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From the Desk of the

Director General

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

Dear Members,

At the very outset of this message, I am delighted to inform that with the overwhelming support of our member organizations and also with the guidance of the Ministry of Petroleum & Natural Gas (MoP&NG), I have completed my first year as Director General at Federation of Indian Petroleum Industry. I would like to take this opportunity to thank officials from MoP&NG, Governing Council and all members of FIPI for their continued support and patronage.

Let me start with the briefing of last quarter where the Indian economy has been resilient to the deteriorating external environment that the world has been witnessing since the last few months. Despite the challenges emanating from rising energy and food prices, as well as geopolitical tensions, the World Bank has revised the GDP growth forecast for FY 2022-23 upward to 6.9 % due to robust domestic demand. Further, according to the Reserve Bank of India (RBI), the Indian economy, supported with strong macroeconomic fundamentals, is expected to become the fourth largest economy, surpassing Germany in 2025-26. Building on India's success in key economic areas, India formally assumed the G20 Presidency in December 2022 and would work to promote the universal sense of one-ness.

In the oil and gas sector, owing to rising urbanization and industrialization, oil demand is expected to grow as IEA under its Stated Policies Scenario (STEPS) has projected India's oil demand to rise from 4.7 million barrels per day (bpd) in 2021 to 6.7 million bpd by 2030 and 7.4 million bpd by 2040.

Key Policy Developments in Oil & Gas Sector during the quarter

In the Indian upstream sector, Directorate General of Hydrocarbons (DGH) under the aegis of MoP&NG had launched the OALP Bid Round- IX, offering 26 blocks covering an area of approximately 2.23 lakh sq km for exploration and development through international competitive bidding. In addition, the Government had also launched the Special CBM Bid Round-2022, offering 16 CBM Blocks under OALP through international competitive bidding.

To accelerate E&P investments and the participation of international investors and operators in the Indian E&P sector, the Ministry has concluded two roadshows in London and Houston. These roadshows were held to create awareness about the recent steps taken by the Government of India to increase the sector's attractiveness. In addition, it captured the priority issues requiring redressal and investors' expectations to invest in India's E&P sector. It also provided an opportunity to increase awareness about the upcoming bidding rounds among potential investors.

The Hon'ble Minister for Petroleum and Natural Gas and Housing & Urban Affairs, MoP&NG, Shri Hardeep Puri's visit kicked off India-US Strategic Clean Energy Partnership Ministerial Meeting which was held in Houston. The roundtable themed 'Opportunities in the India-U.S. Energy Partnership' took place, where Hon'ble Minister met with his counterpart, Secretary of Energy, Jennifer Granholm. The U.S.-India Strategic Energy Partnership is the culmination of two decades of productive energy cooperation between Washington and New Delhi, as both the United States and India discuss avenues of private sector contribution towards energy security.

An Indian delegation led by the Hon'ble Minister for Petroleum and Natural Gas and Housing & Urban Affairs and Secretary, MoP&NG with representation from MoP&NG, DGH and Indian Companies attended the ADIPEC 2022 in Abu Dhabi from 31st September -2nd November 2022. Hon'ble Minister of Petroleum & Natural Gas & Housing and Urban Affairs Shri Hardeep Singh Puri was invited by H.E. Suhail Mohamed Faraj AL Mazrouei, Minister of Energy and Infrastructure, UAE and H.E. Dr Sultan Bin Ahmad Sultan Al Jaber, Minister of Industry and Advanced Technology UAE and MD & Group CEO ADNOC to attend the Opening Ceremony on 31st October 2022. Hon'ble Minister participated in the Ministerial Panel discussions along with his counterparts from UAE, Arab Republic of Egypt and USA.

During the event, Secretary, MoP&NG had one-on-one engagements with E&P majors, small & medium sized majors and Oil Field Service (OFS) providers. Such focused meetings provided a platform for understanding the investor's perspectives, securing their concerns, and ideating the support they need for pursuing opportunities within the Indian E&P sector.

Further, a roadshow to interact with global E&P players on investment opportunities in India was organized by DGH on 2nd November, 2022 at Abu Dhabi. The event was attended by Mr. Vinod Seshan, Director (Exploration), MoP&NG, among other key industry dignitaries to discuss and highlight the key policy reforms institutionalized in India to increase ease of doing business, E&P expansion plans and investment opportunities available within India, including both onshore & offshore regions.

On account of significant rise in the gas prices at global gas hubs, Government has raised the price of domestically produced natural gas by 40% to $8.57 per MMBtu and the maximum sale price allowed to natural gas production from difficult fields was increased to $12.46 per MMBtu, with effect from October 1, 2022 to March 31, 2023.

The Government had constituted a gas price review panel, led by Dr. Kirit Parikh, Chairman, Integrated Research and Action for Development (IRADe) and former member of Planning Commission to look into the pricing of domestically produced natural gas in the country. Accordingly, the Committee has submitted its report to the Government and recommended deregulation of India's administered price for natural gas by 2027, floor and ceiling rates, and several other reforms aimed at boosting investments in cleaner fuel. The panel has suggested a price band of $4-6.50/unit for gas from old legacy fields, which account for over 70 per cent of the domestic output. The committee has also recommended that gas should be brought under the GST regime. The suggested recommendations, which are currently under consideration by the Government of India, if implemented, will provide a stable and transparent pricing, which will help in balancing the twin goals of pricing for the long-term viability of a gas-based economy, and reasonable & affordable pricing for consumers.

Further, there are various initiatives taken by the Government with a view to shift towards cleaner energy solutions. The Government has notified the National Bioenergy Programme on November 2, 2022 which includes- Waste to Energy, Biomass, and Biogas Programmes. The programme aims to provide Central Financial Assistance for setting up of Bioenergy projects for reducing capital cost & thus increase project viability.

Another step towards the clean energy transition is the recently launched Green Energy Open Access portal by the Government to ensure affordable, reliable and sustainable green energy is available to all. The objective of the Green Open Access rules is to provide access to green energy generation, sale & purchase and consumption for Renewable Purchase Obligation (RPO) fulfilment.

Various Events organized by FIPI during the quarter

The Abu Dhabi International Petroleum Exhibition & Conference (ADIPEC) 2022 was held from 31st October -3rd November 2022 at Abu Dhabi, UAE. FIPI participated in setting up the India Pavilion for the participation of the Indian Oil & Gas industry. India's major oil & gas companies exhibited their technologies & facilities to the world-wide organizations during the event.

FIPI organized its 5th R&D Conclave from 16th - 18th November 2022 at Mussoorie on "India's journey towards Net Zero". The event was organized with the focus to drive the industry forward through innovation and collaboration while managing the need for climate change. The conclave witnessed a wide participation of companies across the upstream, midstream, downstream, and technologies domain and was attended by more than 150 delegates.

The India Energy Week (IEW) 2023, being held under the patronage of the MoP&NG, and supported by FIPI and IOCL, is taking place from 6th- 8th February 2023 in Bengaluru, India. IEW 2023 theme is “Growth, Collaboration, Transition” and the event will convene global energy leaders to address India's energy transition under one roof. The logo for IEW 2023 was unveiled by the Hon’ble Minister for Petroleum and Natural Gas and Housing & Urban Affairs, MoP&NG at Gastech, Milan on 6th September, 2022 and at New Delhi, on 9th September 2022. To promote the mega event, IEW Curtain raiser was held in Bengaluru on 16th December, 2022.

In a build-up event to India Energy Week 2023, a one-day event called ‘Dance to Decarbonize’ was organized by MoP&NG. This unique event's key idea was to build sustainability engagement by leveraging dance and music, where renewable energy is generated through ‘dance’ to charge electric vehicles.

Ongoing FIPI Studies

FIPI on behalf of its member companies is currently carrying out an industry study on ‘Emerging Hydrogen Market and its Opportunities in India’ for assessing the hydrogen market potential in India. The study is being carried out by ICF as the Knowledge Partner. ICF has submitted a draft report on the study. The findings of the study will assess the role of hydrogen in the energy sector and provide recommendations for developing a hydrogen-based economy in India.

Further, FIPI, along with its study partner organizations, have initiated a study on “Scope and Role of Natural Gas in Mitigation of Industrial Air Pollution”. TERI has been engaged as the research partner for the study and was awarded the work in September 2021, consisting of three industrial clusters, namely Gurgaon (Haryana), Varanasi (UP) and Sangareddy (Telangana). In August 2022, TERI has submitted a draft report, and final report is awaited. The report's findings will present a pressing case to the policymakers for mandating gas in industrial clusters and serve as a single data point for all advocacy efforts in this direction.

FIPI, on advice from the MoP&NG, has awarded International Consultant “BCG” a Study on “Promotion of Indian E&P Sector for enhancing E&P activities among International Operators/Investors”. This study's main aim is to promote the Indian E&P sector for expediting & enhancing E&P activities on the domestic front to International Operators/ Investors through roadshows in London and Houston.

During the last quarter, FIPI has also conducted various Committee meetings on Natural Gas, Upstream operations, CBM and Petrochemical with our industry members to discuss the relevant issues pertaining to the oil and gas sector. FIPI has always been at the forefront in addressing their issues with the concerned Ministry, Regulator, and other stakeholders from time to time.

I assure you that FIPI will continue to strive for the best to serve our member companies through policy advocacy, studies in frontier areas and organizing conferences & exhibitions within & outside India, etc. I am hopeful and confident that with the onset of a new year, FIPI along with the collaborative efforts of all our member companies will not only be resilient enough to overcome this challenging time but also ready to shape the energy future and thus enhance the quality of life through clean energy and beyond.

I wish all the readers and their families a very happy new year 2023!

Gurmeet Singh

Viability Related Issues in Energy Industries

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Current Scenario

The oil industries are confronting various challenges and recent global pandemic has added many challenges to the basket of overflowing issues of fossil-based industries which is already marred with numerous issues such as competition with non-fossil fuels, environmental pressures, advent of electric cars or waving oil prices. which OPEC (Organization of the Petroleum Exporting Countries) was unsuccessfully trying to moderate in the recent past. The pandemic situation that is nearing the end had caused a major supply lapse and demand disruption causing production/ supply to be nearly 25-30% more than the existing demand which has resulted in unprecedented oil price collapse during lockdown. Such scenario had put lots of pressure on oil producers both big and small who were forced to cut production since the past historic demand disruption that lasted for about 6-9 months, straining them to close and reopen the wells again which was likely to cause problems. As far as India is concerned, all major producers like ONGC, Oil India Limited who are predominantly producing oil and gas from old and depleted fields, their cost of production is very high. The cost of production of oil was $45 per barrel, and of gas was $3.75 per Million British Thermal Units (MMBtu), however, due to less realization, they tend to lose money for every barrel or every million Btu of gas production.

The energy companies have reached the government for help, government considering the request for production in Cess, in royalties have helped them to an extent to tackle the problem. Also, the loan from Oil Industry Development Board (OIDB) which collects Cess was being considered. All these were good initiatives. Since India is 82% dependent on foreign imports, any reduction in oil prices is good and even better when it was added with demand disruption. Demand in India was reduced by 32-40% that encouraged the government because every $10 decrease in oil prices, decreased the current account deficit to 0.5%. Therefore, the same had helped in dealing with the pandemic situation and the government had the opportunity to divert such funds to the needy and down trodden. However, as expected the oil industry is back on its foot to strive and thrive again.

The initial crash in oil prices occurred in second week of March 2021 when discussions, negotiations failed followed by Covid-19 situation among OPEC plus countries like Azerbaijan, Bahrain, Brunei, Kazakhstan, Malaysia, Mexico, Oman, Russia, South Sudan and Sudan that are exporting crude oil. Based on realistic situation, the recovery has been U shaped and low curve has sustained for quite some time until the demand picked up based on public comfort to travel. Another observation made during the pandemic situation was the requirement to travel, where meetings could be managed via online platforms and work from home practice.

It is observed that there is less necessity for people to move out after full recovery from the situation, which is again good news for countries like India depending on foreign imports. Surprisingly, reaching 100 billion barrels oil consumption per day, India may have to wait and watch when we can reach that number as demand is going to be affected.

Also, US shale gas industries were on its knees during the pandemic and most of the rigs deployed at locations were put on hold which is now slowly gearing up again post recovery from the pandemic. The companies involve in energy business would continue to operate even in losses because they have raised huge amounts of borrowings in billions of dollars (about $172-200 billion). Even lenders are also start thinking to convert all such lending into Non-Performing Assets (NPAs). US shale gas industries had recovered sooner than as expected to keep the oil prices low to supplement the other producers like OPEC, OPEC plus to reconcile the lower oil prices.

Energy Integrated Market & Governance

Before addressing the viability issue, we need to analyze the current context due to which the demand arises to address the viability question. As we have witnessed, the Corona pandemic has eroded the major oil supplies globally and disrupted the supply chain to the extent of 30% and under panic of such supply losses, major suppliers have resorted to various strategies to protect their market share and that led to the market price war leading to complications, which ultimately had resulted in the crisis in oil & gas sector during pandemic. As we know, oil prices are subject to such cyclic variations, and India is enthusiastically dealing with it since long back and had just recovered from novel corona-based crisis. Silver lining is that the current crisis was short term and got eliminated within 2-3 quarters because global lockdown cannot be perpetually implemented. When the demand has bounced back, situation was eased out because the major suppliers adopted a balance approach towards a viable supply regime, and India had eliminated the crisis in one year or so. Initially, there was some impact due to lack of global storage space that were already filled up, which had impacted the recovery to some extent, beyond one or one and a half year.

As far as viability issue is concerned, if we question that who are the companies and why they go out for equity oil & gas projects, we find that there are two set of companies, first being international majors and medium size companies striving for financial independence which go to the international market, participate in equity oil projects with risk money, where primary motivation is to make profits. The time horizon is medium to short term and they invest, take the risk, make money and go to new projects.

In the second group of companies which are primarily the NOCs (National Oil Companies) dominantly including Indian companies like OVL (ONGC Videsh), BPRL (Bharat Petro Resources Limited), OIL (Oil India Limited), and others which go with dual motivation, one being profit making but the underlying motive is also to contribute to domestic energy security, which is a very relative term although, in case of defining it for India, primarily bridging the gap between the domestic production with our demand. While India has the option of importing the entire deficit but then we would totally be exposed to the vulnerability of high oil prices and there would also be supply disruptions. So, it's an ideal matrix to have domestic production supplemented by equity oil from overseas in addition to balance the import. This strategy is adopted by most of the Asian NOCs and India is also under the same regime. Also, there is a debate on ensuring the energy security and this kind of arrangement of equity oil. When the oil prices are high, the debate is triggered in the supply nations and NOCs start debating that why they should allow the foreign companies to participate in such projects while taking away their equity oil. And at the same time, when oil prices go down, the same debate start happening in the purchasing nations like ours. Participation in oil & gas equity projects overseas is a much-heated debate, forcing companies to concentrate in the domestic oil & gas market. As oil business is quite risk prone, highly capital intensive, there is a symbiotic relationship between supply and demand entities and supply nations and NOCs want capital income, risk sharing & supply assurances and technologies. Whereas, in buying nations like ours, we want supply assurances at optimized cost. So, it's a win-win approach and we should adopt this approach profitably. Question is whether it would be profitable or not, depends on what price cycle one enters into the project. If making right decision at right time at low price regime, then one could be profitable in long term.

But if entering at a high price regime, then situation is reverse. India has witnessed similar scenario in its own project portfolio. The question is whether we have got adequate resource backing, decision making ability with swiftness and also the risk-taking ability with long term horizon. The viability of international Exploration & Production (E&P) business in equity oil and gas projects is good and India should resort to that. The other problem with India is that unlike other Asian nations, the participating companies do not have direct linkage with end user companies i.e. refineries and as a result when oil prices are collapsing, the equity oil participating companies have to sell their barrels at higher discounts under selling pressure. In case of direct long-term contracts and relationships between the Indian refineries and equity oil & gas companies, there could be a win-win for both. Regarding issues of freight, it can be shared by both the companies and that can be the cost which in any case one has to bear for the long-term optimization of our oil supplies.

