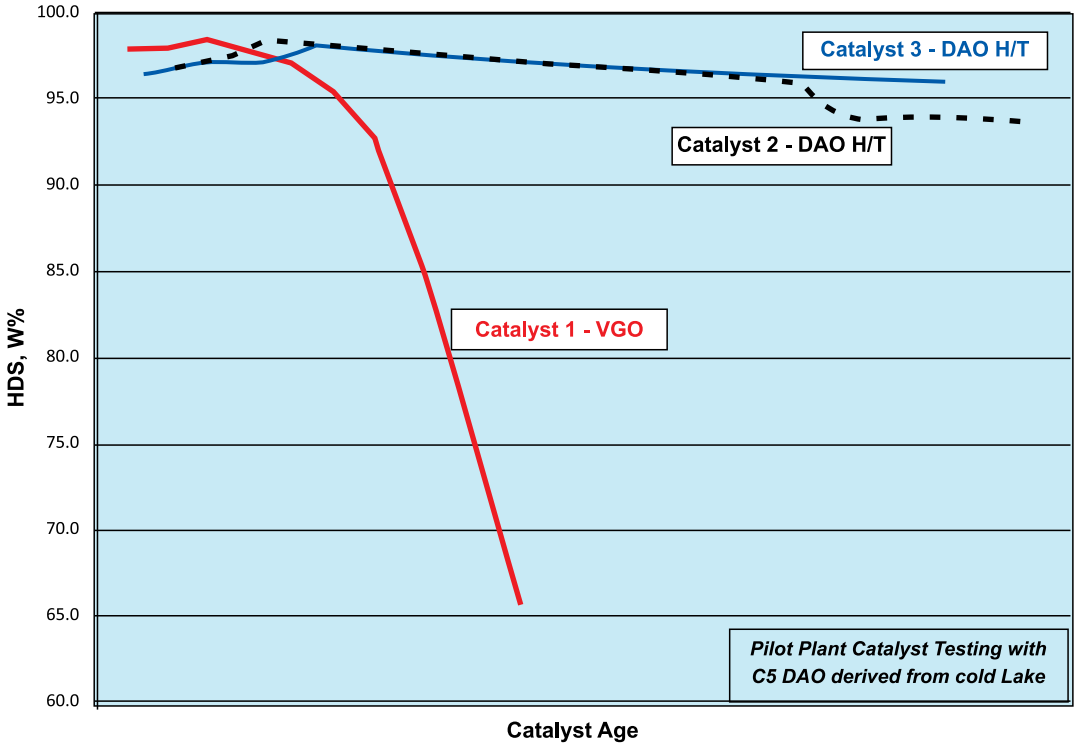

Figure 1 – Catalyst Selection Results for DAO Hydrocracking

DAO QUALITY

The quality of DAO is primarily a function of the vacuum residue properties, SDA solvent, and SDA operation. Heavier, more aromatic crudes tend to contain more sulfur, nitrogen, CCR, metals, and asphaltenes; consequently, DAO produced from these crudes will comparably contain more heteroatoms than lighter crudes.

The composition of vacuum residue can be described in 4 distinct fractions: saturates, aromatics, resins, and asphaltenes. Assuming proper design and operation of the SDA unit, the asphaltene fraction should be mostly rejected with the pitch in the extractor regardless of the solvent composition (down to the ppm range), and the saturates will be mainly extracted with the DAO. This leaves the aromatics and resins as the fractions most affected by the type of solvent and operation of the SDA unit. Heavier solvents achieve higher DAO lift by extracting more of the aromatic and resin phase while lighter solvents extract mainly saturates while rejecting much of the aromatic and resin molecules with the pitch. Figure 2 below summarizes this relationship for an Arabian Light residue.

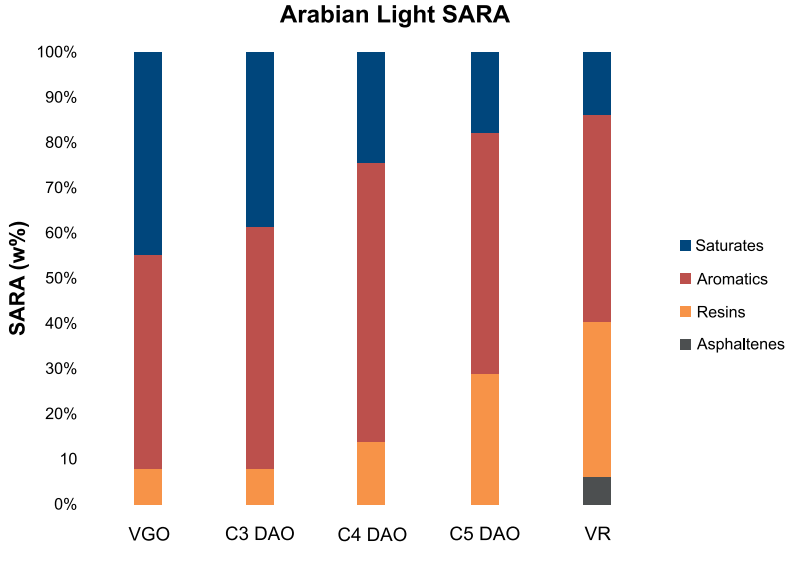

Figure 2 – SARA Analysis for Various SDA Solvents

It is this resin fraction that is most critical to hydroprocessing unit operation, as it contains the majority of the refractory molecules and metals. The high aromatic content of DAO's derived from heavier solvents affects the exothermicity and hydrogen consumption requirements of the H-Oil unit. The table below summarizes DAO contaminants as a function of SDA solvent for a fixed crude VR.

	VR Feed	C3 DAO	C4 DAO	C5 DAO
DAO Lift, wt%	-	30	61	78
Properties				
SPGR	1.018	0.938	0.969	0.987
S, wt%	5.5	3.2	4.2	4.7
Ni+V, wppm	126	5	24	48
CCR, wt%	18.1	1.9	6.6	8.9
C7 Asph., wt%	6.2	< 0.05	< 0.05	< 0.05
Required CFHT LHSV (1)		**Base**	**Base x 0.4**	**Base x 0.2**

Note 1: LHSV required to meet a product sulfur target of 1,000 wppm at iso-conditions

While DAO asphaltenes should theoretically be maintained below 500 wppm in a properly designed and operated SDA unit, commercially, in many instances, this is not the case. Mostly due to high extractor linear velocity or poor control over the extractor temperature gradient, DAO asphaltene carry-over has extremely detriment effects on downstream catalytic processes. Axens quantified the asphaltene effect on H-Oil and fixed-bed catalyst by conducting pilot testing under identical operating conditions using DAO that was artificially spiked with known quantities of asphaltenes to compare "clean" DAO (< 500 wppm C7 asphaltenes) to "dirty" DAO (> 1,000 wppm C7 asphaltenes).

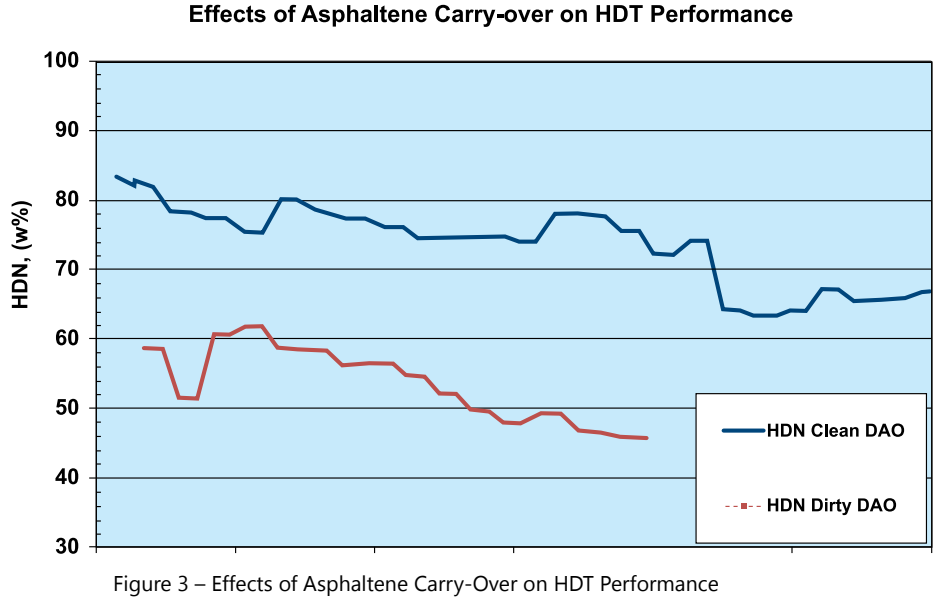

Figure 3 – Effects of Asphaltene Carry-Over on HDT Performance

The results clearly indicate the importance of limiting DAO asphaltene entrainment.

UNCONVERTED OIL (FCC FEED) QUALITY

The 650 °F+ material from the H-Oil$_{DC}$ atmospheric fractionator bottoms is typically routed to the FCC due to its high hydrogen content, low metals, and low sulfur. The quality of this stream is critical to predicting FCC performance when considering a drop-in H-Oil solution. Axens has conducted extensive piloting across a range of conversion levels and feedstocks to quantify the UCO properties. One such analysis performed on C5 DAO from a heavy Canadian Bitumen is representative of the relative FCC feed qualities with varying conversion.

Piloting was conducted for single-reactor and two-reactor H-Oil designs processing DAO from heavy Canadian residue. In the single-stage operation, the 650 °F+ product had 2-3 wppm Ni+V and approximately 2.5-3.0 W% CCR. With two-stages and nearly 100 wppm more Ni+V in the feed, the 650 °F+ product had less than 1 wppm Ni+V. While the final selection of unit configuration, conversion, and catalyst usage will depend on the refiner's requirements for FCC feed rate and quality, the H-Oil technology is very flexible; conversion and product quality can be adjusted depending on refinery objectives both during the design and operational phases.

	Single Reactor		Two Reactor	
	H-Oil Feed	650 °F+ UCO	H-Oil Feed	650 °F+ UCO
Yield, wt%	100	66	100	55
Gravity, °API	9.5	20.5	6.2	18.7
S, wt%	4.3	0.3	5.2	0.2
N, wppm	4,300	1,900	5,300	3,100
Hydrogen wt%	10.7	12.1	10.3	11.8
Metals, wppm	90	3	193	0.4
CCR, w%	10.7	**2.3**	**16.1**	**2.8**

DAO DILEMMA OPTION 2: AXENS SWING REACTOR SYSTEM (PRS)

Axens commercially proven Swing Reactor, or Permutable Reactor System (PRS), provides refiners with a method for drastically extending cycles for fixed-bed hydroprocessing units processing difficult feedstocks. The heart of the PRS technology is the catalyst conditioning system, which allows the refiner to change out catalyst in one reactor "on the fly" without disturbing the operation of the operating unit. This unique arrangement is particularly attractive for configurations where short-cycling CFHT units disrupt FCC operations between turn-arounds.

The Swing Reactor system can be designed in three flavors.

- By-passable guard reactor: The first reactor in a multi-reactor system is installed with a by-pass allowing the operator to take it out of service when it has reached the end of its cycle. The main reactor(s) remain online for the remainder of their cycle.
- PRS_{1R}: The first reactor in a multi-reactor system is by-passable, and a catalyst conditioning system is installed in order to change-out first reactor catalyst on the fly and place it back into service.
- PRS_{2R}: The first two reactors in a multi-reactor system operating in a lead/lag arrangement, and a catalyst conditioning system is installed in order to change-out either reactor catalyst on the fly and place it back into service.

