FIPI

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IN THIS ISSUE

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From the Desk of the

Director General

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

During this global health crisis, we are not only disconnected from the outside world, but the corona virus is keeping us locked in our homes. For the oil industry, the Corona virus seems to be causing more disruption than what the tumultuous past year—marked by a trade war, a series of strikes on Saudi oilfields, near war between Iran and the U.S., current outages in Libya, among other events —could not. Traders and analysts are in turmoil, struggling to anticipate and understand just how much of a dent in the global oil demand, one virus can make. At the same time the oil price disagreement between OPEC and Russia has caused oil prices to dip to nearly 25 $ a barrel, a matter of great concern for oil producers and service providers, though such low prices will help Indian economy in these difficult times.

The ongoing situation is an unprecedented moment in global history in terms of economic crisis. Estimates state that the global economy will contract by about 5 per cent. Even before this crisis, the world was already expecting a 2008-type recession. However, if the current situation rolls on, something far greater and worse is in store, probably the only parallel being the great depression.

As has been stated by the IEA, the current crisis is impacting a wide range of energy markets - including coal, gas and renewable but the most severe impact seems to be on oil & gas markets since it is acting as an impediment to the movement of people and goods, thereby dealing a heavy blow to demand for transport fuels.

While the global oil and gas industry is still scrambling to decode the overall impact of Corona virus on oil demand and economic growth, for the Indian oil and gas companies it seems to be a mixed bag - with trying to balance inventory losses and dealing with lower product cracks while also utilizing the low crude prices and fall in spot cargo rates.

While the short term outlook for the oil market will depend on the prompt action of governments to contain this deadly virus, and how successful their efforts are, a pessimistic low case scenario as developed by the IEA, in which global measures fail to contain the virus states that the global demand will fall by 730,000 barrels a day in 2020. An optimistic scenario on the other hand enables the global demand to grow by 480,000 barrels a day.

The first two months of the year saw our Federation engaged in very crucial workshops and sessions. In February 2020, FIPI organized Budget Analysis Session, in association with Deloitte. The objective of the session was to understand the implications of the recently presented Union Budget 2020-21 and the impact of the Budget on the Indian oil and gas

industry. The session was attended by senior dignitaries from oil and gas companies and key government representatives namely Mr. Yogendra Garg, GST Commissioner, Mr. Y.G. Parande, Former member, CBIC.

FIPI in association with the Society of Indian Automobile Manufacturers (SIAM) organised an Interactive session on BS-VI Rollout on February 19, 2020 at New Delhi with the objective to share the latest status and to resolve any last-minute issue to ensure seamless rollout of BS-VI fuels on April 1, 2020 on pan India basis. The session was attended by dignitaries like Mr Sanjiv Singh, Chairman FIPI & Chairman IndianOil; Mr Rajan Wadhera, President SIAM & President (Automotive), Mahindra & Mahindra; Director General FIPI and Director General SIAM along with 60 participants from both automobile as well as oil industry. The historic meeting between the members of the two industries proved immensely successful in assessing the preparations for BS VI rollout and this leapfrogging to BSVI fuel from BSIV fuel marked a paradigm shift for fuel standards in the country.

In continuation with its tradition, FIPI organized the 3rd program on "Realizing Hydrocarbon Vision 2030 for North East India at Gangtok on March 6-7, 2020. The workshop was attended by the major oil PSUs & private organizations such as ONGC, IOC, OIL, Cairn-Vedanta, IGGL, TNGCL, HOEC, Schlumberger which are operating in North East States. During this one and half day workshop sessions on upstream and downstream were held, where industry leaders from both the sectors updated on the initiatives taken by them in North East states and also discussed the issues and challenges they are facing while operating in the NE areas. We, at FIPI, have taken note of the issues of concern to the industry and will represent the same before the concerned Government authorities for their support and resolution.

At FIPI, we are sensitized to the situation and are adhering strictly to the guidelines set by the government. We value the life of not just our employees but also their families as well as members of the industry and our family countrymen. However, the current situation has forced us at FIPI, to take certain important decisions as well.

While we were very enthusiastic in the preparations for two of the most important workshops for the industry, we have decided to postpone the Young Professionals Forum as well as the WPC Workshop on Energy Storage Systems. Both the workshops will be scheduled, once things are better and we will keep the industry informed about the same.

Currently in this period of lockdown, we continue to operate from home and have been continuing with our regular activities of providing the industry with regular reading material, the WEEKEND READING on every Friday. We are going to continue with our 'Monthly Economic Policy Report' and publishing our quarterly journal in E-form. Some of our research team members are engaged in writing industry related reports which will be shared with the concerned in due course. We are continuing with our efforts to support our industry members by sending representations seeking Government help wherever required in these difficult days.

After discussion with Great Learning, an online education enterprise, we have organised Free learning opportunities for employees of our member companies during their spare time (while working from home) to acquire skills on latest technologies like data science, artificial intelligence, machine learning, cloud computing, big data and digital marketing etc.

While we hope that India will win its war against the Coronavirus, we are committed to continue to support our Government in all its efforts to contain the virus. As a small token, all our employees have already contributed from March salary, one day wages to PM Cares fund. All our employees have also volunteered to support society in whatever way each one can do.

I wish you all and your families a safe period ahead.

Dr. R. K. Malhotra

OIL PRICE CRASH – OPPORTUNITIES FOR INDIA

Ravi Narayanaswamy
Vice President

Gaurav Srivastava
Director

IHS Markit

COVID-19 Linked Demand Decline and Economic Downturn Outrules the Opportunities India could have had from Lower Crude Oil Prices

KEY TAKEAWAYS

Global

- The COVID-19 pandemic has hit the global economy, which is expected to go under recession in 2020 with an expected GDP decline of -2.8%. This outlook is underpinned by the aggressive measures being taken by governments including extreme lockdown measures, coupled with voluntary "social distancing". Our forecast for India is also lowered significantly and we are expecting the GDP growth to be just 2.1% in 2020 versus 5%in 2019.

- Furthermore, border closures and lockdowns of differing degrees across the globe has resulted in significant demand drop in transportation fuels, and the world oil demand for the second-quarter 2020 is anticipated to decline by 16.4 MMb/d year on year, with a decline in April of about 20 MMb/b. The oil demand for 2020 is anticipated to be down by 7.9 MMb/d.

The collapse of world oil demand is the primary force leading to shut-in production, although the abandonment of supply management by Saudi Arabia and Russia in early March 2020 intensified the oil surplus that will soon fill storage tanks around the world. The supply surplus cannot exceed the practical upper limit of 1.2 billion barrels of global crude oil storage capacity that was available as of early first quarter 2020.

- Brutal market forces will bring oil supply into a rough balance with oil demand in the coming weeks and months. Global oil supply surplus in first half 2020 is projected at 1.2 billion bbl - with production cut by 10 MMb/d. OPEC+ in their meeting on 9 April 2020 have agreed to adjust overall crude production in staggered manner with immediate 10 MMb/d of cuts for next two months. However, 10 MMb/d cut in global production is insufficient to eliminate the massive supply surplus that is here.

This report is based on analysis dated 10th April 2020 and owing to fast moving unprecedented situation, we continue to update our outlooks as more information becomes available.

India

- As economic and social activity in India deteriorates further, India's refined product demand* (ex LPG) is expected to decline by more than 1.1 MMb/d y/y in the second quarter 2020. This includes 0.26 MMb/d, 0.55 MMb/d and 0.15 MMb/d demand drop for gasoline, diesel and jet fuel respectively while LPG demand is expected to rise by 0.35 MMb/d. Total refined products* demand decline for 2020 is expected to be 0.17 MMb/d. However, the forecast may be revised further down, if lockdown is extended beyond April 15, which looks imminent.

  As India's domestic demand declines to unprecedented levels during the current lockdown, it is anticipated that the government will be experiencing heavy loss in tax revenue from gasoline, diesel and jet fuel.

- Under our current oil price scenario, we anticipate India's crude import bill to reduce by approximately 50% or $46 billion for CY 2020 based on our downward revision of crude runs and imports.

Global Outlook

Economy: Much Deeper Recession and a Much Slower Recovery

The daily news and incoming data have been unrelentingly bad—rapidly rising global infections, roughly one-third of the world's population "locked down", consumer services (especially travel and entertainment) hit by "sudden stops", global supply chains severely disrupted, unemployment rates soaring and PMIs plunging. Thus, all this means is that the global recession of 2020 will be worse than in 2009—down 2.8%, compared with drop of 1.7%.

Real GDP growth (%)						
	2018	2019	2020	2021	2022	2023
World	3.2	2.6	-2.8	3.3	3.8	3.0
United States	2.9	2.3	-5.4	3.4	5.2	2.7
Canada	2.0	1.6	-3.3	1.8	2.9	1.9
Eurozone	1.9	1.2	-4.5	1.2	1.6	1.4
United Kingdom	1.3	1.4	-4.3	0.8	1.1	1.3
China	6.7	6.1	2.0	6.4	5.6	5.2
Japan	0.3	0.7	-2.5	1.2	0.8	0.7
India*	6.2	5.0	2.1	5.7	6.2	7.0
Brazil	1.3	1.1	-4.5	3.4	2.9	1.9
Russia	2.2	1.1	-3.4	0.7	1.3	1.4

Emerging markets growth will be hammered as not only are infection rates rising rapidly in key economies, such as India, but the combination of the deepest global recession since the 1930s, plunging commodity prices, and depreciating currencies (compounding already dangerous debt burdens) will push many of these economies to the breaking point.

COVID-19 pandemic causing ripples across all markets

The coronavirus or COVID-19 which was first reported in China's city of Wuhan, has now spread to around 185 countries and territories across the globe as on 10 April 2020. Though, new confirmed COVID-19 cases in China had 'peaked out' in early March but the number of new cases is rising drastically now outside China with US and Europe amongst the badly hit regions. With a few exceptions (China and South Korea), the rapid rises in infections have not been slowed or stopped.

As a result, repercussions of the COVID-19 pandemic will be profound and will cause ripples across all markets as many affected countries are now following containment strategies. We are expecting the peak impact of COVID-19 in April and May when many parts of Europe and North America are locked down. Downside risk remains should major outbreaks be seen in other regions, such as Latin America and Africa, which are currently less affected.

Global oil demand collapsing: Down by 16.4 million b/d in 2Q 2020

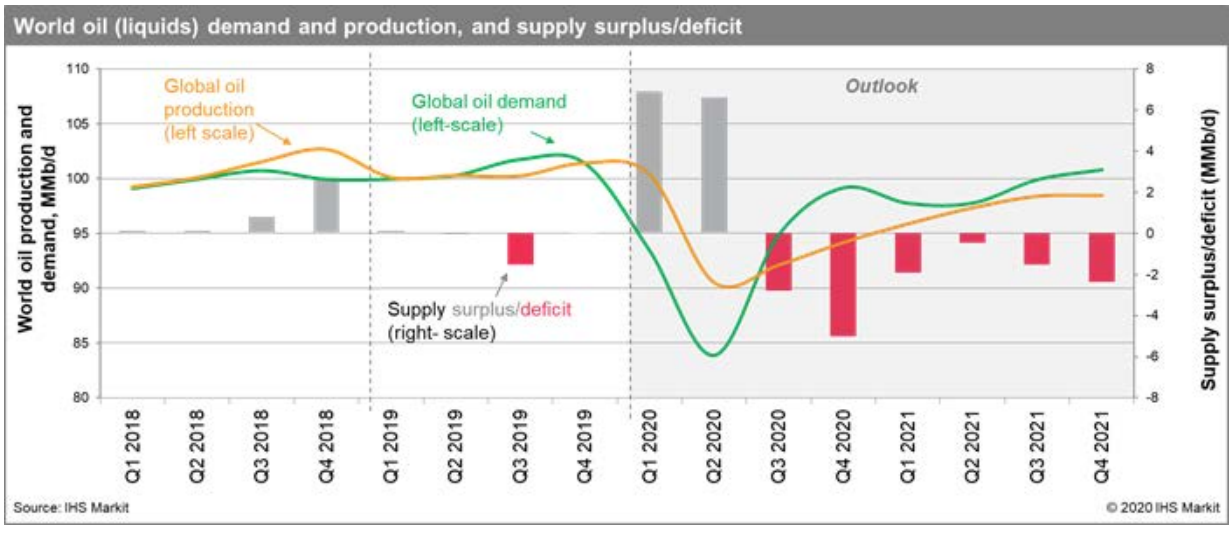
Our latest outlook projects a 16.4 MMb/d decline in world oil demand in the second quarter 2020 compared with a year earlier, which is even deeper than the 6.5 MMb/d first-quarter year-on-year 2020 decline. Previously, the largest quarterly decline ever recorded was in first quarter 2009, when demand fell 2.9 MMb/d. Demand is being hit by three factors: government containment strategies, radically changed consumer behavior and a significantly weakened economic outlook. Consumers have backed away from flying due to the perception of increased risk of infection at airports and in aircraft and concerns about being quarantined at their destination or on their return. Gasoline demand will be impacted hard in countries that have adopted harsh quarantine measures. For now, countries have imposed varying degrees of quarantine, but this may turn into "full quarantine" as virus spreads. Gasoil and bunker fuel demand will be anchored to the trickle-effect impacts on trade and supply chains. The global commercial trade impact started with China but has now progressed along with the virus to other markets as supply chain impacts ripple through the system.

World economy will eventually recover, and oil demand will stop falling with government interventions to address collapsing sectors of the economy, but there is no historical precedent to guide such efforts amid such an enormous decline in demand.

Global oil supply surplus: Nowhere to go as cuts expected in every region of the world in Q2 2020

Collapse of world oil demand is the primary force leading to shut-in production, although the abandonment of supply management by Saudi Arabia and Russia in early March 2020 intensified the oil surplus that will soon fill storage tanks around the world. Brutal and unadulterated market forces will bring supply into a rough balance with demand. The challenge of getting through this extreme period is unprecedented in the post–World War II period. However, the economy will eventually recover, and oil demand will stop falling.

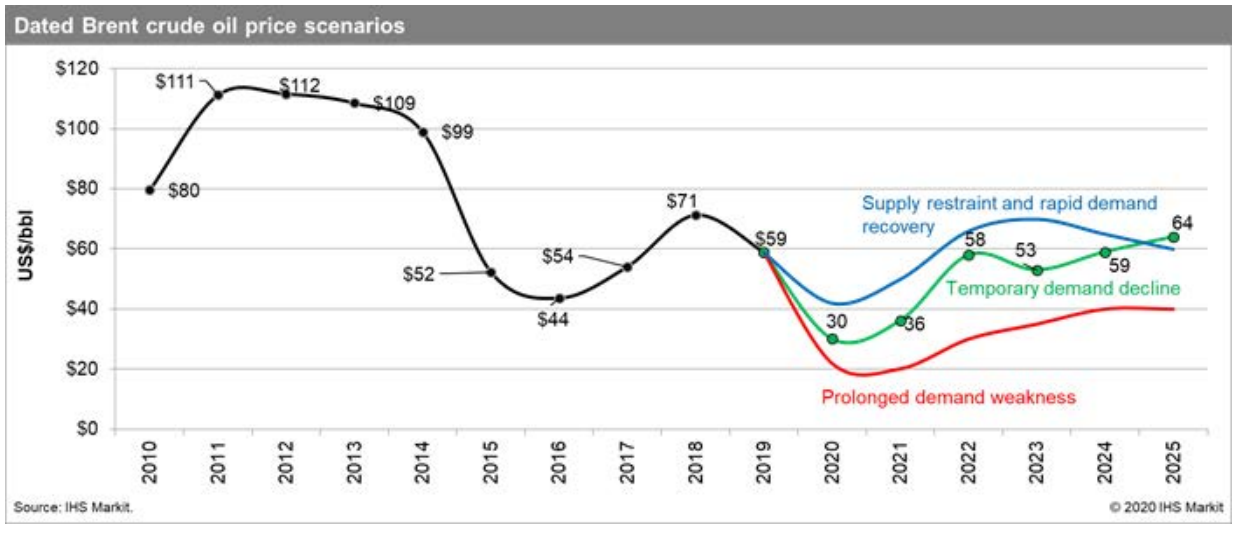
Brutal market forces will bring oil supply into a rough balance with oil demand in the coming weeks and months. Global oil supply surplus in first half 2020 is projected at 1.2 billion bbl - with production cut by 10 MMb/d. OPEC+ in their meeting on 9 April 2020 have agreed to adjust overall crude production by 10 MMb/d from 1 May 2020 for next two months, by 8 MMb/d from July – Dec 2020, by 6 MMb/d for further 16 months up to April 2022. However, 10 MMb/d cut in global production is insufficient to eliminate the massive supply surplus that is here.



The aftermath of the extreme, light-speed rebalancing of the oil market will result in significant changes in some countries' production levels, especially in 2021. By fourth quarter 2021, we estimate that US crude oil production will be 8.8 MMb/d—down 4.1 MMb/d from first quarter 2020 production. In contrast, output from Saudi Arabia is projected to be 1.8 MMb/d higher, with Russian production slightly lower as these two countries are better positioned in a low-price environment to maintain or even increase production over the next two years compared with the United States.

Three Brent oil price scenarios illustrate the range of outcomes

The oil market is under extreme conditions as the world goes through a transformative crisis. The world of oil will be buffeted by the bigger story of how the world economy and national politics react to COVID-19 and its aftermath. A scenario framework is essential owing to heightened uncertainty about the course of the global economy and oil markets because it provides a range of outcomes for decision makers to consider.



Base case: Temporary demand decline

- Peak of new COVID-19 cases outside China by mid-second quarter 2020
- Brent crude oil prices hover around $30/bbl in 2020, which leads to oil being shut in and lower production from key producers in the second half of the year. High inventory levels will weigh on prices as the recovery begins over the second half of 2020.
- Prices rise in 2021 to mid-$30/bbl as year-on-year oil demand growth returns, US production continues to fall, and surplus inventories are eroded

Low case: Prolonged demand decline, no supply restraint

- Global oil demand remains even weaker in second half 2020 compared with that in the base case. There is a full-year decline of 10 MMb/d, with a relatively modest 2 MMb/d increase in 2021.
- Supply infrastructure seizes up in some areas. Prices are $10–20/bbl until second half 2021, keeping higher-opex oil shut in. The price war among major oil powers endures.
- US crude oil production falls to 7 MMb/d by late 2021, which helps erode the supply surplus and push prices to $30/bbl.

High case: Rapid recovery and renewed supply restraint

- The demand decline is not as severe as envisioned in the base case. There is a full-year 2020 demand decline of 4 MMb/d in 2020, with a 2 MMb/d increase in 2021.
- Global oil demand growth returns in second half 2020
- Saudi Arabia, Russia, and the United States agree to supply restraint for a limited time
- US crude oil production stands at 11 MMb/d in late 2021, down 2 MMb/d from early 2020

India Outlook

Economic impact on Indian economy

The first case of COVID-19 in India was reported on 30 January 2020. As of 31 March 2020, India has confirmed a total of 1397 cases, 148 recoveries and 35 deaths in the country. The rate of infection for COVID-19 in India currently stands at 1.7, which is considerably lower than in the worst affected countries such as China and Italy. However, the number of confirmed cases has just started picking up pace in India and is expected to rise in coming weeks. As per Indian Council of Medical Research (ICMR), there are no signs of community transmission in India yet and the country remains to be in Stage-2 (local transmission) of the COVID-19 outbreak. However, the recent cases of mass exodus of migrant workers and cluster spread across different states might increase the infection rate and lead to lockdown extensions.

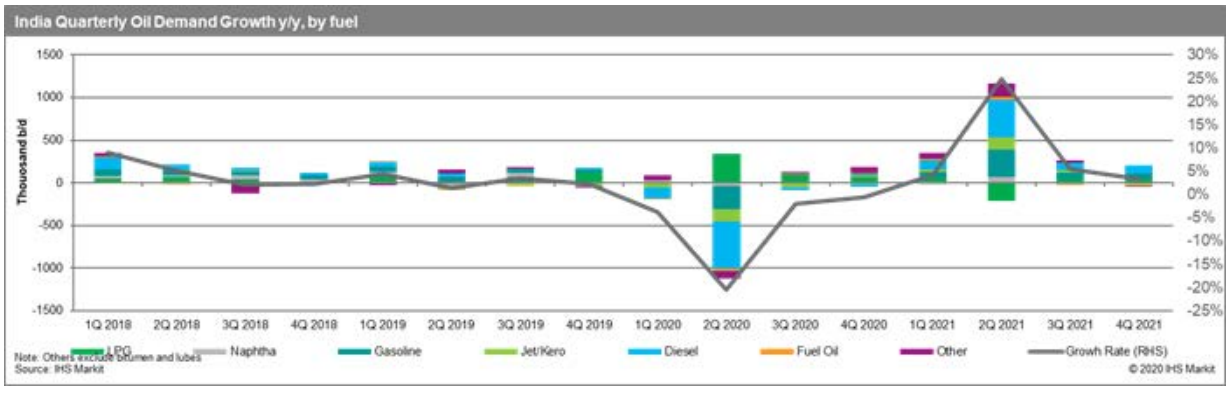
Furthermore, escalating cases of COVID-19 in India is posing renewed challenges for the already struggling economy of India and has started to further weaken fuel demand. The real GDP forecast for FY 2019 (ended March 2020) currently stands at 4.9%, with high frequency data indicating significant weakness in domestic demand. Fiscal and monetary policy stimulus measures implemented during the second half of 2019, gradually started to filter through the economy, thereby boosting GDP growth. As a result, our pre coronavirus outlook for FY 2020 GDP growth for India was 5.4%. However, owing to fast moving changes due to spread of coronavirus in India, IHS Markit has lowered GDP growth for India for FY 2020 to 2.1%.

COVID-19 has started to spread its tentacles across the major cities and districts in India and and is expected to pose new roadblocks for India's economy, thereby causing severe impact on both the supply and demand side of the country. The spread of COVID-19 pandemic will have significant economic consequences as the government implements strict containment measures across India. The government announced a nationwide lockdown for three weeks from 24 March to 14 April 2020. The government had earlier announced "Janta-Curfew" on 22 March followed by a lockdown till 31 March across 80 cities and districts of India where confirmed COVID cases have been reported. The lockdown measures have crimped transportation, manufacturing and business operations in the country and these steps are expected to affect country's economy, thereby further downgrading the economic growth forecast for 2020.

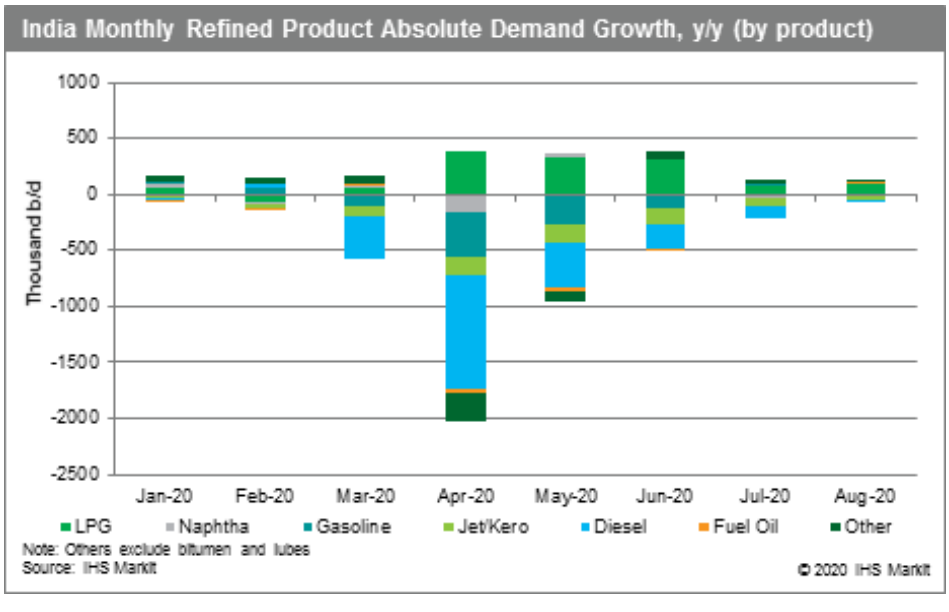
Impact on refined products demand in India

The Indian economy and fuel demand are facing severe challenges from the containment measures taken by the government against COVID-19 spread. The lockdown put in place has halted the transportation, commerical and industrial activities impacting the sales of all petroleum products except LPG. India's refined product demand* (ex LPG) is expected to decline by more than 1.1 MMb/d y/y in the second quarter 2020 while for complete 2020 the same is expected to decline by 0.3 MMb/d.