Another issue to flag at this junction is institutionalized mechanism to have a balance handling of the upstream, downstream and international price volatility. In the past, government had instituted certain subsidy mechanisms between upstream and downstream companies and other funds for supporting this kind of volatility but now India needs to have long term solution to this. One solution is to have a national energy fund balance sheet wherein the finances from gains and losses are not flowing into the central budget but channelized into the upstream and downstream projects within the country and also support the overseas participating companies to have a robust strategy for participating in the bigger projects. Right now, there is dependence on individual balance sheet of the companies and they are guided and directed towards the domestic operations under pressure. So, for the overseas participating companies, the only option left is loan or borrowing for debt financing from overseas which helps in a way but there is a limit to that. Larger risk at times is not taken by the management because there is a huge downward pressure for loan repayment and servicing of the debt in terms of this. In case, India adopts to such national balance sheet, wherein there is some support available to overseas participating companies and also balancing between the upstream and downstream business within the country, that could be a major lesson from this global crisis for long term viability of E&P business and downstream refining business. While the dependence on non-renewables (fossil fuels) for an aspiring nation like ours, cannot be forever, we need to come out for ways to facilitate self-dependence and energy security simultaneously.

Road to renewables

According to US IEA 2020 report, renewables continue to have sustained cost reduction potential by 2050 resulting in lower energy related CO_2 emissions as increasing electricity generation from renewable sources leads to decrease in emissions. The report estimated that in 2050, emissions are likely to remain 8% lower than 2019 levels. Various assumptions regarding global oil prices, domestic energy resources, macroeconomic growth driving energy consumption and production technology estimate the cost for renewable power production.

For conquering new horizons, India needs to step firmly towards real products arising out of renewable energy that can be used by the masses and refraining from just being a highly appreciated doctoral thesis sitting decorated in an archive. Globally, academic research works in a quite different way. Firstly, the academia misconstrues the grave unhealthy publishing journal culture focusing more on 'ideal' journal material, indulging in vicious journal cycle rather than leading science towards applicability. Secondly, channelization of financial funds towards global research, after covid-19 fiasco, should try to acknowledge the fact that R&D cannot generate immediate revenue and continues to remain underfunded. Thirdly, the surmountable gap between the academia and industry needs to be closed as early as possible through practical solutions. ONGC Energy Centre is actively working to bridge this gap in renewable energy area to make the country self-sufficient for sustainable future. Such an initiative would work towards PM's mandate of 'Aatm Nirbhar Bharat' to support a balanced and fair approach towards assessing the impact and quality of research making the nation self-sufficient for energy in order to be prepared one step ahead in dealing with the current situation and energy security in future.

Co-processing of Vegetable Oils in FCC to produce High Quality Fuels

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Introduction

As environmental policies drive to increase the renewables participation in the transportation sector, fuels derived from vegetable origin are becoming an attractive alternative to replace, totally or partially, fossil fuels. An overview of production requirements indicates that biofuel production must consider the balance between food source utilisation and managing climate change. Feedstock selection is also a policy decision. The use of non-food sources is the preferred path towards renewable fuels.

Vegetable oils

Seed oils and animal fats are the primary feeds for the renewable fuels. They contain oxygenate species (triglycerides and organic acids) and reactive olefins/diolefins that can be biologically degraded/oxidised. The breakdown products can be precursors to both gum/coke formation and stable emulsion formation. These species can also have greater corrosion potential, especially when there is a small amount of free water present. Volatile biological breakdown products can result in objectionable odours.

Plant based oils such as corn oil and soybean oil are extracted directly from the plants. These oils consist of a mixture of triglycerides, which are large molecules comprised of glycerol and three long-chain fatty acids. Different oils will contain different mixtures of triglycerides, but all plant oils will contain long-chain fatty acids and an overall carbon number in the order of 50. While containing a mixture of triglycerides, the distribution of different molecules in plant-based oils will be significantly narrower than oils produced by pyrolysis. As a feedstock, several processing options exist to upgrade vegetable oils into fuels and chemicals including co-processing in FCC. The oxygen contained in the glycerol and fatty acid is roughly 10-15%. In the FCC riser, the majority of this oxygen will be converted to CO, CO_2, and H_2O through the deoxygenation pathways discussed above. Depending on which pathway is followed, either carbon will be consumed, resulting in less carbon being available for formation of desired products, or hydrogen will be consumed, potentially increasing selectivity to coke. When co-processing plant oils in a lab-scale ACE unit, the yields of LPG, gasoline, or LCO will generally decrease as the result of producing CO and CO_2. Like plastic pyrolysis oils, plant oils also blend well with gasoil without significant miscibility issues.

Table 1: Physical Properties and Elemental analysis of Vegetable oils [1][2][3][4]

Vegetable oil	Water content	Acid Number	Viscosity	Density	HHV	C	H	O	N	S
Carinata oil	0.05	4.5	87,5 cP	0.88	40.3	78.9	11.8	-	0.24	-
Soybean oil	-	0.58	58 cSt at 20 ◦c	0.92	39.52	77.6	11.9	11	-	0.01
Cottonseed oil	0.03	0.3	58,2 cP	0.92	39.4	-	-	-	-	0.01
Jatropha oil	3.28	27.2	46,8 mm2/s	0.92	39.6	76.1	11.8	12	0.2	-
Sunflower oil	0.06	1.8	77,3 cP	0.92	39.5	77.9	12.5	10.9	0.15	-
Canola oil	0.05	1.8	87,2 cP	0.91	39.8	78.3	12.2	11.5	0.43	0.02
Palm oil	0.47	4.8	48,1 mm2/s	0.9	39	-	-	-	-	0.01
Mustard oil	0.03	0.55	73,0 mm2/s @25 ◦c	0.92	39	-	-	11	-	trace
Rubber seed oil	1.5	25.1	57,9 mm2/s	0.93	37.1	-	-	-	-	-
Flax oil	0.07	0.8	50,3 cP @20 ◦c	0.91	39.1	78.3	11.8	10.5	0.16	-
Rapeseed oil	0.04	1.14	35,2 mm2/s	0.91	39.5	77.2	13.6	10.9	0.01	0.15
Crambe oil	-	0.33	6,64mm2/s	0.89	40.6	-	-	-	-	-
Sesame oil	-	0.55	25,8 mm2/s @40 ◦c	0.9	39.5	69	-	-	-	trace
Safflower oil	0.04	0,97-9,24	31,3 mm2/s @38 ◦c	0,92-0,93	39.5	-	-	-	-	-
Karanja oil	-	1.23	25,0 cP @40 ◦c	0.97	38.4	73.7	10.8	14.5	1	trace

Coprocessing Challenges

Pre-treatment that reduces the renewable feed olefin content, nitrogen, sulphur, chlorides, phosphorus, free fatty acids, metals and gums can make a substantial difference in the ability of existing refinery infrastructure to co-process the renewable material successfully or with the minimum amount of modification.

Renewable feed supply and availability are equally challenging. The diversity in the feedstock source translates well into the difficulties faced in their treatment. Renewable feed requires oxygen removal and olefins saturation to produce fully replaceable fuel components. As a result, hydrogen and hydroprocessing capacity must increase to accommodate additional demand. Vegetable oils are however easier to process that their pyrolysis derived counterparts since they have lower oxygenates and contaminants. The economic incentive to produce renewable feeds depends on uncertain feed and product markets. Bio-feed processing and co-processing may provide significant sustainability and economic benefits for fuels producers but may not be competitive without government subsidies.

Table 2: Market Price of Vegetable Oils [5][13]

Feedstock	Cost USD/Ton
Soybean Oil	1430
Rapeseed Oil	661
Palm Oil	913
VGO	345
Pyro-oil (Sawdust)	700

The prices of edible oils such as soybean oil, rapeseed oil, palm oil considered in this study as well as sunflower oil, sesame oil, coconut oil, mustard oil and olive oil have increased 50-70% in the past few months from their pre-Covid levels. Causes can be attributed to ongoing geopolitical conflicts, sanctions, import embargos as such.

The fluctuating prices of bio-feeds especially vegetable oils in particular make their viable coprocessing equally challenging as opposed to the highly contaminated pyrolysis oils. Currently vegetable oils and pyrolysis oils are costlier than conventional vacuum gas oil. Viable coprocessing is possible in presence of government subsidies or crude oil shortfalls.

Bio-feeds are not all the same. Specifications and quality control need to be established consistent with the chosen processing scheme. For example, if not stored properly, bio-feeds can degrade quickly.

Bio-feeds are successfully co-processed in refinery units but only up subject to unique constraints for each specific unit. As bio-feed concentration increases, increasing hydrogen demand, corrosion issues, and water/amine systems should be assessed based on selected processing options. These changes are predictable and can be effectively implemented with a proper engineering overview. The final renewable diesel or jet require blend recipes and/or additive requirements that will change (quality). The final blends must meet all product quality requirements.

Table 3: Metallic Impurities in Vegetable Oils [5][6][7][8][9]

	Soybean Oil	Rapeseed Oil	Palm Oil (ref)	Pyro-Oil	VGO
O2 (wt%)	10.5	10.6	11.3	51	0-0.5
Na (ppmw)	0-2	5	0	5	0-10
Mg (ppmw)	1-40	0.3	0	130	0-5
K (ppmw)	0-88	0	0	160	0-5
Ca (ppmw)	3-60	14	0	400	0-20
P (ppmw)	6-150	4	0	-	0-5

Yields and Feasibility

In the following study, three vegetable oils were blended with VGO in varying ratios (properties in Table 4). These blends were cracked at identical conditions and catalysts to determine effect of vegetable oil blending on yields. It was commonly observed that coke marginally increases with blending but reduces in case of pure oil cracking. Also, a common observation is increase in LCO with increase in blending. However, this LCO is expected to be less aromatic than conventional. This makes it an excellent blending component in the diesel pool.

Table 4: VGO Properties [13]

Density @ 15°C (g/ml)	0.8796
Distillation	
IBP	285
10%	372
30%	415
50%	453
70%	488
90%	539
FBP	585
Sulfur (ppm)	56
Kinematic viscosity @ 100°C (cst)	5.805

Table 5: Effect of Rapeseed oil co-processing on product selectivity [13]

525°C/ CTO 4						
% Rapeseed oil	0%	20%	40%	60%	80%	100%
Coke	4.63	5.15	5.05	5.31	4.27	3.88
Gas	36.11	30.93	29.29	28.02	26.54	24.27
Gasoline	37.96	39.18	39.39	38.65	37.91	37.86
LCO	13.89	15.46	16.16	17.39	18.96	20.39
Bottoms	7.41	9.28	10.10	10.63	12.32	13.59

In case of rapeseed oil, gasoline yield increases by 1.5wt% at 40% blending and falls beyond that. At higher cracking temperature the gasoline enrichment may be higher.

Table 6: Effect of Soybean oil co-processing on product selectivity [13]

525°C/ CTO 4						
% Soybean oil	0%	20%	40%	60%	80%	100%
Coke	4.63	5.56	4.67	4.72	4.90	4.08
Gas	36.11	32.41	29.91	28.30	24.51	21.43
Gasoline	37.96	38.89	39.25	38.68	39.22	39.80
LCO	13.89	15.74	17.76	18.87	21.57	23.47
Bottoms	7.41	7.41	8.41	9.43	9.80	11.22

Soybean oil seems to be the most suitable for coprocessing since the gasoline improvement is superior. This can be attributed to easier to crack fatty acids present in soybean oil. Coke and gas formation is lower compared to other oils and selectivity is higher towards liquid yield. But at the same time Soybean oil is the most expensive amongst the oils considered in the study.

Table 7: Effect of Palm oil co-processing on product selectivity [13]

525°C/ CTO 4						
% Palm oil	0%	20%	40%	60%	80%	100%
Coke	4.63	6.73	6.80	5.88	5.71	4.55
Gas	36.11	33.65	31.07	29.41	26.67	25.45
Gasoline	37.96	36.54	36.89	36.27	34.29	32.73
LCO	13.89	14.42	15.53	16.67	19.05	22.73
Bottoms	7.41	8.65	9.71	11.76	14.29	14.55

Gasoline yield steadily falls with higher blending in case of palm oil. On the other hand, LCO yield increases. In all cases, the bottoms fraction linearly increases with increased blending.

In another study, similar trend was observed. In this case the blending ratio was kept constant, and conversion was varied. The highest improvement in gasoline yield is observed by blending soybean oil followed by rapeseed oil and palm oil.

Table 8: Effect of Vegetable oil co-processing on gasoline selectivity [12]

	Gasoline wt%		
Conversion	74%	78%	80%
Base	49.5	49.6	47.5
15% Palm	50.4	50	48.6
15% Soy	51.6	50.8	49.7
15% Rapeseed	51.3	50.5	49.3

Conclusion:

The viability of co-processing bio-feeds in FCC plants depends on multiple variables namely cost of bio-feed, cost of pre-treatment of bio-feed, availability of bio-feed, specifications of the product gasoline. Other major challenges include low stability of bio-feeds, deposit formation, corrosion issues etc. The benefit of bio-feeds processing lies solely in its renewable nature in contrast to feedstock obtained from mineral sources. Further studies and research in this area will improve the profitability issues and may lead to successful commercial implementation and improve India's energy security.

References:

1. H. Li, B. Shen, J.C. Kabalu, M. Nchare, "Enhancing the production of biofuels from cottonseed oil by fixed-fluidized bed catalytic cracking", Renew. Energy 34 (2009)
2. U. Rashid, F. Anwar, G. Knothe, "Evaluation of biodiesel obtained from cottonseed oil", Fuel Process. Technol. 90 (2009) 1157–1163
3. M.A. Olutoye, B.H. Hameed, "Kinetics, and deactivation of a dual-site heterogeneous oxide catalyst during the transesterification of crude jatropha oil with methanol", J. Taibah Univ. Sci. 10 (2016) 685–699.
4. N.A. Negm, M.K. Zahran, M.R. Abd Elshafy, I.A. Aiad, "Transformation of Jatropha oil to biofuel using transition metal salts as heterogeneous catalysts", J. Mol. Liq. 256 (2018) 16–21
5. https://markets.businessinsider.com/commodities (accessed on 04/08/22)
6. Grace Catalagram® publication No. 103 - New Opportunities for Co-Processing Renewable Feeds in Refinery Processes
7. Grace AM-11-51- The Economic Value of Producing Renewable Diesel
8. Pinho, et. al., Fuel 188 (2017) p 462-473
9. Anthonykutty, et. al., Energy Science and Engineering 3 (2015) p 286-299
10. P. Bielansky et al. / Fuel Processing Technology 92 (2011) 2305–2311
11.Dupain et.al," Cracking of a rapeseed vegetable oil under realistic FCC conditions" Applied Catalysis B: Environmental 72 (2007) 44–61.
12. Watkins et al., Catalagram® publication No. 103 (2008) 1-13
13. BPCL Laboratory generated data 2021

Unique Technique of Laying Sand Plug with Coil Tubing in Live Well for Water Ingress Control

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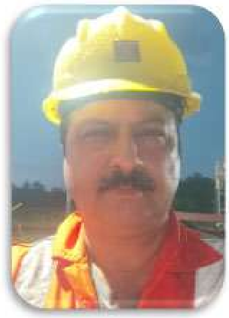

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Summary

In a multiple zone or long perforations completion, when it becomes necessary to isolate a deeper producing zone from a shallower one, a barrier must be placed between them to prevent fluid communication.

There are several advantages to laying a sand plug with coiled tubing. Long intervals can be covered with sand in a short period of time and the sand top can be accurately placed within a selected depth window. The strength and permanence of sand plugs can be adjusted through the use of different types and sizes of sand, and by placing cement or scale caps on the sand plug.