The key features of the technology are:

- Specialty severe service valves to ensure positive isolation for operating pressures from 1,000 psig to in excess of 2,500 psig
- Robust safety permissive systems to prevent potential high pressure to low pressure exposure
- Low pressure catalyst conditioning system for reactor change-outs "on the fly"
- Over 35 combined operating-years of commercial experience

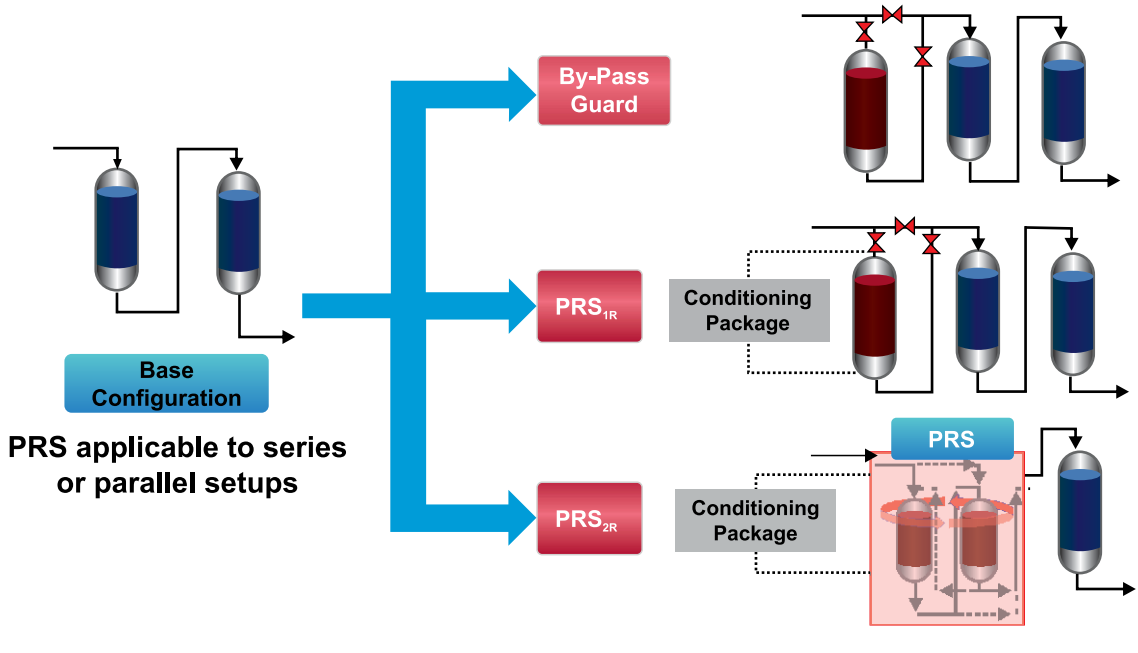

Figure 4 – PRS Configuration Options

The concept was originally designed and implemented on Hyvahl Atmospheric and Vacuum Residue Desulfurization (ARDS and VRDS) units where feed metals content can limit the applicability of traditional fixed-bed units. In these residue configurations, multiple guard reactors are installed upstream of the main hydrotreating catalyst and contain the majority of the demetalization catalyst. These guard reactors are operated in a lead/lag configuration using PRS and changed-out when metals slippage to the main catalyst becomes problematic. In effect, the technology provides limitless metals trapping capabilities, allowing the cycle length of the HDS catalyst to be determined by traditional coke lay-down as opposed to contaminant poisoning.

Today, the swing reactor system is increasingly more applicable for CFHT units as economics favor FCC pretreatment, DAO hydroprocessing, and processing heavy crudes high in metals and CCR. The technology is a relatively low cost solution that is equally suitable for grassroots units or as a drop-in revamp solution for existing short-cycling units. The driver for capital expenditure is the opportunity and logistics costs of multiple 3-4 week FCC shut-downs between FCC turn-arounds.

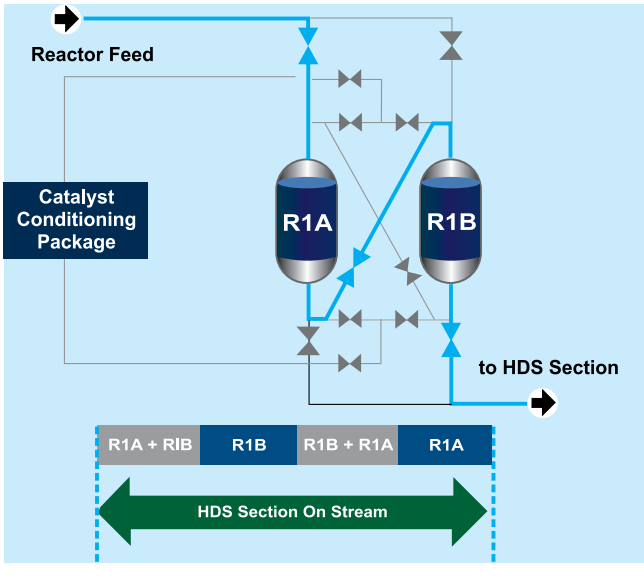

Figure 5: PRS General Arrangement for Series Reactors

The heart of the technology is the Catalyst Conditioning Package, which is used to perform all the requisite start-up and shut-down steps of the offline reactor during catalyst change-out including but not limited to washing, hydrogen stripping, cool down, inerting, loading, and warm-up. The package can also perform catalyst sulfiding, if necessary, although many units can either be loaded with presulfided catalyst or activated online without any appreciable loss of hydrodemetalization activity.

Reliable valve performance is critical to prevent high pressure to low pressure exposure and ensure quick reactor turn-arounds, and, as such, Axens specifies valves exclusively from its proven and qualified supplier in North America.

PRS - COMMERCIAL EXPERIENCE

Axens has licensed and designed five PRS_{2R} configurations; three are currently under operation with the fourth and fifth currently under construction. Four of these units operate on residue and one on FCC slurry. The commercial units have combined for over 35 years of operating experience (over 50 reactor swaps) without a single safety-related incident. There are numerous other 1R and by-passable units in design and operation. In addition, the catalyst addition and withdrawal system in Axens operating H-Oil units has successfully utilized a similar safety interlock system to prevent high-pressure to low-pressure exposure for over 25 years.

DAO PROCESSING OPTIONS: AN AXENS CASE STUDY

Axens performed a quantitative comparison of classical fixed-bed CFHT, PRS-equipped CFHT, and ebullated bed DAO hydrocracking to assess the attractiveness of each of these options. A critical aspect of this case study was the opportunity to increase the processing of discounted heavy, sour crudes via the introduction of the above-described DAO-processing technology solutions.

The Base Case study refinery configuration is summarized in Figure 6. Vacuum residue was processed in an SDA utilizing a butane solvent for moderate DAO recovery, and the DAO fed a CFHT and FCC conversion block for maximum gasoline production. It was assumed that SDA pitch was sold to the asphalt market. For simplicity, the case study refinery produced a full-range diesel without any jet product, and the gasoline pool consisted of reformate, alkylate, FCC gasoline, and straight-run light naphtha.

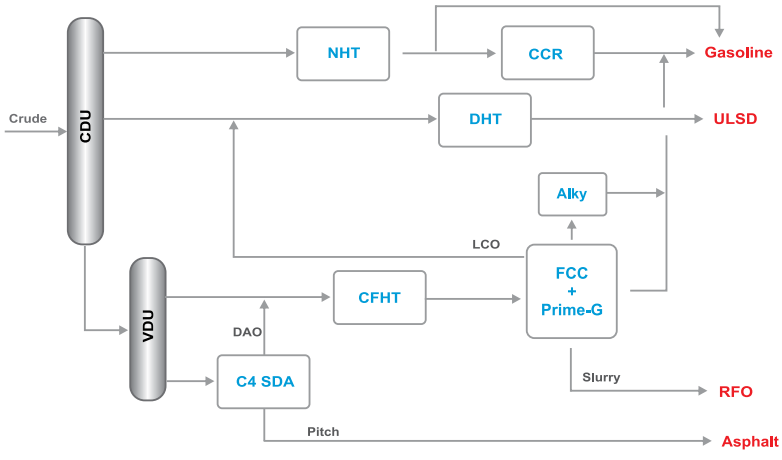

Figure 6 – Base Refinery Configuration

Three operating cases were compared:

- **Base Case** (current operation) processing a medium sour crude diet consisting of WTI, WTS, and Arabian crudes (blend S=1.6 wt%, API=33) utilizing a C4 SDA + CFHT + FCC for residue conversion
- **PRS Case** (revamp operation) where the crude slate was modified to include discounted heavy, sour crude (blend S=1.8 wt%, API=31) and the CFHT was revamped to include a new reactor utilizing Axens PRS_{1R} system.
- **H-Oil_{DC} Case** (revamp operation) where the crude slate was modified to include discounted heavy, sour crude (blend S=1.8 wt%, API=31), the SDA was revamped to a C5 solvent for higher DAO recovery, and 100% of the DAO was processed in a new ebullated bed hydrocracker.

The bottom of the barrel revamps are summarized in the following BFD's:

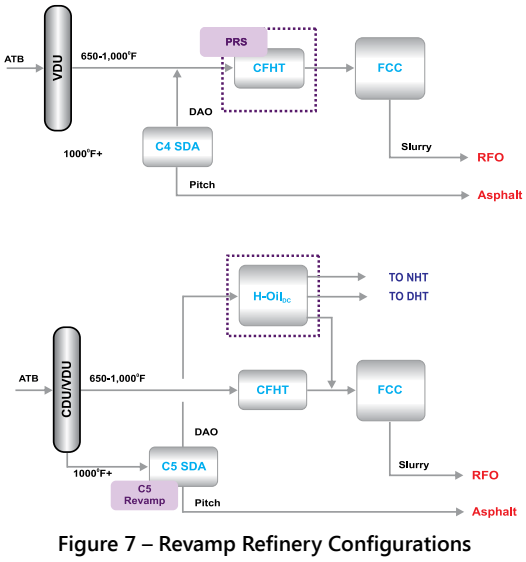

Figure 7 – Revamp Refinery Configurations

The following table summarizes the crude slates for the Base and Revamp cases.

CASE	Base Case	PRS Case	H-Oil Case
Crude Rate, MBPSD	210	210	210
Crude Composition, v%			
WTI	25	25	25
WTS	25	25	25
Arab Med	50	25	25
WCS	0	25	25
Gravity, °API	33	31	31
S, wt%	1.6	1.8	1.8
Vacuum Residue, MBPSD	35.9	41.6	41.6

CASE DESCRIPTIONS AND RESULTS

The Base Case CFHT was assumed to be an existing unit utilizing 2 reactors with a total LHSV of 1.5 hr^{-1} operating at a pressure of 1,500 psig with a product Sulfur target of 1,000 wppm. As a result of processing 27 vol% DAO containing 16 wppm metals, the unit achieved only an 18 month cycle with a total feed rate of 67 MBPSD.

For the PRS case, the crude slate was modified to include more discounted heavy, sour feedstock providing a distinct crude acquisition cost advantage. Consequently, the DAO metals increased from 16 to 24 wppm, which would have reduced the CFHT

unit cycle to 16 months. To extend the cycle, an additional guard reactor was added to the CFHT unit such that it operated in PRS_{1R} mode: when the guard reactor became metals loaded after 18 months, it was changed-out on the fly using the Catalyst Conditioning System and placed back into service in the guard position. The overall LHSV considering the new reactor was 1.1 hr^{-1} for a feed rate of 72 MBPSD (29 vol% DAO), representing a very feasible increase of 8% to the base rate. The product quality target was held at 1,000 wppm, and the resulting **cycle length was increased to 30 months** by the PRS1R system.

FCC slurry oil was sold as low sulfur fuel oil (LSFO) for both the Base and PRS Cases.

The $H\text{-}Oil_{DC}$ case consisted of making the same crude shift as the PRS case. To maximize conversion and production of middle distillate, the SDA unit was revamped to utilize a pentane solvent, and 100% of the DAO was processed in a new ebullated bed hydrocracker. As a result, the CFHT (Base Case reactor configuration – no PRS) now processed only straight-run VGO and could easily achieve a cycle length of 36 months. Hydrocracked naphtha was processed in the existing NHT/CCR block for gasoline production, and the hydrocracked diesel was routed to the existing DHT. The H-Oil unit utilized one reactor with a 690°F+ conversion of 60%; the H-Oil atmospheric fractionator bottoms was of sufficiently high quality to rout directly to the FCC.

A summary of the case results and overall refinery product pools for each case are presented in the following Table and Figure. The Base and PRS cases of course favor gasoline production via the FCC, while the $H\text{-}Oil_{DC}$ scheme shifts the product slate to favor middle distillates while increasing overall refinery residue conversion (40% reduction in residual fuel oil production).

It should be noted that while the overall production of residual fuel oil (via FCC slurry) for the H-Oil case was reduced by 40%, the low sulfur fuel oil (LSFO) production is not possible in the H-Oil case as it was for the other cases. RFO sulfur is expected to be approximately 1 wt% for the H-Oil case.