Transport fuel such as - gasoline primarly used in passenger cars is expected to drop by 35% y/y or 0.26 MMb/d in Q2 2020, diesel which accounts for two-fifths of refined fuel demand and directly linked to industrial activities would drop by 30% y/y or 0.55 MMb/d, travel restrictions and suspension of flights have brought aviation industry to a virtual standstill –jet fuel demand is forecasted to drop by 64% y/y or 0.15 MMb/d in Q2 2020.



In contrast, we would see LPG demand surge by 47% y/y or 0.35 MMb/d in Q2 2020 as governemnt of India announced distribution of three LPG cylinders per household monthly to 80 million Pradhan Mantri Ujjwala Yojana (PMUY) beneficiaries, as a relief package to mitigate the economic impact of lockdown in wake of COVID-19 outbreak. We would see increase in LPG imports and Indian refineries increasing LPG yields to meet this incremental LPG demand.

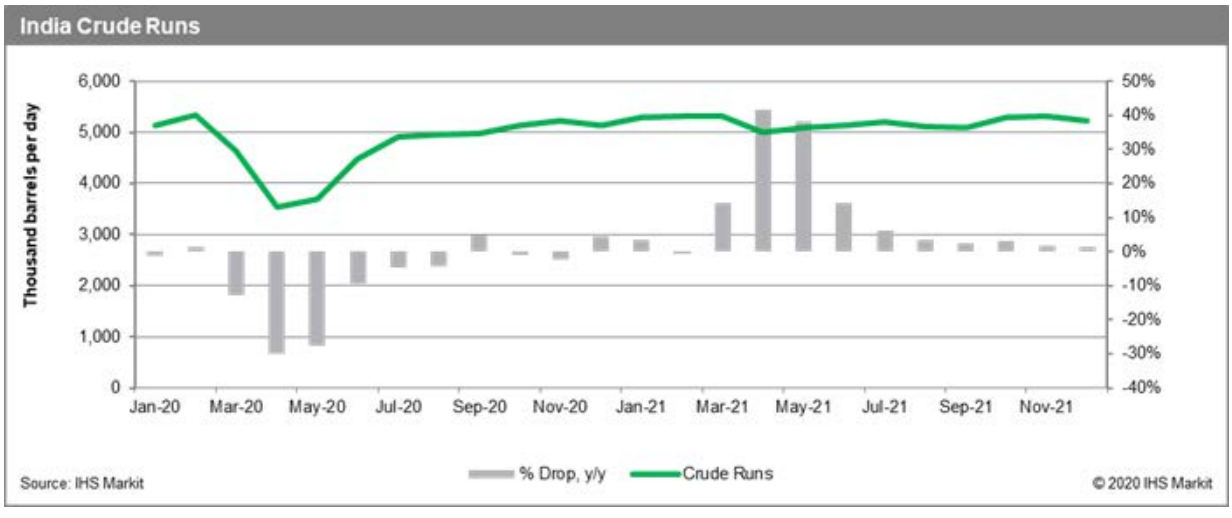


For April'2020, the demand decline is severe, with refined product demand* (ex LPG) is expected to decline by more than 2 MMb/d y/y while LPG demand is expected to grow by nearly 0.4 MMb/d y/y. However, the forecast may be revised further down, if lockdown is extended beyond April 15, which looks imminent.

According to IHS Markit, as prevailing uncertainity looms in containment of COVID-19 outbreak and the economic repurcussions of the spread are yet to be fully seen, India refined product demand (including LPG but excluding bitumen and lubes) for 2020 is forecasted to contract by 4% y/y or 0.17 MMb/d.

Impact on refinery runs in India

Refining runs in India declined by nearly 13% y/y or 0.7 MMb/d in March 2020, as domestic demand dropped due to lockdown measures across the nation to contain the spread of COVID-19 forcing refiners to cut runs and reduce utilizations in response.



Further, the drop in crude throughput is forecast to deepen in Q2 2020 and drop by around a quarter y/y or 1.2 MMb/d, basis the current 21 days lockdown by the government and refinery cuts announced by the refiners. The extent of further drop or increase in runs remain uncertain and would depend on the removal of COVID -19 containment measures. On the other hand, lower planned refinery maintenance in India in the upcoming turnaround season and weak domestic demand will result in more supplies with no disposition outlets. The refinery runs are expected to reduce by 7% y/y or 0.35 MMb/d y/y in 2020 and average at 4.8 MMb/d.

Refiners to declare force majeure on oil purchases

Indian refiners are reported to have declared force majeure on crude purchases from the Middle East as fuel demand has dropped owing to the nationwide lockdown implemented to curb the spread of COVID-19. The drop in local fuel demand has led companies to cut crude refining as their storage tanks are full. According to the refiners, their operations have been totally disrupted owing to the nationwide lockdown and has declared force majeure with respect to contracts with its suppliers.

India's Reliance Industries is also reportedly looking to sell some of its April-deliveries crude cargoes as it plans to cut crude processing after the COVID-19 pandemic hit global fuel demand. The refiner has offered various grades of Middle East crude for sale in Asia's spot market, including grades such as Abu Dhabi's Murban crude and Qatar's al-Shaheen crude. Reliance is hoping to sell cargoes already at sea as Indian rules do not allow export of crude oil. By doing so, it hopes to avoid demurrage costs, especially as freight rates have increased.

Impact/opportunity for India

Top up strategic reserves with cheap oil

India's total strategic petroleum reserves (SPR) planned capacity is 11.83 million metric tons (MMt), of which 5.33 MMt (Phase 1) is operational and 6.50 MMt (Phase 2) is under construction and when completed, both phases will provide around 22 days of additional emergency coverage for India's crude oil requirements. India's total strategic crude inventory—which includes Visakhapatnam and Mangalore—currently stands at about 3.0 MMT, providing import cover of about five days. India's SPR program will help to safeguard its energy security as its energy demand grows.

The steep drop in oil prices has put India's focus on its strategic petroleum reserves, built up against any supply disruptions. The fall in energy

demand across the globe, due to lockdowns, travel bans, and geopolitical feuds have caused the drop-in oil prices to less than US$30 per barrel. India plans to take advantage of low prices to top up its strategic petroleum reserves and Indian Strategic Petroleum Reserves Ltd (ISPRL), had planned to buy oil directly from Saudi Arabia and the United Arab Emirates to fill the caverns. However, due to reduced crude runs, state refiners are now diverting nearly 19 million barrels of Gulf oil to SPRs which will help refiners get rid of extra oil as their storages are full[1].

Indian government to save on oil import bill

India, which imports about 85 percent of its oil requirement has a huge potential to bring down its crude import bill due to slump in oil prices. Lower volume of crude processing by refiners is also expected to have an impact on import bill. If the price remains around US$30 for most parts of 2020, import bill could reach its all-time low in many years. IHS estimates that the projected CY2020 import bill for India could be halved to ~US$47 billion, saving almost the amount allocated to Defense last year.

Lockdown and stagnant economic activities to cost Government in taxes despite low crude price and raised excise duty

On 14 March 2020, tapping into low crude oil prices, the government raised the excise duty on petrol and diesel by INR3 each. Again, on 24 March 2020, the parliament approved an enabling provision that allows the government to increase excise duty on petrol and diesel by INR8 per litre any time it wishes. Higher revenues by means of excise duty were expected to help compensate for the earlier weak tax collections and the gains were likely to be utilized to meet unexpected expenses incurred during the coronavirus outbreak. However, the lockdown and halt in economic activities have affected the potential of raising revenue through taxes on fuel and now the central government is heading towards a loss in excise duty collections on jet fuel and auto fuel during the ongoing three-weeks lockdown. Also, India is expected to undergo an economic slowdown in April to June quarter, therefore the situation may become more alarming for government.

Conclusion

There is the potential for a major hit on Indian demand but so far, the impact seems to be less severe than in China, Europe and the US. But the same may change, if lockdown in India is extended beyond April 15, which appears to be most likely scenarios. Nonetheless, Indian refiners are facing major challenges as they seek to reduce runs as demand dries up due to lockdowns. On the other hand, the government is seizing this opportunity to fill the SPR cheaply and further raise taxes in order to take advantage of falling prices, though reduced demand is also impacting government's tax collections.

1 https://in.reuters.com/article/india-oil-spr/india-shuns-gulf-producers-diverts-refiners-oil-to-spr-idINKCN21Q2ES

*Excludes bitumen and lubes

TECHNOLOGY

Technology in the Service of Sustainability

Ron Beck
Marketing Strategy Director,

AspenTech

Sustainability is a key driver for the energy industry today in India and globally. The industry faces a multi-headed crisis. Access to financial markets is dependent today on a positive sustainability message. The industry also needs to show real progress in terms of carbon intensity of its businesses and addressing global circular economy forces.

What does that mean for a refiner, chemical company, or energy producer? It means an increasingly complex and delicate balancing act between efficient and safe operations and reducing overall carbon footprint while at the same time maintaining or even increasing profitability, margin, and product quality.

Industry consultants, such as McKenzie and Boston Consulting Group (BCG) have identified digitalization as a key tool that organizations can employ to achieve this balancing act effectively, and pivot their companies to turning sustainability into a competitive advantage. While company executives understand intuitively this to be true, they struggle to understand in detail what actions they should take first. Or put another way, what software technologies can be applied first to achieve results quickly? The International Energy Agency (IEA) stated that, "digital technologies present a largely untapped opportunity for increasing energy efficiency in all sectors, and business models that recognise this are starting to emerge." Accenture's recent CEO survey on sustainability reported "75% of CEOs say they are investing in digital to address sustainability challenges (Oct 2019).

Both South India and Southeast Asia face a particular challenge and but it also spells opportunity. In addition to global sustainability imperative, India needs to provide broad access to its 1 billion citizens to affordable electric power and to clean water, at the same time as keeping the nation sustainable. Indonesia faces a similar concern for its 260 million citizens.

This makes the sustainability challenge more complicated. Cut carbon emissions, reduce water use, increase profitability and at the same time support broader access to energy and power.

However, countries such as India and Indonesia have a big opportunity, as the stakes are very high and with the emergence of highly trained technical workers familiar with digital technology, there is an

opportunity to lead globally and gain strategic advantage. Indian companies showcase some of the best examples of how technology supports energy industry sustainability. This article will cover some of the key ways in which technology can help energy companies change their narrative about sustainability.

Digitalization Benefit

There are three big ticket areas where technology will help organizations in their sustainability initiatives: Environmental impact, reliability and safety, and efficiency and innovation.

Figure 1: Some ways in which technology supports sustainability initiatives

ENVIRONMENTAL IMPACT - One area is environmental emissions and impact. With respect to the environment, there are two areas of primary concern. The first is the emission of carbon and other pollutants. The second is the wastage of resources, such as water.

Digitalization helps to provide visibility and reduce environmental impact, as follows:

Reporting and awareness: For any organization with a large plant site, or with multiple assets, simply assembling the information to understand the organization's overall carbon emissions, flaring, solid wastes and so forth is often a formidable task. This is an obvious area where an effective digital solution can provide transparency to the executives and managers as to where an organization stands at any point in time, and whether progress towards goals are being met.

ADNOC, the Abu Dhabi Oil company, has implemented an extremely effective system for this across one of their largest gas fields, the Shah sour gas field. ADNOC already had in place a data historian, which collected and organized all process data from the gas field. On top of that, they implemented a hydrocarbon accounting application, which accounts for the movement of hydrocarbons throughout the facility, in particular identifying places where hydrocarbon is lost (so-called fugitive emissions). Crucially, they then added a comprehensive digital twin process simulation model representing the entire field, from well heads to export of salable gas. They then layered on that an energy optimization model, that identified all uses of energy within the gas operations and where that energy use could be reduced. And a utility model, looking at sources and costs of power, heat and water utilities across the entire gas field.

This then becomes a true digitalization solution with a visualization dashboard, giving everyone in the organization access to energy use, water use, and hydrocarbon loss information – a fully democratized operation. With everyone having access to this information, all workers can feel good about the importance their organization places on sustainability, and importantly can understand the impacts of all their actions on the sustainability performance of the Shah gas field.

The solution has already created significant value for the ADNOC Sour Gas Field, in terms of identifying hydrocarbon losses of 1% which can be addressed, and energy and water use savings of greater than 5 and 10%, respectively.

Reducing emissions from flaring at CEPSA refinery. Many processes within extensive interconnected plants suffer from lack of broad optimization across the facility. That is, operations which are intended to be in-balance in a "steady-state" design environment cannot achieve that when individual components are optimized in isolation. This "silo" approach creates bottlenecks due to operational issues from time to time, or even frequently, when materials pass from one unit operation to the next. This is where the latest digitalization technology, known as dynamic optimization can be strategic for both margin economics and sustainability. Multivariate process control (APC), is a proven technology for optimizing economically important unit operations. When individual units are optimized, though, much opportunity is left on the table by lack of a broader plantwide strategy.

To address that unmet opportunity, dynamic optimization orchestrates across a broad envelop of operations in a plant for to achieve significant economic benefit. CEPSA, in a successful and publicly documented implementation of dynamic optimization, is employing dynamic optimization across their hydrogen processes and bottoms processing in a major refinery. In addition to achieving over $1 million USD in incremental margins for that refinery, CEPSA achieved the sustainability benefit of reducing hydrogen-related flaring by 300% per year.

Improving the effectiveness of sulfur recovery processes at BPCL Mumbai. Most gas processing and refining operations require sulfur removal and recovery to clean the gas and oil, remove corrosive material, and reduce SOX air emissions. Sulfur recovery operations, however are challenging for plant operators, as they are complex and difficult to keep in balance. Bharat Petroleum (BPCL) has implemented an innovative digital solution, an advanced digital twin, which pairs an engineering simulation model (online) with an advanced control solution (APC), using both together to constantly adjust and optimize the sulfur recovery operations. The results obtains have reduced SOX emissions for that refinery by 90% per year and increased sulfur recovery (which is sold onto the market for re-use) by a significant percent.

Dynamic Emissions Modeling System for BPCL Kochi Refinery. In another landmark project, which will soon be documented in an upcoming published article, BPCL has developed a simulation digital twin model that represents its refining reactor units to model and measure emissions much more accurately than before. This digitalization approach overcomes the practical limitations on the number of sampling points, and sampling frequency for understanding the emissions profile in a refinery. By employing a digital twin model, constantly calibrated with plant data, the operators know whenever emissions are approaching levels that would violate their emissions target levels. They can therefore adjust operations dynamically and precisely to achieve company targets, but also stay within the Indian government's increasingly stringent rules. A side benefit is increased yield at their key economic units. This is accomplished due to confidence in operating at higher levels because of their precise understand of actual emissions.

SAFETY AND RELIABILITY: Reducing unplanned downtime and its impacts. Many plant managers identify that up to 50% percent of their total environmental emissions on a yearly basis can be attributed to unplanned downtime.

As I discussed with one operations manager of one of the best operated refineries in Europe, he believes this to be attributable to the fact that normal operations are familiar to operators, are planned for and expected on a daily and weekly basis. But shutdowns and startups are more infrequent and are therefore not expected or easy to respond to by operating staff. He stated that he concluded he needed to set aside specific training and rehearsal time for staff to prepare for each shutdown and startup. Obviously, with an unplanned shutdown, such planning and training cannot occur (see example of a 2017 incident at one refinery in California in figure 2, where on one day's worth of emission is the equivalent of that occurred during the entire preceding two years).

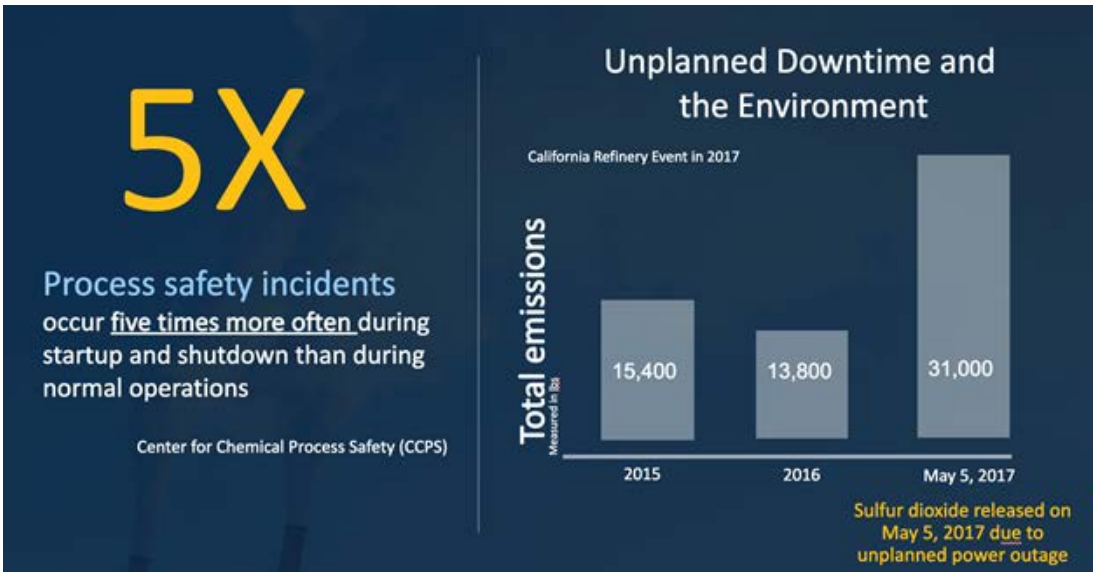


Figure 2: The outsized emissions impact of unplanned outage events.

Technology is already making a very significant impact in this area. Machine-learning based prescriptive maintenance applications are now already providing 30 to 90 days' notice of failure of critical equipment in refining and chemical plants. One US based refiner conducted a one-year trial of this new technology, and during that trial was able to predict a failure 60 days in advance, and take preventative action to avoid the shutdown. They are now rolling this out to their fleet of worldwide refineries.

INNOVATION:

Chemical and energy companies have gone into overdrive to discover economically viable processes for producing recyclable plastics, mainstream processes for converting waste plastics to feedstocks, and more energy efficient bio conversion processes. The biggest challenge in accelerating the commercialization of these processes will be the scale-up and time to market. This is where integrated, concurrent process design plays a crucial role. For the scale-up and capital approval of these new processes, it is crucial to shortcut the traditional design silos and serial review processes that handicap agility and speed. Integration of process and economic models is a key weapon in rapid commercialization of new processes. Mitsubishi Chemicals and ExxonMobil reported at OPTIMIZE Global Conference (sponsored biannually by AspenTech) that they had cut down the time required to make commercialization decisions on new chemicals and processes from six months to two weeks (for Mitsubishi) and by 50% (for ExxonMobil). Also integrated process design and analysis provides a similar impact. Many new bio conversion processes are difficult to make economic and sustainable due to their energy intensity. A number of start-up sustainable chemical companies are using these digitalization approaches to make rapid progressive in a collaborative design process.

COLLABORATION, HARD WORK, INNOVATION, AND DIGITALIZATION

In summary, digitalization is most definitely an almost magic weapon in the hands of energy companies seeking to get a competitive advantage from the sustainability challenge facing the industry.

We have given a few concrete examples of where companies can look to make rapid progress in decarbonization in particular and sustainability in general. Operations-focused approaches range from better and more transparent measurement and reporting, to asset wide sustainability dashboards, to advanced digital twin models to identify efficient operating modes, to dynamic optimization and energy modeling.

Figure 3 shows the key carbon emission areas where these technologies can be applied.

Figure 3: Global Energy CO2 Emissions from Oil and Gas as Identified by McKinsey and Co.

Beyond these ways to improve the oil and gas energy intensity measure, technology can be applied in a more fundamental way to fast track the development and commercial deployment of innovative plastics, to improve recycling of waste plastics, and to develop new economic processes that are more efficient and also provide for substitution of traditional feedstocks with a mix of waste feedstocks and bio feedstocks.

With these approaches, the energy industry can improve its overall sustainability scores, improve its ability to report on its progress, be more transparent to employees and managers, and innovate faster.

UPSTREAM

Excellence in Upstream Industry Through Strategic R&D Approach

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Former Director (Exploration), ONGC

Nature of Oil and Gas industry is known for being capital and tecnology intensive. Technology innovations enable the discovery of new reserves and improving the efficiency of resource extraction. For innovations to be effective, research and development priorties need to be business driven and aligned to the upstream industry's needs. Controlling capital expenditure with cost effective solutions through R&D efforts has been always pursued by the industry and it has always supported the formulation of technology and research priorties to address the common industry challenges. Pursuing a strategic approach in finding solutions through R&D initiatives would be helpful in addressing the challenges of industry.

A strategy which is capable of anticipating future challenges should be able to help selection of projects and partnerships with best in class experts and operators. It should lead to rapid implementation of operational pilot projects in the areas of immediate priority. Formulating a strategic framework based on following criteria can result in successful implementation of R&D strategy for the upstream industry.

1. Anticipation

Future of E&P industry is shaped by scientific and technological developments which have game changing potential for the operations. These developments may not be visible directly in our industry but may be impacting other industries and could find place in E&P industry. Institutes which are dedicated to exploration should aim to identify such technologies to be suitably modified and inducted in upstream. It is desirable to work in defined timeframe through the labs in the institutes so that the outcome is quickly transferred to operation group.

In geophysical research, areas like sensors, data acquisition, processing and interpretation need to be constantly examined with anticipatory lens for future developments and requirements. Similarly other elements of E&P value chain like reseervoir management,driling and production need to be constantly examined for likely advances and future technologies development by the dedicated institutes for each area.

2. Selection of Projects

Identifying flagship programs with an aim to focus on improving the sub-surface image in complex geological set up, improving reservoir modelling and simulation tools and development

of improved recovery technologies should form the basis for pursuing the technological advancements in the upstream sector.A mechanism of sharing the new challenges faced as well as anticipated by the upstream industry with all stakeholders ,needs to be developed. Based on the shared knowledge and experiences,suitable projects can be formulated with an aim of finding apropriate solutions.

3. Operational innovations for rapid implementation

Technological innovation platforms can cover following E&P business chain:

- Geosciences and reservoir integrated platform
- Reservoir management
- Unconventionals
- Drilling and completion of wells
- Field operations
- Deep water and subsea
- EOR
- HSE
- IT

For each of above areas, collaboration with experts, institutes and companies should be pursued and encouraged.

4. Suitable R&D set up

Companies need to create R&D department aligned to technology readiness level and to improve efficiency in exploring new ideas and assessing their potential. It should be developed through-

- Use of prospective labs
- Focused R&D programs
- Creating platform for innovative technologies implementation (bridge between R&D and operations)

Key enablers to succerssful implementation of R&D strategy

Following considerations can enable the success of R&D initiatives:

- Cross functionality and synergy
  - Selecting the programs which require MDT approach e.g. CCUS, HSE, Data science, AI and the institute which can deliver.
- Budget priority
- Strategic alliances
- Digitalisation

Planning for strategy implementation

An action plan for implementing the R&D strategy would call for an approach involving following steps:

A. Defining the Themes

Themes around Frontier Exploration, Earth imaging, Field reservoir, Gas solutions, wells, Deep offshore, next generation facilities, Unconventional etc. could be the starting point.

B. Encouraging the disruptive innovation

Plan for at least one in a year for the areas where the impact could be very high. Priority for the initiatives can be decided on the basis of ranking of the challenges across E&P value chain.Typical order of ranking is based on the gains which the industry can realize through innovations and is being described below:

Area	Rank
• Field management	# 1
• Equipment and material for sour services	# 2
• Drilling and well cost	# 3
• Water management	# 4
• Operation in challenging areas	# 5
• Management of Sulphur	# 6
• Well logging and in well monitoring	# 7
• Fluid property analysis	# 8
• Reservoir description	# 9
• Flow assurance and sand control	# 10
• Environmental impacts	# 11
• Seismic data acquisition and processing	# 12
• Core analysis and fluid property analysis	# 13

C. Technology road mapping

It shall be integral part of the planning process. It can help decision makers in identifying, evaluating and selecting the strategic technological objectives which can deliver value to the company. Areas identified and rank of the same as indicated above, can enable collaboration, knowledge sharing and partnerships which would help reducing the risk of costly investments in less appropriate technology and R&D. Creating a successful alliance of industry partners is the key to development of entire spectrum of technologies which would be demanded by future markets. Synergistic working will help converting technological challenges to technology solutions.

Selecting suitable mechanism for developing Innovations

Upstream industry has a reputation for being slow to develop and adopt innovations. Risks and high cost of failure is the reason for many companies to be fast follower instead of being first user of new technology. It is due to this prevalent mindset, industry's innovations take an average of more than 15 years to progress from the concept phase to commercial adoption. E&P companies have been categorised as low R&D intensive companies because of historical investment being less than 1% of their revenue in R&D. However in the recent past E&P companies have recognised technology as an important strategic priority. The spent on R&D and innovation has dramatically increased by NOCs and IOCs in past few years.It is important in this context to find a suitable mechanism for developing new technologies for upstream industry.