Sand plugs can be placed in live wells without the time and expense of a snubbing operation because the need to 'kill' or control a well is an automatic part of the sand-back operation. Using 'clean', compatible fluids and frac proppant reduces formation damage. Sand plugs can be placed in relatively less deviated wells also and can be removed by coiled tubing fairly successfully. Hence, laying sand plugs is a non-permanent, non-damaging, zone isolation method.

Background

Well “#S”, of ONGC, Jorhat Asset, is a well of priority for the asset, as it has been a good producer on self from Sylhet, since its drilling. Recently, it was completed in the Sylhet layer, in interval (3036-3041 m & 3045-3046.5 m) during the last workover.

Well became active on self and was producing liquid rate of 70-80 m3 per day with water cut more than 90 percent leading to a relatively poor oil rate of around 5-6 m3/day. Due to very high water production, it was not feasible to choke down the well, as it used to get ceased due to water loading. Another problem is that the well fluid has to be transported to the nearest processing facility, as the well head installation at “#S” has no processing facilities.

Several rounds of discussion were done in the asset to enhance the oil production and reduce water cut at “#S”. Production logging was carried out in the well. With the well logs, production trends, Production Logging Tool (PLT) results, it was inferred that the bottom perforation interval (3045-3056.5 m) was mainly contributing most of the water.

Well Services (WS), Jorhat Asset took up the challenge of isolating the bottom perforations without killing the well and also ensure that the top perforations continue to contribute.

The objective was to devise a unique plan to meet these challenges and execute a rig less job to plug the water contributing zone (3045-3046.5 m), keeping the well alive.

Challenges

- Water shut-off by cementation could irreparably damage the productive zone, as the oil zone was thin and fed by active water. Further the gap between the oil producing layer and water producing layer was only 4 m.

- Time would be lost for carrying out a full-fledged work-over job with a rig and would affect the asset's production.
- Studies had shown that the well has good potential to produce the oil and is the only well in that area.
- The requirement was to carry out some rig-less remedial job without killing the well to have quick results.
- The production installation, being in a very remote area, did not have any processing facilities and all the well fluid has to be trucked to facility many kilometres away, raising the expenditures and creating load on the system.

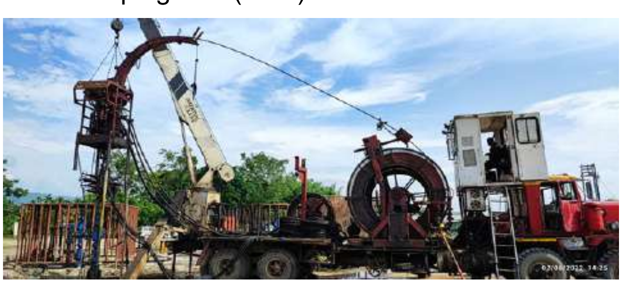
Plan of Action

The available resources at WS, Jorhat were evaluated and various research papers were referred to develop a plan to plug the zone precisely through Coil Tubing Unit (CTU). In particular, the information provided in "SPE 25496 - Laying Sand Plugs With Coiled Tubing", motivated us to devise a plan adapting the said information to the ground circumstances here.

The well details "#S" are:

- Open zones: 3036-41 and 3045-46.5 m (Sylhet-I and II)
- Casing: 5 ½, P-110, 20 ppf; "L" profile well
- Depth to be closed – 3065-3041m = 24 m or 78.7 ft

The chemicals used were around 500 kgs (1100 lbs) of 20/40 standard frac proppant; 20 lbs of polymer; 1 lb of breaker, with clean water. The equipment used was Coil Tubing Unit (CTU) and Acid Pumping Unit (APU).



Keeping the well data of "#S" in mind, a plan was developed for carrying out a "sand plug job" to isolate 3045-3046.5 m, but keep the upper perforations 3036 – 3041 m intact for production. The broad contours of the plan were as under:

- Shut-in the well approx. 4 hrs before job
- If Wellhead Pressure (WHP) > 1000 psi, bulldoze the well in a controlled way, to bring WHP below 1000 psi.
- Run in Coil Tubing (CT) with jetting nozzle (having 3/8" ID) and clear upto well bottom (3065m)
- Pull out CT by 3 m and pump 3 barrels (bbls) plain polymer gel spear, followed by 8 bbls proppant (20/40 frac proppant) slurry and post flush of 3 bbls plain polymer gel. Push this with water. Pump at max rate of CT working pressure until gel spear reaches the nozzle.
- Lay in slurry @ 1 bpm with slow CT pullout speed and pump entire slurry of 8 bbls.
- Flush CT with water after pull out above perforations and take return from tubing side.
- After 2 hours (after breaking of proppant slurry), do a soft tag of sand top (found at 3043m)
- Pull out CT and close the well for the day
- Run in CT to tag the sand top next day (confirmed at 3043m) and pull out.
- Activate the well with compressor application for GLV unloading.

Results

The job was precisely done and the results have been testimony to the success of the job. Currently well is producing liquid at the rate of 75 m3/ day with reduced water cut of 80%, leading to an increased rate of 15 m3/day of oil (more than double the pre-job rate).

Conclusion

1. Rigless sand plug job by Coil Tubing can be a promising techno-economic measure to shut-off bottom perforations in a high water cut oil well to lessen the area of water coning etc.

2. This technique provides the advantage of quick results at the least cost for wells identified with such problems.

3. This technique can be applied multiple times to exactly reach a target sand top, if required, in successive back-to-back CT jobs.

4. Highly deviated wells, say more than 45 degrees (in the payzone area) may not yield good results due to sand dune effect.

References

Ishaan Singh, Aman Saraf, Akash Ramesh Pathak, Bholanath Bandyopadhyay, Madhurjya Dehingia, Danny AryoWijoseno, Lovely Sharma, Ravi Ramniklal Gondalia, Amay Kumar Jha, and Vaibhav Joshi, Schlumberger; Moulali Shaik and Dasari Papa Rao, Oil and Natural Gas Corporation Limited: OTC-30791-MS Executing Unconventional Coiled Tubing Sand Plugs for Multistage Fracturing Operations in HP/HT Wells

M.J. Chambers, BP Exploration (Alaska) Inc., SPE 25496 - Laying Sand Plugs With Coiled Tubing

Terry Palisch, SPE, and Robert Duenckel, SPE, CARBO Ceramics Inc., and Lucas Bazan, SPE, Harmon J. Heidt, SPE, and George Turk, SPE, BP America Inc; SPE 106301 - Determining Realistic Fracture Conductivity and Understanding Its Impact on Well Performance—Theory and Field Examples

Enhancing Crude Procurement Decisioning through Artificial Intelligence Technology

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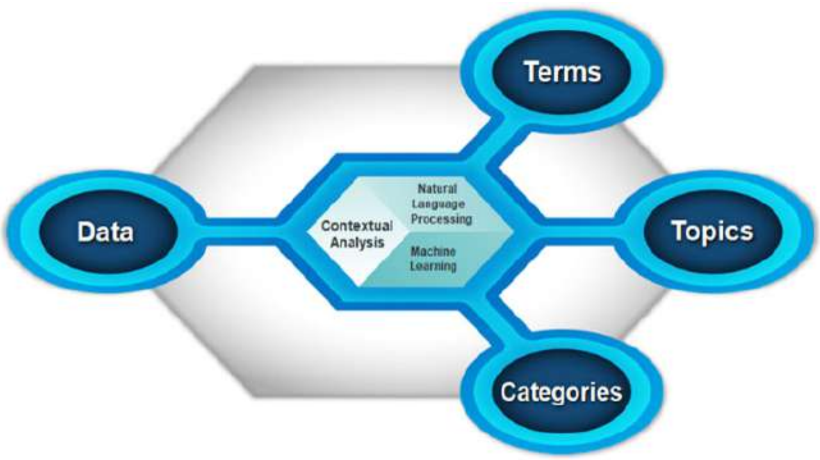
Crude Procurement department of any of the Oil Refining company is primarily engaged in import and export of crude oil and petroleum products respectively. The department receives multiple reports from various sources in PDF files or on e-mails or on the chat network, through the web sites and news channel terminal like Bloomberg, Reuters, etc. These news terminal channels also provide a lot of data and news on wide range of crude and products. To have insights on various business opportunities, the data in structured and unstructured format from various sources need to be searched and collated. There is a general need from these crude procurement professionals to have an artificial intelligence-based foundation that can extract of all relevant news and publishing various reports/dashboards related to:

1. Crude Oil supply and Demand: Insights on the supply and demand trends in various Geographies.
2. Oil inventory dynamics of identified geography: Oil Inventory levels or the amount of oil and oil products (limited to 3 number) stored in various facilities can provide insights on the bullish and bearish crude movement. For e.g. if the increase in crude inventories is more than expected, it implies either greater supply or weaker demand and is bearish for crude oil prices. If the increase in crude inventories is less than expected, it implies either weaker supply or greater demand and is bullish for crude oil prices.
3. Refinery Shutdown and Maintenance: The information based on the Refinery Shutdown and Maintenance will provide insight for the crude movement. The information based on the Cracker maintenance/ refinery maintenance / refinery closures will be provided.
4. Oil Rig activity: Insights will be produced by the number of Rigs in operation, OPEC production and new capacity additions
5. Force Majeure information: News from indicative data sources
6. Oil related Tenders/Deals: Exploratory view will be provided from the available information on deals and open tender in the market, new tender/award of tender in ASIAN market, Western African Crude deals, Middle east crude spot availability.
7. Vessel tracking (trade flows), Marine Logistical constraints: Cargo flows from one region to another. From one region to one country.
8. Crude oil, Product prices
9. Natural Language Query
10. Quality: - Insights from Fuel Specification changes in neighboring countries / Worldwide. IOCL will provide the relevant information from indicative data sources
11. NEWS:- Updates on OPEC / Non OPEC meetings, News on new crude oil streams coming online.

Given the volume of above data available on daily basis from various structured and unstructured data sources, how can a crude trader build a market insight by quantitatively assessing the data that can help the trader in answering its various procurement queries. E.g. if a user asks a query "which crude oil from Latin America region with API more than 45 have been purchased in last 1 month", then artificial intelligence based engine would interact with the user and provide all the details about all the light crude oil which have been procured (not available) to the crude trader in last 1 month from Latin America region. The key part in the above decision-making process is that artificial intelligence-based software solution like SAS could rightly contextualize the complete query from business user in its natural language without searching from all the structured and unstructured data the individual text words such as "crude oil", "Latin America region", "purchased", "1 month". Many Elastic search based artificial intelligence systems do natural language query but may list crude oil of Latin American region, however Watson would not list heavy crude oil and would only list light crude oil with API more than 45 such as Eagleford Condensate, Anoco Wax, etc. procured within last 1 month. Therefore, it is imperative that the right solution that helps in making the right decision in short time and closing the available opportunities with all the right data available in the form of structured and unstructured form. It is important to have a cognitive technology that can think like a human, address challenges, and has Natural Language Processing (NLP) capabilities makes it a unique product for the oil marketing companies. To make it simpler, the cognitive technology works on the below framework:



During 1 of the key engagements, key three-step process for generating and using the framework was followed:

1. Data acquisition and preparation for text analytics: Data is acquired through web interfaces and is converted into a structured data sets using data integration applications

2. Text analytics: Thereafter, the artificial intelligence-based software solution develops linguistic rule-based categorization models for document classification using Boolean operators, qualifiers, regular expressions, and more. Usually, taxonomies developed primarily based on rule-based model development can have anywhere from a few categories to several hundred categories and sub-categories. Further, instead of loading each individual data set to the contextual analysis solution to test a category, a scoring code is used to execute the model on sampled data and generate a resulting table with the predicted value (Match/No Match) for that category.

3. Data preparation for visual analysis: Finally, the output from the scoring code is carefully analyzed and the output table would show the distribution of the matches for that category on the data set that was ingested to perform text analytics. Following were the summary of the match results obtained:

- 65% of the text analyzed matched perfectly from the source documents
- 14% of the text analyzed had matching document with negation
- 12% of the text analyzed could not find terms from the source documents
- 9% of the text analyzed were perfect non-match

Skilling - The need of the hour in the CGD Sector

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1. Background

The Petroleum and Natural Gas Regulatory Board's (PNGRB) focus has been on increasing the market share of natural gas in India's energy basket, developing a robust infrastructure to support increased consumption of natural gas, creating a transparent and vibrant natural gas market and balancing the interests of consumers, transporters and producers of natural gas.

Aiming to meet the commitments made in the Paris Convention, the Government of India intends to increase the share of natural gas in India's energy mix from 6.5 per cent to 15 per cent by 2030. Another goal of the government is to expand the City Gas Distribution (CGD) network in the country at a rapid pace. With this in mind, the PNGRB awarded geographical areas (GAs) quickly in the 9th, 10th, and 11th rounds of the CGD bidding process. If the commitments by all CGDs are fulfiled, there will be a ten-fold increase in PNG connections in less than ten years. A gist till 11th round biddings is tabulated below

Rounds	Geographical Area (GA) –(Nos)	District (Nos)	Pan-India Area coverage (%)	Pan-India Population coverage (%)	Committed Domestic Connections (Cr)
11	295	630	88	98	12.33

2. Demand and availability of skill sets in the CGD segment

CGD is a skill-oriented sector that focuses on laying and operating the network for the natural gas segment and demands many skilled CGD professionals, including engineers, semi-skilled technicians, plumbers, welders, electricians, fitters and operators to meet the committed targets.

Among other factors, the 40+ CGD entities' success lies in their ability to source skilled and semi-skilled workforce for different jobs. According to an industry estimate, the CGD will have to employ over 10 lakh skilled workers country-wide by 2025 to fulfil its commitment to developing and operating domestic PNG connections. But in various review meetings of ministry and industry-specific workshops, the severe shortage of skills and non-availability of the skilled workforce was recognised as a big problem.

Ensuring safe and robust PNG installation and maintenance practices is a critical business activity that can only be achieved by employing highly skilled workers. If poorly installed or maintained, gas appliances and infrastructure can cause gas leaks, fires, explosions, or carbon monoxide (CO) poisoning, which can be seriously harmful or even fatal for consumers. Hence, the training, qualification, and accreditation of field staff engaged in installation operations should comply with the standard and regulated guidelines while incorporating the best practices from around the world.

The PNGRB regulation on 'Integrity Management System for City or Local Natural Gas Distribution Networks' specifies the minimum training requirements for design, construction, operations & maintenance for CGDs. Despite this, the CGD industry often overlooks these requirements primarily due to a gap between the demand and availability of skilled professionals. Even though India has plenty of relevant skill training institutes, the deployed workforce needs to receive the necessary training. This is mainly because of two primary reasons.

- Most training and skill development centers focus on the upstream and midstream segments, while the downstream segment often gets neglected.

- CGDs and their contractors often overlook training because of the cost involved.

3. Best practices in advanced gas-based economies

As an example to illustrate the seriousness of intent concerning safety, the UK has adopted as a legal mandate (a law, as opposed to a regulation or a standard) that gas installers (and businesses) working on the residential gas network should be certified against the BS6400-2 standard (specification for installation, exchange, relocation, maintenance and removal of gas meters with a maximum capacity not exceeding six cubic meter per hour – medium pressure, second family gas). A national database registry called 'Gas Safe Register' serves as a final industry authorisation for the field staff to operate on residential and commercial gas networks. This is equivalent to Ireland's 'The Register of Gas Installers of Ireland'. Here, the workers' qualifications vary according to further sub-categories of gas operations (e.g. An individual with basic CK1 qualification is allowed to work on connecting cooking appliances, not on metering).

A government-backed body maintains a national registry, and a rule violation based on severity could mean permanent de-licensing. So, if the field staff on the gas network operates without the correct qualification or correct registration, it is considered a criminal offence.