CASE	Base Case	PRS Case	H-Oil Case
SDA			
Feed Rate, MBPSD	36,000	41,600	41,600
Lift, v%	50	50	70
DAO Ni+V, wppm	16	24	66
DAO CCR, wt%	6.5	7.0	11.0
CFHT			
Feed Rate, MBPSD	67,100	72,200	51,400
Feed DAO, MBPSD	18,000	20,800	0
No. of Reactors	2	3	2
Cycle Length, mo	18	30	36
$H\text{-}Oil_{DC}$			
Feed Rate, MBPSD	-	-	29,100
690 °F+ Conversion	-	-	60
Diesel Yield (350-690°F), v%	-	-	47
Cycle Length, mo	-	-	Unlimited
FCC			
Feed Rate, MBPSD	66,000	71,000	62,700
Feed API	23.0	23.3	23.5
Gasoline Yield, v%	67	67	65
NHT Feed Rate, MBPSD	57,000	52,400	58,500
DHT Feed Rate, MBPSD	82,700	79,700	91,900

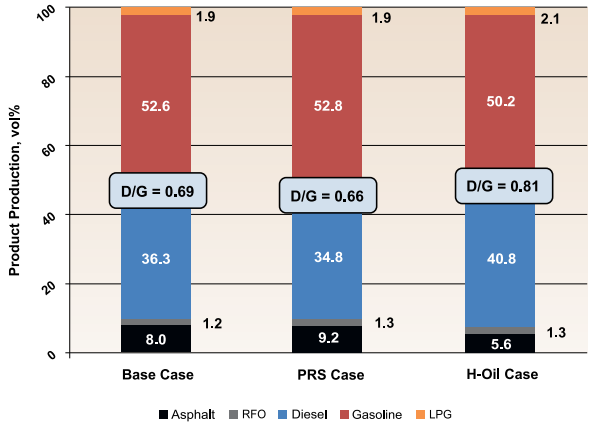

Figure 8 – Case Study Refinery Product Pools

CASE STUDY ECONOMICS

The following price scenarios serve as the basis for economic evaluation.

PRICE, $/BBL (MMSCFD)	Gasoline Favored Scenario	Diesel Favored Scenario	H-Oil Case
Feeds			210
WTI	65	65	
WTS	64	64	25
Arab Med.	63	63	25
WCS	57	57	25
H2	2.5	2.5	25
Products			31
LPG	30	30	1.8
Gasoline	85	83	41.6
ULSD	83	91	
Residual Fuel Oil (LSFO)	51	51	
Residual Fuel Oil (HSFO)	41	41	
Asphalt	42	42	

Refinery-wide margin calculations were performed accounting for operating hydrocarbon margin, catalyst costs, and FCC downtime as a result of short-cycling in the CFHT unit. A justifiable capital expenditure was then calculated assuming a 30% IRR.

The driver for selecting a PRS-FCC-based scheme compared to an H-Oil-based scheme is clearly the gasoline-diesel differential, as H-Oil shifts the product slate to favor middle distillate production. Accordingly, the margin analysis was based on applying the Gasoline Favored Scenario for the Base and PRS Cases and applying the Diesel Favored scenario for the H-Oil$_{DC}$ Case. It should be noted that the H-Oil case is still profitable in the Gasoline Favored Scenario – just to a lesser extent - and hydrocracking conversion can be easily adjusted on the fly to swing the product slate as needed.

The result of the Case Study is clear: US refiners can take advantage of the increased incentive to process heavy, sour crude within existing refinery networks by utilizing DAO hydrocracking or PRS to process the more difficult DAO. Both projects were quite profitable in this analysis.

The PRS system revamp is a relatively low-invest^{tm}ent endeavor that will have an extremely quick pay-back. Previous revamp PRS project total investments have ranged from 12 to $30MM. The results also indicate that H-Oil$_{DC}$ investment can be justified as high as $30,000 per BPSD of unit feed, which is far greater than the expected project TIC.

	Base Case	PRS Case	H-Oil$_{DC}$ Case
Operating Margin			
$MM per day	Base	+ 0.31	+ 0.70
$MM per year	Base	+ 121	+ 257
Justifiable Project CAPEX @ 30% IRR, $MM	-	402	852

It should be noted that even without a crude shift to include more discounted heavy, sour feedstock, the PRS system has a justifiable CAPEX of $77MM based solely on the reduction in FCC downtime associated with the short-cycling CFHT unit.

SUMMARY

For refiners struggling to extend CFHT unit cycle lengths and avoid multiple catalyst change-outs per FCC turn-around, a low-cost CFHT revamp to include a Swing Reactor System (PRS) can have an extremely rapid return on investment while avoiding any major disruptions to the operating plant. In environments where diesel production is favored over gasoline, H-Oil$_{DC}$ for high-conversion hydrocracking of 100% DAO feeds is an attractive major-project option. Project economics for both options become more favorable as the differential between sweet and sour crudes widens thanks to the technologies' ability to process crudes with increasingly high percentages of vacuum residue containing high metals and conradson carbon.

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1. 2015 Worldwide Refining Survey. Oil & Gas Journal December 2015.

Oil refinery plant

REFINING

CONSISTA® CATALYST FOR THE UNIPOL® PP PROCESS – SIX YEARS IN PERSPECTIVE

Jose M. Rego **John Kaarto** **Amaia Montoya**

W.R. Grace Co.

ABSTRACT

W.R. GRACE Co. (GRACE hereafter) commercialized the CONSISTA® catalyst family for the UNIPOL® PP process in 2012. This paper reflects on the six years of implementation that followed and offers a unique perspective of how the CONSISTA® catalyst technology enables polypropylene producers' product innovation. This paper shares unmet needs uncovered before commercialization, and showcases how they were addressed with the CONSISTA® catalyst development.

INTRODUCTION

The polypropylene PP industry is one of the most complex plastic related ones. With a global consumption of 65,000 kta in 2016, PP is used in hundreds of applications in markets such as food packaging, industrial packaging, automotive, consumer durables, medical, building and construction, wire and cable and others. All these markets are served by PP producers use a wide range of process technologies. The number of resins to serve these markets are in the thousands. Finally, a large number of catalyst suppliers (> 8) compete at regional or local level to serve these markets.

A typical value chain for PP markets is given in Figure 1. Interesting enough, the catalyst (raw material) is one of the most significant enablers of PP technology. However, raw material suppliers are the farthest value chain players for the OEM/brand owner and users who are many times the value chain champion. This requires that PP process licensors and catalyst suppliers have a constant dialogue with PP producers, convertors and brand owners to focus process and catalyst inventions on market trends. This is actually GRACE's approach to innovation, viz., drive improvements in PP products by developing new catalyst technology.

Back in 2009, a marketing effort geared towards identifying unmet needs of UNIPOL® PP based PP producers allowed to identify several focus areas that were grouped into four innovation themes (see Figure 2):

i. Lighter materials: customers were asking for higher melt strength (MS) for thermoforming and higher stiffness PP to reduce part thickness
ii. Faster materials: customer were asking for in-reactor high MFR grades with enhanced taste and odor ratings
iii. Cleaner materials: customer were asking for PP grades with lower Volatile Organic Compounds (VOC) content, lower taste and odor by avoiding peroxide cracking and non-Phthalate based and
iv. Clearer materials: customer were asking for clearer random copolymers (RCP).

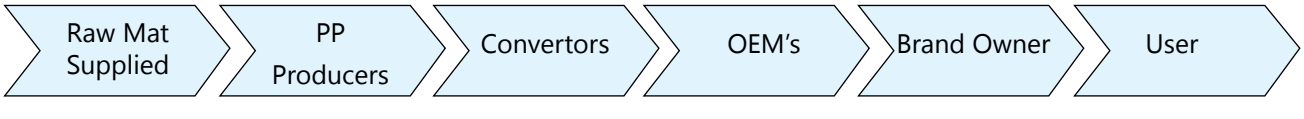

Figure 1: Typical value chain for PP markets. It is common that OEM and brand owner are the same company.

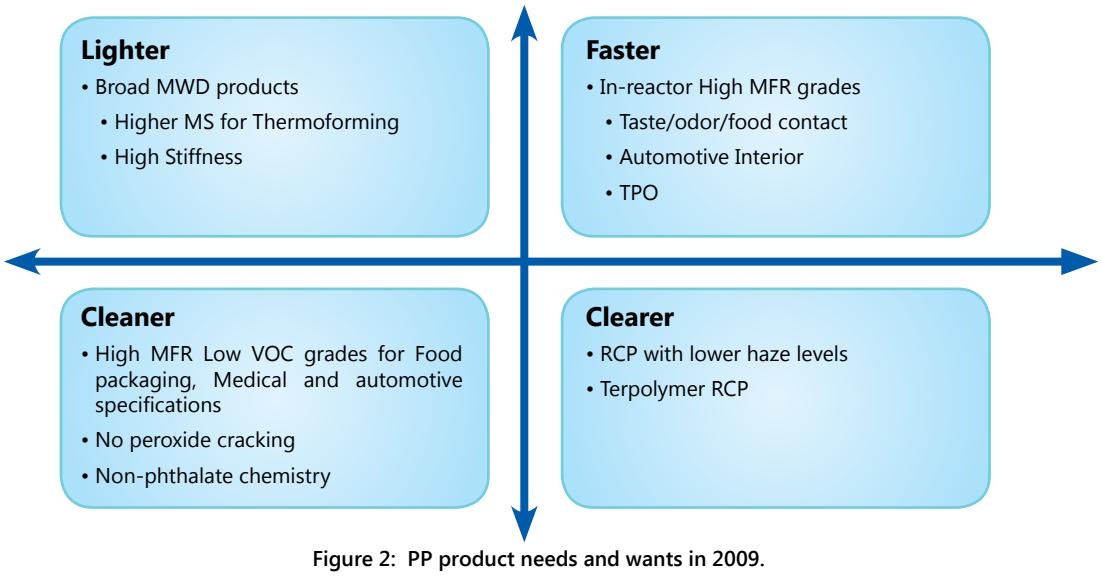

Figure 2: PP product needs and wants in 2009.

This paper discusses how the CONSISTA® catalyst was developed and how it meets the market needs described above and that have allowed a successful implementation of this catalyst system globally.

CONSISTA® CATALYST

One of the first decisions made in the development of the CONSISTA® catalyst was that it had be non-phthalate based.

The internal donor identification was done using high throughput methodologies to screen hundreds of molecules effectively (internal and external donors).

Figure 3 shows a "shotgun" plot of polydispersity index (PDI) versus XS for all the internal and external donors tested. This Figure shows the high number of donors in the GRACE library and highlights the ability that GRACE has to be the industry-leading innovator. The CONSISTA® catalyst commercialized in 2012 for the UNIPOL® PP process is one of the points in this plot. The line represents typical PDI values as a function of XS for the 4th generation

catalyst. As can be seen, the CONSISTA® internal donor selected was one showing a PDI about 1 unit higher than 4th generation catalyst.

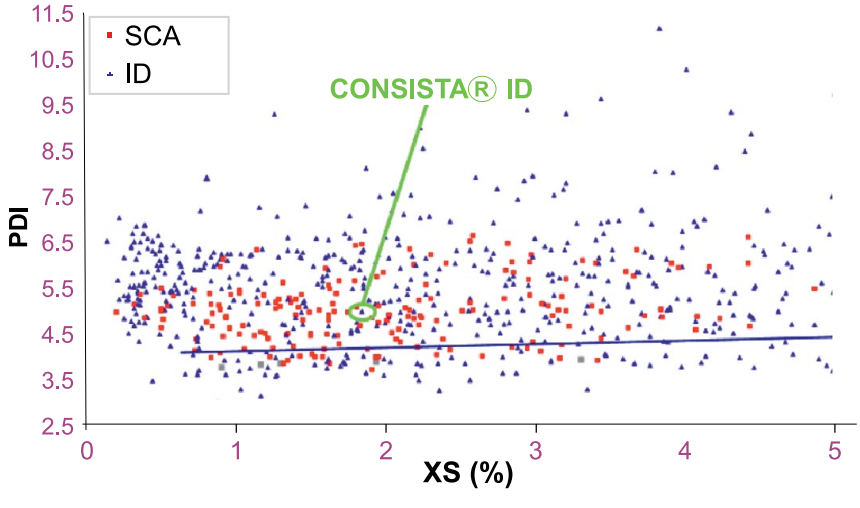

Figure 3: Shotgun plot that shows GRACE's internal donor capability. All internal donors in this plot are non-phthalate in nature

The other catalyst development requirements were: (i) high H2 response for in-reactor high MFR grades, (ii) high productivity; (iii) enhanced stereoregularity; (iv) broad XS response and (v) better ethylene distribution. We'll review how CONSISTA® catalyst addresses these requirements in the coming paragraphs.