E&P companies have followed the concept of "open innovation" and collaborative models of R&D to maximise the gains in shorter possible cycle time. Oil field service companies along with reputed vendors, government agencies and universities now play an important role as a part of the Eco-system of R&D in the industry. Industry's innovation processes have become far more collaborative than they used to be in the past. Development of radical change bringing technologies like 3D seismic, horizontal drilling and hydrofracturing led to acquiring new skill sets by the companies while incremental innovations more or less maintain the status quo.

To take advantage of collaborative approach in R&D, Indian NOCs have tied up with some of the best international universities and it has resulted in development and adoption of several technologies in specialised areas like EOR for onland oil producing fields in our country. Further ONGC has also embarked upon PAN-IIT initiative and identified several thematic areas through its own institutes covering a broad range of projects for developing new technologies with various IITs in a definite time frame. Another example of open innovation approach between upstream NOC Company, ONGC and downstream NOC Company, IOC in the area of CO2 EOR for one of the matured onland oil field of Cambay basin could be a pathsetting example for R&D in our country.

Redesigning the R&D planning process

Though the key elements mentioned above shall result in crafting a framework for obtaining innovative solutions for emerging challenges in upstream industry yet the success would be achieved through a robust R&D planning. Following points need the consideration while designing a suitable R&D planning process:

- Major operators and service companies should share there views on the prime challenges faced on annual basis.
- Information analysed and consolidated to be made available to academic community and should be used to shape the R&D proposals.
- Proposals with merit to identify within the country and international academic partnerships. Proposals to include project cost estimates and timeframes and should cover technology demonstration and field trial requirements.
- Selected proposals would be subjected to relevant data and information sharing from the industry side with R&D proposer.
- It would be imperative on the industry organisation to facilitate field trials of the new technology solution.
- Reasons behind unsuccessful proposals to be made known and further improvement to be made by academic institutions.
- This process can address the issues related to R&D e.g. lack of focus, limited colloboration, poor understanding by the academic community of the challenges and opportunities within the industry and the problems faced in undertaking field trials.

Other enabling mechanisms would be, guiding the academia on commercialisation of R&D, better understanding of patent laws and recognising IPR, relaxation of local content regulations in select emerging technology areas, measures to ease the imported equipments for R&D purpose and field trials and finally involvement of international experts with the work force for developing capabilities for addressing future challenges.

GAS

Managing the Risks of LNG: An Indian Perspective

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Background

India is currently the world's fourth-largest importer of LNG, totaling 21.7 MMTPA in 2018-19 and the demand has increased by over 50% between 2011- 12 and 2018- 19. The share of domestic gas and imported LNG was about 48% & 52% respectively in 2018-19 indicating that LNG forms an integral part of the country's natural gas mix. LNG is being procured on spot, short-term, medium-term and long-term basis and there is a continuous increase in volume of LNG in overall gas consumption. India's domestic production of natural gas can only partially fulfil the expected increase in demand in the coming years, and the country will have to increase its imports to fill the gap. Such reliance on external sources makes the country's energy security susceptible to regional and global events.

Earlier, India depended solely on Qatar for long term LNG supplies and today is diversifying its imports from various gas markets and transit routes, both well-established and emerging markets like US, Russia and Australia (Fig:1). In 2018, India has imported LNG mainly from Qatar (48%), Nigeria (13%), Australia (7%), Angola (7%), Oman (5%) and USA (4%) implying 84% of the total LNG volumes imported from these 06 diversified geographies.

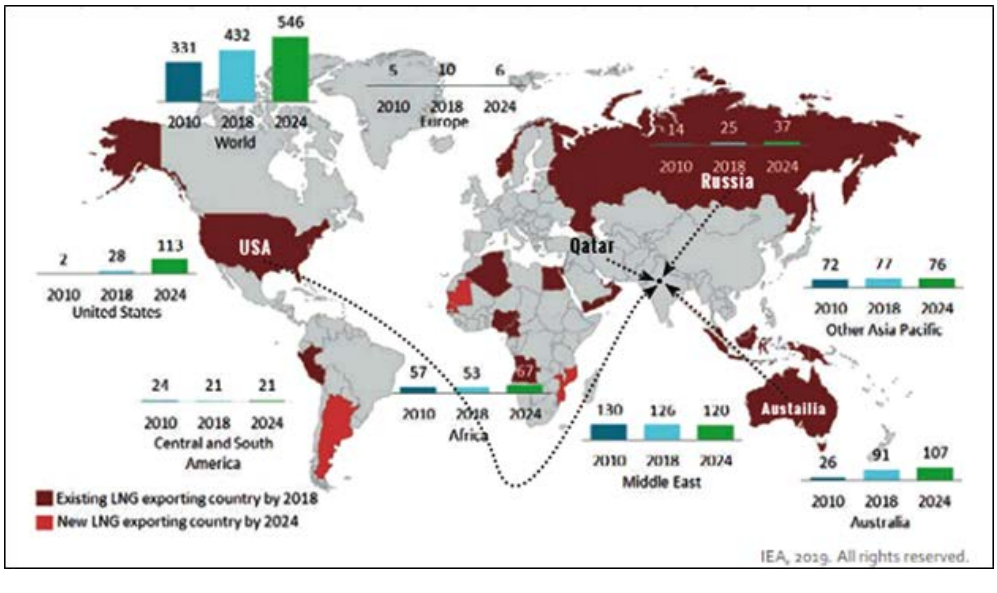

Fig 1: LNG exporting countries and LNG export volumes, 2010–2024, diversifying India's LNG Sourcing (All figs are in BCM)

1. Diversifying LNG Suppliers and Transit Routes

(i) India's existing major import portfolio

a) Qatar

Qatar currently supplies 8.5 MMTPA of LNG making it the country's single largest source of imported gas. Qatar has established a strong partnership with India since July 1999 when Qatargas (erstwhile RasGas) signed a long-term LNG deal starting from 2004 and since then it has delivered over 2,000 cargoes. Following its exit from OPEC in 2019, Qatar is focussed on its gas production and is planning to increase LNG production capacity from present 77 MMTPA to 110 MMTPA by 2024. Despite facing a blockade from Saudi Arabia, Qatar has continued to supply natural gas to different markets and from the perspective of energy security, this behavior by Qatar increases confidence amongst consumer countries like India.

In 2015, after continued dialogues, the long term LNG deal was renegotiated to $8-$8.5 per unit, against additional supply agreement of 1 MMTPA and both the contracts are ending in 2028. After a sharp fall in spot prices, India in January 2020 has again started dialogues to delink the price of its imported gas from oil and to lower the price.

b) United States

The first wave of the U.S LNG projects, driven by shale gas revolution, was a game-changer and has emerged as one of the world's leading producers of gas. With demand for new supply projects increasing, the US now appears well positioned to catch a second rising wave – and its growth could revolutionize the wider LNG market. As per IEA Gas Market report 2019; US LNG is expected to become the largest source of supply by 2024, reaching 113 bcm/y, ahead of Australia (107 bcm/y) and Qatar (110 bcm/y) (Fig: 1). India's LNG imports from U.S are also increasing progressively ever since the imports started in March 2018.

GAIL has contracted 3.5 MMTPA of LNG from Cheniere Energy's Sabine Pass liquefaction facility and another 2.3 MMTPA at Dominion Energy's Cove Point liquefaction plant. Petronet LNG (PLL) and Tellurian Inc. US have signed an MoU as per which PLL will invest $2.5 billion in Tellurian's proposed Driftwood LNG export terminal, in exchange for the rights to 5 MMTPA of LNG per year for over 40 years. IndianOil has an agreement with Mitsubishi Corp of Japan for 0.7 MMTPA of LNG for 20 years from Cameron LNG project.

c) Russia

In 2012, Russia's Gazprom envisaged supplying India with LNG from its planned Schtokman project however later on this project was scrapped as the shale gas revolution in the US removed a key customers base. The inability to deliver LNG helped India to renegotiate the 2.5 MMTPA long-term contract ending 2040 reflecting the current global gas market dynamics. The first LNG Cargo under this long-term contract was received by India on June 2018. In the last few years, Indian companies have made huge investments in acquiring varying stakes in strategic Russian projects Sakhalin-1, Vankorneft and Taas-Yuryakh and in Aug 2019, India held a series of high-level bilateral engagements to further strengthen its commitments in energy sector with the Russian Far East and Arctic regions.

d) Australia

Australia is significantly increasing its liquefaction capacity, to reach to 107 bcm by 2024 (Fig: 1) as the country has a strong remaining conventional resource base and prospective shale gas potential for which the government is also moving forward. The energy trade between the two countries can prove to be mutually beneficial, as India, with its prospects of becoming a gas-based economy, provides a large, stable market for Australia's LNG exports. Moreover, sourcing LNG from Australia is relatively more efficient as the route bypasses several maritime chokepoints.

(ii) Other Emerging LNG Markets

In Middle East; Countries like Saudi Arabia and UAE could also emerge as major gas producers in the future. Given India's growing economic cooperation, friendly relations and close proximity to these countries, could enable smooth access for Indian companies to tap into the natural gas potential of these countries.

BP reports that Saudi Arabia has a whopping 285 trillion cubic feet (TCF) of proven natural gas and it is launching the biggest shale gas development to boost domestic gas supply. It has adopted the techniques developed in U.S. fields - for the huge $110 billion Jafurah shale gas field project. If Aramco hits its targets for development of the field, Saudi Arabia could become a gas exporter by 2030. UAE can expect to develop significant LNG export capacity by 2024, on the back of the latest discoveries of 15 trillion cubic feet of gas reserves, according to consultancy Wood Mackenzie. In South Africa; India could consider making forays in newly discovered gas fields in Algeria, Libya, Egypt, and Mozambique. Indian companies are already involved in joint development of gas resources in Mozambique's Offshore Area 1, having 75 TCF recoverable reserves of natural gas and the project will start production by 2024 according to Total, the operator of the project. Egypt, for instance, is gaining prominence for its rising natural gas production and new discoveries. Furthermore, it is diversifying its exports of natural gas and expanding to countries like China, Malaysia and Japan.

2. Spreading price reference indexes across multiple geographies

There are marked differences in the way LNG has been priced in the three main LNG markets of US, Europe and Asia. In US, LNG producers set their export prices linked to Henry Hub (HH). However the competition between LNG export projects has forced a change and recently Total has agreed to offtake 1.5 MMTPA from the Driftwood LNG project at a price based on Platts Japan Korea Marker (JKM), the benchmark price for spot-traded LNG in Northeast Asia. In Europe, the gas market has already developed to the extent that LNG is competing directly with pipeline gas. As a result, LNG sales contracts are referenced to competing gas prices at gas hubs such as the Dutch Title Transfer Facility (TTF) and the UK's National Balancing Point (NBP). In Asia, LNG has typically been indexed against a benchmark such as Brent crude or, in Japan, against the Japanese Crude Cocktail (JCC) price.

Previously limited (largely) to JCC or HH, nowadays buyers take their pick of JCC, HH, Brent, US gas hub (non-HH), TTF, NBP, Spot (JKM)—all of which have come to the fore (Fig: 2). There is a developing movement towards gas-on-gas pricing in Asia, the driver for this change is gas buyers demanding a pricing mechanism that is more representative of the regional gas market that they are subject to. An Asian benchmark price for LNG that is developing in popularity is the Platts JKM. The prevailing view in the market is that JKM-linked pricing will continue to grow, and in the coming years LNG contracts will increasingly move away from pricing formulae linked to crude oil and towards gas-on-gas pricing linked to trading prices at gas hubs around the world.

Fig 2: Share of LNG contract volumes by price indexation

3. Balancing Portfolio between Long term, Short term & Spot Trade

Spot trades and other short term deals have become increasingly common with growing number of players seeking to capitalize on excess capacity across the LNG value chain (liquefaction regasification facilities and tankers). About 32% of global LNG volumes were traded on a spot or short-term basis in 2018. The emergence of traders and

portfolio players also contributed to more active trade flows in the spot market. Even established buyers like Japan are looking to balance their portfolio between long term contracts, short term and spot cargoes. As sizeable volume of Asian long-term contracts are expected to expire in 2020 (above 6% of global LNG will expire in 2020, and an amount over 20% will expire by2025), both buyers and sellers will have the opportunity to renegotiate terms which could give rise to more short-term flexible deals.

4. Focusing Shorter and Smaller Contracts

The evolution of LNG market players and supply glut are combining to change the way LNG is being contracted. This has taken the pressure off LNG buyers to secure new supply via traditional long term contracts. Today, buyers need more flexibility in their gas supplies due to uncertainty over demand evolution, meaning the historical contract structure of large volumes sold in multi-decade deals is changing. Buyers in Asia, Europe and Latin America are instead pushing for shorter and more flexible gas linked contracts. This has driven a reduction in average contract length since the glut took place in 2014 (Fig: 3)

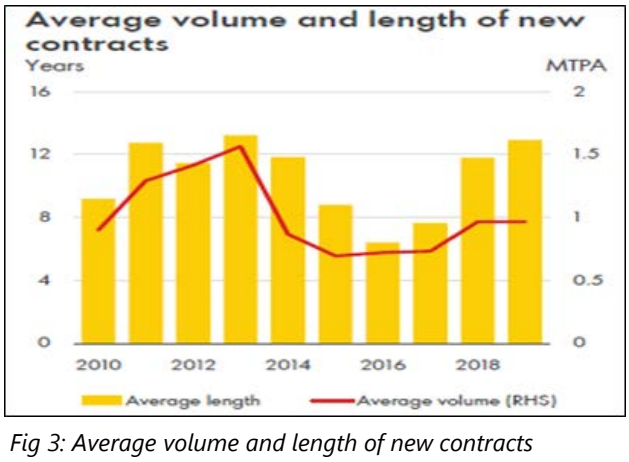

Fig 3: Average volume and length of new contracts

5. Negotiating Flexible Clauses

The LNG contract market is moving irreversibly towards more open, flexible Sales and Purchase Agreements (SPAs). What once would have been considered unusual is now by and large the norm: volume tolerance, diversion rights, scheduling adjustments, etc. The question is no longer whether to offer flexibility; it is how much to offer and at what price. To address more fundamental market changes, India can use its position as fastest growing LNG consumer to include price review mechanisms for oil-linked LNG contracts, providing for the price to be subject to review if the contract price no longer reflects market conditions. In this past, India has used its position to renegotiate various long term contracts with Qatar, Russia & Australia which has helped the country save crores of rupees.

Secondly, Conventional LNG contracts usually contain a destination clause that somewhat restricts destinations of the relevant LNG cargoes and this practice has hindered free LNG trade. Inclusion of Supply flexibility that is having the right to re-sell imports to third parties may be insisted upon. Thirdly, Qatar's Finance Minister in Dec 2019 has conveyed that Qatar is open to accepting all currencies in the trade of LNG; while the dollar will dominate. As India is receiving almost half of its LNG requirement from Qatar, this position may be used to consider INR for the LNG trade to reduce foreign exchange risk arising out of exchange rate fluctuations.

6. Accessing gas through Transnational Gas Pipelines

International examples particularly of EU and China indicates that a pooled strategy of accessing gas through transnational gas pipelines and LNG imports can provide a stable, reliable, cost effective and diversified gas supply mechanism to a large energy consumer like India. China's first transnational gas pipeline (China-Central Asia Gas Pipeline), length of 1833 km and capacity of 60 BCM per year, is operating since 2009 which runs from Turkmenistan and passes through Uzbekistan and Kazakhstan. This Pipeline has delivered ~ 48 BCM of natural gas to China in 2019. The Newly operational Chinese- Russian gas pipeline (Power of Siberia), length of 3000 Km and capacity of 38 BCM per year was launched in Dec'19 has the potential to transform China's energy landscape and even slow the country's surging imports of LNG. Therefore, India needs to explore such opportunities for setting up of transnational gas pipelines from Russian, Asian or Middle East gas rich regions.

7. Focusing mix of Land based LNG terminals and FSRU's

Gas consumption has to rise to ~600 MMSCMD for achieving 15% share in energy basket from current level and it will require a huge increase in imports and the construction of more LNG terminals. A combination of land-based LNG terminals and FSRU's may be developed along the coastal line which is 7500+ Kms (Mainland- 5422 Kms, Island- 2094 Kms) to cater to the localized demand centers. FSRUs not only provide an alternate option to onshore regasification solution, but also offer a better economic fit in many cases. They are versatile, convenient and can make natural gas available to the market faster and the movable nature of the FSRU mitigates credit risk and allows relocation of the FSRU if import needs or demand conditions changes. They also add flexibility to the system and can be used for trading if utilization rates are too low. We have seen the emergence of some seasonal FSRU charters such as Golar's 2013 charter with KNPC where the vessel is deployed as a FSRU for nine months and is free to pursue spot carrier and short-term business opportunities for the remaining three months of the year. Growing use of LNG as marine fuel will support the introduction of domestic LNG bunker vessels and will boost the LNG demand which can be met through these FSRUs.

8. Building Strategic Natural Gas Reserves

India needs to explore building strategic reserve of natural gas, to further strengthen country's energy security and shield itself from supply disruptions. The reserve will also help the country cope with demand spike and price rise. Several heavy energy consuming countries have built storage to ensure supply security. US has almost a third of global gas storage while Russia, Ukraine, Canada and Germany together account for another big chunk. China, is also developing gas storage facilities.

9. Building world- class LNG carriers locally

Though the country has adequate ship-building capacity, none of India's shipyards have built an LNG ship although a plan to manufacture LNG vessels at the Cochin Shipyard has also been approved. India would be importing more LNG and there will be a significant future demand for more LNG carriers and hence needs to develop LNG shipping capabilities to meet its spot /short/mid/ long term shipping requirements. South Korea, Japan and China dominate the LNG shipbuilding sector. China has made it mandatory for LNG imported into that country to be carried on ships that are constructed at Chinese yards and majority owned by Chinese firms. This is an opportunity India can grasp through partnerships and technological assistance of successful maritime countries and policy & fiscal support from the government.

10. Creation of Joint working groups

India has been making the most of its position as one of the world's biggest energy consumers to strike better bargains for its companies. The Asian countries such as Japan, China, South Korea, India and Taiwan are the world's largest consumers of LNG and represent the dominant share (~70%) of the global LNG demand. In order to have a better negotiating power and influence over contract terms, India along with these Asian countries may come together to form Joint working groups to establish a flexible and transparent global market and to strengthen collaboration on issues of cooperation in the LNG segment.

11. Protecting Import terminals / Facilities

As India's dependence on sourcing LNG from abroad is increase substantially, India must invest in building its naval capabilities and strategy to protect these LNG import terminal/facilities & FSRU's.

Conclusion

With growing LNG demand, India has increasingly diversified its supply sources of LNG in the recent years and is also investing abroad for securing its supplies. India must continue to diversify with new supply sources and increase its volumes of investments in the overseas assets like New Gas fields/ LNG terminals, etc. to create additional degree of inter-dependence that will offset the risks for India. Further, arranging a long term and assured supply of natural gas at reasonable price through transnational pipelines will bring an ultimate transformation to India's energy basket.

India's gas demand does not have a strong seasonal component because there is no winter heating load; however, storage does play an important factor in gas security of supply. Further, India must explore possibilities of cooperation with both suppliers and all major Asian LNG consumers in order to remove obstacles in the trading of LNG and to advance towards free, liquid, and transparent global LNG markets.

The views and opinions expressed in this article are those of the author through analysis of data and information/ published reports available in the public domain

GAIL (India) Limited

BRING ABOUT A REFRESHING CHANGE

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FINANCE

Abolition of Dividend Distribution Tax

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Dividend Distribution Tax ('DDT') is a tax levied by the Government of India ('GOI') on distribution of accumulated profits to the shareholders. Till now, DDT was levied at 20.56% on the profits distributed to shareholders. The rate of DDT determined the Return on Income ('ROI') for investors and made significant contribution to the government treasury.

The Finance Minister in the Union Budget for the year 2020-2021, abolished the DDT and shifted the liability to pay tax, to the shareholders. This is not the first time DDT regime has changed and each time the regime has changed, it has resulted in significant impact on the ROI of the shareholders.

In this article we will be discussing brief history on DDT, issues faced during the DDT regime, and the impact on abolishment of DDT on various taxpayers.

Bird eye view on DDT

As discussed earlier, distribution of profits by way of dividends by domestic companies up to 31 March 2020 were subject to DDT under section 115-O of the domestic tax law at 20.56%. The company paying such dividends was liable to discharge aforesaid liability, and such dividends were tax exempt in the hands of the shareholders.

The key benefit of DDT was not only to encourage companies to invest its surplus back into the company, but also to facilitate administrative convenience to collect tax on dividends. While this was regarded as beneficial for select class of resident taxpayers (whose income was subject to tax at maximum marginal rate or where effective tax cost was higher than 20.56%), it was an added tax cost for non-resident taxpayers, as usually credit for such DDT was not available in most foreign jurisdictions.

Until the amendments made by the Finance Act, 1997, the tax on distributed profits (i.e. dividends) was charged in the hands of the shareholder as 'Income from Other Sources'. However, the Finance Act, 1997 inserted special provisions relating to tax on distributed profits of domestic companies. The Finance Minister, in his budget speech highlighted that during those days, the companies used to declare exorbitant dividends instead of retaining them and ploughing them in fresh investments. Hence in order to reward the companies who reinvested the surplus into business, tax on distributed profits at the rate of 10% was introduced on the amount so distributed. The Memorandum to the Finance Bill also mentioned that the existing

system of dividend taxation, that is, which is tax deduction [Tax deducted at source ('TDS')] by the company on dividend, followed by issue of TDS certificates for the same and then offering dividend income by recipient was very cumbersome and involved a lot of paperwork. Hence, for administrative convenience also, DDT regime was found favorable as an efficient way of collecting taxes.

Subsequently, vide Finance Act 2000, the rate of DDT was increased to 20%. In the year 2001, the rate of DDT was reduced to 10%. Further, in the year 2002, highlighting dividend is income in the hands of recipient, the Finance Minister abolished DDT and shifted the incidence of tax in the hands of shareholders. In support of this, the Finance Minister mentioned that because of DDT, persons belonging to high-income groups could get away with lower rate of tax vis-à-vis the rate applicable to them. It was also mentioned in the memorandum that the provision of DDT was 'iniquitous' and hence the incidence of tax was shifted in the hands of recipient. However, once again, while presenting the Finance Bill 2003, the Finance Minister re-introduced tax on dividend distributed by domestic companies at the rate of 12.50% citing the convenience to collect tax at a single point, that is, from the company, instead of the shareholders. This tax on profits distributed by companies, which was introduced from Finance Act 2003 has continued till March 2020 only with a minor modification of rate hike and grossed up tax rate.

Issue revolving around DDT

Tax treaty - Eligibility of lower rate

An interesting controversy revolves around applicability of DDT especially in the case of non-resident / foreign shareholders. Most of the tax treaties entered by India provide for a concessional rate for taxing dividend income in case the recipient shareholder is the beneficial owner of such income (within the range of 5-15% on gross basis). However, whether a domestic company while declaring dividends to such shareholders, who are eligible to claim protection under relevant tax treaties, is required to discharge DDT as per prescribed rates i.e. 20.56%, or can restrict it to the rate provided for dividend income under the tax treaty i.e. in the range of 5-15% as the case may be, currently remains untested.

As such DDT can be argued to be a tax on profits distributed by the companies. It is only for the sake of convenience that the point of collection is made from the company declaring the dividend as against from shareholders. In such a situation, a question arises whether DDT is a tax in the hands of the shareholders or in the hands of the company, notwithstanding that it is collected from the company. Based on certain judicial precedents one can argue that DDT is a tax on the income of shareholder and not on the company. Hence, whether it can be contended that in case the recipient is from a tax treaty country, dividend should be taxed at the concessional rate (which is lower than the existing DDT).

There could be several arguments, that could be taken for claim of lower rate under the tax treaty. It could be contended that dividend is ultimately the income of shareholders under the domestic tax law. This is because, in order to classify an income as exempt, it should be chargeable in the first place. Thus, DDT has always been a charge on the income of recipient shareholder. Further, in order to balance the tax levied on dividend, section 115BBDA was introduced whereby dividends in excess of INR 1 million were brought to tax in the hands of the recipient shareholders. Thus, the introduction of this section supports the argument of dividend being the income of the shareholders.

One, however, needs to be mindful that an alternate view is also possible where it could be argued that DDT is not a tax on dividends but an additional tax on distributed profits.