This framework in the UK has proven to be successful, boasting the lowest gas-safety incident rates in the world. This has been possible owing to the institutionalised and accredited professional body – Institution of Gas Engineers and Managers regulating the training procedures and white-listing the installers to operate on consumer premises.

4. Building skillsets – an Indian practice in power utilities

Numerous industrial training institutes (ITIs) and industrial training centers (ITCs) offer vocational courses, but many haven't been able to keep up with industry demands. While the CGD industry has kept up with good practices to remain competitive, the same has not been true for courses offered by the ITIs and ITCs. Another concern is the availability of qualified trainers.

Education and training would enable a better understanding of the nature of pressurised gas pipelines and help improve the skillsets of the workforce involved in the sector. A perfect example of such skilling and training can be found in the electricity segment in India, where programs like USAID - Distribution Reform Upgrades and Management (DRUM) have been successfully implemented in a mission mode.

A few years back, the Ministry of Power (MoP) - Government of India (GoI) and USAID India recognised that the electricity distribution sector was lagging because of a lack of domain knowledge among workers of different levels.

To solve this issue, USAID India designed and funded the Distribution Reform Upgrades and Management (DRUM) project. This project aimed to train distribution utility workers, engineers, and managers on how to improve 'last mile' power distribution quality and reliability in selected urban and rural areas.

Since this sector had deep drawn problems, it required a long and consistent training program to run for the Discoms. The training activity was regionally spread and comprised of 24 courses on 19 subjects. Several geographically dispersed Indian institutions engaged in the power sector and distribution reform activities conducted these trainings.

Initially, 25,000 upper, middle, and lower-level utility employees were to be trained by 2008, but the goal was revised to 35,000 by 2012. This training component developed a culture of training at all levels of electricity utilities, which was well worth USAID's money. Later, Govt of India (GOI) adopted this framework to impart its training under its urban electrification program, R-APDRP.

5. The way forward – conclusion:

Based on the experience in other fields as well as in the CGD business, it is established that

- While workforce deployment is the highest in the downstream segment, there are no prominent training institutes that provide training in this area. Therefore, multiple training institutes on the downstream side of CGD should be encouraged and established.
- Taking into account UK experience, there is a vital need to have an indigenous gas installer / LMC training institute(s) and an associated accreditation body in India to ensure that field staff (gas installers) are well-versed with the best installation practices and are trained by the recognised institutions. A nominated government organisation can monitor this program.
- With the growth of the CGD sector, the Indian power sector and European countries can be used as models for training and skilling. Providing government funding for such training courses will give training the much-needed momentum it currently lacks.
- A mandate by the government to use a certain minimum percentage of skilled workforce will go a long way in strengthening the skilling ecosystem. The Government of India and PNGRB should consider implementing a policy like BS 6400-2.

Such an ecosystem will encourage organisations from the private and public sectors to create better training infrastructure, a suitable course curriculum and collaboration with industry members to meet the training needs.

Developing a skilled workforce will lead to Health, Safety, Security, and Environment (HSSE) friendly operations, which are crucial to CGD's success.

Heavy Metal Accumulation in Marine Sediments - An Assessment in ONGC's Platforms in Mumbai High Region, Arabian Sea

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Abstract

Heavy metal pollution, in the aquatic ecosystem, especially sediments, has become an area of concern garnering increasing attention since the past few decades. Some metals like manganese (Mn), copper (Cu), iron (Fe) and zinc (Zn) are biologically important for marine life, others like lead (Pb), cadmium (Cd), and Arsenic (As) are non-essential and become toxic at higher concentrations. These metals introduced into the marine ecosystem mainly due to anthropogenic activities. These heavy metals when discharged into the marine ecosystem may be absorbed in suspended solids, remain in seawater, etc., but ultimately end up in the sediments which act as a "sink" and later the "source", due to their restricted mobility. Hence, monitoring the heavy metal concentrations in these marine sediments over a period of time is of great help in checking the pollution level and identifying the trend, which in turn will be instrumental in formulating sustainable practices.

The paper mainly focuses on the study of the concentration of non-essential heavy metals in sea sediment around the operational areas of ONGC in western offshore area. The distribution of heavy metals in the sediments of ONGC's exploratory blocks in Mumbai High Region, Arabian Sea was investigated. Surface sediment samples collected from 5 platforms (R-12A, WO-16, NBP, B-48 and SCA) of Mumbai High Region, Arabian Sea and digested samples were analyzed by ICP-MS for As, Cd and Pb. Comparison of results in studied 5 platforms with various sediment quality guidelines is discussed to assess the present contamination. It reveals that sediments in study area are not contaminated with respect to perceived heavy metals. Generated data will assist in future for proactive measures and minimize the impact of anthropogenic sources.

Keywords: Heavy metal pollution, Mumbai High, sediment

Introduction

Marine environmental pollution is a growing concern today. There are a lot of activities (both anthropogenic as well as natural) that may contribute to marine pollution, E&P activities of Oil and Gas companies being one of them. ONGC, one of the most valued Maharatnas of India, is committed to adopting sustainable E&P practices in its offshore installations, in order to protect and preserve our marine ecosystem. Hence, ONGC through its institute IPSHEM, has been conducting regular offshore environmental monitoring in the Western Offshore region. The aim of this study is to paint an overview of the environmental status and trends over time in relation to our offshore E&P activities- to indicate whether the environmental status is stable, deteriorating or improving.

The study of heavy metals in the marine sediments is particularly important in comparison to other parameters due to their non-biodegradable nature, accumulative properties and long biological half-lives. Heavy metals like Arsenic (As), cadmium (Cd), and lead (Pb) are non-essential and when discharged into the marine ecosystem may be absorbed in suspended solids, remain in seawater, etc., but through various physical, chemical or biological mechanisms ultimately end up in the sediments which act as a “sink” and later the “source”, due to their restricted mobility. They are potential threats to the ecosystem because they could be concentrated and biomagnified at sufficiently high concentrations, and sometimes be converted to more toxic organic compounds. Therefore, the distribution of such toxic metals in sediments, over a period of time, might provide evidence for human activities and their effects on the marine ecosystem. For this reason, sediments are most commonly chosen as environmental indicators of the quality and potential risks within aquatic systems.

The study is intended to determine the present level of three metals (As, Cd, and Pb) concentrations in sediments of ONGC platforms (R-12A, WO-16, NBP, B-48 and SCA) of Mumbai High Region, Arabian Sea. Pollution status of collected sediments was assessed by comparing with sediment quality guidelines (SQG). Marine environmental researchers use SQGs as useful tool to assess quality and toxicology of sediments as they provide comprehensive assessment. The results of this study, can be considered as base-line data, will help for proactive measurements to manage and control pollution in coastal region. Thus, study is vital so that any change caused by anthropogenic sources over a period of time can be monitored and managed.

Study Area

Mumbai High Region, Arabian Sea is considered significant address for oil and gas reserves. The study area extends from ***18°16'20.32"N*** to ***19°37'32.77"N*** and ***71°1'40.59"E*** to ***72°22'48.52"E.*** (Table 1)

Table 1: The coordinates of each Platforms

Sr. No.	Platform	Latitude	Longitude
1	R-12A	18°16'20.32"N	72°22'48.52"E
2	WO-16	18°58'16.34"N	71° 37'18.03"E
3	NBP	18°36'9.93"N	71° 1'40.59"E
4	B-48	19°37'32.77"N	71° 2'23.97"E
5	SCA	19°25'2.25"N	71°23'22.08"E

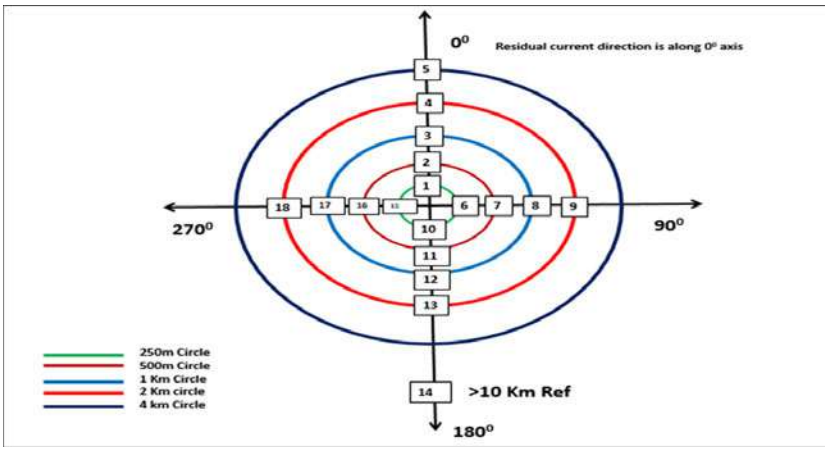
Fig1. Map showing the location of sampling stations in the study area

Sampling Methodology

OSPAR (Oslo and Paris) Commission Guidelines have been followed, as shown in Figure 2.

A Van Veen Grab of 25 cm x 30 cm dimension and approximately 1.5 kg capacity having a penetration depth of 10 cm was used for collection of sediments, from the sampling vessel. This medium version of the grab was used to prevent likely damage to pipelines etc. in case of any accidental strike on flow lines. Prior to deployment, the grab was cocked with the safety key in place. The grab was then hoisted over the side, the safety key was removed, and the grab was lowered at 2 m/sec until it was 5 m above the bottom. From this point, it was lowered at 1 m/sec to minimize the effects of bow wave disturbance. After bottom contact had been made (indicated by slack in the lowering wire), the tension on the wire was slowly increased, causing the lever arms to close the grab. Once the grab was back on board, the top doors were opened for inspection.

Figure 2: OSPAR Commission Sampling Strategy



Procedure for Sample Analysis

From the bulk sediment, a representative subsample was transferred to an oven and dried at 50 ± 2 ºC. The homogenized samples were then ground to powder in granite mortar with a pestle and kept in a pre-cleaned container for further analysis. Trace metal extraction was carried out following the standard method EPA 3052. Approximately 200 mg of homogeneous sediment sample was digested with 6 mL of nitric acid and 3 mL of perchloric acid in Teflon vessels for 50 minutes using a closed microwave reaction system for 12 h. After cooling the vessel completely, dissolved samples were then filtered through Whatman filter paper and diluted to 25 mL with milli Q water. The extract was stored in polythene bottles at 4°C for the analysis of trace metals. In order to obtain more accurate data, all the glassware and Teflon sample cups in this study were soaked with 5% nitric acid, rinsed with milli-Q water, and dried to eliminate potential contamination.

Table 2: Average metal concentration in ppm (mg kg−1 or µg/g) of each Platforms

Platform	^{75}As	^{111}Cd	^{208}Pb
R-12A	5.52	0.10	1.87
WO-16	6.66	0.07	1.74
NBP	3.00	0.04	0.83
B-48	6.25	0.15	2.93
SCA	3.66	0.04	1.25

An inductively coupled plasma mass spectrometer (ICP-MS; model Agilent 7700) was used for determination of trace metals concentration. Background correction and matrix interference were monitored throughout the analysis. The accuracy was examined by analysing all samples in duplicate. The analytical concentrations of the selected metals of our interest were listed in Table 2 & Table 4.

Table: 4 - Heavy Metals in Sediments (mg kg^{-1} or µg/g) around Installation

DISTANCE	DIRECTION	HEAVY METALS IN SEDIMENTS (all values in mg kg^{-1} or µg/g)														
		R-12A			WO-16			NBP			B-48			SCA		
		^{75}As	^{111}Cd	^{208}Pb	^{75}As	^{111}Cd	^{208}Pb	^{75}As	^{111}Cd	^{208}Pb	^{75}As	^{111}Cd	^{208}Pb	^{75}As	^{111}Cd	^{208}Pb
250m	N	5.98	0.11	1.74	7.53	0.09	2.15	3.91	0.05	1.01	7.31	0.11	3.07	3.48	0.04	1.22
	S	4.76	0.11	1.84	7.43	0.09	2.89	5.27	0.06	1.13	6.98	0.17	3.01	4.55	0.05	1.07
	E	5.28	0.09	1.88	7.43	0.08	1.81	2.83	0.09	1.18	6.58	0.15	2.90	2.63	0.06	0.82
	W	6.58	0.12	1.96	6.63	0.08	1.60	3.44	0.05	1.13	5.09	0.16	2.76	2.91	0.04	0.82
500m	N	6.46	0.14	2.51	7.28	0.08	2.40	3.15	0.03	0.89	6.24	0.17	2.95	2.72	0.02	0.68
	S	5.66	0.10	1.90	7.65	0.09	2.65	4.64	0.04	1.08	7.76	0.18	3.41	4.16	0.04	0.86
	E	5.47	0.12	2.20	6.99	0.08	1.57	2.39	0.02	0.76	5.74	0.16	2.70	3.97	0.03	1.13
	W	6.38	0.13	2.17	8.31	0.07	1.61	3.21	0.03	0.96	6.68	0.14	2.82	3.79	0.05	1.16
1km	N	6.08	0.10	1.96	6.81	0.06	1.82	2.68	0.03	0.73	6.38	0.16	2.98	3.19	0.04	1.76
	S	5.77	0.11	1.79	5.31	0.06	1.59	3.05	0.04	0.73	6.63	0.15	3.33	4.62	0.06	3.67
	E	5.21	0.10	1.78	6.04	0.06	1.34	2.57	0.04	0.77	5.82	0.16	3.11	3.64	0.07	1.22
	W	5.93	0.10	1.93	6.73	0.06	1.52	3.46	0.04	0.77	5.59	0.17	3.05	5.49	0.07	1.34
2km	N	5.37	0.10	1.95	6.23	0.07	1.64	2.57	0.02	0.77	6.30	0.11	2.53	2.96	0.03	1.00
	S	5.01	0.09	1.59	6.20	0.07	1.70	2.33	0.02	0.63	6.55	0.14	3.08	4.36	0.04	1.40
	E	5.13	0.09	1.67	6.20	0.07	1.33	2.28	0.03	0.69	6.58	0.13	2.99	3.35	0.05	1.19
	W	4.82	0.09	1.64	5.88	0.06	1.19	1.88	0.04	0.56	5.06	0.18	2.50	3.44	0.03	1.03
4km	N	4.59	0.06	1.52	5.85	0.06	1.31	2.17	0.02	0.52	5.27	0.15	2.77	3.44	0.03	1.06
10km	NW	4.82	0.10	1.59	5.46	0.04	1.18	2.10	0.03	0.54	6.04	0.15	2.86	3.24	0.03	1.01
Average		5.52	0.10	1.87	6.66	0.07	1.74	3.00	0.04	0.83	6.25	0.15	2.93	3.66	0.04	1.25

Results and Discussion

The sediments of the present study area were mainly composed of clay-silt (>90%) with varied proportions of clay (29-52%), silt (35-49%) and sand (10-12%). Silt and clay were the dominant textural class at all the sampling locations. Relative high ratio of sand in comparison with deep ocean platforms in Arabian Sea may be due to lower water depths and enormous river influx. In this study, the concentrations of selected Three heavy metals in sediments were measured (Table 2). These three metals Arsenic (As), Cadmium (Cd), and Lead (Pb) cause a serious threat to aqua system at higher concentration.

In the present investigation, average concentrations of different platforms in sediments of present study area varied from 3.00 to 6.66 mg kg^{-1} for Arsenic, 0.04 to 0.15 mg kg^{-1} for Cadmium, and 0.83 to 2.93 mg kg^{-1} for Lead. It is noticed that the distribution of metal concentrations in the sediments of study area has not followed particular trend as concentration varied from one location to another but variation is found minimum when area, depth, and other oceanographic parameters are concerned. It was also documented that all measured metals were found nearly uniformly distributed across all the sampling sites.