Figure 4 shows the H2 response for the CONSISTA® catalyst and different external donors and how it compares with the H2 response of 4th generation (SHAC® catalyst) at a XS level of 1.5 wt%. The CONSISTA® catalyst shows a H2 response that enables in-reactor MFR as high as 400 g/10min vs the typical maximum associated with 4th gen catalyst at about 50-60 g/10min.

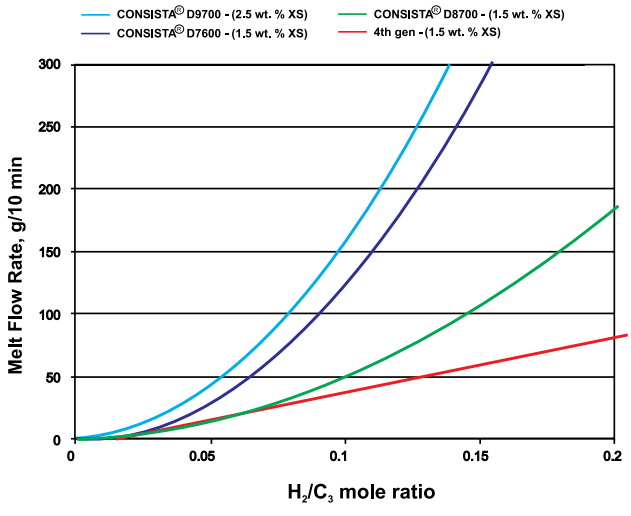

Figure 4: MFR as a function of H2/C3 ratio for CONSISTA® catalyst with various donors vs 4th gen catalyst. XS is 1.5 wt% in all cases except one.

Figure 5 shows the productivity of CONSISTA® catalyst vs 4th gen catalyst (SHAC® catalyst) as a function of XS. CONSISTA® shows 2-3 times higher productivity than 4th gen catalyst across the XS range.

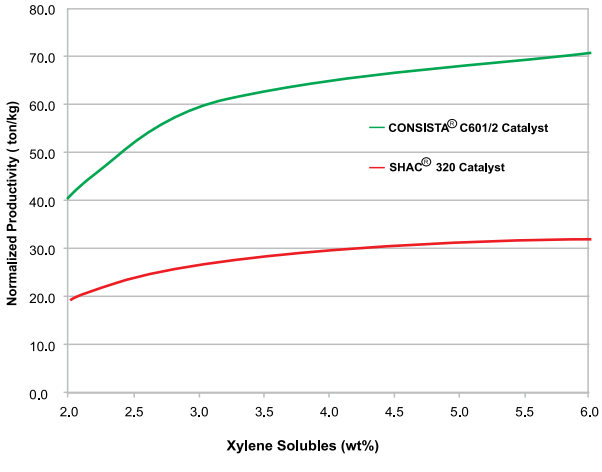

Figure 5: Productivity as a function of XS for CONSISTA® catalyst vs 4th gen catalyst.

Figure 6 shows the ^{13}C NMR pentads for CONSISTA® catalyst vs 4th gen catalyst across the XS range and for cracked and non-cracked grades. In all cases, the pentad level appears to be higher for CONSISTA® catalyst based homopolymer PP (HPP).

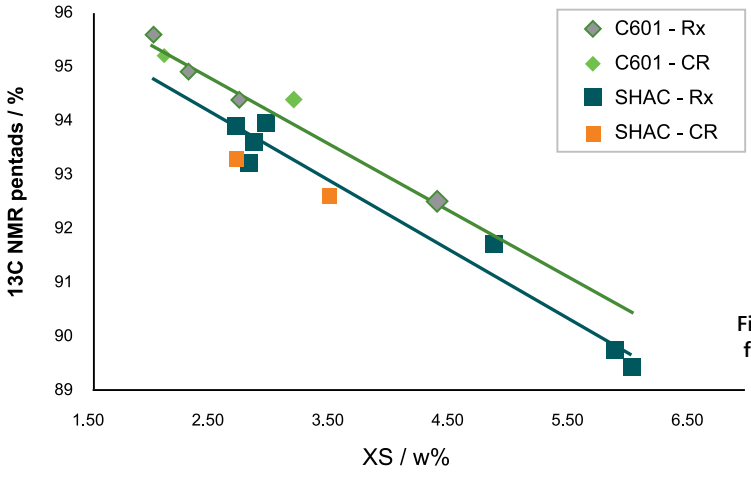

Figure 6: 13C NMR pentads as a function of XS for CONSISTA® catalyst vs 4th gen catalyst.

Finally, Figure 7 shows the reactivity ration r_1 for random copolymer PP (RCP) made with CONSISTA® and 4th gen

catalysts. This reactivity ratio was calculated using O'Driscoll's equation [Reference 1] which is included below. It is apparent from Figure 7 that r_1 is double for CONSISTA® catalyst based RCP's relative to 4th gen SHAC® catalyst based RCP's. This indicates that the probability of P-P additions is about the same as the one for P-E additions for CONSISTA® based RCP's whereas for SHAC® based RCP's P-E additions have double probability to occur than P-P additions. Accordingly, CONSISTA® based RCP's show a more random distribution than 4th gen based RCP's. This translates into clearer resins, as it will be shown later.

$$r_1 = \left(\frac{EPE+EPP+PPP}{EPE+\frac{PPE}{2}}-1\right)(C2/C3) \quad \text{...(1)}$$

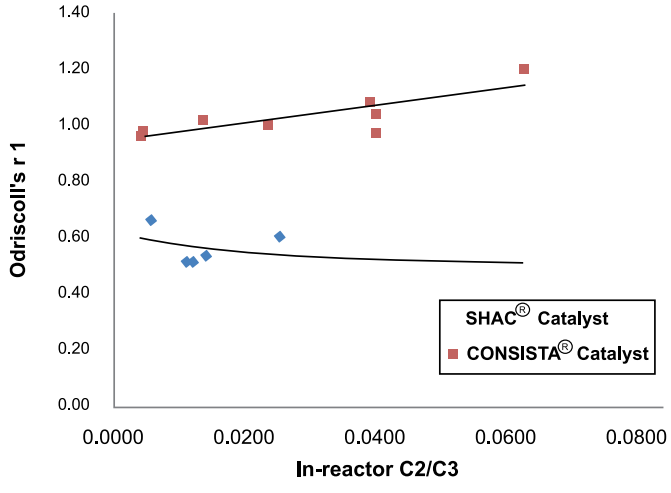

Figure 7: Reactivity ratio r1 as a function of in-reactor C2/C3 mole ratio for CONSISTA® catalyst vs 4th gen catalyst based RCP's.

As can be concluded from Figures 3 through 7, CONSISTA® catalyst meets the design criteria described earlier. The next section focuses on whether these design criteria meet customer needs mentioned in Figure 2.

PERFORMANCE PRODUCTS

Higher stiffness HPP

The higher PDI and stereo-specificity associated with CONSISTA® catalyst based PP was expected to result in higher flex modulus and this can be seen in Figure 8 where flex modulus is represented against XS range. An increase from 10 to 15 % vs 4th gen catalyst based HPP is observed in this plot.

In-reactor TPO with good -20 °C izod impact

High MFR in-reactor TPO's were also uncovered as one of the needs in the industry. An example is the need for a 20 MFR TPO with a -20 °C izod impact of 150 J/m for the Asia Pacific market. Figure 9 shows how the Izod impact at -20 °C changes with ethylene-propylene rubber (EPR) content (Fc) and with the ratio of EPR and matrix viscosities (β/α ratio). The first reactor (Rx1) or matrix XS level ranges from 1.7 to 5 wt% in this data set. Target izod values are obtained for β/α ratios of 2 or higher and this requires a higher matrix MFR. CONSISTA® catalyst enables this kind of TPO technology.

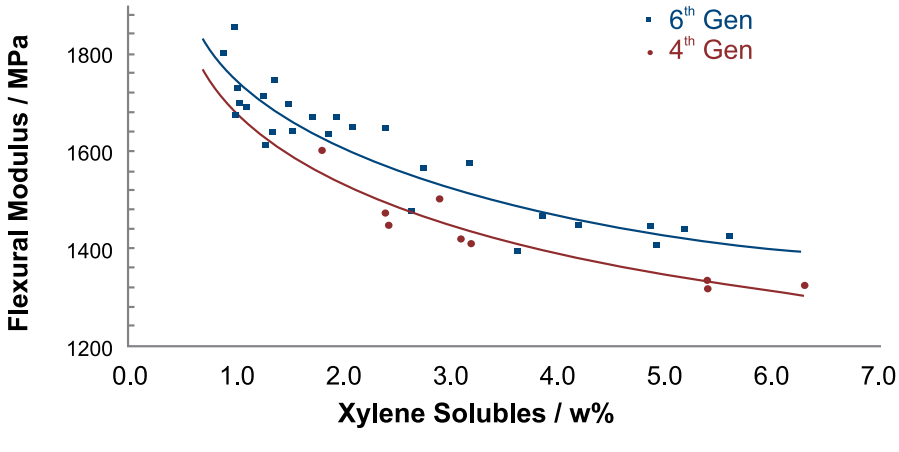

Figure 8: Flex modulus as a function of XS for CONSISTA® catalyst vs 4th gen catalyst based HPP.

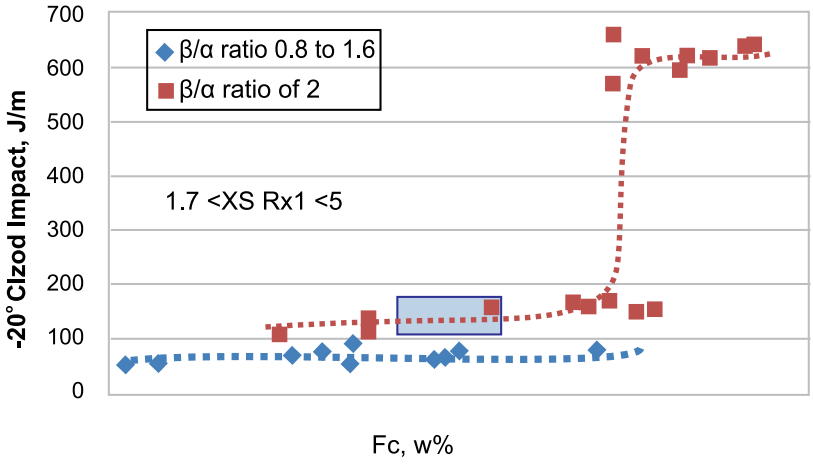

Figure 9: -20 °C Izod impact as a function of Fc and β/α ratio. (Fc values are not shown because this is proprietary information)

IN-REACTOR HIGH STIFFNESS ICP AND LOW VOC

High MFR high stiffness ICP are key grades in automotive applications in Asia Pacific where they are often referred to as HCPP grades. The property balance of these materials is achieved with low EPR content and high b/a ratios which makes it necessary to use a catalyst with excellent H2 response (for final MFR values of 30 g/10min and higher). Figure 10 shows the toughness-stiffness balance of three CONSISTA® catalyst based HCPP's (10, 30 and 60 MFR) and how they compare with competing grades in the market. Given the error associated with izod and flex modulus measurements, the toughness-stiffness balance of the CONSISTA® catalyst based HCPP's is comparable to incumbents in the Asian market.

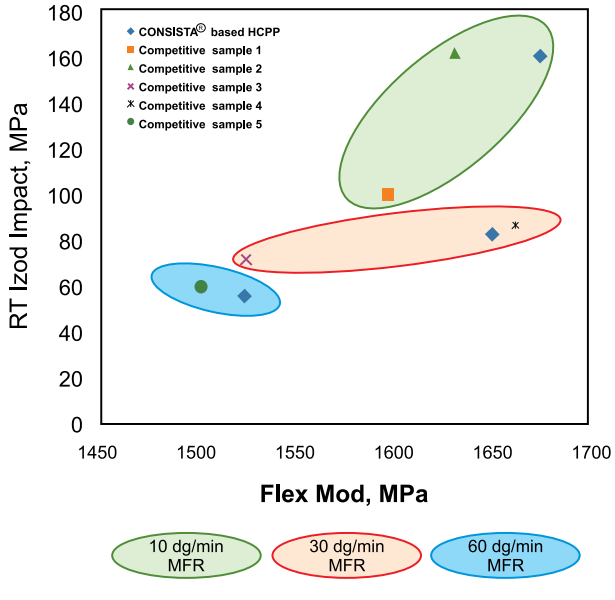

Figure 10: Stiffness-toughness balance of CONSISTA® catalyst based HCPP's vs incumbent grades in the Asian market.