This claim of paying DDT at a concessional rate under the tax treaty has been litigious. The Authority for Advance Ruling have admitted a few applications on the aforesaid question. Certain taxpayers have also made claims before Appellate authorities or even before tax officers during the

course of assessment proceedings to contend that DDT rate should not exceed the rates applicable under the tax treaty. It is also worthwhile pondering whether it is at all possible to claim excess DDT paid on dividends declared to such non-resident shareholders in the tax return of the domestic company.

Post Amendment scenarios

Now let's have a look the impact of abolishment of DDT. The shift of collection of tax from single point (in the hands of company declaring dividend) to the classical system (in the hands of the recipient shareholder) has not only resulted into a lot of amendments under various tax provisions but also the rates at which dividends will now be taxed for different types of shareholders viz. individuals, companies, foreign institutional investors, etc. Certain peculiar aspects have been discussed in the ensuing paragraphs.

Individuals

Following is the comparison on the tax payable by individuals in the DDT era and Post DDT era

Particulars	DDT Era	Post DDT era
Incidence of tax	DDT payable by the declaring company	Tax payable by the recipient individual
Taxability in the hands of company	Tax on dividend paid at 20.56% - irrespective of slab rate of recipient	No tax payable on profits distributed
Taxability in the hands of shareholder	Additional tax at 10% for individuals earning dividend exceeding INR 1 million in a financial year	Tax payable at Maximum Marginal Rate at 42.74%

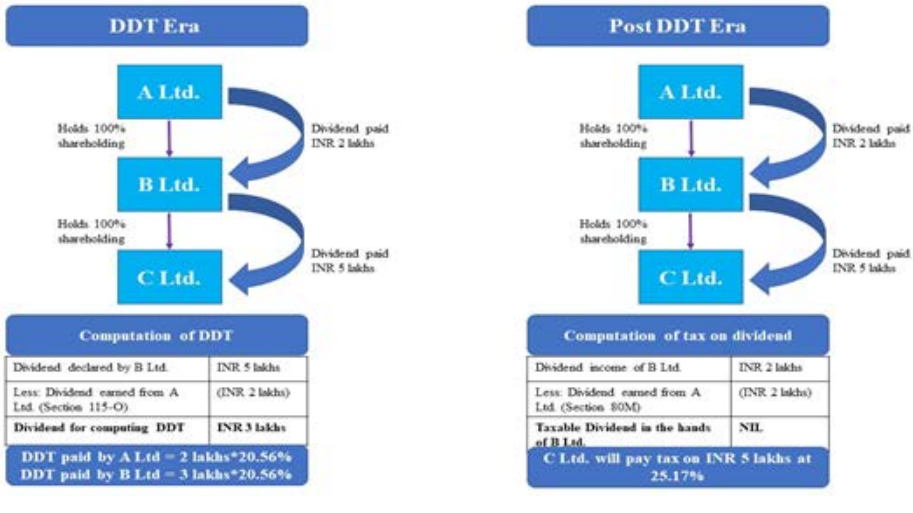
The taxability of dividend in the hands of Indian promoters at 42.74% is disproportionately higher than taxability in the hands of foreign Multi-National Companies ('MNC's'), which is discussed in the ensuing paragraphs.

Domestic Companies

Following is the comparison on the tax payable by domestic companies in the DDT era and Post DDT era

Particulars	DDT Era	Post DDT era
Incidence of tax	DDT payable by the declaring company	Tax payable by the recipient company
Taxability in the hands of shareholders	Tax on dividend paid at 20.56% - irrespective of slab rate of recipient	No tax payable on profits distributed
Removal of cascading effect under multi-layer shareholding	In case recipient company wishes to declare dividend – dividend income received from subsidiary company was reduced from dividend declared for the purpose of computing DDT	In case recipient company wishes to declare dividend – it can claim deduction to the extent of dividend received from any domestic company while computing its taxable income

An illustration giving the credit mechanism under both the regimes is as under:



Further, from a recipient company perspective, it is also necessary to analyze deductibility of expenses incurred for the purpose of earning dividend income. In the erstwhile DDT regime, any expenditure incurred to earn tax free income was not considered as an allowable expense and disallowance was made under section 14A of the Income-tax, Act 1961. With the abolishment of DDT, litigation on account of disallowances under section 14A shall die out. However, it may give rise to a similar disallowance which may arise on account of provision introduced under the new regime, for restricting deduction on account of interest expenditure incurred for earning dividend income to 20% of the dividend income and disallowing all other indirect expenses.

Foreign companies

Foreign companies receiving dividends from Indian subsidiaries can opt to offer the said income to tax as per the rate specified under the tax treaty, subject to fulfillment of certain prescribed conditions i.e. percentage shareholding, beneficial ownership of shares, etc. (depending on the applicable treaty). In addition, such foreign companies, with effect from 01 April 2020, shall also be required to fulfill the principal purpose test, that is, they would be required to prove substance for the claim of benefit under particular tax treaty.

Foreign Institutional Investors ('FII') Following is the comparison on the tax payable by FII's in the DDT era and Post DDT era

Particulars	DDT Era	Post DDT era
Incidence of tax	DDT payable by the declaring company	Tax payable by the recipient FII
Taxability in the hands of shareholders	Tax on dividend paid at 20.56% - irrespective of slab rate of recipient	Differential rates depending upon constitution under Indian tax provisions FII (Corporate) – Tax payable at 21.84% FII (Association of Persons / Trust) – Tax payable at 28.50%[2] (Difference due to applicable rates of surcharge)

In addition, concessional tax rate for dividends under the tax treaty is usually available only to a beneficial owner of the dividends. In case of FIIs registered as trusts it needs to be evaluated whether the trust or the trustees can be said to be beneficial owner of the dividends and it needs to be analyzed hence whether provisions of the tax treaty can apply while evaluating taxability of dividends in the hands of such trusts.

Reduced rate of DDT by applying Most Favored Nation ('MFN') clause

MFN Clause under a tax treaty usually allows a taxpayer to adopt a beneficial provision which a particular country might have agreed with another country subsequent to signing of the agreement with such taxpayer's home country. Such beneficial provisions apply subject to fulfillment of prescribed conditions mentioned in the MFN clause. Usually, such MFN clause allow a beneficial rate and/or scope of definition of dividend, royalty, fees for technical services, etc.

As regards dividends are concerned, it is worthwhile exploring MFN clause in certain tax treaties as with the Netherlands and France. India has agreed to apply a dividend tax rate of 5% in tax treaty with Slovenia, which has been entered into after the tax treaty with aforesaid countries. Accordingly, the aforesaid lower rate as agreed with Slovenia can be imported while applying tax treaties such as the Netherlands and France.

Concluding remarks

Abolishment of DDT is a welcome step and would lead to better ROI for investors, specially MNC's operating in India who can opt to pay reduced tax under the tax treaty. However, for Indian promoters, the rate of tax on dividend can extend beyond 40% and this could be a big dampener for making investment. The GOI may consider capping maximum marginal rate on dividend income to encourage investment in corporate sector which is facing challenges at domestic and global level.

Views expressed are personal.

1 Bacha F Guzdar (Supreme Court) and Union of India vs Tata Tea Co. Ltd.
2 Assuming highest tax rate applicable

GAS

Morbi NGT Order: A Stride Towards Gas Based Economy

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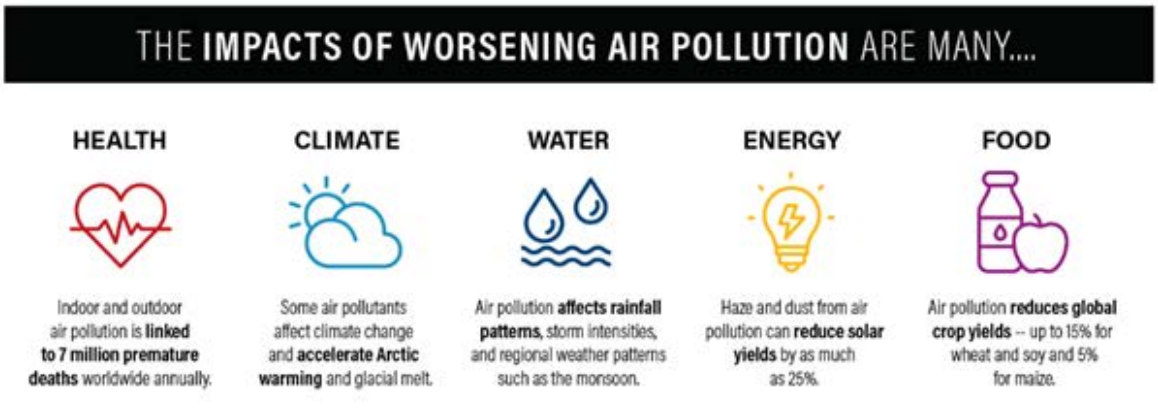
Background

Air pollution is a major global environmental risk to our health and well-being. A recent World Health Organization (WHO) suggests that air pollution claims over 7 million lives annually mainly from heart diseases, strokes, chronic obstructive pulmonary diseases, lung cancer, and acute respiratory infections in children. Unlike other forms of pollution, which largely cause local health problems, impact of air pollution extend far beyond health and affect climate change, water sources and agriculture. Countering air pollution costs the global economy trillions of dollars in health, welfare and productivity losses every year.



Source: World Resource Institute (WRI)

Air pollution is costing to India dearly both in terms of human lives and economic damage. A 2017 report by the Centre for Science and Environment (CSE) claims that the ambient air pollution in the country is responsible for over 30 percent premature deaths, cancer and mental diseases. The reports further suggested that by year 2020, 1.73 million new cancer cases will be triggered by air pollution alongside tobacco, alcohol and diet change. According to a study carried out by IQAir AirVisual and Greenpeace 22 of the 30 most polluted cities in the world are in India. Another recent study by CSE points out that outdoor and household air pollution in the country has reduced life expectancy by 2.6 years. A recent World Bank report estimates that air pollution costs India an equivalent of 8.5 per cent of its GDP. With the Indian economy poised to witness a fast paced growth and industrialization, the problem is only set to further exacerbate.

Undeniably, the manufacturing sector has unparalleled contribution towards the growth of the country and maintaining a robust GDP growth. However, the sector is also one of the major contributors towards the worsening air quality in the country. Some of the most polluted industries in India include ceramics, metals, chemicals and petroleum. India is faced with the dilemma of maintaining high growth in the manufacturing sector while ensuring minimum impact of the environment.

Contrary to popular belief many regions across continents have demonstrated that air pollution can be curbed drastically without any apparent negative impacts on economic growth. The city of London and the State of California in the US have exemplified how a region could make tremendous economic progress while curbing the air pollution levels through a combination of policy, regulations, and technology. Many of these cities benefitted immensely from switching their manufacturing sector form coal to natural gas.

Taking cognisance of the impending threat posed by degrading air quality in the India, the Government has set a vision of increasing the penetration of natural gas in the Primary Energy Mix from a present 6.2 per cent to 15 per cent by 2030. To achieve this ambitious target, the Government has been aggressively pushing for increasing the usage of natural gas in domestic and transportation sector. The industrial sector in India, has been heavily dependent on polluting fuels such as coal, pet coke and fuel oil. In 2018-19, India consumed over 896 MMT of coal. Over 71 per cent of this was used for power generation and steel industry while another 241 MMT (~27 per cent) was used by other industries. Considering only 10 per cent of the coal consumption is replaced by natural gas, it would generate an incremental gas demand of around 76 MMSCMD (~27.7 BCM). Similarly, a replacement of only 30 per cent of each of pet coke and fuel oil will present a demand of around 25 MMSCMD (9.12 BCM) of natural gas. Such rise in demand not just make the industrial sector an anchor consumer of natural gas but will also incentivise and fast track pipeline infrastructure development.

However, such large scale switching to natural gas by the industrial sector will require Government policies and regulation to work hand in hand. In this direction, the 2019 order of the National Green Tribunal (NGT) to shut down all coal-based gasifiers in the Morbi-Wankaner tiles cluster of Gujarat and switching to Piped Natural Gas (PNG) sets an example for rest of the country on how effective regulations can facilitate switching to cleaner fuel while maintaining economic activity.

Case in Focus: Morbi – Wankaner

Morbi is a mid-size city, located in the Saurashtra region in the state of Gujarat. It is the second largest tile manufacturing zone in the world after the Guangdong province in China. The ceramics industry in the Morbi - Wankaner region, set up with an investment in the upwards of Rs 8000 Crore, accounts for over 80 per cent of the total ceramics production in the country. The industry generates direct and indirect employment for more than 60,000 people across the country. Morbi - Wankaner region houses some 900 ceramic manufacturing units, which have significant contribution towards the local and regional economy. However, over the last few years, the use

of coal gasifiers by these manufacturing units had caused considerable anxiety among the local population over the alarming situation of ambient air quality and the resulting health issues.

The manufacturing of ceramic tiles is a highly energy and heat intensive process. The ceramic manufacturers of the Morbi - Wankaner region have traditionally used coal gasification for their energy and heating requirements. Coal gasification, though cheap, is a heavily polluting technology, which generates wastes that are highly carcinogenic. Coal gasifiers in the region generated over 8 lakh Kgs per day of coal tar daily. The International Agency for Research on Cancer (IARC) which is part of World Health Organization (WHO) has clearly noted that coal tar is one of the major reasons of lung cancer in humans. However, the ceramic manufacturing units completely overlooked the environmental regulations and continued the use of cheaper coal over natural gas.

The issue of non-compliance and degrading ambient air quality in the region was first brought to the notice of National Green Tribunal (NGT) in 2015.

It was reported that in spite of an order of the High court and the Hon'ble Supreme Court to use LNG or CNG, the ceramics industry in the Morbi – Wankaner region continued the use of coal gasifiers unabated. Taking account of the grave situation, NGT constituted an Expert Committee comprising of representatives from Central Pollution Control Board (CPCB), Gujarat Pollution Control Board (GPCB) and Head of Department (HoD) and Environment Engineering Department of M.S. University, Baroda to establish the parameters for coal-gasifiers which could meet the standards. It also directed GPCB to take actions into the matter based on the findings of the report. In July 2017, when the issue came up for hearing, based on the findings of the report, the tribunal commissioned another Expert Committee comprising of Senior Scientists from CPCB, GPCB and National Environmental Engineering Research Institute (NEERI) to investigate the industries in the Morbi - Wankaner industrial cluster and submit environment status report of the area after examining recommendations of the earlier Expert Committee on coal based gasifiers. It further directed GPCB to shut down the coal gasifier unit not following the standards within a period of two months.

The report of the Expert Committee appointed by the NGT was filed in January, 2019. Some of the major findings of the Expert Committee report are depicted below:

1. All Type A and Type B coal gasifiers being used in the Morbi - Wankaner industrial cluster should be closed/dismantled. The cumulative impact of the waste water and coal tar generated from these coal based gasifiers is severe and cannot be over looked

2. Management and handling of waste water and the hazardous coal tar produced exceeds the capacity of the region as is evident from the monitoring of water bodies and ambient air quality

3. There is an urgent need to provide adequate air pollution control devices to all the sources of air emission including spray driers, coal/clay handling systems with proper roads and solid waste management

4. *"....It is a case of negligence towards natural resource, common man's need and environment by the gasifier operators and ceramic producers...."*

Based on the findings of the Expert Committee, a three judge bench on 6 March, 2019, directed the closure of coal gasifiers and units operating in the Morbi - Wankaner region. It further asked GPCB to immediately start prosecuting violating industries and recover compensation for heavily polluting the air. The Tribunal appointed an oversight committee headed by Just (retd) B C Patel, former Chief Justice of Delhi High Court and former Judge of Gujarat High Court to oversee the execution of the order. It further directed a committee including representatives from CPCB, GPCB and NEERI to assess the damage and cost associated with it and accordingly suggest a restoration plan. The tribunal emphasized ***"....the purpose of economic development in any region is to provide opportunities for improved living by removing poverty and unemployment. While industrial development invariably creates more jobs in any region, such development has to be sustainable and compliant with the norms of environment.....It is imperative to ensure that steps are taken to check such pollution to uphold statutory norms. Adequate and effective pollution control methods are necessary...."***

Key Highlights of the NGT order

1 PNG over coal gasifiers

All coal gasifiers (Type A/B/C/D/E) have been deemed non-viable given their impact on the environment of the Morbi - Wankaner industrial cluster. Ceramic units will be permitted to operate only if they adopt Piped Natural Gas (PNG) until a cleaner technology for synthetic gas generation is demonstrated

2 Reason for coal gasifier ban

Coal gasifiers produce wastes that are highly carcinogenic and may lead to lung cancer. Coal tar and condensate wastewater generated during the process is also causing air and water pollution due to illegal discharge into the region's natural drains, or into the atmosphere through steam

3 Penalty for units that violated the law

The tribunal has instructed GPCB to initiate immediate steps to prosecute industrial units which have not complied with regulations and recover compensation for damage caused to the environment and public health. NGT has appointed a committee that will assess the penalty amount within one month

4 All Counter applications disposed off

The NGT states that local industry units which have filed applications against the order have no merit and are not maintainable under the NGT Act. As a result, all these applications have been disposed of accordingly.

Implementation

In light of the NGT order, GPCB visited 952 industrial units in the Morbi – Wankaner cluster and found that some 568 ceramic manufacturing units were still using gasifiers. It found that these units would have discharged an estimated 2160 cubic metre (m3) wastewater and 1176 tonnes coal tar in their premises.

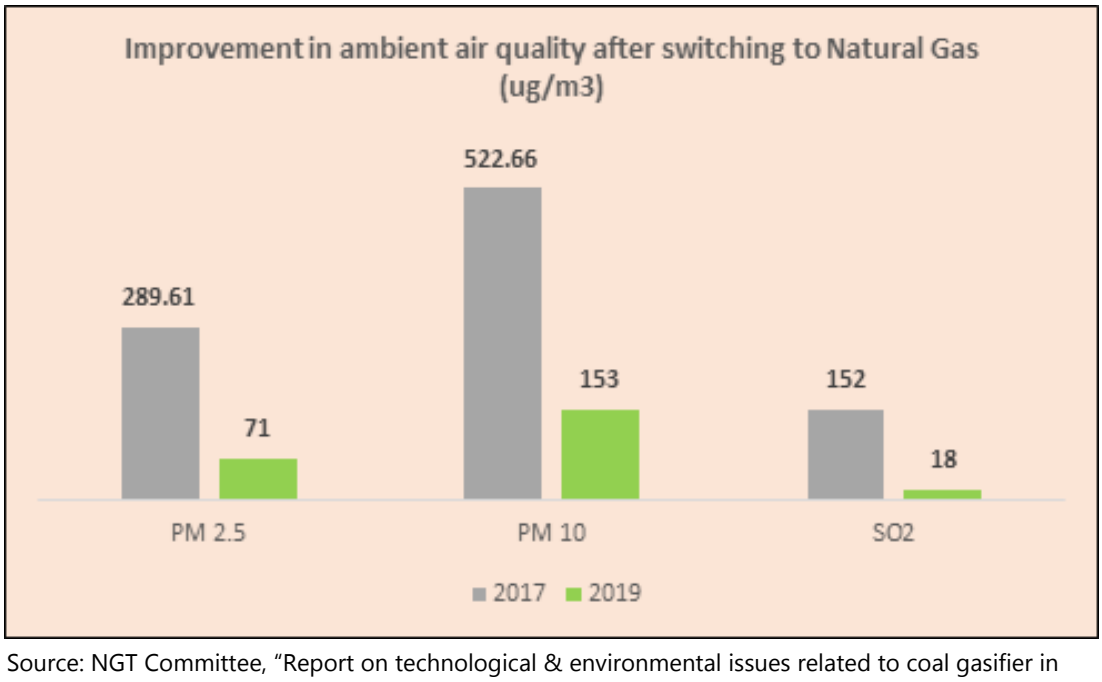
Complying with the NGT March' 2019 order, barring a few units, all the ceramic manufacturing units located in the Morbi Wankaner region have now shifted to natural gas. In accordance with the NGT order, GPCB has issued notices to some 640 out of the 900 odd ceramic units located in the region, seeking penalty at the rate of Rs 5000 per day as per the 'Polluter Pays' principle. The penalty has been calculated from the day these units had applied for the coal based gasifiers. The cumulative penalty from these ceramic manufacturers adds to an astounding Rs 450 Crores.

'Polluter Pays' Principle

The polluter pays principle is a commonly accepted practice that those who cause the pollution should bear the costs of managing it to prevent any damage to human health or the environment. This principle underpins most of the regulation of pollution affecting land, water and air. The principle found its first mention in the recommendations of the OECD dated 26 May, 1972. In 1992, the UN Declaration on UN Environment and Development 1992 laid down the Polluter Pays Principle as principle 16 of the declaration. The Principle 16 of UN Rio declaration clearly states *"National Authorities should endeavour to promote the internationalization of the environmental costs and the use of economic instruments, taking into account the approach that the polluter should, in principle, bear the cost of pollution, with due regard to public interest and without distorting international trade and investment".*

Impact on Environment

The impact of the NGT order on the local environment in the Morbi – Wankaner region has been palpable. Due to the availability of the natural gas pipeline infrastructure in the region, most of the ceramics manufacturing units in the region could switch to natural gas within a short time period.



Source: NGT Committee, "Report on technological & environmental issues related to coal gasifier in ceramic industries of Morbi-Wankaner area, Gujarat"

Since the NGT order came into effect, a significant improvement in the regional ambient air quality has been noted. The PM 2.5 levels plummeted from 289.61 ug/m3 in 2017 to 71 ug/m3. The PM 10 levels in the region fall from 522.66 ug/m3 to 153 ug/m3 during this period. The sulphur dioxide levels in the air came down to 18 ug/m3 in 2019 from over 152 ug/m3 in 2017.

Some of the other benefits of switching to natural gas have been listed below:

S No.	Parameter	Total Consumption in the area	Impact of using natural gas as fuel
1	Reduction in coal consumption	900 MT/Day	Reduced truck movements lead to lower vehicular emissions; prevention of fugitive emission due to storage and handling of the coal
2	Tarry waste	900 MT/Day	Use of natural gas does not produce any tarry waste and hence transportation and disposal not required
3	Wastewater management	3150 KL/Day	No water generation due to use of Natural Gas as fuel
4	Water Consumption	2250 KL/Day	Reduced Consumption of fresh water which can cater to the town of @16,000 Population
5	Improved public perception	Low smog conditions, improved water sources, etc	Image of the industry in the public has improved due to improved ambient air quality and cleanliness in the area.

Source: IGU; GPCB, Case Summary, 2019

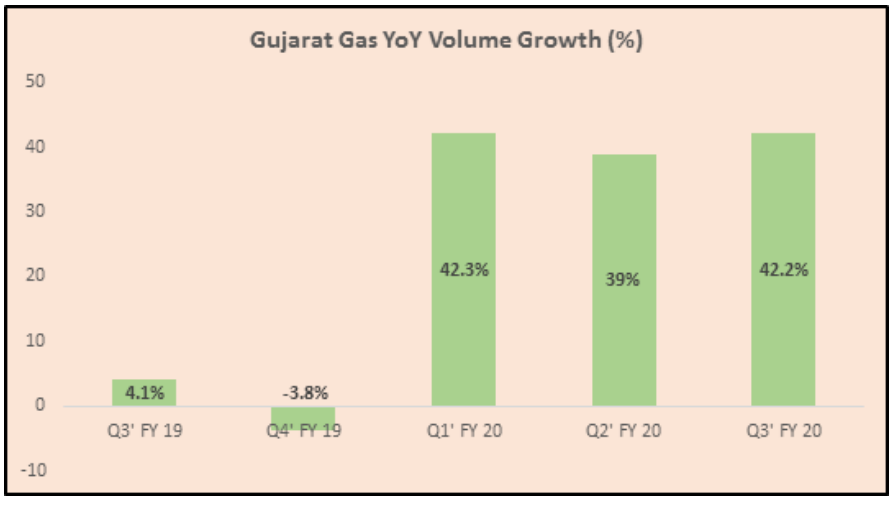
Impact on gas sales

The NGT order clearly directs for use of piped natural gas until a cleaner technology for synthetic gas generation is demonstrated. Within a week of the tribunal's order, gas consumption in the Morbi – Wankaner region almost doubled from 2 MMSCMD to 4 MMSCMD. In the foreseeable future, the demand from the industrial cluster is expected to increase to 8 MMSCMD.