These obtained metal concentrations were compared with sediment quality guidelines to assess present marine pollution status with respect to perceived metals and impact of industrial and economic activities in this area. Table 3 shows guidelines used in present study; sediment criteria proposed by EPA, CBSOG Consensus-Based Sediment Quality Guidelines, New York Sediment Criteria for metals and Provincial Sediment Quality Guidelines for metal contents in marine sediments. According to SQGs, more toxic metal is Cd followed by As, and Pb respectively in terms of concentration which indicates that a high percentage of the concentration is likely to have adverse effects on sediment organisms. Metals concentration higher than ISQG-L level which indicates these elements probably have adverse effects on organisms that live in sediment.

Table 3: Comparison of average concentration heavy metals obtained in this research with Sediment Quality Guidelines (mg kg^{-1} or µg/g)

Sediment Quality Standard / Element	As	Pb	Cd
Present Study	3.0 – 6.66	0.83-2.93	0.04 - 0.15
EPA Sediment Quality proposed			
Non-Polluted	---	<40	---
Slightly Polluted		40-60	
Severely Polluted	---	>60	>6
CBSOG SQG*(2003)			
Non-Polluted	<9.8	<40	<0.99
Moderately Polluted	9.8-21.4	40-70	0.99-3
Heavily Polluted	>21.4	>70	>3
New York Sediment Criteria			
Lowest effects range	6	32	0.6
Sever effects range	33	110	9
Sediment Quality Criteria Guidelines(1992)**			
Lowest effects range(ISQG-low)	6	31	0.6
high effects range(ISQG-high)	33	250	10
Safe limit of Dutch guidelines***	55	530	12
Oman Gulf ****	15.1	11.62	5.02

It is observed that metal contents in sediments are fall under non-polluted category with respect to perceived metals but the concentration of Chromium and Mercury in few samples is nearing to threshold limit. This may be considered as a serious threat for aquatic organism and human being health. Present relative lower values could be due to the basic nature of the sediments and also due to great turbulence which basically restrict the accumulation of trace metals into the sediment. Therefore, it may be concluded that studied sediments are not contaminated in terms of studied heavy metals. Though the precise source of current metal inputs in the study area is accurately unknown and, hence requires further research. However, observed concentrations are believed to have perhaps been enriched through natural processes, industrial activities around the study area and polluted river water influx.

The results of this study supply valuable information about the metal contents in sediments from different sampling stations of the Mumbai High Region, Arabian Sea. This can be considered as a bio-indicator of the environmental contamination in this zone by estimating the bioavailability of metals to the marine biota.

Conclusion

The results of present study emphasise that heavy metal concentrations in sediments of 5 platforms ***(R-12A, WO-16, NBP, B-48 and SCA)*** of Mumbai High Region, Arabian Sea were on absolutely lower side and well comparable with the reported values of available oceanographic scientific literature. This can be thought to have resulted from absence of significant anthropogenic influence around the study area. In relation to this, the low metal contents found in all the studied sediment samples are insufficient to cause any toxicological effects on human health when seafood is included in the diet. Therefore, sediments in present study area in Bay of Bengal are not polluted with respect to heavy perceived metals but requires regular monitoring of marine environment, particularly zones where industrial operations are planned.

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Disclosure of conflict of interest
The authors declare no conflict of interest.

References
[1] Xin Jiang, et al, Distribution and pollution assessment of heavy metals in surface sediments in the Yellow Sea, Marine Pollution Bulletin 83 (2014) 366–375.
[2] Feng Ye, et al, Distribution of heavy metals in sediments of the Pearl River Estuary, Southern China: Implications for sources and historical changes, Journal of Environmental Sciences 24(2012) 1–10.
[3] Hasrizal Shaari, et al, Spatial Distribution of Selected Heavy Metals in Surface Sediments of the EEZ of the East Coast of Peninsular Malaysia, International Journal of Oceanography, Volume 2015, Article ID 618074.
[4] O.J. Aderinola, et al, Heavy Metals in Surface Water, Sediments, Fish and Perwinklesof Lagos Lagoon, American-Eurasian J. Agric. & Environ. Sci., 5 (5): 609-617, 2009, ISSN 1818-6769.
[5] Luoping Zhang, et al, Heavy metal contamination in western Xiamen Bay sediments and its vicinity, China, Marine Pollution Bulletin, 54 (2007) 974–982.
[6] Sukalyan Chakraborty, et al, Benthic macroalgae as biological indicators of heavy metal pollution in the marine environments: A biomonitoring approach for pollution assessment, Ecotoxicology and Environmental Safety100 (2014)61–68.
[7] Rui Zhang, et al, Heavy metal pollution and assessment in the tidal flat sediments of Haizhou Bay, China, Marine Pollution Bulletin 74 (2013) 403–412.
[8] A.W. Muohi, et al, Heavy metals in sediments from Makupa and Port–Reitz Creek systems: Kenyan Coast, Environment International 28 (2003) 639– 647.
[9] N. Balkıs, et al, Heavy metals in shallow sediments from the Black Sea, Marmara Sea and Aegean Sea regions of Turkey, J. Black Sea/Mediterranean Environment, Vol. 13:147-153 (2007).
[10] G. Suresh, et al, Spatial and vertical distributions of heavy metals and their potential toxicity levels in various beach sediments from high-background-radiation area, Kerala, India, Marine Pollution Bulletin 91 (2015) 389–400.
[11] Humood A. Naser, Assessment and management of heavy metal pollution in the marine environment of the Arabian Gulf: A review, Marine Pollution Bulletin 72 (2013) 6–13.
[12] Henry Vallius, et al, Classification of heavy metal contaminated sediments of the Gulf of Finland, Baltica 16 (2003) 3-12.
[13] B.Tavakoly Sany, et al, Assessment of Sediment Quality According to Heavy Metal Status in the West Port of Malaysia, International Journal of Environmental, Chemical, Ecological, Geological and Geophysical Engineering Vol:5, No:2, 201
[14] IPSHEM, ONGC. Offshore Environmental Monitoring Projects of Western Offshore Region for the year of 2021-22 (Unpublished reports).
[15] OSPAR Guidelines for Monitoring the Environmental Impact of Offshore Oil and Gas Activities, 2004-11.

Budget 2023 – Direct Tax Expectations – Oil & Gas Sector

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A. Overview of Oil and Gas Industry

The oil and gas sector is among the core industries in India and plays a major role in influencing decision making for all other important sections of the economy. India had crude petroleum reserves of 587.33 million tonnes and 1,372.62 billion cubic metres of natural gas reserves as at 1 April 2021[1].

However, due to the size of the population of India, the demand for such fuel far exceeds current reserves, which result in substantial import of oil and gas in India.

The reliance on imports would be reduced by accelerating the exploration and production ('E&P') activities in India, which could be boosted by various measures from the Government of India ('GOI'). In recent times, the GOI has tried to boost the domestic production in India through the introduction of various reforms in existing policies and new framework to enhance domestic production and incentivize enhanced recovery methods. However, the sector has experienced several challenges from direct tax perspective due to factors such as removal of tax holidays, litigation on existing incentives, etc. Hence, to attract better traction and investments, it is important to tackle these issues to provide certainty and clarity.

[1] *https://www.mospi.gov.in/documents/213904/1606151//Energy%20Statistics%20India%2020221644825594802.pdf/aed59aac-4d5a-995b-1232-bb68397cd873*

B. Overview of Current Tax Regime

Indian incorporated companies

Currently, Indian companies having turnover of more than INR 400 crore are taxed at a maximum marginal tax rate of 34.94 per cent. All other companies are taxable at a maximum marginal tax rate of 29.12 per cent. However, such companies are entitled to claim various exemptions, incentives, etc. provided under the provisions of the Income-tax Act, 1961 ('the Act'). Taking cues from the global economic turmoil, there was an increased need to boost economic business investments in India and generate employment. Accordingly, the GOI on 20 September 2019 has announced several direct tax measures to reduce the corporate tax burden on Indian companies. A summary of relevant announcements is as under:

► Option to apply reduced corporate tax rate of 22 per cent (25.17 per cent including surcharge and cess) for Indian companies not claiming any exemption, incentive benefits, on satisfaction of certain conditions;

► Option to apply concessional corporate tax rate of 15 per cent (17.16 per cent including surcharge and cess) for companies' setup and registered on or after 1 October 2019, which begins manufacturing on or before 31 March 2024, on satisfaction of certain conditions;

► No Minimum Alternate Tax ('MAT') for companies who opt for reduced rate of taxation of 22 per cent / 15 per cent. Reducing MAT rate to 15 per cent (excluding surcharge and cess) for all other companies.

Foreign companies

Foreign companies are taxed at a marginal maximum tax rate of 43.68 per cent (no changes in tax rate of foreign companies in recent direct tax measures announced by GOI). Under Double Taxation Avoidance Agreements ('DTAA') signed between India and another country, a foreign company is liable to pay tax in India from its business operations, in case the said entity constitutes a Permanent Establishment ('PE') in India. Entities engaged in the business of exploration, extraction or production of gas assets may constitute a PE in India depending on the terms of each DTAA, and only income attributable to the said PE would be taxable in India.

Further, under Section 44BB of the Act, an option to avail presumptive tax regime is provided to a non-resident service providers to oil and gas companies operating in India. Under these provisions, the taxpayer shall be allowed to offer 10 per cent of their gross receipts as profits and compute tax thereon.

C. Key tax benefits/ incentives expected

GOI is on the verge of revising, consolidating and simplifying the existing direct tax laws by amending the domestic tax laws. In order to give impetus to businesses in India, it is wished that GOI could provide tax incentives by way of lower tax rates, additional deductions and relaxations of similar nature. In the ensuing paragraphs, we have discussed key tax benefits/ incentives wished as a result of such changes, along with global developments, which may impact the sector.

i. Lower corporate tax rates for foreign companies:

A current overview of the Indian tax regime has been depicted in the previous paragraphs. It is noteworthy that a domestic company is now taxed 25.17 per cent or 17.16 per cent, the corporate tax rates for foreign companies in India still stands at a steep 43.68 per cent.

Further, the Act also provides, under Section 115BA, an incentive to domestic manufacturing/ production companies to offer their incomes to tax at a reduced rate of 25 per cent.

While the GOI has taken steps to attract domestic investors, it is pertinent to understand the significance of foreign investment in the growth of Indian economy. To make India an attractive jurisdiction for business investments, the industry wished that the GOI brings down the high tax rates applicable to foreign companies to bring about parity with tax rates for domestic companies. Thus, industry would wish that the reduced tax rate of 17.16 per cent applicable to domestic companies, be applicable to companies in the oil and gas sector to make the sector more attractive to investments.

ii. Removal of MAT for Oil and Gas Companies

MAT is an alternate mechanism to tax companies having tax payable, under normal provisions of the Act, lower than 15 per cent of book profits. The aforesaid provisions of MAT are not applicable to non-resident taxpayers opting for taxation under the presumptive provisions of 44BB of the Act.

However, keeping in mind the long gestation period and high uncertainty involved in the oil and gas business, and to provide an impetus to the sector in general, it would be an industry wish that MAT should not be applicable to all oil and gas companies operating in India.

iii. Tax holiday for Oil and Gas Companies

Oil and gas companies in countries such as Thailand enjoy tax holiday for 8 years pursuant to signing of the Production Sharing Contract ('PSC'). In India also, tax holidays were provided to companies in E&P sector. To boost investment and provide a fillip to the oil and gas sector, the industry would hope that the GOI introduces a tax holiday framework for oil and gas companies in India.

iv. Relaxation on conditions to claim deduction under Section 42 of the Act

Under the current tax regime, the taxpayer is allowed to claim 100 per cent deduction of capital expenditure incurred on E&P assets under Section 42 of the Act. To claim the said deduction, the Act requires the production sharing contract as well as revenue sharing contract entered into by E & P Company with the GOI to be tabled before each house of the Parliament. It has been observed that such contracts are not tabled before the Parliament immediately upon signing of contracts and at times takes years before the same is tabled. Accordingly, such companies face serious challenges in tax proceedings while claiming allowance under Section 42 of the Act. The industry would wish that the GOI remove the tedious burden as these contracts are already signed by the President of India.

Further, under Section 42 of the Act, taxpayers may be allowed to claim expenses that were incurred towards infructuous or abortive exploration. However, for such claim of expenses, there currently exists a pre-requisite to surrender the exploration area of abortive or infructuous exploration. The timing difference between abandoning an exploration area and surrendering it to the GOI may lead to disallowance of such expenses in a year of abandonment and deferral of the allowance until the year in which the exploration area is surrendered. Industry would wish that the GOI brings about a clarification that expenditure towards infructuous or abortive exploration be allowed in the very year of abandonment of the exploration area and the requirement to surrender the abortive exploration area be waived off.

v. Necessary clarifications for specified businesses

The Act provides for deductions in respect of capital expenditure incurred for the purposes of "laying and operating cross-country natural gas or crude or petroleum oil pipeline network for distribution, including storage facilities being an integral part of such network".

100 per cent deduction for capital expenditure is available for companies engaged in laying and operating cross-country natural gas or crude or petroleum oil pipeline network. However, there is lack of guidance on application of the aforesaid provision. Scope of the term 'cross-country' is unclear. Thus, it needs to be clarified whether this provision can be applied to pipeline used within the city gas distribution network spanning from one city to another or whether it can be applied for pipeline spanning from one state to another.

Interestingly, the prescribed rules define natural gas pipeline to include spur lines but excludes pipelines in a city or local natural gas distribution network. Accordingly, there is uncertainty whether aforesaid deduction can be claimed by companies engaged in the business of operating a cross country pipeline under domestic tax laws of India. Therefore, inadvertently, the intended benefit to oil and gas pipelines is not actually available to crude oil pipelines and the pipelines dedicated to the supply of petroleum products to a specific consumer. It is wished by the industry that the GOI waives off the requirement to obtain PNGRB approval for crude oil pipelines to be eligible to claim the intended tax benefits under this provision.

vi. Widening the scope of presumptive taxation regime

Section 44DA of the Act provides for taxability of royalty and fees for technical services received by a non-resident through its business presence in India.

As discussed in preceding paragraphs, Section 44BB of the Act provides a deeming fiction which allows the taxpayer to offer 10 per cent of its gross receipts as business profits and compute tax thereon. This section explicitly carves out incomes that a taxpayer may earn under Section 44DA of the Act. As a result, such taxpayers are not given the option to offer royalties or fees for technical services, arising on account of providing services to oil and gas companies, under the presumptive taxation mechanism under Section 44BB of the Act.

Applicability of presumptive tax regime (viz. Section 44BB of the Act) to certain foreign companies are challenged and, in many cases, benefit of presumptive taxation is denied on the grounds such as:

- ► Services rendered by foreign companies do not have proximate nexus to field operations (for e.g. design and engineering done outside India);
- ► Foreign companies engaged by sub-contractors are not eligible for presumptive taxation;
- ►Foreign companies rendering decommissioning services in relation to oil and gas fields are denied the presumptive taxation; and
- ► If foreign company is rendering a bouquet of services, only income earned from certain services are eligible for presumptive basis of taxation.

This is a practical difficulty that taxpayers are facing, and the industry would hope that GOI widen the scope of Section 44BB to allow such service providers to offer income from aforesaid activities under Section 44BB since the activities are in connection with the prospecting and extraction of mineral oil.

D. Final thoughts

With the hope to push the oil and gas sector, the industry would hope for several amendments to the Act in the upcoming Budget 2023 to reduce the complexities and bring a welcoming change to oil and gas sector.

The information contained herein is of a general nature and is not intended to address the circumstances of any particular individual or entity. The views and opinions expressed herein are those of the author.

Oil & Gas in Media

Dance to Decarbonise, the first public awareness event in the run-up to India Energy Week 2023

'Dance to Decarbonise', the first public awareness event organised on 23rd December 2022 by Ministry of Petroleum and Natural Gas, in the run-up to India Energy Week 2023, which is scheduled to be held in Bangalore from 6th to 8th February 2023. During the event, renewable energy generated through dance was used to charge electric vehicles.