Another important want for the automotive industry is resins with volatile organic compounds (VOC) concentrations below a certain level. A common method used in the industry is PV3341 and a request is VOC levels below 50 ppm. Since the VOC concentration increases with increasing MFR, the 50-ppm mark becomes more challenging with the resins MFR increases that has been the trend in the last 30 years. The CONSISTA® catalyst technology coupled with specialized external donors afford an increase in MFR with VOC levels < 50 ppm from 20 to 50 g/10min as can be seen in Figure 11.

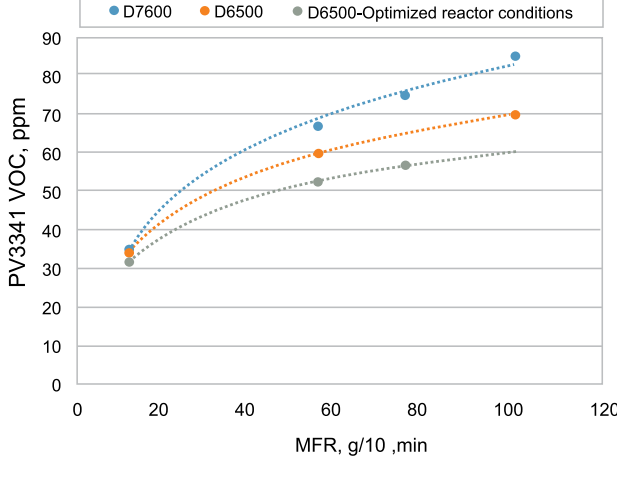

Figure 11: PV3341 VOC as a function of MFR for CONSISTA® catalyst based ICP's made with different external donor technologies.

CLEARER PP AND TERPOLYMER RCP

Finally, our 2009 voice of the customer showed that different players in the value chain wanted clearer materials and in particular a broad terpolymer RCP design window and lower haze RCP's. Figure 12 shows the design window associated with the UNIPOL® PP process and the CONSISTA® catalyst in terms of heat seal initiation temperature (HIST) and melting point (Tm). Comonomer levels as high as 16 wt% provide very low haze materials.

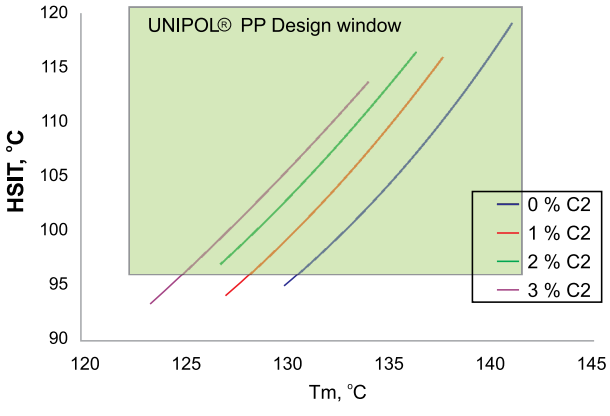

Figure 12: HSIT as a function of Tm for butene-RCP (0 wt% C2) and terpolymer RCP's and design window for the UNIPOL® PP process in conjunction with the CONSISTA® catalyst technology.

Finally, Figure 13 shows haze values as a function of plaque thickness for a 45 MFR CONSISTA® catalyst based RCP vs a 45 MFR 4th gen catalyst based RCP (denoted as std grade). Haze values in injection molded plaques are about 20 % lower for the CONSISTA® catalyst based RCP. This is explained by the better random ethylene distribution discussed earlier in this paper.

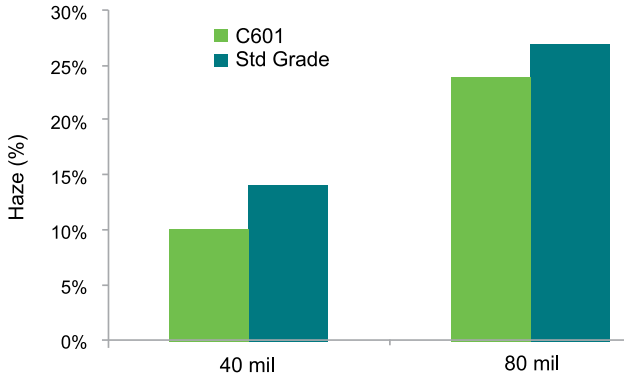

Figure 13: Haze as a function of plaque thickness for a 45 MFR CONSISTA® catalyst based RCP vs a 45 MFR 4th gen catalyst based RCP (denoted as std grade). Note: 40 mil = 1 mm.

CONCLUSIONS

GRACE commercialized the CONSISTA® catalyst family for the UNIPOL® PP process in 2012. This paper reflected on the six years of implementation that followed and outlined how CONSISTA® development succeeded in meeting industry needs and wants uncovered before commercialization. It also created a pipeline for continued development of new technology solutions such as for low VOC. Figure 14 shows that the CONSISTA® catalyst technology addressed unmet needs such as higher stiffness PP, low VOC grades, in-reactor high MFR ICP's and TPO's and clearer RCP's.

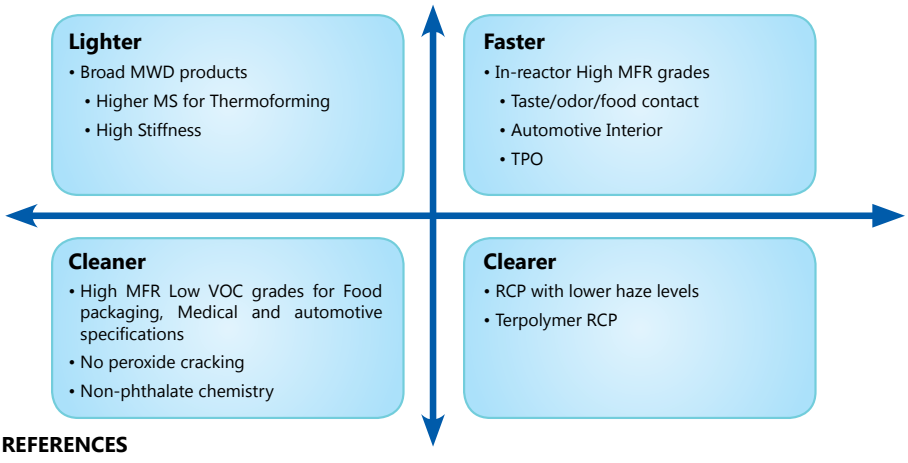

Figure 14: Stiffness-toughness balance of CONSISTA® catalyst based HCPP's vs incumbent grades in the Asian market.

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1. Rudin, A., O'Driscoll, K.F., and Rumack, M.S., Use of NMR. data to calculate copolymer reactivity ratios, Polymer (1981) Vol 22, pp 740 – 747

Appendix - Methods

Property	Method
Flexural Modulus, MPa	ASTM D790
Notched Izod Impact, J/m	ASTM D256
MFR, g/10 min	ASTM D1238
XS, w%	ASTM D5492
Haze in injection molded plaques	ASTM D1003
VOC	PV3341
Et, Ec and Fc	NMR–Grace method
HSIT	ASTM F2029 and F88

OIL & GAS IN MEDIA

9TH CGD BIDDING ROUND : A MAJOR STEP TOWARDS 'GAS BASED ECONOMY'

9TH CGD BIDDING ROUND

Petroleum and Natural Gas Regulatory Board (PNGRB), on 8th May 2018 launched its 9th CGD Bidding Round. The initiative is a part of India's efforts to shift to a 'Gas Based Economy' by increasing its contribution to primary energy basket from the current of about 6.5 % to 15 %.

Speaking on the occasion, The Petroleum & Natural Gas and Skill Development Minister, Shri Dharmendra Pradhan said that CGD coverage has doubled in four years to 94 Geographical Areas (GAs) spread across 130 districts in the country. Reforms in Natural Gas sector in India are important to attract the investors and PNGRB is playing an important role in refining the gas usage model and even becoming a 'Facilitator', the Minister said. A JV of 5 companies is developing a mini gas grid of about 1500 kms in North East States connecting all states capitals. He mentioned that the support to CGD entities and MOP&NG from the State governments is essential.

City Gas Distribution (CGD) networks were covering 35 Gas prior to incorporation of PNGRB and first round of bids for CGD in 2009. Till then PNGRB launched total eight rounds for CGD bidding till 2017, 6th round being the largest with bids invited for 34 GAs. In total 106 GAs were offered in total eight rounds out of which 56 were awarded making total 91 authorised GAs with CGD networks.

PRESENT CGD SCENARIO

Current 91 GAs cover about 361.2 thousand square kilometre area (about 11 % of India) with following users base as on 1st April 2018 (source: PPAC)

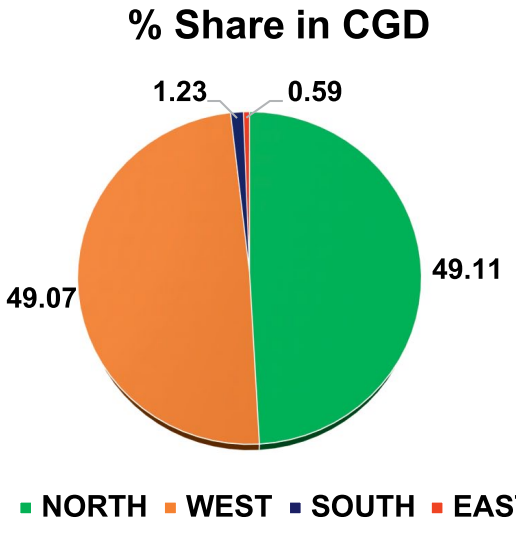
User Category	Numbers as on 1/4/2018
Domestic	4,28,054
Industrial	7,601
Commercial	26,131

1,424 CNG stations provide fuel to 3,090,139 CNG based vehicles . During 2017-18 , about 8.54 BCM (16.3% of total consumption) of natural gas was consumed through CGD networks for domestic and transport fuel . When compared with 2014-15 consumption , the growth rate (CAGR) is about 16.4 % per annum.

Year	Total gas Consumption in India , BCM (A)	Gas for Domestic / Transportation , BCM (B)	% of (B) over (A)
2014-15	49.95	5.42	10.9
2015-16	47.85	5.46	11.25
2016-17	50.78	7.35	14.5
2017-18	52.52	8.54	16.3
Source : MOSPI Energy Statistics except for 2017-18 which is PPAC data			

On PAN India basis , North (Delhi , Haryana , Rajasthan, Chandigarh) and West (Gujarat , Maharashtra, Madhya Pradesh) consume about 98% of Gas in CGD sector in the ratio of about 50:48 (Source : PPAC – Ready Reckoner, November 2017).

About 16,800 km long natural gas (NG) pipeline network with 375 MMSCM is in operation whereas about 13,500 km pipeline network with design capacity of 548 MMSCMD is under construction.



Four LNG terminals with a capacity of 26.7MMTPA are receiving import . However , current capacity utilisation is about 12 % only due to lack of product evacuation and distribution infrastructure.

IMPACT OF 9TH ROUND

This round is the largest in all dimensions . It is covering 86 GAs in 174 districts spread across 20 States and 2 UTs With this round , 24 % more area of India and 29 % population will have access to CGD network making total of 35% area and 48 % of population coverage . Sh. D.K Saraf , Chairman , PNGRB during his presentation told that debottlenecking of LNG infrastructure to 50 MMTPA by 2022 in parallel , is necessary for achieving end to end benefits. Environmental considerations like ban on Petcoke / FO in NCR , designated CGD as 'Public Utility' , Government drive to provide PNG connections to one crores household and commitment of State Governments are acting as 'Enablers' , he said.