Natural gas demand in Morbi (MMSCMD)

Source: IGU and GPCB

The sudden spurt in natural gas demand due to hundreds of ceramics plants switching over to gas from coal-gasifiers following the NGT order, led to an initial demand supply gap. The sudden rise in demand created problems of low pressure at several manufacturing units. As a result, for the initial few months, the regional gas supplier Gujarat Gas Ltd rationed the gas supply to tile manufacturing units to ensure equitable supply to all units. Taking account of the rising demand from the region, Gujarat Gas Ltd commissioned and laid a 4.5 Kms pipeline from Gala to Shapar in Morbi within a record period of 18 days. The gas pressure and flow is reported to have improved significantly due to the additional pipeline. Since the NGT order, gas sales for Gujarat Gas Ltd jumped by 39 per cent on YoY basis.



Source: Bloomberg

It was also noted that the ceramic manufacturing units were reluctant to switch to natural gas since cheaper coal was readily available in the local black markets. Use of coal also helped the units in evading taxes and lowering production figures. The NGT mandate to switch to natural gas, has now removed all such mal-practices through use of proper gas metering systems.

Conclusion

In a world with growing awareness about global warming and impacts of health and water pollution, all major economies are forced to introspect their choice of fuels. At CoP-21, Paris, 195 countries committed to follow Intended Nationally Determined Contributions (INDCs) to significantly reduce the emission intensity of their economies. India's INDC targets include setting up 175 GWs of renewable power generation capacity by 2022 and reducing the emissions intensity by 33-35 per cent from 2005 levels by 2030. While the country is well on track to achieve its renewable capacity commitment, it needs to take urgent measures to curb emission intensity of its economy. To reduce emissions, the Government of India has set a vision for increasing usage of cleaner natural gas. However, the power generation and the industrial sector in India still remain heavily dependent on the use of coal and oil. As a result, the smog that envelops the Delhi-NCR region every winter continues to capture global headlines and all major Indian cities hold prominent positions in the list of most polluted cities.

Switching from polluting but cheaper fuels to natural gas in power generation and the industrial segment in the country will require an ecosystem comprising of Government policies, effective regulations and technology. In this direction, India could draw from the successful experience of the European Union, where as a result of targeted policies and stringent regulations introduced by individual countries, use of coal in the energy generation mix has come down drastically by 30 per cent between 2012 and 2018. In India, the National Green Tribunal's order in March, 2019 to ban coal gasifiers and directing the local ceramic industry to switch to piped natural gas has proved a landmark judgement to prohibit use of polluting fuels and facilitate switch to cleaner natural gas. In this regard, another forward looking initiative worth mentioning here is the launch of world's first trading programme for particulate air pollution in Surat, Gujarat. Under this programme, the Government sets a cap on emissions and allows industries to buy and sell permits in order to stay below the cap.

Under the National Clean Air Programme (NCAP), the Government of India has identified 122 cities and has set a target of 20%–30% reduction of PM2.5 and PM10 concentration by 2024, taking 2017 as the base year for the comparison. Allocation of Rs 4,400 Crores for clean air initiatives at the union Budget 2020-21 only further emphasises Government's commitment against air pollution. For any Government initiative to result significant improvement in ambient air quality, natural gas will have to play a crucial role in India's primary energy mix. The NGT order in Morbi stands testimony to the impact effective legislation and the resulting regulation could make to facilitate fuel switching. The order will go a long way in setting an example on how switching to natural gas can bring immediate relief from air pollution while maintaining fast paced economic growth.

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OPERATION

An Insight into Analysis of Scale Deposits in Sour Water Stripping Unit Using Advanced Characterization Techniques: A Case Study

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Abstract:

Sour water stripping units (SWSU) are commonly used in gas processing facilities, sulfur recovery units, wellhead facilities, and refinery applications. Over a period of time, these units face operational difficulties because of deposition of scales. This can severely compromise operational reliability, performance and safety of these units. It is therefore imperative to closely analyze the deposits to determine underlying causes and possible preventive measures that can be taken. In this context, we, in this paper describe a detailed analysis of scale deposits from sour water striping unit in one of HPCL's refineries through a combination of advanced surface and elemental characterization techniques. Extensive studies were carried out using elemental techniques such as Inductively Coupled Plasma-Mass Spectrometry (ICP-MS), CHNSO elemental analysis, thermal techniques like thermogravimetric analysis (TGA), separation techniques such as Ion Chromatography (IC) and surface characterization techniques such as Field Emission Scanning Electron Microscope (FESEM) and X-ray Photoelectron Spectroscopy (XPS). All the microscopic and spectroscopic techniques complemented each other and helped to build a comprehensive composition profile for the scale deposits as well as provided valuable insight into the mechanism of formation. Combination of these advanced techniques will provide valuable inputs to the refiner to optimize the conditions for maintaining better throughput and better reliability.

Introduction:

Scale deposits are frequent issues in the pipelines during many processes. Often these create plugging, flow hindrance, surge in friction and subsequently affect the performance. The hardness of water, flow rate, non-ionic constituents in water, electromagnetic forces between water and pipeline play a critical role in the formation of scales. It is often observed that general scaling can be attributed to quality of water in terms of pH, hardness, salt content, dissolved gases like CO2, O2, or any other gases etc.

In a more complex scenario, a sour water stripper unit scaling is more prone to happen due to the quality of process water. Sour water stripping is a process in an oil and gas refinery where waste water consists of hydrogen sulfide (H2S). H2S is both corrosive as well as toxic which needs to be stripped of the process water to recycle the stripped water. The objective of this work is to analyze elemental composition and morphological distribution of the deposits in the sour water stripping unit by various analytical techniques. The effect of H2S and hardness of water is demonstrated by evaluating the deposits formed during the stripping process.

Materials and Methods:

ICP-MS: ICP-MS analysis was carried out in a Perkin Elmer NexIon 350x instrument at 1600 W, with a Nebuliser Gas Flow of 0.82 L/min with auxiliary Gas Flow of 1.2 L/min.

XPS: X- Ray photoelectron spectra of deposits were recorded on a Scienta Omicron X— instrument operating at a base pressure of less than 1 X 10-9 Torr. High resolution XPS were recorded at an analyser pass energy of 20eV using Al- Kα X rays (1486. eV) as the exciting radiation.

FE-SEM (Field Emission Scanning Electron Microscope): FESEM images of scale samples were obtained on JSM-7610F from JEOL, Japan.

Powder-X-Ray Diffraction: Scale samples were also characterized by P-XRD measurements on a X'pert3 X-ray diffractometer from Panalytical, Netherlands. Source being Cu K-alpha, 0.15418 nm (Bragg-Brentano geometry).

Fourier Transform InfraRed (FTIR): FTIR of deposits was performed on Frontier FT-IR spectrometer from Perkin Elmer (USA) in ATR (Attenuated Total internal Reflection) mode having MCT detector.

Ion-Chromatography: Ionic speciation and quantification was carried out on Thermo Fisher Ion Chromatograph equipment with: Column - AS-11; Flow Rate: 1.0 ml/min; Eluent- NaOH 25 mm. Thermogravimetric Analysis (TGA): Thermal Analysis of scale samples were carried out on SDT750 model from TA instruments, USA. Analysis was carried under N2 atmosphere with a flow rate of 100 mL per min.

Results and Discussions:

ICP-MS: Elemental analysis was carried out by ICP-MS .0.2 g of sample is mixed with 9 mL Conc. HNO3 and 1 mL HF and digested in Milestone microwave digestion system. The analysis provided quantitative elemental composition of the scales formed. The detailed studies clearly showed Iron and Magnesium as the dominant species in the scales with copper, nickel and manganese as the other minor components (Table 1).

Table 1: ICP-MS results

Elements	Abundance (in ppm)
Iron	95000
Silicon	49000
Magnesium	15700
Copper	4200
Nickel	2550
Aluminum	740
Manganese	530
Boron	410

X-ray Photoelectron Spectroscopy: The detailed surface analysis was done using XPS studies. X- Ray photoelectron spectra were recorded on a Scienta Omicron X— instrument operating at a base pressure of less than 1 X 10-9 Torr. High resolution XPS were recorded at an analyser pass energy of 20eV using Al- Kα X rays (1486. eV) as the exciting radiation. The static charge effect was corrected using adventitious C 1s electron binding energy at 284.6 eV. The anode was operated at 10 kV and 20 mA and the pass energy of the analyzer was fixed at 20 eV. The samples were analyzed with a spot size of 250 X 1000 mm located approximately in the center of the sample.

XPS technique was employed to examine the scale surface more closely to find out the elemental distribution and the constituent phases and to obtain further information on the mechanism of scale

formation. The XPS survey scan showed intense peaks for C, O, Ca, Fe, S and Mg with a surface composition of 12, 21, 11, 1.5, 6 and 4%, respectively. High resolution XPS was recorded for all the major elements.

A well resolved doublet was observed for Ca, with Ca 2p3/2 and Ca 2p1/2 peaks appearing at 347 eV and 350.5 eV respectively, indicating the presence of Ca 2+ species. The specimen only showed a single O1s peak at 531.0 eV. Whereas, a strong C1s peak at 289 eV was observed (alongside the C1s from environmental carbon at 284.6 eV) which is indicative of CO3 species. The Fe 2p3/2 and Fe 2p1/2 peaks were observed at 710.82 eV and 724.19 eV respectively, suggesting Fe is present predominantly in +2 oxidation state.

The Fe 2p3/2 also showed considerable asymmetric broadening at the higher energy side of the peak which could be attributed to presence of multiple Fe (II) salts. The deconvoluted peak positions were found to be consistent with typical FeS and FeSO4 spectra. This observation was further supported by S2p spectra which were observed as two distinct sets. The higher energy S2p3/2 and S2p1/2 peaks were observed at 167.8 eV and 169.1 eV respectively which is indicative of SO42- species. Whereas, S2p3/2 and S2p1/2 peaks corresponding to the sulfide species were observed at 162.5 eV and 163.9 eV respectively. Characteristic Mg peaks were observed at 50 eV, suggesting Mg2+ to be the predominant oxidation state of Mg, on the scale surface.

These results conformed well to EDS analysis and composition of the scales can broadly be assigned to CaCO3, FeS, FeSO4 as major components.

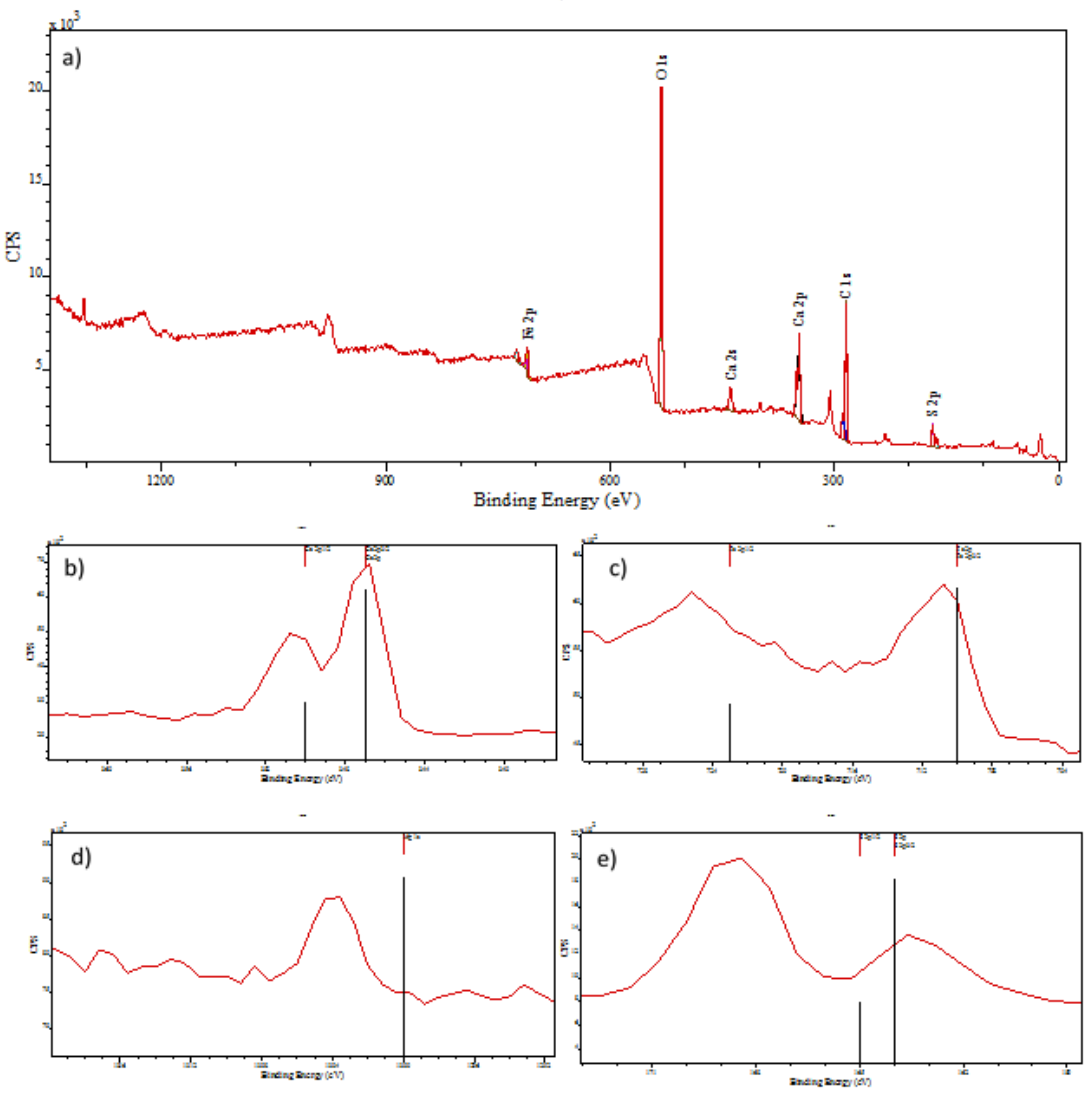

Fig. 1. a) Charge –neutralized XPS survey scan recorded at an analyser pass energy of 20eV using Al- Kα X rays (1486. eV) as the exciting radiation ; High resolution XPS spectra of b) Ca2p; c) Fe2p; d) Mg1s and e) S2p

FESEM-EDS analysis:

Extensive FESEM-EDS analysis of SWSU scales was carried out to explore the morphology and elemental distribution. A close analysis of the surface reveals it to be consisting of both crystalline rods and amorphous particles. The needle and rod shaped crystals were found to be of 3-6 μM diameter and a relatively high aspect ratio of about 30-50:1. Whereas the amorphous particles were found to be of 100-150 nm size. A qualitative elemental analysis of the scales was obtained by recording the EDS spectra. The sample was found to be mainly consisting of Ca (21%), Fe (9%), S (3%), O (41%) and C (23%) whereas Mg and W was found to be present in trace (>1%) quantities (Fig. X).

In view of these results, elemental mapping was done for different structural motifs. Interestingly, the amorphous particles were found to be almost exclusively consisting of Fe, S and O (Fig. X) which can be interpreted as either sulfides or sulphate salts of iron such as FeS or FeSO4 to be present. Whereas, the crystalline motifs were shown to be predominantly consisting of Ca, C and O (page 4) which probably hints at CaCO3 crystals to be present. Accordingly, Ca/C rich areas were found to be exclusive of Fe/S and vice versa which was also been confirmed by line scan technique (see SI).

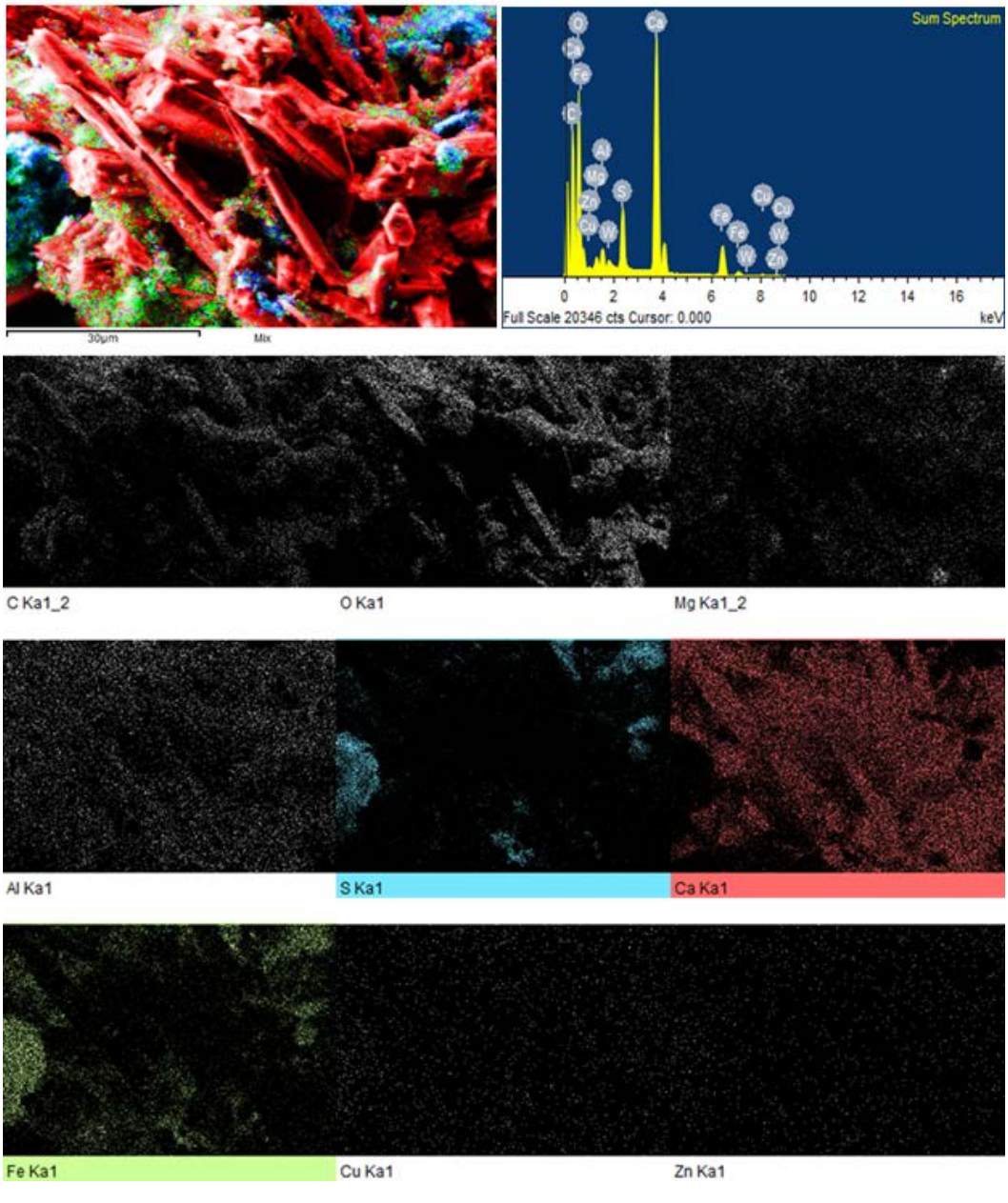

Fig. 2. a) FESEM image of SWSU scales with elemental mapping; b) EDS spectra of SWSU-1 (below) c)

Powder X-Ray Diffraction measurements: To further confirm the postulated chemical composition that can be arrived intuitively through surface analysis, bulk solid characterization techniques such as PXRD and FTIR was employed. PXRD also provided critical information on the crystallinity of the scales that is beneficial for elucidating deposition mechanism and possible remediation method. As expected, lattice diffractions of scale sample confirmed the presence phases from calcium carbonate. It was interesting to find out the phase contribution of two polymorphs of CaCO3 (aragonite and calcite). Aragonite is the stable polymorph of CaCO3 but calcite is thermodynamically more stable. In case of calcite (104) at 2θ 29.8 was observed but was weak. Strong peaks of aragonite phases of (111) and (021) at two 2θ 22 and 24 were also seen in the diffractogram of the scale sample. Phases of aragonite (in red) and calcite (in green) were identified in the xrd pattern (Fig. Y).

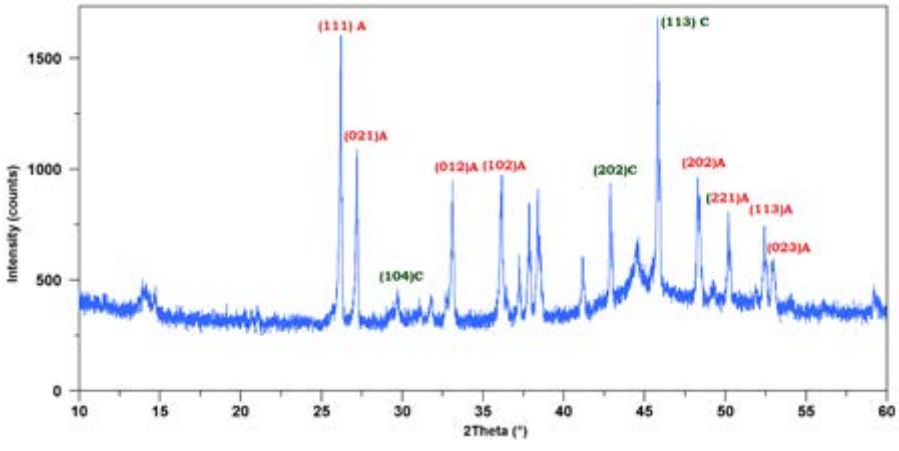

Fig 3: P-XRD of Scale Samples

Other peaks of both aragonite and calcite were also evident. The comparison of intensities suggested the high percentage of aragonite polymorph. This was expected as theses scale are formed much below phase change temperature of aragonite to calcite. However diffraction from phases of third polymorph of CaCO3 vaterite were weak, likely because of its less stability.

FTIR Measurements:

The FTIR spectrum was obtained by scanning the scale sample from 450 to 4000 cm-1 (Fig. Z). It also confirmed the presence of aragonite polymorph of CaCO3 by revealing stretching frequencies at 1455, 1124, 853. The vibrational mode of metal sulphide at 1082.3, 712 were also observed.

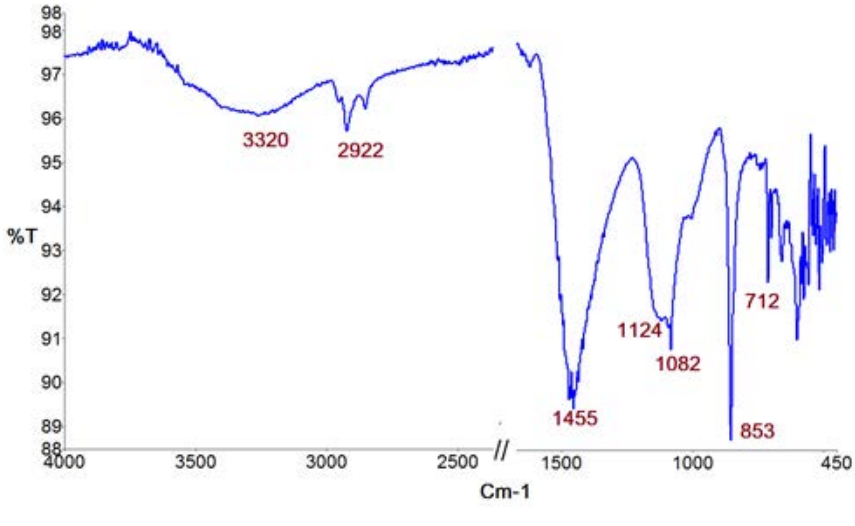

Fig 4: FTIR spectrum of scale sample

At 2922 cm-1 stretching of sp3 C-H was noticed from residual hydrocarbons and present in the sample suggesting the conditions in which scales are formed. Even O-H stretching at 3320 confirmed the presence of moisture in the sample.