Addressing the gathering at one of a kind musical event, the Minister said that this initiative underscores the importance of LIFE - which calls for living a lifestyle which is in harmony with the environment and doesn't harm it. The clarion call for a lifestyle for environment was given by our Prime Minister during CoP26 and has resonated strongly with the many stakeholders.

Highlighting the significance of India Energy Week in today's transforming energy landscape, where countries and companies alike are constantly facing new challenges and meeting new opportunities, Shri Hardeep S. Puri said that IEW is going to be an ideal platform for policymakers, business leaders, researchers, and entrepreneurs to contemplate, deliberate and take decisive steps to navigate this ever-evolving energy scenario.

Elaborating on India's journey of energy transition to achieve its 'Net Zero Target', the Minister said that India is undertaking an ambitious journey of energy transition to achieve its 'Net Zero Target' by 2070. However, for the transition to be enduring and stable it is imperative that the accessibility and affordability aspects of energy remain intact.

He said that in coming decades India's energy base load will be met by hydrocarbons. In this context, Government has undertaken landmark reforms in the upstream, midstream, and downstream sectors of Hydrocarbon industry in India, he said.

The event 'Dance to Decarbonise', witnessed attendance by dignitaries from the industry including cabinet ministers, Member of Parliament, officials from MOP&NG, Ambassadors/Diplomats of foreign countries, CEO's/Senior executives of select industries, EV manufacturers through SIAM, Leading Airlines Officials, Oil PSU associates in Defence, Border Road organisations, PSU associates in Railways, PSU sports persons and Senior officials from Oil PSUs.

India is projected to witness the largest increase in energy demand by any country over the next two decades as the economy continues to grow and create opportunities for its people, as well as for the global value chain. Achieving India's target of net-zero emissions by 2070 needs to be weighed against the country's growing economy, rising energy requirements, and the implementation of responsible energy sources over transformational energy systems for the future.

The inaugural event - India Energy Week comes at a critical time, with the challenges such as energy security and environmental sustainability impacting long-term energy transition and paths towards decarbonisation. As a rapidly developing country, and soon to be the world's most populous nation, India's energy transition will play a pivotal role in global energy markets.

As India's largest and all-encompassing energy event, India Energy Week brings international energy stakeholders from 100+ countries across the full value chain to Bengaluru. Over 1,000+ exhibiting companies, NOCs, IOCs, NECs, and IECs and 10 global country pavilions will drive India's energy transition conversation forward, and will connect the energy community together to discuss trends, address challenges and collaborate, for upcoming opportunities. More than 30,000 energy professional, 650 exhibiting companies, 8,000 conference delegates and 500 international speakers will attend India Energy Week, which will cover 80 conference sessions.

With a focus on sustainable solutions, the company has been on the forefront when it comes to collaborating with government ministries, non-profit organizations and other implementing agencies to achieve a sustainable development.

Curtain Raiser Programme of 1st edition of India Energy Week 2023

The Curtain Raiser of India's flagship Energy Event "India Energy Week 2023 "(IEW 2023), was organised at the Bangalore palace, Bengaluru on 16th December 2022. Shri Hardeep S. Puri, Minister of Petroleum and Natural Gas & Housing and Urban Affairs, inaugurated the curtain raiser. The curtain raiser was attended by representatives of Global Energy Majors, leading Indian companies from Karnataka including from Energy, IT, financial companies, members of the international diplomatic community etc. Shri Basavaraj Bommai, Hon'ble Chief Minister of Karnataka was the Chief Guest for the occasion.

The Curtain Raiser marks the beginning of number of preparatory events being hosted in the run up to the India Energy Week 2023. Various other events lined up include "Dancing charge Electric Vehicles" on 23rd December 2022 at Kartavya Path, New Delhi, a "car rally of Sustainable Fuel Vehicles" from New Delhi to Manesar, on 8th January 2023, to name a few, which will showcase India's multiple pathways for a cleaner and greener energy future.

Expressing delight on organisation of India Energy Week in Bangalore in February, 2023, the Minister for Petroleum & Natural Gas Shri Hardeep S. Puri said that Bangalore is a city that has grabbed attention not just with in country but also globally due to the spirit of innovation, entrepreneurs talent, start ups particularly in energy sector. In addition to the location for IEW, the context setting becomes necessary, he said. He further said that energy today in Indian context assumes significance, economic growth. Indian growth is 3 times of that of global growth. We have taken steps in exploration, production, biofuels, refinery sector, green hydrogen. Today the buzz around world is that significant part of energy demand in future will be from India.

The challenge for India is that it has to meet the energy demand of fast emerging economy. Talking about Prime Minister's vision of Amrit Kal, Shri Puri said that India will not only be a developed nation by 2047 in line with PM's vision of Amrit Kal and at the same time we will not deviate from commitment towards Green Transition.

During the event, the Minister stated that under India's presidency of G20, we want to set up International Biofuel Alliance.

During the curtain raiser, Shri Hardeep S. Puri highlighted the tremendous strides India has made in the Energy Sector including in making India an investment friendly destination in the Exploration and Production Sector, energy infrastructure and for shifting the manufacture centre to India. Some of these initiatives included; reducing 'No Go' areas by almost 99%, easy access to data through the National Data Repository (NDR) project and Hydrocarbon Resource Assessment (HRA) project, launching of stratigraphic wells initiative, robust City Gas Distribution system, considerable impetus to gas infrastructure etc.

Minister also reiterated the steps the government was taking to ensure that the 60 Million consumers who on average visit the petrol pumps on a daily basis are safeguarded from the extreme volatility visible in global energy markets. He also welcomed all the participants to join the Indian grown story and invited the attendees to IEW 2023.

India Energy Week 2023 is being organised during India's G20 Presidency, under the tagline "Growth, Collaboration, Transition", from 6-8 February 2023 in Bengaluru. The India Energy Week 2023 is expected to feature more than 30 energy Ministers, 50 CEOs and 10000+ delegates. It will provide a unique opportunity to showcase India as both an engine of global economic growth and a driver for global consumption, supported by a conducive and investment-friendly environment, and a skilled workforce. IEW 2023 will provide an unprecedented opportunity for regional, international leaders and CEOs to come together for strategic policy making and technical knowledge sharing.

During the IEW 2023, through 19 strategic conference sessions, the comprehensive gamut of issues covering the entire energy sector would be discussed and deliberated by panels of Energy Ministers from various countries, CEOs / leaders of Energy Majors, etc.

The Strategic Conference of IEW 2023 covers themes such as Energy Security, pathways for decarbonization, Resilient Energy Supply Chains, Emerging Fuels such as Biofuel and Hydrogen, Investments in Upstream and Midstream Sector etc. Besides the Strategic Conference, IEW 2023 will also have Technical and Commercial Conference Sessions, wherein critical aspects of prevailing and prospective energy market scenarios will be deliberated upon.

Ministry of Petroleum amends Natural Gas Tariff, Authorisation and Capacity Regulations

To accelerate the development of the natural gas infrastructure and usher rapid growth of natural gas market in the country, Petroleum and Natural Gas Regulatory Board (PNGRB) has brought out amendments in its three regulations namely Natural Gas Pipeline Tariff, Authorisation and Capacity Regulations. These amendments will act as stepping stone for implementation of Unified Tariff regulations which will be effective from 1st April 2023. To address the settlement issues for implementation of Unified tariff, industry committee has been constituted.

The objective of these changes is to provide access of natural gas in the far-flung areas at the competitive and affordable rates to achieve the long-cherished objective of one nation one grid and one tariff. To simplify the implementation of unified tariff, entity level Integrated natural gas pipeline tariff has been introduced in the said regulations which will act as a building block for unified tariff at national level. Further to protect the overall interest of consumers in different regions number of unified tariff zones have been increased from two to three.

In addition, other amendments like allowing unaccounted gas, moratorium period, ramp up in capacity, etc., have been incorporated.

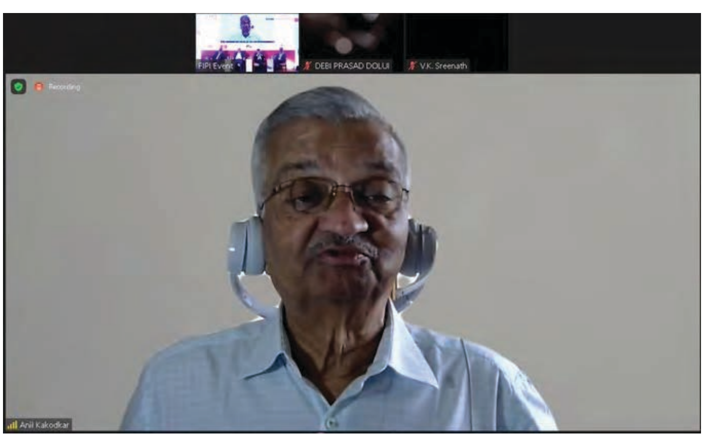
Events

R&D Conclave 2022

Federation of Indian Petroleum Industry (FIPI) organised a three-day R&D Conclave from 16th November to 18th November 2022 at Jaypee Residency Manor, Mussoorie. This year's theme of the Conclave was "India's journey towards Net Zero". The event was being organized with the focus to drive the industry forward through innovation and collaboration while managing the need for climate change.

The broad topics that were discussed included- electric mobility, role of Hydrogen in energy transition, role of CCUS, refineries of the future, biomass value chain, energy storage, carbon financing solutions etc. The conclave witnessed a wide participation of companies across the upstream, midstream, downstream, and technologies domain. The workshop was attended by more than 150 delegates (physically and virtually) and was appreciated in terms of content by everyone.

The Welcome Address at the inaugural session was delivered by Mr. TK Sengupta, Director (Exploration & Production), FIPI. Mr. Sengupta welcomed the delegates and mentioned that R&D in oil and gas industry plays a pivotal role in the company's scale of operations for providing techno-economical solutions for the problems faced in the areas of exploration, drilling, production and transportation of crude oil and natural gas. In the light of climate change and global warming, apart from its routine nature of operations, R&D sector has also assumed the responsibility of integrating low-cost carbon free renewables into the hydrocarbon mix.



Dr. Anil Kakodkar, Chancellor, Homi Bhabha National Institute; Chairman, Rajiv Gandhi Science & Technology Commission and former Chairman, Atomic Energy Commission delivered the special address virtually. He said R&D would have to plays a crucial role in India's journey towards net zero. The energy transition in today's world includes a shift from fossil fuel-based energy sources to low carbon energy sources such as renewables, hydro and nuclear along with CCUS in conjunction with fossil energy sources, hydrogen etc. Biofuels would become the key for meeting energy needs of kitchens in rural and urban areas. The energy transformation will have spill over effects in terms of eliminating costly crude oil imports as clean energy sources can be mostly produced domestically, and also in term of new technological deployment in the demand side. Hydrogen, production, initially through electrolysis and later through thermochemical splitting of water, along with its utilisation in hard to abate segments will become a major part of the energy economy.

Dr. R.K. Malhotra, Professor of Practice (Adjunct) in Depts. of Energy at IIT, Delhi delivered the Special address on R&D needs in the era of Energy Transition. He said that with rising population & urbanisation, the energy demand is bound to rise and thus there is greater need of clean energy sources that can take care of the rising energy demand as well as emit less/zero CO2 emissions in the atmosphere. India's expanding natural gas network, massive bio-mass potential, and great push for renewable energy, hydrogen and EVs, offers opportunity to achieve a decarbonised future. Under refineries segment, process intensification and flexibility to vary product mix is the key to achieve higher efficiency and lower CO2 emissions.

Mr. Sanjay Khanna, Director (Refineries), BPCL delivered the Special address on Net Zero initiatives. He mentioned that India currently stands at 4th position in renewable energy (mainly solar and wind) and the ranking is expected to improve further in the coming decades. The positive growth rate in GDP as well as geographical versatility are another positive aspect that will help in harnessing the clean energy sources. In terms of challenges, energy trilemma exists in India – which includes affordability, accessibility & sustainability that needs to be addressed. BPCL's plans to rigorously follow several steps in order to become net zero. The ways adopted by BPCL to increase energy efficiency include- reducing steam consumption, methods to convert turbine drive to motor drive or electrical re- tracing etc.

Dr. SSV Ramakumar, Director (R&D), IOCL delivered the Special address on Net Zero initiatives. He mentioned that IOCL has the ambition to be "operational net zero" by year 2046. The energy & innovation trends in year 2022 mainly depends on 3 factors- decarbonisation, decentralisation, & digitalization. HE said that India cumulatively accounts (since 1970) – only 4% and 1.9% of total global CO2 emission footprint and per capital CO2 emission footprint, respectively, and thus there should be different yardsticks for dealing with the climate change policies on a pan - global basis. Therefore, the importance of climate justice, climate finance and climate adaptation are crucial. He said IOCL thus plans to mitigate CO2 emissions by improving energy efficiency of company's operations, switching internal fuels to natural gas, Switching to CBG, shifting from captive power generation to grid power generation, adopting renewable energy and switching to green hydrogen once the economies of scale is achieved.

After the inaugural session on 16th November, 2022 over the next two days, R&D Conclave 2022 witnessed sessions on various topics related to electric mobility, role of Hydrogen in energy transition, role of CCUS, refineries of the future, biomass value chain, energy storage, carbon financing solutions etc.

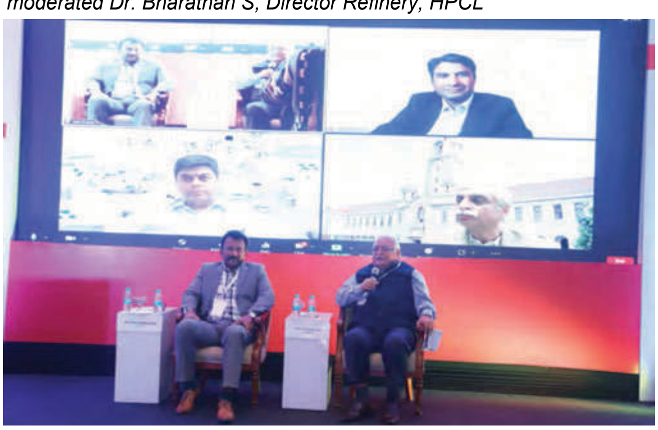
The Conclave was concluded by Mr. D.L.N. Sastri, Director (Oil Refining & Marketing) FIPI, who delivered the vote of thanks to the delegates. He mentioned that there have been diverse range of engaging sessions conducted by the esteemed set of speakers and panellists – which have stimulated the minds to look for future business solutions in the R&D space and ensures that we move towards the path of success in our respective organisations. He sincerely thanked the member companies, IOCL, GAIL, ONGC, BPCL, HMEL, EIL and OIL for their kind support and participation as well as the contribution made by them, that have helped in making this event a grand success.

Dr. Anjan Ray, Director, CSIR, IIP Dehradun, Dr. Ajit Sapre, Group President R&D Reliance Group and Dr. Ajay Mehta, VP Engineering Technology Shell discussed R&D strategies for achieving net-zero goals with Dr. SSV Ramakumar, Director R&D, Indian Oil.

Session on Electric Mobility - Potential & Challenges moderated by Dr. R K Malhotra, Prof. of Practice IIT Delhi.