In his presentation , Mr. Saraf highlighted the following investors friendly regulations :

- Marketing exclusivity increased from 5 to 8 years (extendable to 10 years for performers)
- Infrastructure exclusivity for 25 years
- Time for Financial closure and Gas Tie up increased from 180 to 270 days.
- Gas pipeline company to provide connectivity in 180/270 days.
- Easy eligibility criteria.
- Capping of bank guarantee to Rs. 50 crores

Beside the above , PNGRB has also rationalised bidding parameters to make the system more transparent.

With 10th July 2018 as the final of date of submission , PNGRB plan to award the authorisation by October 2018.

OIL & GAS IN MEDIA

MAIDEN BID ROUND UNDER OALP – A STEP TO REVIVE E&P ACTIVITIES IN INDIA

The first ever auction of blocks under Open Acreage Licensing Programme (OALPP) , 'OALPP Bid Round- I' was completed on 2nd May 2018. With the receipt of 110 e-bids for 55 blocks in spite the global E&P investment consolidation environment , Director General of Hydrocarbon (DGH) , the country's apex regulator in the domain , term this venture 'Successful'.

POLICY FRAMEWORK FOR E&P IN INDIA

NELP

Let us first have an overview the development of various policy frameworks in India before we discuss the current venture. Realising the need of private investment in Oil & Gas exploration and production in India , government in 1997 formulated New Exploration and Licensing Policy (NELP) with the objective of providing level playing field for both private and public companies. Between 1999 – 2010, nine rounds of invitation of Bids were launched.

Out of total 254 blocks for whom the license were awarded under nine NELP rounds , only 98 covering 170864 sq. km. area were operational (10 deep water – 52484 sq. km., 22 shallow water – 51770 sq. km. and 66 on land – 66574 sq.km.) as on 1.4.2015. The rest were relinquished. Last 9th round was launched in 2010 with signing year 2012. During this period , indigenous crude production achieved a peak from average of 32 million MT per annum (MMTPA) to about 36 MMTPA in 2011-12 and declined to 34 MMTPA in 2017-18 (all condensate excluding).

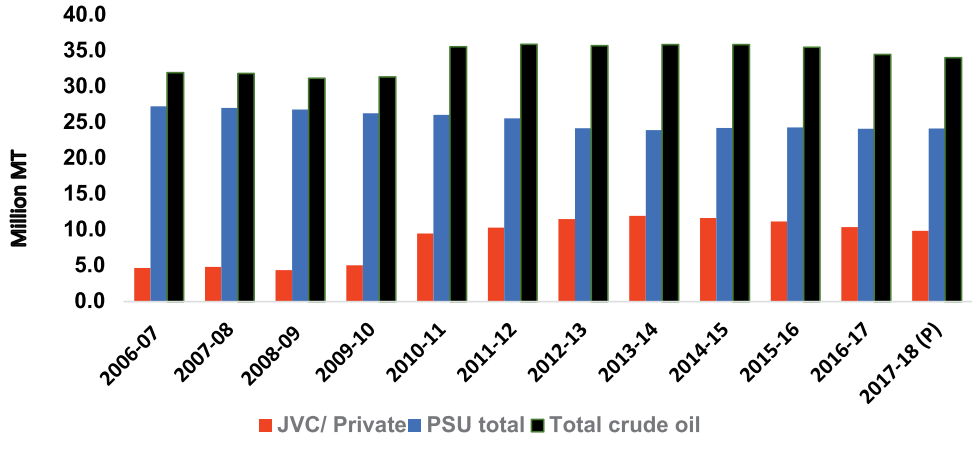


Table 1 : Indigenous Crude Production (source : PPAC)

HELP

In its last phase , NELP mired with certain critical issues and litigations and was found not serving the national interest of enhancing indigenous Oil & gas production in its true spirit. Government in March 2016, approved the new policy 'Hydrocarbon Exploration and Licensing Policy (HELP)' . **Open Acreage Licensing Program** (OALP) developed under this policy is meant to make it more investor friendly through its flexible nature and attract more investment for E&P in India. OALP replaces the old system of government carving out areas and bidding them out. It allows investors to carve out any areas (min. 10'x10' – 336 sq.km with some exceptions) not under license currently (Petroleum Exploration License -PEL and Mining Lease -ML) but evince interest for doing E&P and put in an EOI. Once an EOI is received for an area, it is put on competitive bidding and any company offering the government maximum share of oil and gas revenue is awarded the block. HELP has the following reform components that differentiate it from NELP:

- Based on Revenue Sharing Contract (not profit as in NELP)
- Provides unified licensing for all , conventional and non – conventional hydrocarbons
- Blocks carving by the investors based on data from National Data Repository (NDR)
- Market pricing and free access to markets for products
- Low regulatory burden

Operational activities under HEP with OALP i.e. submission of EOI , bids , evaluation , award of blocks and signing of contract will be a continuous . Bids are accepted round the year but bunched together once in six months. Two windows ; one from November to May and second from May to November will remain functional throughout with following schedule :

Activity	Time (weeks)	Window 1 (November – May)	Window 2 (May – November)
		Activity to be over by	
EOI Submission	--	November	May
Block Finalisation and Inviting BID	4-6	December / January	June / July
Bid Submission	10-12	April	October
Bid Evaluation and declaration of winner	4	May	November
Contract Signing	4	June	December

Bid evaluation will be on marks basis of three criteria i.e. Minimum Program Commitment – MPC (45 marks for total four sub-parameters), Revenue share offered (50 marks) and originator incentive (5 marks). MPC include 2D and 3D seismic surveys, number of wells drilled and number of core analysis wells (for Shale resources).

DGH in an interactive meeting at Ahmedabad in February 2018 stated that India will attract about 25 billion $ investment in Oil & Gas exploration and production by 2022 . About 22 billion $ investment have received technical approvals and the rest of the investment is expected from auctions under OALP.

OALP BID ROUND –I

In this round, submission of EOI started in July 2017 and closed on 15th November 2017. Total 57 bids were received out of which two were withdrawn as found more than half of the bid areas were overlapping with existing leases and regulator 'No-Go Zones'. Nine Indian companies (individually or in consortium), 5 in Public Sector (ONGC, OIL, IOCL, GAIL India , BRPL) and 4 Private (Vedanta, Selan , HOEC, Sun Petro) participated in successful bids. Vedanta submitted bids for all 55 blocks. ONGC participated for total 45 blocks (individually - 26 and in consortium -19). Except for one shallow water block in KG basin, ONGC has submitted bids for all other off-shore blocks including one deep-water block of KG in individual capacity. For one shallow block of KG basin , ONGC and Oil consortium has bid. Private company M/S Selan Exploration Tech Ltd. Has submitted bid for two On-Land blocks in Camay Basin and one bid of M/S Sun Petrochemicals Pvt. Ltd. is for one block in Cambay basin.

These 55 blocks are spread across 10 sedimentary basins cover 59,282 sq. km area. Following gives more details of these basins:

S. No.	Basin	Off-shore No. of Blocks		On Land No. of Blocks	Undiscovered Resources MMTOe (Area – sq.km.)
		Deep Water	Shallow		
1	Rajasthan	-	-	9	3188 (10104)
2	Cambay	-	-	11	786 (7551)
3	Kutch	-	1	1	827 (5650)
04	Saurashtra	-	2	-	1246 (3301)
5	Mumbai off-shore	-	2	-	4852 (3415)
6	Cauvery	-	2	1	1672 (5099)
7	Krishna-Godavari (KG)	1	1	3	7578 (9789)
8	Ganga	-	-	1	128 (1817)
9	Himalayan Foreland	-	-	1	44 (666)
10	Assam & Assam-Arakan	-	-	19	7634 (11890)
	Total	1	8	46	27955 (59282)

MMTOe : Million MT of Oil Equivalent

Out of total 110 e-bids, 92 are for 46 'On Land' blocks and 18 for total 9 'Off-shore' blocks. Technical bids have been opened on 2nd May 2018 and evaluation is in progress. Announcement of awards is scheduled for June 2018.

Although HELP has been developed further on the past experience of NELP and other issues, its outcome on the ground will unfold much later. International geopolitics impacting international market prices, internal economic scenarios and policies, financial issues with stakeholders are the risk factors. Government must keep a watch and respond fast with appropriate solutions in the national interest.

OIL & GAS IN MEDIA

NATIONAL BIOFUELS POLICY 2018 – A MOVE TOWARDS GROUND REALITIES

BIOFUELS POLICY – AN OVERVIEW

Biofuel Policy prior to 2018 (Biofuel Policy 2009) was primarily to facilitate and bring about optimal development and utilization of indigenous biomass feedstocks for production of biofuels. The Policy also envisaged development of the next generation of more efficient biofuel conversion technologies based on new feedstocks. The current National Biofuels Policy 2018 (Policy 2018), approved by the Cabinet on 16th May 2018, builds on the achievements of earlier policy. The new policy aims at helping farmers in disposing of their surplus or waste stocks in economically beneficial manner and also put a control on rising need of fossil fuels by supplementing with renewable sources of energy thus contributing towards national energy security by reducing import dependency.

Policy 2018 aims to utilize, develop and promote domestic feedstock and its utilization for production of biofuels thereby increasingly substitute fossil fuels while contributing to National Energy Security, Climate Change mitigation, apart from creating new employment opportunities in a sustainable way. Simultaneously, the policy will also encourage the application of advance technologies for generation of biofuels.

The Goal of the Policy is to enable availability of biofuels in the market thereby increasing its blending

Percentage. Currently the ethanol blending percentage in petrol is around 2.0% and biodiesel blending percentage in diesel is less than 0.1%. An indicative target of 20% blending of ethanol in petrol and 5% blending of biodiesel in diesel is proposed by 2030. This goal is to be achieved by

(a) Reinforcing ongoing ethanol/biodiesel supplies through increasing domestic production

(b) Setting up Second Generation (2G) bio refineries

(c) Development of new feedstock for biofuels

(d) Development of new technologies for conversion to biofuels.

(e) Creating suitable environment for biofuels and its integration with the main fuels.

CATEGORIES OF BIOFUELS

i 'Bioethanol': ethanol produced from biomass such as sugar containing materials, like sugar cane, sugar beet, sweet sorghum etc.; starch containing materials such as corn, cassava, rotten potatoes, algae etc.; and, cellulosic materials such as bagasse, wood waste, agricultural and forestry residues or other renewable resources like industrial waste;

ii. 'Biodiesel': a methyl or ethyl ester of fatty acids produced from non-edible vegetable oils, acid oil, used cooking oil or animal fat and bio-oil;

Both the above are 'Basic Biofuels or 1G biofuels

iii. **'Advanced biofuels':** Fuels which are (1) produced from lignocellulosic feedstocks (i.e. agricultural and forestry residues, e.g. rice & wheat straw/

corn cobs & Stover/bagasse, woody biomass), non-food crops (i.e. grasses, algae), or industrial waste and residue streams, (2) having low CO2 emission or high GHG reduction and do not compete with food crops for land use.

Fuels such as Second Generation (2G) Ethanol, Drop-in fuels, algae based 3G biofuels, bio-CNG, bio-methanol, Di Methyl Ether (DME) derived from bio-methanol, bio-hydrogen, drop in fuels with MSW as the source / feedstock material will qualify as "Advanced Biofuels".

iv. **'Drop-in fuels':** Any liquid fuel produced from Biomass, agro-residues, wastes such as Municipal Solid Wastes (MSW), Plastic wastes, Industrial wastes etc. which meets the Indian standards for MS, HSD and Jet fuel, in pure or blended form, for its subsequent utilization in vehicles without any modifications in the engine systems and can utilize existing petroleum distribution system.

v. 'Bio-CNG': Purified form of bio-Gas whose composition & energy potential is similar to that of Fossil based natural gas and is produced from agricultural residues, animal dung, food waste,

MSW and Sewage water.

It is apparent from the classification that Policy 2018 expand the spectrum of feed stocks for ethanol production.

The prime purpose of categorisation is to provide focussed policy support and fiscal incentives to facilitate availability of biofuels through the new and advance routes. With a thrust on Advanced Biofuels, the Policy indicates a viability gap funding scheme for 2G ethanol Bio refineries of Rs.5000 crore in 6 years in addition to additional tax incentives, higher purchase price as compared to 1G biofuels.

DISTRIBUTION & MARKETING OF BIOFUELS

Oil Marketing Companies will continue to store, distribute and market biofuels. They will be primarily

Responsible for maintaining and improving the storage, distribution and marketing infrastructure to meet the requirements of biofuels. Government may also consider to allow other players to distribute and market biofuels depending upon factors like ensuring quality standards, consumer awareness about blending percentages, warranty requirements etc.