Ion Chromatography:

The scale samples were analyzed by ion chromatography for the identification and quantification of water dissolved cations and anions. The soluble ions were extracted from the scales by employing the sonication with the DI water. The chromatograph for the cations and anions were shown in the Figures 1 and 2, respectively. From the analysis, the most predominate anion was found to Sulphate with the 3.85 %, whereas the chloride and nitrate were also identified in low concentration. By combining the imaging (SEM) and XPS analysis, the data indicating the presence of Iron sulphate (II or III, verify with XPS). In the cation analysis, as expected, the calcium and magnesium ions were found be predominant with the 1.25 and 0.29 %, respectively. By comparison with total calcium (43 % by XRF), only a fraction of calcium (3 %) has been extracted into the water layer, whereas the in the case of Mg 13 % (2.1 % of total Mg) has been extracted into the DI water. The hard cations from the sour water typically exist as a carbonate salts (as evident from SEM analysis) suggesting the presence of $CaCO_3$ and $MgCO_3$

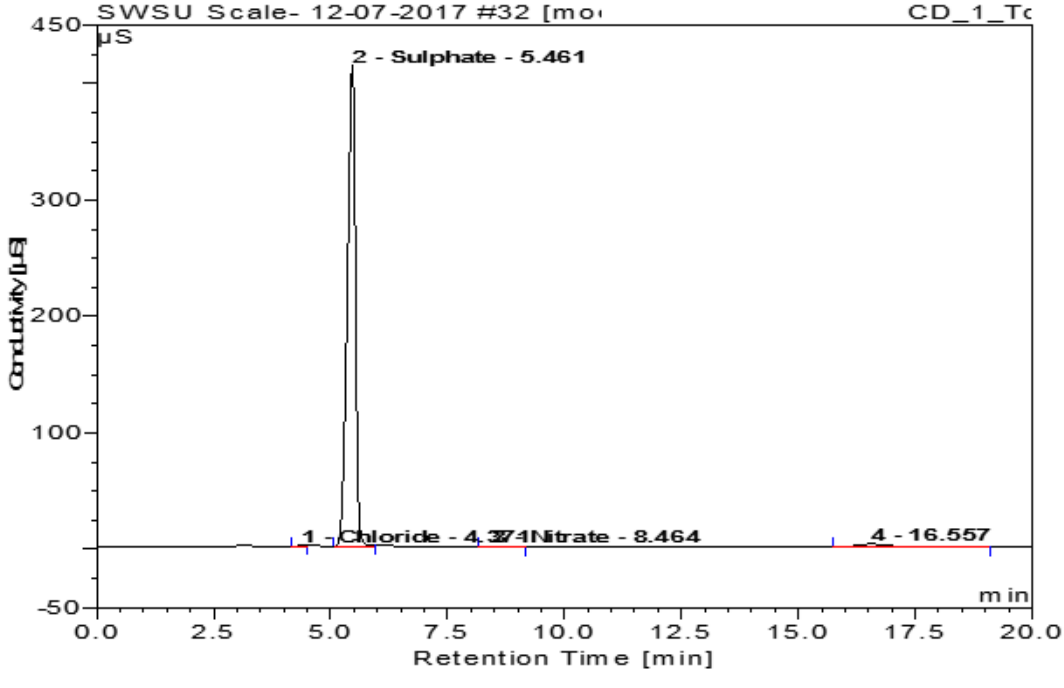

Figure 5: IC trace of dissolved anions of refinery SWSU scales

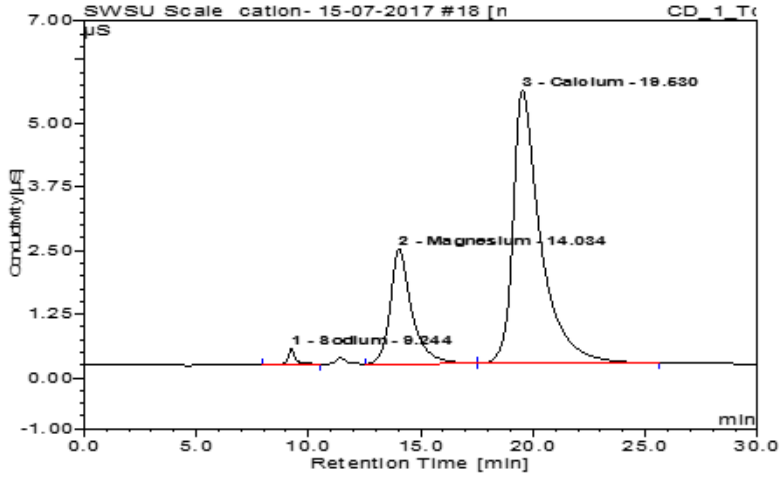

Figure 6: IC trace of dissolved cations of refinery SWSU scales

Subsequently to identify the remediation conditions of the scale samples, acid treatment for the scales was performed with an aim to dissolve them in water. Two different types of acids, namely, AcOH (50 %, 100 %) and HCl (1N and 10 N) were used for the study. Table 2 summarizes the water dissolved cations that obtained from pure scale sample as well as their post acid treatment. As we can see the Table 1, the 1N HCL solution is able to dissolve the 27.9 % of Ca, (65 % total calcium of scale sample). The higher concentration of HCL (10N) solution also exhibited similar calcium ion dissolving efficacy. On the other hand, 50 % AcOH exhibited the maximum calcium uptake among the series (34.5% Calcium, 80 % in terms of calcium uptake efficacy). Interestingly 100 % acetic acid exhibited the least calcium uptake 3.1 % to the water layer, which might be due to poor dissociation of 100 % AcOH and poor dissolving ability of calcium acetate in acetic acid. By comparing the corrosion by the different acid solutions and cation dissolving efficacy, 50 % acetic acid would be good remediation strategy to dissolve the scale samples in water.

Table 2: water soluble Cations extracted from pure scale samples and their post acid treatment

Sample group	Na	Mg	Ca
SWSU Scale+ DI water	0.02 %	0.29 %	1.25%
SWSU Scale +10 N HCl	0.05 %	0.62%	29.2%
SWSU Scale +1N HCl	0.17%	1.1%	27.9%
SWSU Scale +100% AcOH	643 ppm	0.42 %	3.1%
SWSU Scale +50% AcOH	0.19 %	0.48 %	34.58%

Thermogravimetric analysis: To study the thermal and chemical stability of the scales and explore possible remediation routes the scales were further characterized by TGA.

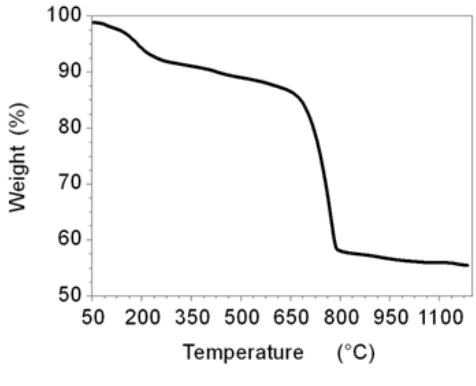

Figure 7: TG of Scales

TGA analysis of scale samples were performed under inert conditions (N_2 atmosphere). The decomposition took place in two stages as observed in Fig. X. The initial 8-9% weight loss was observed from 100-200 °C which can be attributed to mainly moisture and residual hydrocarbons. The weight loss was insignificant (< 2%) from 200 to 750 °C. Then second stage volatilization of about 30% was noticed from 750-780 °C. This was probably due to CO2 loss from CaCO3 to form CaO. Further no change in the weight was observed till 1200 °C.

Conclusions: Detailed studies of SWSU scales were done using analytical characterization techniques. The surface morphology of the scales, probed by FESEM, was found to be inherently inhomogeneous and consisting of rod shaped crystals and amorphous solids. The surface was mainly composed of Ca, Fe, S, O and C whereas Mg, Cu, Zn and W was found to be present in trace quantities. Interestingly, elemental distribution was found to be non-uniform and distinctly concentrated on certain morphologies which further aided in determining the composition. The findings were further supported by chromatographic and spectroscopic analysis. Simultaneously powder X-ray diffraction patterns elucidated possible compositions through crystal structure analysis. The thermal analysis of the scales showed the scales being sable upto about 700 C. The studies in combination, elucidate the composition of the scale in and shed light on the possible scale formation mechanism. Considering the high abundance of H2S in the sour water, the formation of insoluble iron sulphides were along expected lines. However, surface analysis of the scales showed most of the these sulphides have been oxidized to corresponding sulphates which are thermodynamically more stable and enjoys better chemical inertness. This complicates the remediation process further as conventional dilute acid treatment might be ineffective in removal of the scales. Deposition of CaCO3 and other minor sulphates and carbonate salts are also observed. These poses significantly less operational difficulties as they can be cleaned via conventional techniques. Further studies in remediation techniques are necessary to establish better cleaning practices which would yield better operational benefits for refineries.

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2. McNeill, L. S., & Edwards, M. Review of iron pipe corrosion in drinking water distribution systems. Journal of AWWA, 2001, 93(7), 88-100.
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DIGITALISATION

Internet of Things (IoT): Science Fiction or New Megatrend?

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Smart homes, smart cars, smart cities, smart locks, smart oil terminals — you've probably heard some of these terms, and you're going to hear them even more as the year goes on. But what are these things exactly — and what makes them so smart? The questions that come into mind "what do we mean by 'smart' things and how are they 'smart'?".

Simply put, when the information of the internet is added to previously dumb objects, stuff gets useful and become 'smart'. For example, the wearable activity tracker, Fitbit. These devices track the physical activities of the wearer, including steps taken, stairs climbed, sleep hours and quality logged, and distance travelled. Some can also detect and monitor pulse, blood glucose level, and other basic physiological parameters. They promise to accurately monitor and analyse health and fitness activity on a continuous, real-time basis.

Similarly, Nest has connected smoke and CO_2 alarms, security cams and, most famously a smart thermostat that can learn your routines and adjust your house to match. Philips Hue, is all about taking control of the lighting in your home.

You can see the difference when you're sitting in your lounge and the light gradually ramps up to full brightness as the sun sets. There are locks from August that can allow us to give our friends and families guest passes to our home, so they can automatically enter.

These devices are all part of an emerging category called the Internet of Things (IoT). At its very basic level, IoT refers to the connection of everyday objects to the Internet and to one another, with the goal being to provide users with smarter, more efficient experiences.

In what's called the Internet of Things, sensors and actuators embedded in physical objects are linked through wired and wireless networks, that connects to the Internet. These networks churn out huge volumes of data and provide Predictive and Prescriptive analysis. When objects can sense the environment and communicate, they become tools for understanding complexity and responding to it swiftly.

The new information networks complemented with analytics, promise to create value through better decisions, new business models, improved business processes, and reduced risks.

IoT in Oil and Gas Sector:

Oil and Gas is a capital & asset intensive and high scale operations sector. There are opportunities in the Industrial Internet of Things throughout the oil and gas value chain for optimization of operations, better asset management and supply chain logistics. The future will see deployment of emerging technologies, such as Digital convergence of data from various sources; Big data analytics to identify otherwise unrecognizable trends and conditions, enabling safety, risk, operational and commercial optimization; Wearable safety devices to monitor the hazardous atmosphere; Innovative leak detection tools that use robotics, fibre optics, acoustic sensors and satellite monitoring to increase the chance of preventing an incident, perimeter surveillance and right-of-way monitoring; Lightweight unmanned aerial vehicles (UAVs) that can monitor remote areas for leaks and encroachments; Portable devices that enable safer and more efficient operations by providing immediate access in the field to process data and safety procedures etc.

Upstream exploration and production segment will be able to make operations safer and more productive and to extract resources from more challenging environments. Midstream segment involved in transportation, pipelines and storage will be able to create a safer, more robust network with fewer leaks by creating more data-rich infrastructure. Downstream segment will benefit from having greater visibility over their supply chain and being better able to target consumers.

Shell having around 25,000 wells worldwide, many of those are in challenging areas, is efficiently producing oil by adopting Smart Field technology. It installed thousands of sensors on its equipment. The sensors capture data on temperature, pressure, and other measurements, and sends it out to control centres back on land. Here, engineers read the measurements and monitor production in real time so they can optimize each individual process.

Rockwell is using a combination of cloud-based solutions, software, sensors and devices to predict equipment failures, track performance in real time, and help refine designs and processes to prevent future failures. Preventing those failures means savings millions of dollars.

IoT at HPCL:

HPCL has been implementing a number of solutions which can be classified as "IoT". These are Tank Farm Management Systems (TFMS), Terminal Automation system (TAS), Retail Outlet Automation Systems, pressure and flow subsystems (venturi/ PCV) in Aviation refuelling equipment and Supervisory Control & Data Acquisition Systems (SCADA) in operating locations at cross country pipelines and Refineries.

……. The challenges

As with any major technological shift, realizing IoT's potential will require significant management attention not just to new technical imperatives but also to organizational issues.

Aligning the organization- IoT will challenge traditional organizational roles as information technology becomes widely embedded across assets, inventories, and operations. Organizations need to hire/ train employees in new skills and vendor development strategies to become analytically rigorous and data driven.

Overcoming interoperability and analytics hurdles- IoT ecosystems require interoperability to create seamless programmability of devices or sensors in enabling a world of connected devices. Also, data should be brought together from different IoT systems and the algorithms will have to analyse data streams in real time.

Security Concerns- Security threat in the form of Botnet, a group of internet enabled devices that have been remotely accessed without permission with intent to be used illicitly. The same interoperability that creates operational efficiency and effectiveness also exposes more of organization's units to cyber risks, hence requires the strategic approach of "Digital Resilience".

Way ahead…….

IoT, the next Mega trend, has great promise. Yet, new sensor driven business models must create superior value by tackling business, policy, legal and technical challenges. IoT and Deep learning are two game-changing technologies that have the potential to revolutionize the stakes for oil and gas companies and differentiate the winners from the laggards in the competitive energy market space.

As in the words of Brendan O'Brien, Chief Architect & Co-Founder, Aria Systems- "If you think that the internet has changed your life, think again. The IoT is about to change it all over again!"

TECHNOLOGY

Looking to the future

Eric Benazzi
Vice President Marketing & External Communication

Axens

By embracing new technologies and focusing on energy efficiency improvements, Axens is contributing to reduce industry's environmental footprint.

Stimulated by the growing middle-class in high-growth countries, demand for cleaner transportation fuels and petrochemicals remains strong. Global demand for crude oil is expected continue to grow at around 1.0% per year to reach about 106 Mbpd in 2024 according to the International Energy Agency (IEA).

If the current trend in oil demand remains strong, it continues to shift from transportation fuels to petrochemicals. By 2030, petrochemicals should account for one third of the growth in oil demand and 50% by 2050.

To meet this demand, Axens is continuously developing innovative schemes to convert an increasing share of crude into olefins and aromatics. An outstanding example of this trend is the implementation of Axens technologies in the Hengli complex.

With growing consumer awareness and legislative control, plastics recycling is developing and will have an influence on demand for virgin plastics over the coming years. Also, to address the impact of plastic waste on the environment, Axens is involved in recycling processes for plastics such as Polyethylene terephthalate (PET).

Looking at the longer-term, the global demand for refined products should peak in the twenty-thirties, driven by passenger vehicles mandated engine efficiency gains, rising electric vehicles penetration and fossil fuel substitution by biofuels or LNG that will offset the increase in travel demand.

This would be an important step meeting Paris Agreement objectives but it will not be enough! That is why, to minimize our industry's environmental footprint, we are focusing our efforts on three main areas:

- First, is the energy efficiency improvement of existing or grassroots plants through audits and an especially developed custom early efficient design offer including the implementation of high Energy Efficiency equipment and digitalization,

- Second, is the deployment of technologies for low-carbon fuel production from non-food crops therefore not affecting food security such as:
  - Futurol process for cellulosic ethanol enabling to reduce 90% of greenhouse gas emissions compared to fossil gasoline, which is crucial to curb greenhouse gas emissions from transport,
  - BioTfueL project for advanced biodiesel and bio-jet fuel for which no medium term alternate exist.
- And, finally, CO2 capture. Axens is involved in the "3D" project in Dunkirk, an innovative process reducing by nearly 35% energy consumption of the capture process.

In a fast-changing world shaped by increasing environmental awareness, low-carbon economy transition and connectivity (figure 1), the energy and chemical industries must invent and deliver ever more advanced and efficient solutions to contribute.

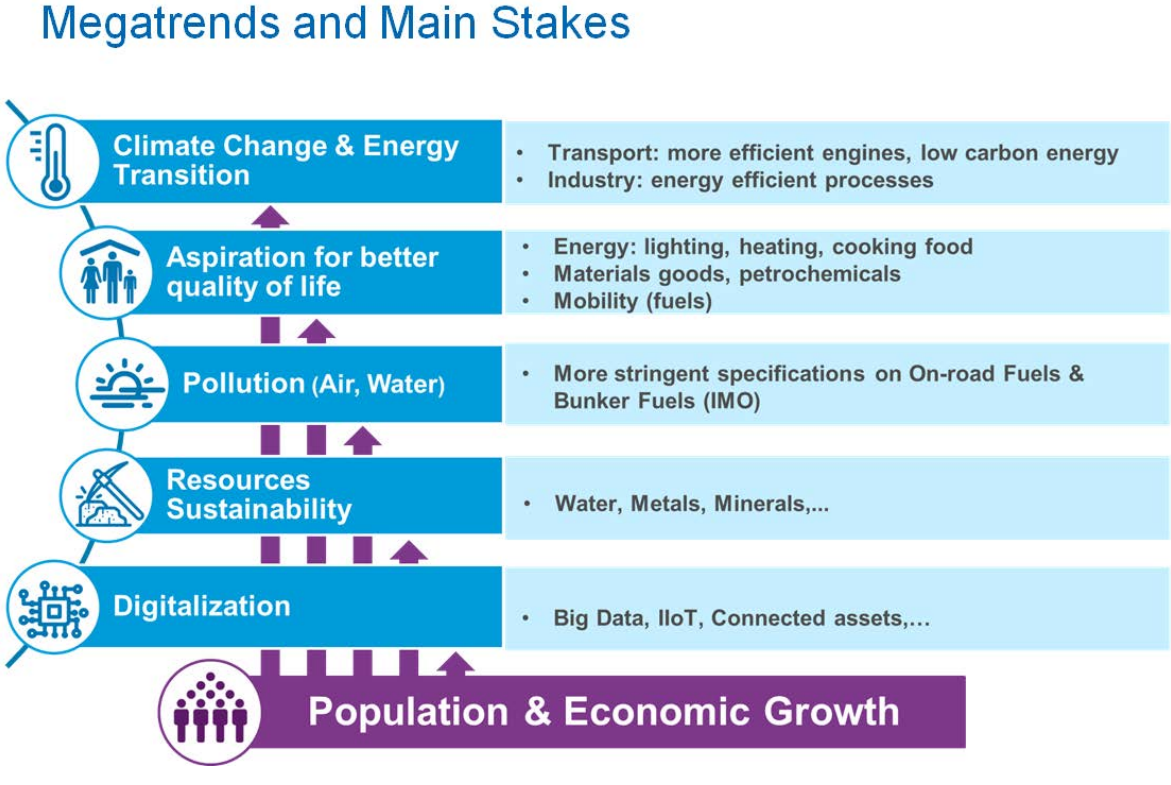


Figure 1

OIL & GAS IN MEDIA

Ministry of Petroleum and Natural Gas signs Contracts for 7 Blocks Awarded under Open Acreage Licensing Programme (OALP) Bid Round – IV

Ministry of Petroleum and Natural Gas signed contracts for 7 blocks, awarded under Open Acreage Licensing Programme (OALP) Bid Round – IV on 2nd January 2020. The Government had launched OALP Bid Round – IV on 27th August 2019. The Bid Round-IV offered 7 blocks under International Competitive Bidding (ICB) process. The bidding round closed on 31st October, 2019.

Subsequent to evaluation, all 7 blocks were approved for award to ONGC, for which the Revenue Sharing Contracts have been signed, in the presence of the Minister of Petroleum and Natural Gas & Steel, Shri Dharmendra Pradhan. The total area awarded in the 7 Onland blocks is 18,510 sq.km. The blocks are spread across 3 sedimentary basins.

Speaking on the occasion, Shri Pradhan highlighted the success of OALP Bid Rounds under the ambit of Hydrocarbon Exploration and Licensing Policy (HELP) introduced in the year 2016, primarily characterized by Revenue Sharing Mechanism replacing the earlier New Exploration and Licensing Policy (NELP) which had Production Sharing Mechanism. He said, "In the last two and a half years, Government has successfully bid out nearly 1.4 lakh sq. km for exploration and production. Seven blocks awarded under OALP IV to ONGC have resource potential of approx. 33 billion bbls of oil and oil equivalent gas."

Speaking about reforms in the hydrocarbon sector, Shri Pradhan said, "We have shifted our focus from revenue to production maximisation and have adopted the path of continuous reform." He said, "Technology infusion in E&P activities has seen tremendous progress in recent times. Our oil and gas companies are adopting digitisation, new technologies for augmenting production and growth." Speaking about investments in energy sector, he added, "Energy sector will witness huge investments in coming years. Government has recently released the report of the task force on National Infrastructure Pipeline for 2019-25 which lays down a roadmap for 102 lakh crore rupees worth of investments. Energy sector will comprise about 24% of the projected capital expenditure in infrastructure".

The four OALP Bid Rounds, conducted till date have been a success, with total of 94 blocks awarded covering an area of 1,36,790 Sq. Km to leading E&P companies. The operators of these blocks have since then initiated petroleum exploration activities or are in final stages of obtaining Petroleum Exploration Licenses (PELs).

The Hydrocarbon Exploration & Licensing Policy (HELP), which has adopted the Revenue Sharing contract model, is a giant step towards improving the 'Ease of Doing Business' in the Indian Exploration and Production (E&P) sector. It comes with attractive and liberal terms like reduced royalty rates, no oil cess, marketing and pricing freedom, round the year bidding, freedom to investors for carving out blocks of their interest, a single license to cover both conventional and unconventional hydrocarbon resources, exploration permission during the entire contract period, and an easy, transparent and swift bidding and awarding process. This was the maiden bidding round under the further liberalized policy terms, which focused on production maximization with higher weightage to work programme as part of evaluation criteria in Category I basin and no revenue share commitment as part of bidding parameters for category II and III basins.

With the successful roll out of the HELP/OALP regime, based on the world-class National Data Repository (NDR), the Government has achieved massive enhancement of exploration acreage in India. The exploration acreage which stood at approximately 80,000 sq. km. in 2019 from earlier regimes has now been enhanced to approx. 2,15,000 sq. km. after 4 rounds of OALP. The cumulative exploratory work commitment after the 4 rounds of OALP comprise 29,270 LKM of 2D Seismic Survey, 43,272 sq. km of 3D Seismic Survey, 369 Exploratory Wells and 290 Core Analysis to establish Shale Resources. This will generate an investment of approx. US$ 2.35 billion over next 3 to 4 years in exploratory work alone.

Source: PIB

Promoting Ease of Doing Business and Boosting Private Players to invest in Retail Sector Petrol Pump Business

Ministry of Petroleum and Natural Gas (MoPNG) vide Resolution dated 08.11.19 revised the guidelines for authorization to market transportation fuels which have been published in the Gazette of India. The revised guidelines would promote ease of doing business and boost private players to invest in retail sector. The said Resolution is available on the website of MoPNG. The main features of the said guidelines are as below:-

i. The resolution applies for marketing of only Motor Spirit and High Speed Diesel for "Bulk" and "Retail" business.

ii. An entity desirous of seeking authorisation for either retail or bulk must have a minimum net worth of Rs. 250 crore at the time of making application. In case authorization is required for both retail and bulk, minimum net worth will be Rs.500 crore.

ii. An entity desirous of seeking authorisation for either retail or bulk must have a minimum net worth of Rs. 250 crore at the time of making application. In case authorization is required for both retail and bulk, minimum net worth will be Rs.500 crore.

iii. Separate applications to be made for retail and Bulk business.

iv. For retail authorisation, an entity has to set up at least 100 retail outlets, out of which 5% should be in the notified remote areas within 5 years of the grant of authorization. An effective mechanism has been prescribed to ensure that the entity deliver on its commitment to set up the ROs in remote areas.

v. An entity is required to deposit prescribed Bank Guarantee amount as a security at the time of grant of authorization in addition to application fee.

Oil Price War may Leave Petro-economies Gasping for Air

On 6 March 2020, the dramatic collapse of an alliance between the OPEC oil cartel and Russia resulted in a plunge in oil price to a 18 years low and sent shockwaves through the financial markets already suffering due to the spread of COVID-19 pandemic. The fall out of Russia's deal with the 13 Member OPEC oil cartel marks the end of an alliance that underpinned the world oil prices for the last three years. This has triggered a sudden price war in the international oil market.

It was though the joint efforts of Russia and Saudi Arabia that OPEC and 11 non-OPEC countries signed the Vienna Agreement in December, 2016 with an objective of cutting oil production to prevent the free fall of oil prices and ensuring stability in the market. The deal, initially for a period of six months, was extended several times. It also led to the formation of a permanent forum-like structure 'OPEC+' with its own charter signed in July 2019, which allowed participants to coordinate and adjust their production policies.