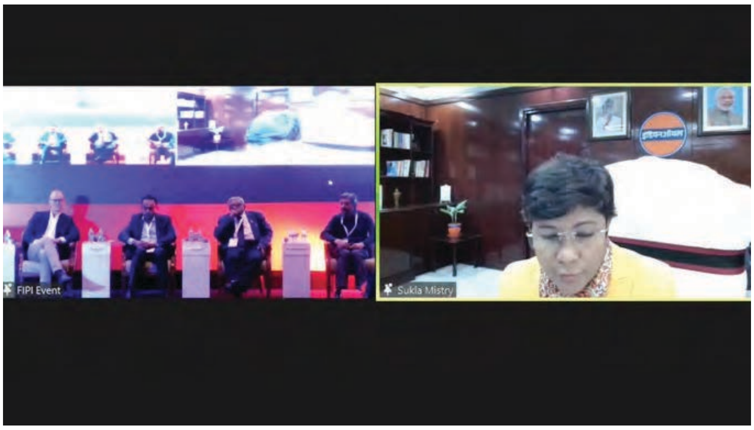
Session on Chemicals on the Rise – Managing Molecules & Circularity moderated Dr. Bharathan S, Director Refinery, HPCL

Panel Discussion on Renewable powered future and Energy Storage moderated by Ms. Sushmita Ajwani, ICF

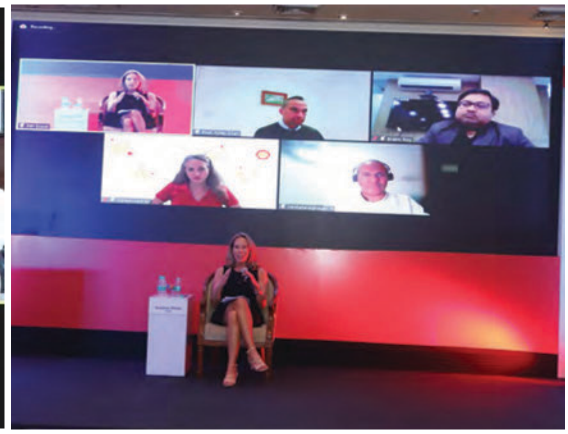


Dr. R K Malhotra chaired the discussions on Hydrogen's role in energy transition with Mr. Amar Singh, Head New Energy Business unit, Siemens, India; Mr. Anish Paunwala, Director, Linde plc; Dr. Charu Datta Patil, Manager Shell and Prof. S. Dasappa, Indian Institute of Science (IISc), Bangalore

Session on Role of Hydrogen in Energy Transition -Storage & Applications moderated Dr SSV Ramakumar, Director (R&D), Indian Oil Corporation



Mr. Michael McBride, Honeywell, Dr. M.O. Garg, President R&D Reliance group, Mr. Sangeet Jain, Director, LanzaTech, Dr. Ashwani Malhotra, CGM, EIL talked about refineries of future and biomass value chain with Ms. Sukla Mistry, Indian Oil



Panel Presentation: Carbon Trading Mechanism / Financing Energy Solutions moderated by Ms. Suzanne Minter, Director Client Strategy, Energy Solutions, Platts.

Session on Accelerating Decarbonisation with CCUS technologies moderated by Mr. Pankaj Kumar Goswami, Director (Operations), Oil India Limited

Indian Oil signed a Statement of Intent (SoI) with Solutum Technologies Ltd., Israel for collaboration and commercialization of biodegradable plastics in India

India Pavilion at ADIPEC-2022

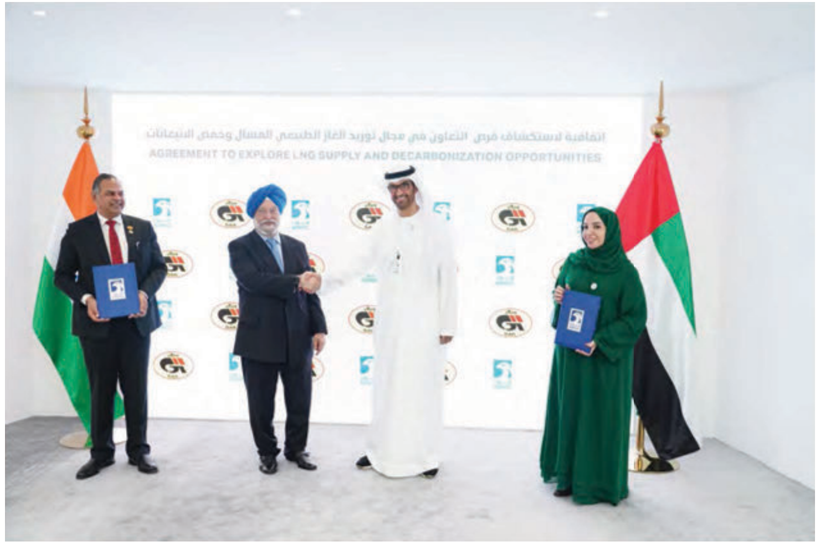
The Abu Dhabi International Petroleum Exhibition & Conference 2022 was held from 31st October -3rd November 2022 at Abu Dhabi, UAE. FIPI had once again coordinated to set-up the India Pavilion for the participation of the Indian Oil & Gas industry in the above Exhibition. India's major oil & gas companies viz. ONGC, IOCL, BPCL, HPCL, OIL, GAIL, EIL and PLL had participated and exhibited their technologies & facilities to the world wide organizations during the above Exhibition & Conference.

Hon'ble Minister of Petroleum & Natural Gas & Housing and Urban Affairs Shri Hardeep Singh Puri was invited by H.E. Suhail Mohamed Faraj AL Mazrouei, Minister of Energy and Infrastructure, UAE and H.E. Dr Sultan Bin Ahmad Sultan Al Jaber, Minister of Industry and Advanced Technology UAE and MD & Group CEO ADNOC to attend the Opening Ceremony on 31st October 2022. Hon'ble Minister participated in the Ministerial Panel discussions along with his counterparts from UAE, Arab Republic of Egypt and USA.

Chairman FIPI & Chairman IOCL along with MDs/CMDs from ONGC, HPCL, GAIL, EIL and PLL welcomed Shri Hardeep Singh Puri, Hon'ble Minister of Petroleum & Natural Gas and Housing & Urban Affairs at India Pavilion. Hon'ble Minister inaugurated the India Pavilion at ADIPEC 2022 in the presence of H.E. Shri Sanjay Sudhir Ambassador of India to UAE, Senior officials' from Indian Oil & Gas Companies, Ministry of Petroleum & Natural Gas and Indian Embassy.

During ADIPEC 2022, Hon'ble Minister had meetings with his counterparts from various countries, heads of international energy organizations and CEOs of global oil & gas companies. He also had a meeting with senior Officials of DMG Event to review the preparations made for the India Energy Week being organized from 6th-8th February 2023 at Bengaluru, India.

On 31st October 2022, GAIL had signed an agreement with ADNOC to Explore LNG Supply and Decarbonization Opportunities. The agreement was exchanged between Shri Sandeep Kumar Gupta, C&MD, GAIL (India) Ltd and Ms Fatema Al Nuaimi, CEO ADNOC LNG in the presence of H.E. Dr. Sultan Bin Ahmad Sultan Al Jaber, UAE Minister of Industry and Advanced Technology and H.E. Shri Hardeep Singh Puri, Minister of Petroleum and Natural Gas and Housing & Urban Affairs, India.



On 1st November 2022, Shri Pankaj Jain, Secretary, Ministry of Petroleum and Natural Gas had visited ADIPEC-2022 and interacted with each company at India Pavilion.

The India Pavilion at ADIPEC 2022 was successfully set up by FIPI team. It had a great footfall and delivered various business opportunities to the partner organizations.

NEW APPOINTMENTS

Arun Kumar Singh joins as ONGC Chairman

Mr. Arun Kumar Singh has joined as the Chairman of Oil and Natural Gas Corporation Limited (ONGC). He assumed the charge as the Chief of the Energy Maharatna on 7 December 2022.

A Mechanical Engineer from National Institute of Technology, Patna, he has more than three decades of diversified experience in Oil & Gas industry, both in India and abroad.

Earlier, he was the CMD of Bharat Petroleum Corporation Limited (BPCL), a 'Maharatna' and a Fortune Global 500 Company.

He was also Chairman of Indraprastha Gas Ltd. (IGL) a Joint Venture (JV) City Gas Distribution (CGD) Company, listed on Indian bourses. He was also on the Board of Petronet LNG Ltd (PLL), a Joint Venture Company, listed on Indian bourses.

He has also held the position of President (Africa & Australia) in Bharat Petro Resources Ltd, a wholly owned Subsidiary of BPCL, engaged in exploration of Oil & Gas, largely overseas.

Vetsa Rama Krishna Gupta takes over the Additional Charge of CMD of BPCL

Mr. Vetsa Rama Krishna Gupta has taken over the additional charge of Chairman and Managing Director of Bharat Petroleum Corporation Limited (BPCL) on 1st November 2022.

With an illustrious career spanning over 24 years at BPCL, in various Finance roles, Mr. V R K Gupta is Director (Finance) in the company and holds the additional charge of Director (HR).

Mr. Gupta joined BPCL in August 1998 and has a well-rounded experience across Finance functions covering Commercial Finance, Corporate Accounts, Risk Management, Business plan, Budgeting, Treasury operations, etc. He is a member of the Institute of Chartered Accountants of India (1998 batch) and a Bachelor of Commerce. He is also a member of the Institute of Cost Accountants of India.

NEW APPOINTMENTS

Amit Garg takes over as Director (Marketing) of HPCL

Mr. Amit Garg has been appointed as Director (Marketing) of Hindustan Petroleum Corporation Limited (HPCL) effective December 27, 2022. Prior to joining HPCL as Director (Marketing), Mr. Amit Garg was Executive Director (Aviation) in Bharat Petroleum Corporation Limited (BPCL).

Mr. Amit Garg is a Post Graduate in Electronics & Management.

Mr. Amit Garg is a senior leader in Oil & Gas space having rich and varied experience of over 35 years across the entire value chain in the Industry including sourcing, storage, logistics and sales across various functions in BPCL. He also served as a full time Director with Indraprastha Gas Ltd., the largest CGD in the country and as a Nominee Director with Maharashtra Natural Gas Limited, a Joint Venture of BPCL & GAIL (India) Limited.

Rajeev Gupta assumes charge as Director (Projects) of EIL

Mr. Rajeev Gupta has assumed charge as Director (Projects) of Engineers India Ltd (EIL), a Navratna PSU on 28th December, 2022.

Mr. Rajeev Gupta graduated in Electrical Engineering from Punjab Engineering College, Chandigarh. He joined EIL as a Management Trainee in year 1985. He has extensive technical and Project Management experience across complete Hydrocarbon value chain. He has served EIL in various capacities and led successful implementation of many prestigious projects in Oil and Gas sectors.

During his illustrious career spanning more than 37 years, he has led execution of Mega Refinery and Petrochemical Projects, Gas processing complexes, Offshore Oil & Drilling platforms, Pipelines, LNG Terminals, Ports & Harbor within and outside India. He has multi-faceted experience of leading teams of Engineering, Inspection, Offshore and Projects division of the company.

He has contributed extensively in development of new Vendors and Contractors to make India local hub for manufacturing & global production.

STATISTICS

INDIA: OIL & GAS

DOMESTIC OIL PRODUCTION (MILLION MT)

		2016-17	2017-18	2018-19	2019-20	2020-21	2021-22 (P)	April - Sept. 22 (P)	
									% of Total
Onshore	ONGC	5.9	6.0	6.1	6.1	5.9	5.8	3.0	39.9
	OIL	3.3	3.4	3.3	3.1	2.9	3.0	1.6	20.9
	Pvt./ JV (PSC)	8.4	8.2	8.0	7.0	6.2	6.3	2.9	39.2
	Sub Total	**17.6**	**17.5**	**17.3**	**16.2**	**15.1**	**15.1**	**7.5**	**100**
Offshore	ONGC	16.3	16.2	15.0	14.5	14.2	13.6	6.9	94.2
	OIL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Pvt./ JV (PSC)	2.1	1.9	1.9	1.5	1.1	1.0	0.4	5.8
	Sub Total	**18.4**	**18.1**	**16.9**	**16.0**	**15.4**	**14.6**	**7.3**	**100.0**
Total Domestic Production		36.0	35.7	34.2	32.2	30.5	29.7	14.7	100.0
	ONGC	22.2	22.2	21.0	20.6	20.2	19.5	9.8	66.7
	OIL	3.3	3.4	3.3	3.1	2.9	3.0	1.6	10.6
	Pvt./ JV (PSC)	10.5	10.1	9.9	8.4	7.4	7.3	3.3	22.7
Total Domestic Production		**36.0**	**35.7**	**34.2**	**32.2**	**30.5**	**29.7**	**14.7**	**100.0**

Source : PIB/PPAC

REFINING

Refining Capacity (Million MT on 1st January 2022)

Indian Oil Corporation Ltd.	
Digboi	0.65
Guwahati	1.00
Koyali	13.70
Barauni	6.00
Haldia	8.00
Mathura	8.00
Panipat	15.00
Bongaigoan	2.70
Paradip	15.00
Total	**70.05**

Chennai Petroleum Corp. Ltd.	
Chennai	10.50
Narimanam	0.00
Total	**10.50**

JV Refineries	
HMEL	11.30
JV Total	**11.30**

Bharat Petroleum Corp. Ltd.	
Mumbai	12.00
Kochi	15.50
BORL-Bina	7.80
Total	**35.30**

Hindustan Petroleum Corp. Ltd.	
Mumbai	9.50
Visakhapattnam	8.30
Total	**17.80**
Other PSU Refineries	
NRL, Numaligarh	**3.00**
MRPL	**15.00**
ONGC, Tatipaka	**0.07**
Total PSU Refineries Capacity	**151.72**

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

Total Refining Capacity of India 251.5 (5.02 million barrels per day)
Source : PPAC

CRUDE PROCESSING (MILLION MT)

PSU Refineries	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22 (P)	April-Sept. 22 (P)
IOCL	65.19	69.00	71.81	69.42	62.35	67.66	35.03
BPCL	25.30	28.20	30.90	31.53	26.22	29.84	18.36
HPCL	17.80	18.20	18.44	17.18	16.42	13.97	9.29
CPCL	10.30	10.80	10.69	10.16	8.24	9.04	5.76
MRPL	15.97	16.13	16.23	13.95	11.47	14.87	8.27
ONGC (Tatipaka)	0.09	0.08	0.07	0.09	0.08	0.08	0.04
NRL	2.68	2.81	2.90	2.38	2.71	2.62	1.56
SUB TOTAL	137.33	145.22	151.04	144.71	127.50	138.08	78.30

JV Refineries	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22 (P)	April-Sept. 22 (P)
HMEL	10.52	8.83	12.47	12.24	10.07	13.03	6.29
BORL	6.36	6.71	5.71	7.91	6.19	7.41	--
SUB TOTAL	16.88	15.54	18.18	20.15	16.26	20.44	6.29

Pvt. Refineries	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22 (P)	April-Sept. 22 (P)
NEL	20.92	20.69	18.89	20.62	17.07	20.16	10.24
RIL	70.20	70.50	69.14	68.89	60.94	63.02	31.47
SUB TOTAL	91.12	91.19	88.03	89.51	78.01	83.19	41.71

	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22 (P)	April-Sept. 22 (P)
All India Crude Processing	245.40	251.90	257.25	254.38	221.77	241.70	126.30

Source : PIB Release/PPAC

CRUDE CAPACITY VS. PROCESSING

	Capacity On 01/01/2022 Million MT	% Share	Crude Processing April-Sept. 22 (P)	% Share
PSU Ref	151.7	60.4	78.3	62.0
JV. Ref	11.3	4.5	6.3	5.0
Pvt. Ref	88.2	35.1	41.7	33.0
Total	**251.2**	**100**	**126.3**	**100**

Source: PIB/PPAC

POL PRODUCTION (Million MT)

	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22 (P)	April-Sept. 22 (P)
From Refineries	239.2	249.8	257.4	258.2	229.3	250.2	129.6
From Fractionators	3.5	4.6	4.9	4.8	4.2	4.1	1.8
Total	**242.7**	**254.4**	**262.4**	**262.9**	**233.5**	**254.3**	**131.4**