PRICING OF BIOFUELS

At present, the price of first generation molasses based ethanol for EBP Programme is being determined by the Government based on the recommendation of a Committee constituted for this purpose. For procurement of biodiesel for blending in diesel, the price is being determined by OMCs. The Government will continue to incentivise first generation biofuels by administered prices or market determined prices depending upon various factors including market conditions, availability of biofuels in domestic market, import substitution requirement, etc. The advanced biofuels will be given a differential pricing to further incentivise them. The mechanism for differential pricing for advanced biofuels will be decided by the National Biofuel Coordination Committee.

EXPECTED BENEFITS

- **Reduce Import Dependency:** One crore litre of E10 (10% ethanol blended Gasoline) saves Rs.28 crore of forex at current rates. The ethanol supply year 2017-18 is likely to see a supply of around 150 crore litres of ethanol which will result in savings of over Rs.4000 crore of forex.
- **Cleaner Environment:** One crore lit of E-10 saves around 20,000 ton of CO2 emissions. For the ethanol supply year 2017-18, there will be lesser emissions of CO2 to the tune of 30 lakh ton. By reducing crop burning & conversion of agricultural residues/wastes to biofuels there will be further reduction in Green House Gas emissions.

- **MSW Management:** It is estimated that, annually 62 MMT of Municipal Solid Waste gets generated in India. There are technologies available which can convert waste/plastic, MSW to drop in fuels. One ton of such waste has the potential to provide around 20% of drop in fuels.
- **Infrastructural Investment and employment in Rural Areas:** It is estimated that, one 100klpd bio refinery will require around Rs.800 crore capital investment. At present Oil Marketing Companies are in the process of setting up twelve 2G bio refineries with an investment of around Rs.10,000 crore. Further addition of 2G bio refineries across the Country will spur infrastructural investment in the rural areas and will generate 1200 jobs in Plant Operations, Village Level Entrepreneurs and Supply Chain Management.
- **Additional Income to Farmers:** By adopting 2G technologies, agricultural residues/waste which otherwise are burnt by the farmers can be converted to ethanol and can fetch a price for these waste if a market is developed for the same. Also, farmers are at a risk of not getting appropriate price for their produce during the surplus production phase. Thus conversion of surplus grains and agricultural biomass can help in price stabilization.

The Bureau of Indian Standards (BIS) has already evolved standards for bioethanol, biodiesel for standalone and blended form applications. Development of specifications for higher blending levels are underway.

FIPI EVENT

WORKSHOP ON CHANGING OIL & GAS LANDSCAPE

FIPI organised a workshop in association with Stratas Advisors on "Changing Oil & Gas Landscape at Hotel Taj Mahal in New Delhi on 27th April 2018"by inviting international oil and gas experts who shared their insights on the emerging trends in transformation of the global oil and gas sector.

Mr. N. K. Bansal Director (Oil Refining and Marketing) welcomed the participants to the workshop and gave a brief overview of the sessions to be taken up experts from Stratas Advisors.

Mr.John Paisie Executive Vice President, Stratas Advisors shared his understanding on emerging trends in clean energy sector. He outlined the importance of hydrocarbons in evolving transport sector and stated that the new found hydrocarbon potential in the US will result in flow of crude from the US towards global economies, majorly towards Asia as global demand of oil & gas makes a shift from the Atlantic basin to the Pacific basin. This growth & shift in demand will make larger refiners more resilient, with focus on 'lighter' production with 'tighter' fuel specifications. He also underscored that India's high crude imports will be driven by the growing investments in oil refineries and gas based crackers in the country, which will lead to cheaper access to Olefins and reduce Naptha demand in market.

Mr. Shuqiang Feng, specialist on Upstream Oil and Gas Field Development and Oilfield Service Market, discussed about the factors influencing the global hydrocarbon supply. He indicated tha t oil and gas sector will continue to grow supported by OPEC and the newly accessed US Shale and a major boom in Natural Gas and Natural Gas Liquids production is expected steered by strong backing from North America & Middle East.

Ms. Ashley Petersen, Senior Oil Market Analyst, indicated that the hydrocarbon market is currently recovering from the price imbalance due to which supply capacity and capability will play a major role in oil and gas pricing. She further sighted a rise in petrochemical prices alongside crude as market maturity focuses on demand growth on selected products, which in turn will be supported by the strongly growing consumer class in the high demand regions. Sharing her perspective on Indian market, she highlighted a secured growth in country's LPG demand due to restructuring of Government of India's assistance program.

Mr. George Popps, specialist on World Trade of LNG, shared his analysis on gas market dynamics exploring the impact of geo-political ties and technological advancement in the LNG sector. He also discussed about the possibility of new gas hubs in Asia and increase in spot trade.

Mr. Trey Hohmann, specialist in Global Light-Duty Vehicle forecasting, Emissions Modeling, outlined India, China & ASEAN as the new hub of growing fuel demand and transformations in Automotive sector. He also indicated towards a rapid growth in petrol hybrids & xEVs in China's automotive market and a sustained growth in LMVs and two wheelers is expected for Indian automotive market.

Ms. Huiming Li, specialist in Fuel Quality and Policy Issues advised to lower the Sulphur content of fuels in all the developing demand-hub countries, like India & China. She also underscored the existing gap between fuel quality and emissions in developing countries where alternatives like MTBE and Ethanol are already available to meet the high octane needs.

The workshop was attended by senior oil and gas professionals from the industry and the intense debate during the sessions made it a highly productive one.

16TH BIENNIAL INTERNATIONAL ENERGY FORUM MINISTERIAL MEETING (IEF16)

The Government of India hosted the 16th biennial International Energy Forum Ministerial Meeting (IEF16) in New Delhi on 10-12 April 2018 with the support of the People's Republic of China and the Republic of Korea as co-hosts. The meeting was held under the theme: "The Future of Global Energy Security - Transition, Technology, Trade and Investment". Providing the opportunity for attendees to discuss relevant issues that currently affect global energy markets, the IEF Ministerial is the largest gathering of energy ministers in the world. More than 90 delegations including 50 energy ministers, 30 CEOs, 12 heads of international organisations and 500 guests participated in the IEF16.

On behalf of the IEF16 host country, Shri Narendra Modi, Hon'ble Prime Minister of India inaugurated the IEF16 Ministerial Meeting. Prime Minister shared his energy vision as comprising four pillars – energy access, energy efficiency, energy sustainability and energy security. Hon'ble Prime Minister called for a mutually supportive relationship between producers & consumers and also called for optimal use of the neutral platform of the IEF to build a global consensus on 'responsible pricing', that serves the mutual interests of both producers and consumers. Shri Dharmendra Pradhan, Hon'ble Minister for Petroleum and Natural Gas and Minister for Skill Development and Entrepreneurship of India, HE Khalid Al Falih, Minister of Energy, Industry and Mineral Resources of the Kingdom of Saudi Arabia, and H.E. Sun Xiansheng, Secretary General of the International Energy Forum also addressed the delegates at the Inaugural Session, setting the scene for the Forum's discussions.

Hon'ble Prime Minister, Shri Narendra Modi with the other dignitaries, at the 16th International Energy Forum Ministerial Meeting. The Union Minister for Petroleum & Natural Gas and Skill Development & Entrepreneurship, Shri Dharmendra Pradhan is also seen.

IEF16 ministers, industry leaders, and heads of international organisations applauded the leadership of the government of India in taking the IEF energy dialogue forward as host of the 16th International Energy Forum Ministerial. Thanking the government of India for its generous hospitality, and the People's Republic of China and the Republic of Korea for their support as co-hosts, IEF16 delegates took note of the productive outcomes of their dialogue reflected in the concluding statement presented by Shri Dharmendra Pradhan, Hon'ble Minister for Petroleum and Natural Gas, and Minister for Skill Development and Entrepreneurship on behalf of the government of India

INDUSTRY 4.0 / INDUSTRIAL INTERNET OF THINGS

The Indian Institute for Chemical Engineers (IIChE) with Engineers India Limited (EIL) as knowledge partner organised a One-day seminar on "Industrial internet of Things & Industry 4.0 – A disruptive change" on 20th March 2018.

This conference had aimed towards providing a platform to industry experts from all the three segments of industry namely manufacturers or service providers, engineering company and end user. Objective was to exchange of ideas, technical advancements and requirements and come up with practicable solutions which will nurture, cultivate, and accelerate the adoption of IIoT technologies and applications for the benefit of industry.

The Inaugural session started with lighting of lamp by dignitaries and felicitation of Mr. Ajay N Deshpande (Ex. Chairman & Managing Director, EIL). Mr. Abhijit Bikas Pal (Honarary Secretary, IIChE-NRC) delivered the welcome address. Mrs. R. Priyamvada (Group General Manager, EIL) out lined the overview of the event and the relevance of the IIoT/Industry 4.0 for process industries, thus setting the tone for the event.

In the technical sessions, industry experts from the major technology and solution providers in IIoT, such as Honeywell, Emerson, Siemens, Rolta, Schneider Electric and IBM showcased the solutions and services available with them which will enable the industry to leverage the power of IIoT.

The first technical session was chaired by Mr. S.K. Handa (Executive Director, EIL). During this session, possibilities of implementing IIoT for energy management, end-to-end solutions of Industry 4.0 for pharmaceutical industry and the effect of predictive analytics on plant architecture were explored. The post lunch second technical session was chaired by Dr. Shashikant (Indian Oil Corporation, R&D). In this session topics such as concept of unified supply-chain management and augmented intelligence towards plant operational excellence were explained. The Final session was the group discussion session, based on T-R-U-S-T where-in the dignitaries from all across the industry, discussed and chalked out a clear and convenient road-map for reaping the benefits of the power of IIoT in Indian Industry. The dignitaries for the panel, Shri Ajay N Deshpande, Shri Rajiv Narang, Shri Abhijit Bikas Pal, Shri Shyam Bang, Shri Rajan Desai, shared their expectations and vision for implementation of the IIoT/Indutry 4.0 in Process Industry in India. This session witnessed lively discussions with delegates and suppliers. The program ended with vote of thanks and a resolution of organizing one more event, with the similar agenda.

NEW APPOINTMENTS

SANJAY KUMAR MOITRA
Director (Onshore), ONGC

Mr. Sanjay Kumar Moitra has taken over charge of Director (Onshore) of Oil and Natural Gas Corporation (ONGC). As Director (Onshore), he will look after oil and gas production from ONGC's onshore fields.

With over 35 years of experience in oil & gas production activities at various Indian basins, Mr. Moitra has conceptualised many out-of-box ideas for efficient resource management leading to implementation of a large number of complex and high-value projects in India's oil & gas industry. Before assuming charge as Director (Onshore), Mr Moitra headed the Bassein & Satellite (B&S) Asset in Western Offshore, Mumbai - the highest gas-producing and second highest oil producing Asset of ONGC and the country - since 2013. The B&S Asset caters to about 30% of total gas production of the country. Mr Moitra joined ONGC in the year 1982. He holds a BE in Mechanical Engineering from Jabalpur University and has also completed an Advance Management Course from Cambridge University, UK in 2011.

Mr. Lalit Kumar Vijh is the Director (Technical) of Engineers India Ltd. In a career spanning over 36 years, Mr. Vijh has a wide spectrum of experience in areas of process design, technology development and its commercialization, plant operation & process safety and other specialist design and engineering services across the entire hydrocarbon value chain. Having joined EIL in 1982 in Process Design Division, he has been associated with many green and brown field projects. Mr. Vijh holds a B. Tech. in Chemical Engineering from Punjab University.

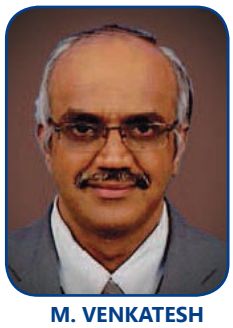
L.K. VIJH
Director (Technical), EIL

MANOJ JAIN
Director
(Business Development) GAIL

Mr. Manoj Jain, a Mechanical Engineering Graduate and MBA in Operations Management possesses rich and diverse experience encompassing more than 32 years with GAIL (India) Ltd. in the areas of Projects, O&M, Pipeline Integrity Management and Marketing which has allowed him to gain insight and knowledge across multiple business units and functional areas.