The alliance proved effective in temporarily achieving relatively high and stable oil prices. In December 2019, the deal was extended until April 2020 and it was taken for granted that OPEC+ would continue leveraging the market with production cuts beyond 2020. However, the turn of events on 6 March 2020 took the global oil markets by surprise. While Saudi Arabia tried to push for additional oil production cuts to compensate for the slump in demand for oil due to the coronavirus, Russia not only rejected the move but also announced it will no longer abide by the previous cuts. Diplomatic efforts at the top levels also could not achieve any result. This brought an end to the OPEC + approach of production cuts. Some analysts are also of the opinion that the parting of ways aimed at causing a drop in oil prices in order to hit US shale producers, who have continued to benefit from OPEC production cuts (thereby price stability above 60 $ per barrel) by expanding their market share. This helped US joining the league of major oil & gas exporter with no commensurate commercial benefits to the other economies (rather trade restrictions). A price collapse could put some of these producers out of business as fracking has a high production cost.

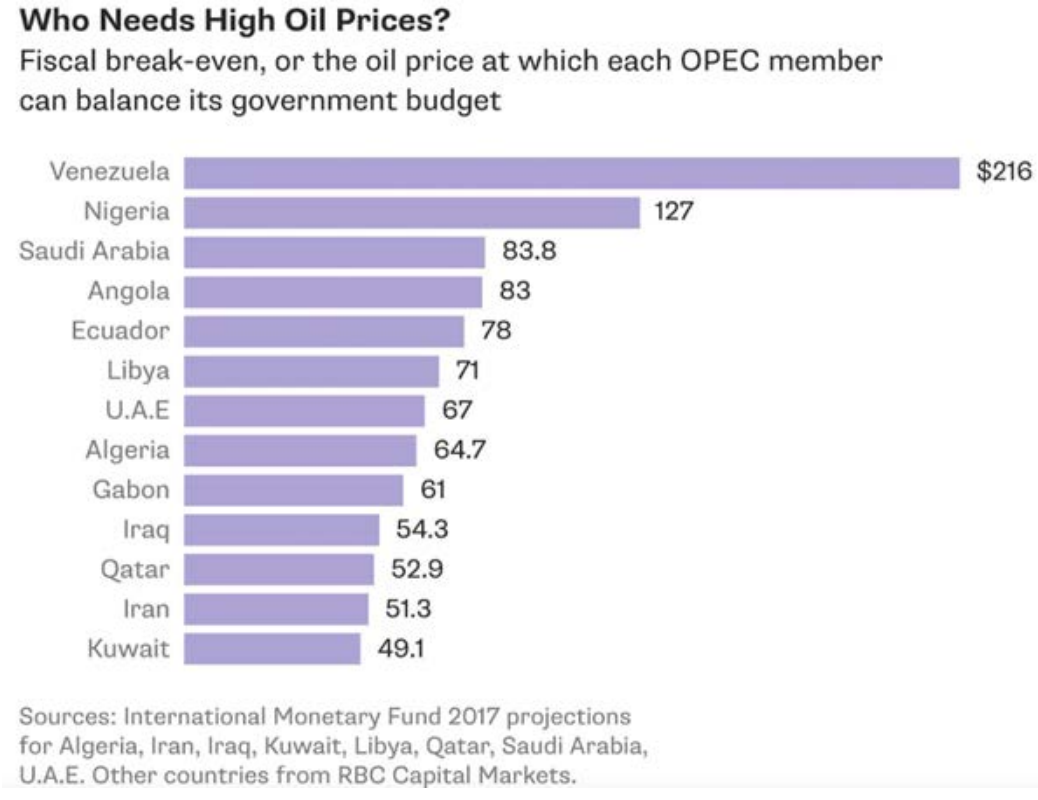
Impact on the US

Many drillers in shale producing regions look vulnerable, as they're overly indebted and already battered by rock-bottom natural gas prices. The price of oil tumbled more than 50 per cent to less than USD 25 a barrel in the days following the OPEC + fallout, and began to swing violently as investors tried to assess the increases in oil output and the collapse in demand due to travel bans and other pandemic containment measures. The peculiar coincidence of the developments is that international demand of energy is steeply down due to adverse impact of global coronavirus spread. That prompted the main oil regulator in Texas to consider whether the state should curb crude production for the first time in nearly half a century in a coordinated effort with Saudi Arabia and Russia to calm the market and stave off a total industry meltdown.

Impact of low oil prices on Russia and Saudi Arabia

In the short run, Russia is in a good position to withstand a price slump. It's Government budget breaks even at a price of USD 42 a barrel and has saved billions of dollars in a rainy-day fund. Saudi Arabia, which is almost entirely dependent on oil to fund lavish government spending, holds about USD 500 billion in foreign currency reserves to cushion the blow. However, one source of potential stress for the country is its currency, the Riyal, has been pegged to the U.S. dollar for more than three decades, providing economic and financial stability. OPEC will also benefit from the fact that its Members will have a clear competitive advantage as most of them can produce crude at about a third of the cost of US shale.

Impact on other countries



The sudden fall in oil prices, if sustained, will have a detrimental impact on the national budgets of Petro-States such as Venezuela, Iran and Nigeria. This will only further heat up the global geopolitical climate. To policy makers, volatile oil prices are an added complication as they try to shield economies from the impact of the coronavirus epidemic.

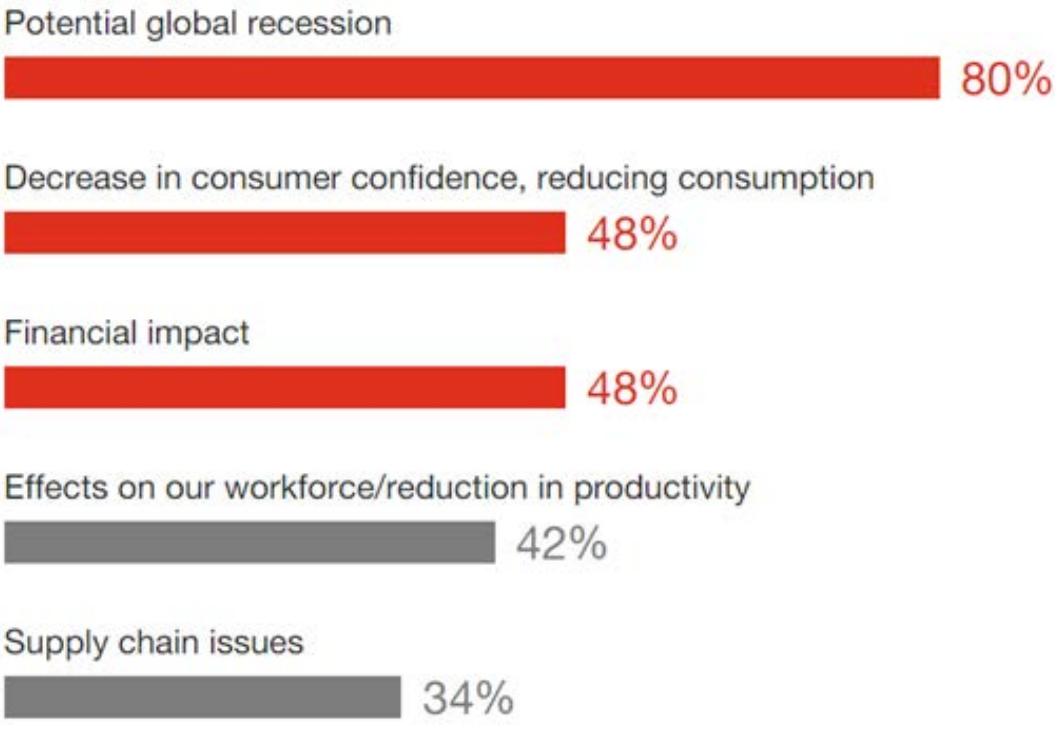
COVID 19: An Unfamiliar Risk for Global Oil and Gas Industry

The International oil and gas industry has been hit by a double whammy of falling oil and gas prices and shrinking demand. Under normal circumstances, a drop in retail fuel prices would not witness a matching fall in consumption as it used to encourage higher consumption and equilibrium used to return soon. March 2020 is different from this. Oil marketing companies across the world are also witnessing a drop of over 10 per cent in fuel consumption in the first half of March 2020. With the impact of coronavirus further intensifying, the industry experts are of the view that the next quarter will be even worse for the sector.

In the foreseeable future, the oil and gas companies are facing two major headwinds: managing the issues of the health emergency that all sectors face; and coping with a low oil-price scenario, lower demand and the need to shore up revenue and manage debt obligations.

A typical contingency plans enable operational effectiveness following events like natural disasters, cyber incidents and power outages, among others. These are generally confined to a limited space or region. However, they don't generally take into account the widespread global quarantines and travel restrictions of extreme order resulting from COVID-19. Faced with such difficult times, a recent survey explores the major challenges the energy industry will have to withstand due to the COVID-19 outbreak.

Top Energy industry CFO concerns about Covid-19



Source: PWC

In light of the COVID-19 pandemic and the ongoing price war between Russia and OPEC, depressed oil prices and revenue, and production declines will likely continue to present major challenges for oil and gas companies, especially for those at risk of being unable to refinance debt or meet existing debt covenants. As a result, the industry could well face potential bankruptcies.

Even in the scenario in which the market rebalances from Saudi Arabia's decision to add production, and demand bounces back following a COVID-19 containment, the industry may still be looking at a prolonged recovery period lasting as long as two years. Some analyst expect that with containment of pandemic, re-bouncing will be with more steep in the initial stage till it achieve balance. However, the counter view is that current situation may change the society differently and changes may impact economy and its pace. If, however, OPEC and Russia come together on joint energy policies, the recovery could likely be shorter.

To tackle the ongoing crisis, the Global oil and gas companies may consider one of the below mentioned steps:

a. Assess how profitability and cash flow generation can support ongoing operations in a low oil-price climate — including current (and forecasted) cash operating expenses, taxes and other cash expense items. Analyse at the field or well level as cash forecasts will be dependent on this "cash margin" against the decline curve.

b. Review of capital and corporate cost budgets to identify not only marginal investments, but also discretionary items that can be culled.

c. In case the company is faced with debt risk, it may consider diversifying or divesting non-core or underperforming assets.

d. Stay open for M&A opportunities, as distressed assets or non-core assets may be a potential source of cash for embattled companies.

FIPI EVENTS

Budget Analysis – Union Budget 2020-21

The Federation of Indian Petroleum Industry (FIPI) organized its flagship Budget Analysis Session, in association with Deloitte as the knowledge partner, on Monday, 3rd February, 2020 at Hotel Hyatt Regency, New Delhi. The objective of the session was to analyse the recently presented Union Budget 2020-21 and weigh the impact of the Budget with respect to Indian oil and gas industry. The session was attended by senior dignitaries from oil and gas companies and key government representatives namely Mr. Yogendra Garg, GST Commissioner, Mr. Y.G. Parande, Former member, CBIC.

Welcoming the audience Mr. Rajiv Bahl Director (Finance), FIPI gave an insight into the GST study recently concluded and submitted to Govt.

Welcoming the dignitaries, Mr. Rajiv Bahl, Director (Finance, Taxation and Legal), FIPI, gave an insight into the GST study recently concluded and submitted by FIPI to the government. He stated that we have come a long way in taking up this issue with the Government and will now take the advocacy further with Minister of Finance and GST council.

Dr R K Malhotra, Director General, FIPI, in his opening remarks, spoke about some of the key positives in terms of infrastructure developments plans for expansion of gas pipeline up to 27,000 kms from the present 16,200 kms and pricing reforms for natural gas with improved transparency. Dr. Malhotra said that, the budget has been prepared to strike a balance between the government expenditure and fiscal deficit. He said FIPI is still pursuing the government on issues such as OID cess and inclusion of five petroleum products under the ambit of GST and thanked the industry members for their continued support.

"The government plans to undertake further reforms to make natural gas pricing more transparent which would incentivize domestic production"- Dr. R. K. Malhotra, DG, FIPI

Setting the context for the session, Mr. Rakesh Alshi, Tax Partner, Deloitte made presentation on the key takeaways of the budget 2020-21 and Oil & Gas Outlook prepared by Deloitte. Mr. Alshi, in his opening remark said that, through this budget, fundamental changes have been attempted to encourage spending over saving. When speaking about the direct taxes, Mr. Alshi pointed out that removal of Dividend Distribution Tax is a welcome step and this could push up foreign investments.

Mr. Rakesh Alshi, Partner Deloitte highlighted the key takeaways from the Union Budget 2020-21

All foreign companies would be able to save 20% of their cash flow and it is a big move in ease of doing business. Speaking on Oil & Gas outlook, he further added that rise in crude oil supply from US, Brazil and Canada is likely to increase the supply despite the decrease in demand. With oil market facing uncertainties, rise in renewables, carbon consciousness, emission reduction are seen as disruptive trends. Ms. Bela Sheth Mao, Tax Partner, Deloitte highlighted the provisions made under the indirect tax.

The main highlight of the session was the 'Panel Discussion on Hits & Misses of Union Budget 2020-21, focusing on the outcome for oil and gas companies on the new budget. The panel comprised of Mr. Yogendra Garg, GST Commissioner, Mr. Subhash Kumar, Director (Finance) ONGC, Mr. Sandeep Kumar Gupta, Director (Finance), IOCL, Mr. A K Tiwari, Director (Finance), GAIL, Mr. Kartikeya Dubey, Director (Finance) & Vice President (Tax), BP India, and Mr. Vivek Rathi, Deputy Chief Financial Officer, Cairn Oil & Gas, Vedanta Ltd. The panel discussion was moderated by Ms. Bela Sheth Mao, Tax Partner, Deloitte

Responding to the industry concerns on GST Mr. Yogendra Garg, Principal Commissioner stated, "GST Council is working on updates and amendments to the law to make it simpler and will suitably address the concerns of the oil industry at an appropriate time"

During the course of the discussions, it was highlighted that the few budget announcements can increase the demand for oil & gas. The panel felt that, while the budget has less relevance to the oil & gas industry, they found some key positive outcomes like infrastructure development, funding for pipeline projects, transparent mechanism for gas and phasing out of older power plants. This could increase the demand for cleaner fuel. The panel had a common consensus for inclusion of all petroleum products under GST. Replying to the request made by the other panel members, Mr. Yogendra Gar, GST commissioner told that GST council is working on making changes and amendments to the GST system to make it simpler.

When asked about inclusion of Natural Gas & ATF under the ambit of GST, Mr. Garg told that the call has to be made by GST council and it needs more stability in terms of revenue and this will happen with the development of City Gas Distribution networks as gas demand will spread evenly across the country. Panelists also sought the removal of OID cess, as it is affecting their profit before tax. Acknowledging the issue, Mr. Garg said that the GST council is working on the issue and would suitably address the concerns of the oil industry at an appropriate time.

"To bring tax reform, we need to Shift the focus from revenue target to tax gap analysis" - Mr. Y. G. Parande Former Member, CBIC

Delivering the closing remarks at the session, Mr. Parande mentioned that government must shift the focus from target revenue to tax gap analysis. He further said that, it is important to make realistic and reliable estimates for revenue generation, since making unrealistic revenue forecast could further impact the budget deficit. In his final comments, he said there must be a balance for the domestic industry against unfair competition, with stability and clear path for the future.

The Budget Analysis was attended by senior executives from the oil and gas industry and as in the past, was a highly successful event.

FIPI - SIAM Interaction on Rollout of BS VI Fuels

FIPI in association with the Society of Indian Automobile Manufacturers (SIAM) organised an Interactive session on BS-VI Rollout on February 19, 2020 at New Delhi with the objective to share the latest status and resolve any last-minute issue to ensure seamless rollout of BS-VI fuels on April 1, 2020 on pan India basis. The session was attended by dignitaries like Mr Sanjiv Singh, Chairman, FIPI and Chairman, IndianOil, Mr Rajan Wadhera, President, SIAM and President (Automotive), Mahindra & Mahindra, Director General, FIPI and Director General, SIAM along with 60 participants from both automobile as well as oil industry.

"Seamless transition to BS VI fuels, leap frogging for BS IV, will mark paradigm shift in fuel standards and prove a boon for the environment." - Dr R K Malhotra, DG,

The meeting started with Dr R K Malhotra, Director General, FIPI extending a warm welcome to all participants from the automobile and the Oil industry. He apprised the participants that the historic meeting has been called to discuss the preparedness for BS VI rollout to reach end consumer before 1 April, 2020 on pan India basis and to jointly resolve any concern or apprehension in achieving the same. He pointed out that the transition to BS VI fuels, leapfrogging from BS IV, will mark a paradigm shift for fuel standards in the country. He further stated that substantial reduction in emissions from BS VI fuels driven vehicles will be beneficial for the environment in general and the ambient air quality in particular.

Mr Sanjiv Singh, Chairman, IndianOil and FIPI, during his opening address, informed the participants that all Indian refiners have now completed the technology up-gradation and started rolling out BS VI fuels. Wash out of supply chain components like depots , terminals , transport facilities, retail outlets etc. spread across the country is in fast progress and are all set to supply BS VI compliant fuels from 1 April, 2020.

"All Indian refineries are now well equipped for the BSVI roll out aand are well placed to guarantee the highest quality fuel at the nozzle tip" - Mr Sanjiv Singh, Chairman, IndianOil and FIPI

He underlined that the shift from BS IV to BS VI standards required installation of new units in the refineries with a cumulative investment in the upwards of Rs 35,000 crore in PSU refineries. Such large-scale investment by Indian refiners stands a testimony to India's commitment for a cleaner environment. He further mentioned that the biggest challenge that India faces today is to maintain a high growth while maintaining a cleaner environment. Indian refiners have accomplished a commendable task to ensure a seamless transition within a very short period. The hard work and efforts, of both automobile and oil sector to ensure this successful transition will be recognised not just by India but the entire global community. Mr Singh highlighted the need for mutual cooperation and understanding between the two sectors.

"The automotive manufacturers have invested about Rs 70,000 Crores for developing BSVI product portfolios: Mr Rajan Wadhera, President, SIAM "

Mr Rajan Wadhera, President, SIAM mentioned that the transition to the new fuel standards was a huge challenge for the Indian automobile industry. The industry had to incorporate two major technologies and adapt to Indian conditions with an investment of several thousand crores. He mentioned that the

out-break of Coronavirus in China has created logistics constraints for international auto part suppliers which may possibly impact the availability of BS VI compliant diesel vehicles. The representatives of automobile industry have apprised the Hon'ble Finance Minister with the issue and sought procedural support at the initial phase.

Participants from automobile industry emphasised that with a number of alternate fuels / traction systems for automobiles being pursued by various governmental agencies, a detailed roadmap for new fuel standards and their introduction should be prepared. Such roadmap will help both the sectors to plan and prepare better for the transition.

"IndianOil Research proves that use of BSVI quality fuels will only further improve performance for BS IV compliant vehicles" - Dr. S S V Ramakumar, Director R&D, IndianOil

Dr S. S. V. Ramakumar, Director – R&D, IndianOil informed that the in-house research by IndianOil indicates that use of BS VI fuels in BS IV vehicles improves the emissions to some extent. He highlighted that the benefits of BS VI compliant cleaner fuel will be more evident only after the older vehicles are scrapped.

Answering to a query from the automakers about the availability of BS VI quality winter grade diesel in cold regions, Mr Sanjiv Singh informed that this year onwards there will be regular and adequate availability of winter grade diesel in the region throughout the year.

The historic meeting between the members of the two industries proved immensely successful in assessing the preparations for BS VI rollout. It was agreed that both the industry associations – FIPI and SIAM need to interact more frequently and draw out a common action plan that will benefit both the industries.

3rd Summit on Realizing Hydrocarbon Vision 2030 for North East India – Way Forward

Lighting of lamp by Dignitaries

The 3rd one and half day summit on "Realizing Hydrocarbon Vision 2030 for North East India-Way Forward" was held at the Hotel Lemon Tree, Gangtok on March 6-7, 2020. The summit was participated by Oil & Gas Companies like ONGC, IOCL, OIL, Cairn-Vedanta, IGGL, TNGCL, HOEC, Schlumberger etc. operating in North East States.

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

In his Opening Address, Dr. R.K. Malhotra, Director General, FIPI reiterated the key objectives of North East Vision document i.e. leveraging hydrocarbon sector for the development of the Region. He also mentioned that two such programs (in 2017 at Kaziranga and 2018 at Shillong) were organized by FIPI to review the progress and capture the challenges and constrains in the Region. He stated that the region has witnessed various development in hydrocarbon exploration & production activities in recent years and under HELP policy new contracts were signed for 20 blocks under OALP-1, five blocks under OALP III and 9 small field contracts were signed under DSF round I & II. Apart from that Oil & Gas companies are investing more than Rs. 10,000 Crore in next five years for exploration & production activities in the region.

There were three more eminent speakers in the Opening Session representing the major oil & gas companies operating in the North East Region.

1. **Dr. P. Chandrasekaran, Director (Exploration & Development), Oil India Limited (OIL)**
2. **Dr. Deben Buragohain, CEO, Indradhanush Gas Grid Limited (IGGL)**
3. **Shri Manoj Sharma, Executive Director (Operations), Indian Oil Corporation Ltd (IOCL)**

Dr. P. Chandrasekaran, Director (E&D), OIL addressing the participants

Dr. Deben Buragohain, CEO, IGGL addressing the gathering

Shri Manoj Sharma, ED (Ops.) IOCL addressing the participants

Some of the key points of the session are:

- Intent of the vision document which is to develop common and shared structure for benefiting people of the North East region. Lot of collaboration and partnership required amongst the E&P companies to understand the challenges in the region and provide solutions to each other.
- It was mentioned that the Assam and Assam Arakan basins are the two super basins of India producing for a long time. It is still having enough potential to contribute to the production of Oil & Gas in the country. It was also mentioned that 45% of Natural Gas production from Onshore are being produced by NE region states.
- Lot of new reforms have been introduced by GoI in last few Years and aggressive exploration including survey, exploratory drilling, testing etc. have already been started by ONGC, OIL, Cairn etc.
- The requirement of Gas in North East is around 23 MMSCMD and the current supply is around 11 MMSSCMD. It was mentioned that all out efforts are being done to enhance the gas production.

Members requested FIPI to facilitate these wish-lists for an effective implementation of government aspiration for enhancing oil & gas production in NE Region.

At the end of Inaugural Session, Shri T.K. Sengupta, Director (Exploration & Production), FIPI proposed a vote of thanks to the eminent speakers for presenting good progress in North East region. He mentioned that after policy reform in upstream sector huge work has been initiated in NE region both in Award of blocks to Surveys and drilling exploratory well.

Vote of Thanks by Shri T.K. Sengupta, Director (E&P), FIPI

The summit was split into three Technical Sessions covering Exploration, Development & Production; Midstream, Natural Gas & Marketing and Technology & Downstream, Operations & Pipelines. The session were chaired by eminent experts namely Dr. P. Chandrasekaran, Director (E&D), OIL; Shri T.K. Sengupta, Director (E&P), FIPI & Shri N.K. Bansal, Director (Oil Refining & Marketing), FIPI.

1. Session on Exploration, Development & Production

From left - Hemasundara Rao Kambala, Manager, ONGC; Indrajit Barua, CGM Basin Manager (Frontier), OIL; Dr. P. Chandrasekaran, Director (E&D), OIL; Puneet Suri, ED (BM, AAAK Basin), ONGC; Sudhir Mathur, Cain Oil & Gas, Vedanta; Anish Borkakoty, Suptdg. (Eastern Asset), OIL; Joseph Zacharia, Domain Champion (Petrophysics), Schlumberger

Some of the key takeaways from the session are

- Nagaland could be the potential new frontier for exploration activities. Discovered resources in the region is 2046 MMTOE while the undiscovered potential is 5588 MMTOE. Despite the presence of huge potential, the region faces geological complication impacting the field development activity. Major hindrance in acquiring reasonably good quality seismic data in these areas are the presence of high dipping beds (max. up to 60-70 degree) and surface and sub-surface thick boulder beds which affects energy penetration resulting in poor signal to noise ratio.

- The region has multiple hydrocarbon bearing pays with good to moderate permeability. The current recovery is 15% of In-place reserves and there is a scope for improving water injection for improved recovery rate. The technology improvement like radial drilling, produced water re-injection, ESP/SRP, Gravel pack completion, extended reach drilling, Acidisation, chemical water shut off and carbon dioxide flooding are implemented to improve the recovery.

- Using state of Art technology, companies can look to maximize potential of exploration blocks, reduce time to production and optimize the source and maximize value of information.

2. Session on Midstream, Natural Gas & Marketing and Technology

from Left - Anand Vaidyanathan, FIPI; Joyjeet Chaudhuri, Sr. Manager (Marketing & CC) TNGCL; T.K. Sengupta, Director (E&P), FIPI; Dr. Deben Buragohain, CEO, IGGL

Some of the key takeaways from the session are

- The share of natural gas in India (6.2%) is significantly lower than that of the global average (23.9%). With a population of 1.3 billion people would require energy solutions that are - Reliable, Convenient, Low Carbon intensive, sustainable and affordable.

- Natural gas has 4 key value propositions i.e. Abundance, Availability, Affordability and Acceptability as it has a cleaner footprint makes it an ideal fuel to propel India's sustainable economic development. Indradhanush Gas Grid will connect the NE region with Barauni - Guwahati pipeline, which is a part of Jagdishpur – Haldia & Bokaro – Dhamra Natural Gas Pipeline Project, popularly known as 'Pradhan Mantri Urja Ganga'.

- This will boost the consumption of Natural Gas in the region. Considering the long term environmental and societal benefits of switching to a cleaner fuel, transforming India to a gas-based economy can become the backbone of India's sustainable economic development.

- CGD companies called for faster gas allocation process and the need for single window clearance to obtain the required clearances and approval from governments and other bodies.

- North East region must be given participation in the policy making considering the role on the region in the India Oil & Gas industry.

3. Session on 'Downstream' segment witnessed four presentations on various actions in NE for:

From Left - Deva Kumar R, Chief Project Manager, IOCL; Nirmal.C. Borah, DGM (Ops.), IOCL, N.K. Bansal, Director (Oil Refining & Marketing), FIPI; S. Bhar, DGM (TS), IOCL; Pranta Pratim Singha, Sr. Manager (C.P.), NRL

Following are points of focus and fast track actions to achieve the timeline targets:

1. Current refining capacity of four NE refineries is about 7.0 million MT per annum (MMTPA) whereas crude supply from indigenous sources is around 4.2 MMTPA. With current expansion projects, the combined refining capacity of these refineries will be about 16 MMTPA by 2024-25.

2. POL demand - supply outlook up to 2030 indicate surplus position. As such backward evacuation of POL outside NE is expected to continue Economic viability through State Governments incentive may have to continue till regional demand pick-up in the long run.

3. Export of POL (HSD) to Bangladesh and Myanmar has to be tied up with infrastructure projects completion in time to ensure product supplies in line with Govt. policies. This will also help in product evacuation from NE.

4. LPG demand - supply outlook indicate continuation of deficit status with wider gap by 2030. LPG pipelines projects; one from Numaligarh to Imphal and other from Chittagong (Bangladesh) to Agartala with extension up to Silchar and Aizwal need to be firmed up fast.

5. PESO approval to receive bulk LPG through road carriers of Bangladesh to be followed up.
6. Environmental clearance on proposal of Guwahati Refinery to use low pet coke as fuel for boiler from State Pollution Control to be expedited.
7. Pipelines for pumping multiple products pose special technical and operational challenges due to undulation in the geography and steep slopes. Shutdown of pipelines due to low demand may cause larger interface mixing and product down gradation. This may pose extra challenge in the size of marketing tankages.
8. Implementation of Guwahati- Silchar-Imphal product pipeline project depends on Utility Corridor of NHAI which will come with 4 lane widening of highway NH 37. HHAI is yet to firm up plans. This project also seeks VGF up to 40 % of cost for which Govt. approval is awaited.

While NE companies in Downstream (refineries, Pipelines and Marketing) and Midstream have started actions and are progressing to upgrade technologies and infrastructure, a coordinated and integrated approach is essential to synchronised timings and matching capacities in all domains.

N.K. Bansal, Director (Oil Refining & Marketing) FIPI delivering the concluding remarks

The vote of thanks was given by Shri N.K. Bansal Director (Oil Refining & Marketing) FIPI.

The program was a grand success.

NEWS FROM MEMBERS

HPCL Launches HP Pay App

HP Pay is targeted to make fuel purchases Quick, Easy and Convenient for customers thru its two modes of payment viz., Paycode and QR code. HP Pay app can be used for fuel purchases in the Retail outlets, Book and make payment for cylinders, make payment for refills at the time of delivery, purchase APPU cylinders from select locations and can also purchase lubricants using this app.

This Integrated Payment Solution is first of its kind in the Oil Industry. This enables "What is filled is billed" concept an initiative for ensuring Quantity Assurance,wherein the automation is directly linked to payment device thus eliminating manual entry of amount in a payment device. Also the device has OCR capability which enables reading of number plate, a major technological initiative first time ever in a payment Industry. The IPS is rolled out at 2000 outlets and the entire network is expected to be covered in next three to four months

HP Pay, a Unified Customer facing Mobile app for HPCL Customers. HP Pay is a wallet based closed loop payment solution which can be used for purchase of Motors Fuels, Domestic LPG and Lubricating oils for Vehicles. It is first time in the industry that a mobile payment app has been launched for providing one stop solution for customers for all their fuel needs.

HPCL Launches HP Shine

HPCL has introduced for the first time ever, branded MTO in barrels "HP Shine", for catering to the demand of the unorganised paint and allied industry. 'HP Shine' was launched by our Chairman & Managing Director, Shri Mukesh Kumar Surana recently in the presence of Functional directors and other senior officials during the Regional Manager's Conference.

HPCL is one of the major players for supplies of Speciality Products segment which includes Mineral Turpentine Oil (MTO). Despite stiff competition from private players and imports, HPCL has not only been able to sustain its performance but also show major growth and profitability in this product segment.

In order to continue this growth trajectory, HPCL is looking for new opportunities in the unorganised sector which typically require smaller quantities and thus rely on small importers/traders and resellers in the market. Now with 210 lts 'HP Shine' MTO barrels, customers will be able to rely on trusted brand of HPCL for fulfilling their needs.

NEW APPOINTMENTS

Mr. Manoj Jain takes charge as Chairman & Managing Director of GAIL

Manoj Jain

Mr. Manoj Jain assumed charge as Chairman & Managing Director of GAIL (India) Limited on 14th February 2020.

A Mechanical Engineer with an MBA in Operations Management, Mr. Jain joined GAIL as a Graduate Engineer Trainee in 1985 and rose through the ranks to his current position. Before his appointment as CMD, Mr. Jain was Director (Business Development) of the company.

Mr. Jain possesses rich and diverse experience in the areas of Business Development, Projects, O&M, Petrochemicals, Pipeline Integrity Management and Gas Marketing which has allowed him to gain insight and knowledge across multiple business units and functional areas.
As Director (Business Development) he was responsible for building GAIL's business portfolio in India and abroad, Merger and Acquisition, Petrochemical O&M and Expansion, Exploration & Production, R&D, Start–Up, Health Safety & Environment management, Quality Management, Project Development including feasibility study and investment approval for new pipelines, process plants, renewables, etc.

Mr. Jain is also currently Chairman of GAIL Global (USA) Inc. (GGUI), GAIL Global (USA) LNG LLC (GGULL) and Konkan LNG Pvt. Ltd (KLPL).

Mr. Ashok Kumar Kalra assumes charge as Director (HR) of EIL

Mr. Ashok Kumar Kalra has assumed charge as Director (HR) of Engineers India Ltd. (EIL) w.e.f. March 1, 2020.

Mr. Kalra graduated in Civil Engineering from NIT Rourkela in 1985 and acquired an MBA (HRM) in 2011. He joined EIL in 1992, having worked for approx. six years in the Construction sector. He has more than 21 years of overall experience in Projects/ Construction spanning the areas of Refineries, Petrochemicals, Pipelines, Infrastructure, etc.

Mr. Kalra has also made extensive contribution in digitization of HR Processes & Policies, Corporate Planning, Corporate Branding and CSR. He is a certified Workplace Coach and a Mentor. Prior to this, he was holding the position of Executive Director (HR) in EIL.

Ashok Kumar Kalra

Mr. S. Krishnan takes over as Director (Operations) of CPCL

S. Krishnan

Mr. S. Krishnan taken over as Director (Operations) of Chennai Petroleum Corporation Ltd (CPCL) on 1st March 2020.

Mr. Krishnan holds a Bachelor's Degree in Electrical & Electronics from Alagappa Chettiar College of Engineering. He has more than three decades of experience in CPCL and has held various positions in the fields of Projects, Maintenance, Operations etc.

STATISTICS

INDIA: OIL & GAS

DOMESTIC OIL PRODUCTION (MILLION MT)

		2013-14	2014-15	2015-16	2016-17	2017-18 (P)	2018-19 (P)	April - Dec. 2019 (P)	
									% of Total
On Shore	ONGC	6.7	6.1	5.8	5.9	6.0	6.1	4.6	36.9
	OIL	3.5	3.4	3.2	3.3	3.4	3.3	2.4	19.1
	Pvt./ JV (PSC)	9.4	9.1	8.8	8.4	8.2	8.0	5.4	44.1
	Sub Total	**19.6**	**18.5**	**17.8**	**17.6**	**17.5**	**17.3**	**12.4**	100
Off Shore	ONGC	15.5	16.2	16.5	16.3	16.2	15.0	10.8	90.1
	OIL	0.0	0.0	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	1.9	1.2	9.9
	Sub Total	**18.2**	**18.9**	**19.1**	**18.4**	**18.1**	**16.9**	**12.0**	**100**
Total Domestic Production		37.8	37.5	36.9	36.0	35.7	34.2	24.4	100.0
	ONGC	22.3	22.3	22.4	22.2	22.2	21.0	15.4	63.1
	OIL	3.5	3.4	3.2	3.3	3.4	3.3	2.4	9.7
	Pvt./ JV (PSC)	12.1	11.8	11.3	10.5	10.1	9.9	6.6	27.2
Total Domestic Production		**37.8**	**37.5**	**36.9**	**36.0**	**35.7**	**34.2**	**24.4**	**100**

Source : PIB/PPAC

REFINING

Refining Capacity (Million MT on 1st January 2020

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 Refine ies	
DBPC, BORL-Bina	7.80
HMEL,GGSR	11.30
JV Total	**19.10**

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 Refine ies	
NRL, Numaligarh	**3.00**
MRPL	**15.00**
ONGC, Tatipaka	**0.10**
Total PSU Refine ies Capacity	**142.10**

Private Refine ies	
RIL, (DTA) Jamnagar	33.00
RIL , (SEZ), Jamnagar	35.20
Nayara Energy Ltd. , Jamnagar #	20.00
Pvt. Total	**88.20**

Total Refining Ca acity of India 249.4 (4 .99 million barrels per day)

Nayara Energy Limited (formerly Essar Oil Limited)

Source : PPAC

CRUDE PROCESSING (MILLION MT)

PSU Refine ies	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19 (P)	April-Dec. 2019 (P)
IOCL	53.13	53.59	58.01	65.19	69.00	71.81	52.32
HPCL	22.97	23.20	24.10	25.30	28.20	30.82	23.34
BPCL	15.51	16.20	17.20	17.80	18.20	18.44	12.64
CPCL	10.70	10.70	9.60	10.30	10.80	10.69	7.63
MRPL	14.60	14.60	15.53	15.97	16.13	16.23	10.15
ONGC (Tatipaka)	0.10	0.05	0.07	0.09	0.08	0.07	0.07
NRL	2.60	2.78	2.52	2.68	2.81	2.90	1.76
SUB TOTAL	**119.61**	**121.12**	**127.03**	**137.33**	**145.22**	**150.96**	**107.89**

JV Refine ies	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19 (P)	April-Dec. 2019 (P)
HMEL	9.27	7.34	10.71	10.52	8.83	12.47	9.15
BORL	5.40	6.21	6.40	6.36	6.71	5.71	5.82
SUB TOTAL	**14.67**	**13.55**	**17.11**	**16.88**	**15.54**	**18.18**	**14.97**

Pvt. Refine ies	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19 (P)	April-Dec. 2019 (P)
NEL	20.20	20.49	19.11	20.92	20.69	18.89	15.55
RIL	68.03	68.10	69.50	70.20	70.50	69.14	51.98
SUB TOTAL	**88.23**	**88.59**	**88.61**	**91.12**	**91.19**	**88.03**	**67.52**

	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19 (P)	April-Dec. 2019 (P)
All India Crude Processing	**222.40**	**223.26**	**232.90**	**245.40**	**251.90**	**257.17**	**190.38**

Source : PIB Release/PPAC

CRUDE CAPACITY VS. PROCESSING

	Capacity On 01/01/2020 Million MT	% Share	Crude Processing Million MT April-Dec. 19 (P)	% Share
PSU Ref	142.1	57.0	107.9	56.7
JV. Ref	19.1	7.7	15.0	7.9
Pvt. Ref	88.2	35.4	67.5	35.5
Total	**249.4**	**100**	**190.4**	**100**

Source: PIB/PPAC

POL PRODUCTION (Million MT)

	2013-14	2014-15	2015-16	2016-17	2017-18 (P)	2018-19 (P)	April-Dec. 2019 (P)
From Refineries	216.4	217.1	227.9	239.2	249.8	257.4	190.4
From Fractionators	3.9	3.7	3.4	3.5	4.6	4.9	3.6
Total	**220.3**	**220.7**	**231.2**	**242.7**	**254.4**	**262.4**	**194.0**

DISTILLATE PRODUCTION (Million MT)

	2013-14	2014-15	2015-16	2016-17	2017-18 (P)	2018-19 (P)	April-Dec.. 2019 (P)
Light Distillates, MMT	62.7	63.2	67.1	71.0	74.7	70.4	53.3
Middle Distillates , MMT	112.8	113.4	118.3	122.5	127.5	130.8	97.3
Total Distillates, MMT	175.5	176.6	185.4	193.5	202.2	201.2	150.7
% Distillates Production on Crude Processing	**78.9**	**79.1**	**79.6**	**78.9**	**80.3**	**78.2**	**79.1**

Source: PIB/PPAC

PETROLEUM PRICING

OIL IMPORT - VOLUME AND VALUE

	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19 (P)	April-Dec.. 2019 (P)
Quantity, Million Mt	189.2	189.4	202.9	213.9	220.4	226.6	168.5
Value, INR ₹000 cr.	864.9	687.4	416.6	470.6	566.0	783.4	550.1
Value, USD Billion	143.0	112.7	64.0	70.2	87.8	112.0	78.3
Average conversion Rate, INR per USD (Calculated)	60.5	61.0	65.1	67.0	64.5	70.0	70.3

OIL IMPORT - PRICE USD / BARREL

	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19 (P)	April-Dec.. 2019 (P)
Brent (Low Sulphur - LS-marker) (a)	107.5	85.4	47.5	48.7	57.5	70.0	64.6
Dubai (b)	104.6	83.8	45.6	47.0	55.8	69.3	63.5
Low sulphur-High sulphur differential (a-b)	2.9	1.7	1.8	1.7	1.6	0.7	1.1
Indian Crude Basket (ICB)	105.52	84.16	46.17	47.56	56.43	69.88	63.99
ICB High Sulphur share %	69.90	72.04	72.28	71.03	72.38	74.77	74.77
ICB Low Sulphur share %	30.10	27.96	27.72	28.97	27.62	25.23	25.23

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

	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19 (P)	April-Dec. 2019 (P)
Gasoline	114.3	95.5	61.7	58.1	67.8	75.3	70.8
Naphtha	100.2	82.2	48.5	47.1	56.3	65.4	57.4
Kero / Jet	121.2	66.6	58.2	58.4	69.2	83.9	74.2
Gas Oil (0.05% S)	122.0	99.4	57.6	58.9	69.8	84.1	78.0
Dubai crude	104.6	83.8	45.6	47.0	55.8	69.3	63.5
Indian crude basket	105.5	84.2	46.2	47.6	56.4	69.9	63.9

CRACKS SPREADS ($/ BBL.)

	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19 (P)	April-Dec. 2019 (P)
Gasoline crack							
Dubai crude based	9.7	11.7	16.1	11.1	12.0	5.9	7.3
Indian crude basket	8.8	11.3	15.6	10.6	11.4	5.4	6.9
Diesel crack							
Dubai crude based	17.4	15.7	12.0	12.0	13.9	14.8	14.5
Indian crude basket	16.5	15.3	11.5	11.4	13.4	14.2	14.1

DOMESTIC GAS PRICE ($/MMBTU)

Period	Domestic Gas Price (GCV Basis)	Price Cap for Deepwater, High temp Hingh Pressure Areas
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
October 18 - March 19	3.36	7.67
April 19 - September 19	3.69	9.32
October 19 - March 20	3.23	8.43

Source: PIB/PPAC/OPEC

GAS PRODUCTION

Qty in MMSCM

	2015-16	2016-17	2017-18 (P)	2018-19 (P)	April-Dec. 2019 (P)
ONGC	21177	22088	23429	24675	17918
Oil India	2838	2937	2882	2722	2078
Private/ Joint Ventures	8235	6872	6338	5477	3854
Total	**32250**	**31897**	**32649**	**32873**	**23850**

		2015-16	2016-17	2017-18 (P)	2018-19 (P)	April-Dec. 2019 (P)
Onshore	Natural Gas	8845	9294	9904	10046	7536
	CBM	393	565	735	710	485
	Sub Total	**9237**	**9858**	**10639**	**10756**	**8021**
Offshore		23012	22038	22011	22117	15829
	Sub Total	**23012**	**22038**	**22011**	**22117**	**15829**

	2015-16	2016-17	2017-18 (P)	2018-19 (P)	April-Dec. 2019 (P)
Total	**32249**	**31897**	**32649**	**32873**	**23850**
(-) Flare loss	1120	1049	918	815	707
Net Production	31129	30848	31731	32058	23143

	2015-16	2016-17	2017-18 (P)	2018-19 (P)	April-Dec. 2019 (P)
Net Production	31129	30848	31731	32058	23143
Own Consumption	5822	5857	5806	6019	4566
Availabilty	25307	24991	25925	26039	18577

AVAILABILTY FOR SALE

	2015-16	2016-17	2017-18 (P)	2018-19 (P)	April-Dec. 2019 (P)
ONGC	16076	17059	18553	19597	14014
Oil India	2314	2412	2365	2207	1640
Private/ Joint Ventures	6917	5520	5007	4235	2923
Total	**25307**	**24991**	**25925**	**26039**	**18577**

CONSUMPTION (EXCLUDING OWN CONSUMPTION)

	2015-16	2016-17	2017-18 (P)	2018-19 (P)	April-Dec. 2019 (P)
Total Consumption	46695	49677	53364	54779	43296
Availabilty for sale	25307	24991	25925	26039	18577
LNG Import	21388	24686	27439	28740	24719

GAS - IMPORT DEPENDENCY

	2015-16	2016-17	2017-18 (P)	2018-19 (P)	April-Dec. 2019 (P)
Net Gas Production	31129	30848	31731	32058	23143
LNG Imports	21388	24686	27439	28740	24719
Import Dependency (%)	40.7	44.5	45.3	45.7	51.6
Total Gas Consumption*	**52517**	**55534**	**59170**	**60798**	**47862**

* Includes Own Consumption

Source:PIB/PPAC

SECTOR WISE DEMAND AND COMSUMPTION OF NATURAL GAS

Qty in MMSCM

		2017-18 (P)	2018-19 (P)	2019-20 (P)									
				Apr.	May	June	July	Aug	Sep.	Oct.	Nov.	Dec.	Total
Fertilizer	R-LNG	7781	8711	611	716	769	784	815	784	750	803	878	4479
	Domestic Gas	6862	6258	541	525	499	519	588	574	598	577	602	3246
Power	R-LNG	2645	2869	265	336	687	313	272	321	248	267	247	2194
	Domestic Gas	9375	9194	711	700	641	620	646	598	657	611	578	3916
City Gas	R-LNG	3881	3981	290	322	328	447	449	423	416	442	415	2259
	Domestic Gas	4659	5240	471	472	463	492	486	478	490	488	514	2862
Refinery Petro-chemical Others	R-LNG	11109	12650	1021	1056	1030	1131	1116	1008	1109	1019	1124	6362
	Domestic Gas	5225	5225	432	438	448	502	635	449	481	426	434	2904

Source:PPAC

Member Organizations

S No	Organization	Name	Designation
1	Antelopus Energy Pvt. Ltd.	Mr. Suniti Kumar Bhat	Chief Executive Officer
2	Axens India (P) Ltd.	Mr. Philippe Bergault	Managing Director
3	Baker Hughes, A GE Company	Mr. Ashish Bhandari	CEO (Oil & Gas) South Asia
4	Bharat Oman Refineries Ltd.	Mr. Mahendra Pimpale	Managing Director
5	Bharat Petroleum Corporation Ltd.	Mr. D. Rajkumar	Chairman & Managing Director
6	BP Group	Mr. Sashi Mukundan	Regional President and Head of Country, India
7	Cairn Oil & Gas, Vedanta Limited	Mr. Ajay Kumar Dixit	Chief Executive Officer
8	Chandigarh University	Mr. Satnam Singh Sandhu	Chancellor
9	Chennai Petroleum Corp. Ltd.	Mr. S.N. Pandey	Managing Director
10	CSIR-Indian Institute of Petroleum, Dehradun	Dr. Anjan Ray	Director
11	Deepwater Drilling & Industries Ltd.	Mr. Naresh Kumar	Chairman & Managing Director
12	Delonex Energy Advisors India Private Ltd.	Mr. Rahul Dhir	Managing Director
13	Dynamic Drilling & Services Pvt. Ltd.	Mr. S. M. Malhotra	President
14	Engineers India Ltd.	Mr. J.C. Nakra	Chairman & Managing Director
15	Ernst & Young LLP	Mr. Rajiv Memani	Country Manager & Partner
16	ExxonMobil Gas (India) Pvt. Ltd.	Mr. Bill Davis	Chief Executive Officer
17	GAIL (India) Ltd.	Mr. Manoj Jain	Chairman & Managing Director
18	GSPC LNG Ltd.	Mr. Anil K. Joshi	President
19	Haldor Topsoe India Pvt. Ltd.	Mr. Alok Verma	Managing Director
20	Hindustan Petroleum Corporation Ltd.	Mr. M.K. Surana	Chairman & Managing Director
21	HPCL Mittal Energy Ltd.	Mr. Prabh Das	MD & CEO
22	IHS Markit	Mr. James Burkhard	Managing Director
23	IIT (ISM) Dhanbad	Prof. Rajiv Shekhar	Director
24	IMC Ltd.	Mr. A. Mallesh Rao	Managing Director
25	Indian Oil Corporation Ltd.	Mr. Sanjiv Singh	Chairman

S No	Organization	Name	Designation
26	Indian Strategic Petroleum Reserves Ltd	Mr. H.P.S. Ahuja	CEO & Managing Director
27	Indraprastha Gas Ltd.	Mr. E.S. Ranganathan	Managing Director
28	Indian Oiltanking Ltd.	Mr. Vivek Venkatachalam	Managing Director
29	IPIECA	Mr. Brian Sullivan	Executive Director
30	Jindal Drilling & Industries Pvt. Ltd.	Mr. Raghav Jindal	Managing Director
31	LanzaTech	Dr. Jennifer Holmgren	Chief Executive Officer
32	Larsen & Toubro Ltd	Mr. S.N. Subrahmanyan	CEO & Managing Director
33	Maharashtra Institute of Technology (MIT), Pune	Dr. L.K. Kshirsagar	Principal
34	Mangalore Refinery & Petrochemicals Ltd.	Mr. M. Venkatesh	Managing Director
35	Megha Engineering & Infrastructures Ltd.	Mr. P. Doraiah	Director
36	Nayara Energy Ltd.	Mr. B. Anand	Chief Executive Officer
37	Numaligarh Refinery Ltd.	Mr. S.K. Barua	Managing Director
38	Oil and Natural Gas Corporation Ltd.	Mr. Shashi Shanker	Chairman & Managing Director
39	Oil India Ltd.	Mr. Sushil Chandra Mishra	Chairman & Managing Director
40	Petronet LNG Ltd.	Mr. Prabhat Singh	Managing Director & CEO
41	Pipeline Infrastructure Limited	Mr. Akhil Mehrotra	Chief Executive Officer
42	Rajiv Gandhi Institute of Petroleum Technology	Prof. A.S.K Sinha	Director
43	Reliance Industries Ltd.,	Mr. Mukesh Ambani	Chairman & Managing Director
44	SAS Institute (India) Pvt Ltd.	Mr. Noshin Kagalwalla	CEO & Managing Director-India
45	Schlumberger Asia Services Ltd	Mr. Gautam Reddy	Managing Director
46	Shell Companies in India	Mr. Nitin Prasad	Country Chair
47	South Asia Gas Enterprise Pvt. Ltd.	Mr. Subodh Kumar Jain	Director
48	Total Oil India Pvt. Ltd.	Mr. Dilip Vaswani	Chairman & Managing Director
49	University of Petroleum & Energy Studies	Dr. S.J. Chopra	Chancellor
50	UOP India Pvt. Ltd.	Mr. Mike Banach	Managing Director
51	VCS Quality Services Private Ltd.	Mr. Shaker Vayuvegula	Director
52	World LPG Association	Mr. James Rockall	CEO and Managing Director

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