Before being appointed as Director (Business Development), Mr. Jain was responsible for Gas Marketing activities in his role as Executive Director (Marketing-Gas). Mr. Manoj Jain is also Chairman of Central UP Gas Ltd (CUGL) & Konkan LNG Pvt. Ltd (KLPL) and Director on the Boards of Indraprastha Gas Ltd. & GAIL Global Singapore Pte. Ltd.

Mr. M. Venkatesh has been appointed as the Managing Director of Mangalore Refinery and Petrochemicals Ltd. (MRPL). Prior to this, he was Director (Refinery) of MRPL. Mr. Venkatesh is a Chemical Engineer having over three decades of experience in Oil & Gas Sector. He is associated with MRPL since 1994 and executed all major projects.



M. VENKATESH
Managing Director, MRPL

RAJEEV AILAWADI
Director (Finance), CPCL

Mr. Rajeev Ailawadi has been appointed as Director (Finance), CPCL. Prior to this appointment, he was with Indian Oil Corporation Ltd. Mr. Ailawadi is a Chartered Accountant having more than 30 years of experience in Downstream Oil & Gas and Petrochemical businesses.

GAIL (India) Limited

BRING ABOUT A REFRESHING CHANGE

- Switch to Natural Gas, a Greener Fuel
- Use Public Transport
- Ensure Pollution-Free Air

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STATISTICS

INDIA: OIL & GAS

DOMESTIC OIL PRODUCTION (MILLION MT)

		2013-14	2014-15	2015-16	2016-17	2017-2018 (P)	
							% of Total
On Shore	ONGC	6.7	6.1	5.8	5.9	6.0	34.2
	OIL	3.5	3.4	3.2	3.3	3.4	19.2
	Pvt./ JV (PSC)	9.4	9.1	8.8	8.4	8.2	46.5
	Sub Total	**19.6**	**18.5**	**17.8**	**17.6**	**17.5**	100.0
Off Shore	ONGC	15.5	16.2	16.5	16.3	16.2	89.5
	OIL	0.0	0.0	0.0	0.0	0.0	0.0
	Pvt./ JV (PSC)	2.7	2.7	2.5	2.1	1.9	10.5
	Sub Total	**18.2**	**18.9**	**19.1**	**18.4**	**18.1**	100.0
Total Domestic Production		37.8	37.5	36.9	36.0	35.7	100.0
	ONGC	22.3	22.3	22.4	22.2	22.2	62.4
	OIL	3.5	3.4	3.2	3.3	3.4	9.5
	Pvt./ JV (PSC)	12.1	11.8	11.3	10.5	10.1	28.2
Total Domestic Production		**37.8**	**37.5**	**36.9**	**36.0**	**35.7**	100.0

Source : PIB/PPAC

REFINING

REFINING CAPACITY (MILLION MT ON JANUARY 2018)

Indian Oil Corporation Ltd.	
Digboi	0.65
Guwahati	1.00
Koyali	13.70
Barauni	6.00
Haldia	7.50
Mathura	8.00
Panipat	15.00
Bongaigoan	2.35
Paradip	15.00
Total	**69.20**

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

JV Refineries	
DBPC, BORL-Bina	6.00
HMEL,GGSR	11.30
JV Total	**17.30**

Bharat Petroleum Corp. Ltd.	
Mumbai	12.00
Kochi	15.50
Total	**27.50**

Hindustan Petroleum Corp. Ltd.	
Mumbai	7.50
Visakhapattnam	8.30
Total	**15.80**
Other PSU Refineries	
NRL, Numaligarh	3.00
MRPL	15.00
ONGC, Tatipaka	0.10
Total PSU Refineries Capacity	**142.10**

Private Refineries	
RIL, (DTA) Jamnagar	33.00
RIL , (SEZ), Jamnagar	35.20
Essar Oil Ltd. , Jamnagar	20.00
Pvt. Total	**88.20**

Total Refining Capacity of India 247.6 (4.95 million barrels per day)

Source : Report of Working Group of MOP&NG on Enhancing Refining Capacity by 2040

CRUDE PROCESSING (MILLION MT)

PSU Refineries	2013-14	2014-15	2015-16	2016-17	2017-2018 (P)
IOCL	53.1	53.6	58.0	65.2	69.0
HPCL	15.5	16.2	17.2	17.8	18.2
BPCL	23.0	23.2	24.1	25.3	28.2
CPCL	10.7	10.7	9.6	10.3	10.8
MRPL	14.6	14.6	15.5	16.0	16.1
ONGC (Tatipaka)	0.1	0.05	0.07	0.09	0.08
NRL	**2.6**	**2.8**	**2.5**	**2.7**	**2.8**
SUB TOTAL	**119.6**	**121.1**	**127.0**	**137.3**	**145.2**

JV Refineries	2013-14	2014-15	2015-16	2016-17	2017-2018 (P)
HMEL	9.3	7.3	10.7	10.5	8.8
BORL	5.4	6.2	6.4	6.4	6.7
SUB TOTAL	**14.7**	**13.6**	**17.1**	**16.9**	**15.5**

Pvt. Refineries	2013-14	2014-15	2015-16	2016-17	2017-2018 (P)
ESSAR	20.2	20.5	19.1	20.9	20.7
RIL	68.0	68.1	69.5	70.2	70.5
SUB TOTAL	**88.2**	**88.6**	**88.6**	**91.1**	**91.2**

	2013-14	2014-15	2015-16	2016-17	2017-2018 (P)
All India Crude Processing	**222.4**	**223.3**	**232.9**	**245.4**	**251.9**

Source : PIB Release/PPAC

CRUDE CAPACITY VS. PROCESSING

	Capacity 0n 01/01/2018 Million MT	% Share	Crude Processing Million MT April-March 2017-18 (P)	% Share
PSU Ref	142.1	57.4	145.2	57.6
JV. Ref	17.3	7.0	15.5	6.2
Pvt. Ref	88.2	35.6	91.2	36.2
Total	**247.6**	**100**	**251.9**	**100**

POL PRODUCTION (Million MT)

	2013-14	2014-15	2015-16	2016-17 (P)	2017-2018 (P)
From Refineries	216.4	217.1	227.9	239.2	249.8
From Fractionators	3.9	3.7	3.4	3.5	4.6
Total	**220.3**	**220.7**	**231.2**	**242.7**	**254.4**

DISTILLATE PRODUCTION (Million MT)

	2013-14	2014-15	2015-16	2016-17	2017-2018 (P)
Light Distillates, MMT	62.7	63.2	67.1	71.0	74.7
Middle Distillates , MMT	112.8	113.4	118.3	122.5	127.5
Total Distillates, MMT	175.5	176.6	185.4	193.5	202.2
% Distillates Production on Crude Processing	**78.9**	**79.1**	**79.6**	**78.9**	**80.3**

Source: PIB/PPAC/OPEC

PETROLEUM PRICING

OIL IMPORT - VOLUME AND VALUE

	2013-14	2014-15	2015-16	2016-17 (P)	2017-2018 (P)
Quantity, Million Mt	189.2	189.4	202.9	213.9	220.4
Value, INR '000 cr.	864.9	687.4	416.6	470.6	566.0
Value, USD Billion	143.0	112.7	64.0	70.2	87.8
Average conversion Rate, INR per USD (Calculated)	60.5	61.0	65.1	67.0	64.5

OIL IMPORT - PRICE USD / BARREL

	2013-14	2014-15	2015-16	2016-17	2017-2018 (P)
Brent (Low Sulphur - LS- marker) (a)	107.5	85.4	47.5	48.7	57.5
Dubai (b)	104.6	83.8	45.6	47.0	55.8
Low sulphur-High sulphur differential (a-b)	2.9	1.7	1.8	1.7	1.6
Indian Crude Basket (ICB)	105.52	84.16	46.17	47.56	56.43
ICB High Sulphur share %	69.90	72.04	72.28	71.03	72.38
ICB Low Sulphur share %	30.10	27.96	27.72	28.97	27.62

INTERNATIONAL PETROLEUM PRODUCTS PRICES EX SINGAPORE, ($/bbl.)

	2013-14	2014-15	2015-16	2016-17	2017-2018 (P)
Gasoline	114.3	95.5	61.7	58.1	67.8
Naphtha	100.2	82.2	48.5	47.1	56.3
Kero / Jet	121.2	66.6	58.2	58.4	69.2
Gas Oil (0.05% S)	122.0	99.4	57.6	58.9	69.8
Dubai crude	104.6	83.8	45.6	47.0	55.8
Indian crude basket	105.5	84.2	46.2	47.6	56.4

CRACKS SPREADS ($/ BBL.)

	2013-14	2014-15	2015-16	2016-17	2017-2018 (P)
Gasoline crack					
Dubai crude based	9.7	11.7	16.1	11.1	12.0
Indian crude basket	8.8	11.3	15.6	10.6	11.4
Diesel crack					
Dubai crude based	17.4	15.7	12.0	12.0	13.9
Indian crude basket	16.5	15.3	11.5	11.4	13.4

DOMESTIC GAS PRICE ($/MMBTU)

Period	Domestic Gas Price (GCV Basis)	Price Cap for Deepwater, High temp Hingh Pressure Area
November 14 - March 15	5.05	-
April 15 - September 15	4.66	-
October 15 - March 16	3.82	-
April 16 - September 16	3.06	6.61
October 16 - March 17	2.50	5.30
April 17- September 17	2.48	5.56
October 17 - March 18	2.89	6.30
April 18 - September 18	3.06	6.78

Source: PIB/PPAC/OPEC

GAS PRODUCTION

Qty in MMSCM

	2015-16	2016-17	2017-2018 (P)
ONGC	21177	22088	23429
Oil India	2838	2937	2882
Private/ Joint Ventures	8235	6872	6338
Total	**32250**	**31897**	**32649**

		2015-16	2016-17	2017-2018 (P)
Onshore	Natural Gas	8845	9294	9904
	CBM	393	565	735
	Sub Total	**9237**	**9858**	**10639**
Offshore		23012	22038	22011
	Sub Total	**23012**	**22038**	**22011**

Total	**32249**	**31897**	**32649**
(-) Flare loss	1120	1049	918
Net Production	31129	30848	31731

	2015-16	2016-17	2017-2018 (P)
Net Production	31129	30848	31731
Own Consumption	5822	5857	5806
Availabilty	25307	24991	25925

AVAILABILTY FOR SALE

	2015-16	2016-17	2017-2018 (P)
ONGC	16076	17059	18553
Oil India	2314	2412	2365
Private/ Joint Ventures	6917	5520	5007
Total	**25307**	**24991**	**25925**

CONSUMPTION (EXCLUDING OWN CONSUMPTION)

	2015-16	2016-17	2017-2018 (P)
Total Consumption	46695	49677	52253
Availabilty for sale	25307	24991	25925
LNG Import	21388	24686	26328

GAS - IMPORT DEPENDENCY

	2015-16	2016-17	2017-2018 (P)
Net Gas Production	31129	30848	31731
LNG Imports	21388	24686	26328
Import Dependency (%)	40.7	44.5	45.3
Total Gas Consumption*	**52517**	**55534**	**58059**

* Includes Own Consumption

Source:PIB/PPAC

SECTOR WISE DEMAND AND COMSUMPTION OF NATURAL GAS

Qty in MMSCM

		2016-17 (P)	2017-18 (P)											
			Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Total
Fertilizer	**Domestic Gas**	**7802**	554	615	614	611	600	550	572	571	555	**532**	**525**	**563**	**6862**
	R-LNG	**7592**	584	519	542	626	646	629	695	674	731	**746**	**652**	**737**	**7781**
Power	**Domestic Gas**	**9131**	697	837	799	824	741	739	858	826	784	**776**	**697**	**797**	**9375**
	R-LNG	**2410**	204	188	182	210	233	341	348	224	193	**191**	**145**	**186**	**2645**
City Gas	**Domestic Gas**	**4276**	371	372	355	394	389	385	392	391	408	**412**	**383**	**408**	**4659**
	R-LNG	**3030**	301	321	304	336	340	296	316	326	338	**345**	**308**	**350**	**3881**
Refinery Petro-chemical Others	**Domestic Gas**	**3978**	397	398	416	433	436	497	406	226	388	**395**	**471**	**409**	**4872**
	R-LNG	**12440**	912	999	897	1022	1009	1141	1154	924	1161	**1157**	**882**	**1182**	**12440**

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