DISTILLATE PRODUCTION (Million MT)

	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22 (P)	April-Sept. 22 (P)
Light Distillates, MMT	71.0	74.7	75.4	76.8	71.4	76.5	38.0
Middle Distillates , MMT	122.5	127.5	130.8	130.2	110.7	120.2	64.3
Total Distillates, MMT	196.9	206.8	211.1	211.7	186.3	200.7	104.1
% Distillates Production on Crude Processing	**79.1**	**80.6**	**80.5**	**81.7**	**82.4**	**81.7**	**81.3**

PETROLEUM PRICING

OIL IMPORT - VOLUME AND VALUE

	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22 (P)	April-Sept. 22 (P)
Quantity, Million Mt	213.9	220.4	226.5	227.0	196.5	212.0	115.7
Value, INR '000 Cr.	470.2	566.5	783.2	717.0	469.8	899.3	700.2
Value, USD Billion	70.2	87.8	111.9	101.4	62.2	120.4	89.3
Average conversion Rate, INR per USD (Calculated)	67.0	64.5	70.0	70.7	75.5	74.7	78.4

OIL IMPORT - PRICE USD / BARREL

	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22 (P)	April-Sept. 22 (P)
Brent (Low Sulphur - LS-marker) (a)	48.7	57.5	70.0	61.0	44.3	80.7	107.2
Dubai (b)	47.0	55.8	69.3	60.3	44.6	78.1	102.3
Low sulphur-High sulphur differential (a-b)	1.7	1.6	0.7	0.6	-0.3	2.7	4.9
Indian Crude Basket (ICB)	47.56	56.43	69.88	60.47	44.82	79.18	103.68
ICB High Sulphur share %	71.03	72.38	74.77	75.50	75.62	75.62	75.62
ICB Low Sulphur share %	28.97	27.62	25.23	24.50	24.38	24.38	24.38

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

	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22 (P)	April-Sept. 22 (P)
Gasoline	58.1	67.8	75.3	67.0	47.5	89.7	121.8
Naphtha	47.1	56.3	65.4	55.1	43.9	79.9	84.3
Kero / Jet	58.4	69.2	83.9	70.4	45.8	87.3	138.3
Gas Oil (0.05% S)	58.9	69.8	84.1	74.1	50.0	90.2	148.4
Dubai crude	47.0	55.8	69.3	60.3	44.6	78.1	102.3
Indian crude basket	47.6	56.4	69.9	60.5	44.8	79.2	103.7

CRACKS SPREADS ($/ BBL.)

	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22 (P)	April-Sept. 22 (P)
Gasoline crack							
Dubai crude based	11.1	12.0	5.9	6.7	2.9	11.7	19.5
Indian crude basket	10.6	11.4	5.4	6.5	2.6	10.5	18.1
Diesel crack							
Dubai crude based	12.0	13.9	14.8	13.8	5.5	12.2	46.1
Indian crude basket	11.4	13.4	14.2	13.6	5.2	11.0	44.7

DOMESTIC GAS PRICE ($/MMBTU)

Period	Domestic Gas Price (GCV Basis)	Price Cap for Deepwater, igh ` temp High Pressure Areas
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
April 20 - September 20	2.39	5.61
October 20 - March 21	1.79	4.06
April 21 - September 21	1.79	3.62
October 21 - March 22	2.90	6.13
April 22 - September 22	6.10	9.92
October 22 - March 23	8.57	12.46

Source: PIB/PPAC/OPEC

GAS PRODUCTION

		2016-17	2017-18	2018-19	2019-20	2020-21	2021-22 (P)	April-Sept. 22 (P)
	ONGC	22088	23429	24677	23746	21872	20629	10076
	Oil India	2937	2881	2722	2668	2480	2853	1527
	Private/ Joint Ventures	6872	6338	5477	4770	4321	10502	5582
	Total	**31897**	**32648**	**32875**	**31184**	**28672**	**33984**	**17184**
		2016-17	**2017-18**	**2018-19**	**2019-20**	**2020-21**	**2021-22 (P)**	**April-Sept. 22 (P)**
Onshore	Natural Gas	9294	9904	10046	9893	9601	10471	5193
	CBM	565	735	710	655	477	518	343
	Sub Total	**9858**	**10639**	**10756**	**10549**	**10078**	**10989**	**5535**
Offshore		22038	22011	22117	20635	18428	22869	11649
	Sub Total	22038	22011	22117	20635	18428	22869	11649
	Total	**31897**	**32649**	**32873**	**31184**	**28506**	**33858**	**17184**
	(-) Flare loss	1049	918	815	927	721	727	412
	Net Production	30848	31731	32058	30257	27785	33131	16772
		2016-17	**2017-18**	**2018-19**	**2019-20**	**2020-21**	**2021-22 (P)**	**April-Sept. 22 (P)**
	Net Production	30848	31731	32058	30257	27785	33131	16772
	Own Consumption	5857	5806	6019	6053	5736	5760	1237
	Availabilty	24991	25925	26039	24204	22049	27371	15535

AVAILABILITY FOR SALE

	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22 (P)	April-Sept. 22 (P)
ONGC	17059	18553	19597	18532	16972	15874	8883
Oil India	2412	2365	2207	2123	1930	2190	1338
Private/ Joint Ventures	5520	5007	4235	3549	3147	9307	5314
Total	**24991**	**25925**	**26039**	**24204**	**22049**	**27371**	**.....**

CONSUMPTION (EXCLUDING OWN CONSUMPTION

	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22 (P)	April-Sept. 22 (P)
Total Consumption	49677	53364	54779	58091	54910	59277	30241
Availabilty for sale	24991	25925	26039	24204	22049	27371	15535
LNG Import	24686	27439	28740	33887	32861	31906	14706

GAS IMPORT DEPENDENCY

	2016-17	2017-18	2018-19	2019-20	2020-21 (P)	2021-22 (P)	April-Sept. 22 (P)
Net Gas Production	30848	31731	32058	30257	27785	33131	16772
LNG Imports	24686	27439	28740	33887	32861	31906	14706
Import Dependency (%)	44.5	46.4	47.3	52.8	54.2	49.1	46.7
Total Gas Consumption*	**55534**	**59170**	**60798**	**64144**	**60646**	**65037**	**31478**

* Includes Own Consumption

Source: PIB/PPAC

SECTOR WISE DEMAND AND CONSUMPTION OF NATURAL GAS

		2017-18	2018-19	2019-20	2020-21	2021-22 (P)	2022-23						
							April	May	June	July	Aug.	Sept.	Total
Fertilizer	R-LNG	7781	8711	9556	11227	12363	1125	1247	1107	1286	1216	1181	**7162**
	Domestic Gas	6862	6258	6559	6554	5716	402	475	466	427	466	493	**2729**
Power	R-LNG	2645	2869	3554	3564	2670	168	141	177	89	72	76	**723**
	Domestic Gas	9375	9194	7526	7272	6260	388	485	434	572	584	538	**3001**
City Gas	R-LNG	3881	3981	5146	4456	5238	455	428	405	454	407	301	**2450**
	Domestic Gas	4659	5240	5737	4774	6890	574	617	656	624	671	659	**3801**
Refinery	R-LNG	11109	12650	13130	12386	9725	563	696	533	601	491	401	**3285**
Petro-chemical Others	Domestic Gas	5225	5225	5285	5823	10656	818	892	866	1065	1060	1021	**5722**

Qty. in MMSCM

CGD INFRASTRUCTURE

		As on 31st March 2019	As on 31st March 2020	As on 31st March 2021	As on 31st March 2022	As on 1st Oct 2022
PNG	**Domestic**	50,43,188	60,68,415	78,20,387	93,02,667	99,77,630
	Commercial	28,046	30,622	32,339	34,854	63,007
	Industrial	8,823	10,258	11,803	13,215	14,212
CNG	**CNG Stations**	1,730	2,207	3,101	4,433	4,800
	CNG Vehicles	33.47 lakhs	37.10 lakhs	39.55 lakhs	44.09 lakhs	46.35 lakhs

Source: PPAC/Vahan

MAJOR NATURAL GAS PIPELINE NETWORK As on 30.06.2022

Nature of Pipeline		GAIL	GSPL	PIL	IOCL	AGCL	RGPL
Operational	Length	9,577	2,695	1,459	143	107	304
	Capacity	167.2	43.0	85.0	20.0	2.4	3.5
Partially commissioned#	Length	4,777			282		
	Capacity						
Total operational length		**14,354**	**2,695**	**1,459**	**425**	**107**	**304**
Under construction	Length	5,097	100		1,149		
	Capacity		3.0				
Total length		**19,451**	**2,795**	**1,459**	**1,574**	**107**	**304**

Nature of pipeline		GGL	DFPCL	ONGC	GIGL	GITL	Others*	Total
Operational	Length	73	42	24				**14,424**
	Capacity	5.1	0.7	6.0				
Partially commissioned#	Length				1,254	365		**6,678**
	Capacity							**-**
Total operational length		**73**	**42**	**24**	**1,254**	**365**	**0**	**21,102**
Under construction	Length				1,078	1,666	2,915	**12,005**
	Capacity							**-**
Total length		**73**	**42**	**24**	**2,332**	**2,031**	**2,915**	**33,107**

*Includes AGCL, DFPCL, ONGC and excludes CGD pipeline network

Source: PPAC/PNGRB

EXISTING LNG TERMINALS

Location	Companies	Capacity (MMTPA) As on 01st Dec. 22	Capacity Utilisation (%) April-Oct 2022
Dahej	Petronet LNG Ltd	17.5	80.6
Hazira	Shell Energy India Pvt Ltd	5.2	47.4
Dabhol*	Konkan LNG Ltd	5	22.5
Kochi	Petronet LNG Ltd	5	17.0
Ennore	Indian Oil LNG Pvt Ltd	5	13.0
Mundra	GSPC LNG Ltd	5	17.7
Total Capacity		**42.7 MMTPA**	

*To increase to 5 MMTPA with breakwater. Only HP stream of capacity of 2.9 MMTPA is commissioned
Source: PPAC

2022 WORLDWIDE ACTIVE RIG COUNT

REGION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV
US	601	636	661	690	718	739	756	764	763	768	779
Canada	190	220	185	107	93	143	186	201	211	214	201
Latin America	158	153	160	163	155	160	163	172	180	188	185
Europe	111	102	78	81	79	87	87	104	106	107	102
Middle East	289	287	303	300	314	303	309	308	308	326	330
Africa	86	81	87	78	76	78	78	77	80	84	91
Asia Pacific(1)	120	112	111	108	115	119	119	122	128	129	124
India	77	78	76	76	78	77	77	77	77	77	78
TOTAL	**1632**	**1669**	**1661**	**1603**	**1628**	**1706**	**1775**	**1825**	**1853**	**1893**	**1890**

Source: Baker Hughes

(1) Excluding India's Rig Count

Member Organizations

S.No	Organization	Name	Designation
1	Adani Welspun Exploration Ltd.	Mr. Arvind Hareendran	Sr. Vice-President (Exploration)
2	Axens India (P) Ltd.	Mr. Siddhartha Saha	Managing Director
3	Baker Hughes, A GE Company	Mr. Neeraj Sethi	Country Leader
4	Bharat Petroleum Corporation Ltd.	Mr. Vetsa Ramakrishna Gupta	CMD (Addl.Charge), Director Finance)
5	BP Exploration (Alpha) Ltd	Mr. Sashi Mukundan	President, bp India & Senior Vice-President, bp Group
6	Cairn Oil & Gas, Vedanta Ltd	Mr. Sunil Duggal	Group CEO, Vedanta Ltd
7	Central U.P. Gas Ltd.	Mr. Rathish Kumar Das	Managing Director
8	Chandigarh University	Mr. Satnam Singh Sandhu	Chancellor
9	Chennai Petroleum Corp. Ltd.	Mr. Arvind Kumar	Managing Director
10	Chi Energie Pvt. Ltd.	Mr. Ajay Khandelwal	Director
11	CSIR- Indian Institute of Petroleum	Dr. Anjan Ray	Director
12	Decom North Sea	Mr. Will Rowley	Interim Managing Director
13	Dynamic Drilling & Services Pvt. Ltd.	Mr. S.M. Malhotra	President
14	Engineers India Ltd.	Ms. Vartika Shukla	Chairman & Managing Director
15	Ernst & Young LLP	Mr. Rajiv Memani	Country Manager & Partner
16	ExxonMobil Gas (India) Pvt. Ltd.	Mr. Monte Dobson	Chief Executive Officer
17	FMC Technologies India Pvt. Ltd.	Mr. Housila Tiwari	Managing Director
18	GAIL (India) Ltd.	Mr. Sandeep Kumar Gupta	Chairman & Managing Director
19	GSPC LNG Ltd.	Mr. Anil K. Joshi	Chief Executive Officer
20	h2e Power Systems Pvt Ltd.	Mr. Siddharth R. Mayur	MD &CEO
21	Haldor Topsoe India Pvt. Ltd.	Mr. Alok Verma	Managing Director
22	Hindustan Petroleum Corporation Ltd.	Dr. Pushp Kumar Joshi	Chairman & Managing Director
23	HPCL Mittal Energy Ltd.	Mr. Prabh Das	Managing Director & CEO
24	HPOIL Gas Pvt. Ltd.	Mr. Arun Kumar Mishra	Chief Executive Officer
25	IHS Markit	Mr. James Burkhard	Managing Director
26	IIT (ISM) Dhanbad	Prof. Rajiv Shekhar	Director
27	IMC Ltd.	Mr. A. Mallesh Rao	Managing Director
28	Indian Gas Exchange Ltd.	Mr. Rajesh Kumar Mediratta	Managing Director & CEO
29	Indian Oil Corporation Ltd.	Mr. S.M. Vaidya	Chairman
30	Indian Oiltanking Ltd.	Mr. Rajesh Ganesh	Managing Director
31	Indian Strategic Petroleum Reserves Ltd.	Mr. L.R. Jain	CEO & MD
32	Indraprastha Gas Ltd.	Mr. Sanjay Kumar	Managing Director
33	International Gas Union	Mr. Milton Catelin	Secretary General

S.No	Organization	Name	Designation
34	Invenire Petrodyne Ltd.	Mr. Manish Maheshwari	Managing Director
35	IPIECA	Mr. Brian Sullivan	Executive Director
36	IRM Energy Pvt. Ltd.	Mr. Karan Kaushal	Chief Executive Officer
37	Jindal Drilling & Industries Pvt. Ltd.	Mr. Raghav Jindal	Managing Director
38	Lanzatech Pvt. Ltd.	Dr. Jennifer Holmgren	Chief Executive Officer
39	Larsen & Toubro Ltd.	Mr. S.N. Subrahmanyan	CEO & Managing Director
40	Maharashtra Institute of Technology (MIT) Pune	Mr. Rahul V. Karad	Executive President
41	Mangalore Refinery & Petrochemicals Ltd.	Mr. M. Venkatesh	Managing Director
42	Megha Engineering & Infrastructures Ltd.	Mr. P. Doraiah	Director
43	Nayara Energy Ltd.	Mr. Prasad K. Panicker	Chairman & Head of Refinery
44	Numaligarh Refinery Ltd.	Mr. Bhaskar Jyoti Phukan	Managing Director
45	Oil and Natural Gas Corporation Ltd.	Mr. Arun Kumar Singh	Chairman
46	Oil India Ltd.	Dr. Ranjit Rath	Chairman & Managing Director
47	Petronet LNG Ltd.	Mr. Akshay Kumar Singh	Managing Director & CEO
48	Pipeline Infrastructure Ltd.	Mr. Akhil Mehrotra	Chief Executive Officer
49	Rajiv Gandhi Institute of Petroleum Technology	Prof. A.S.K. Sinha	Director
50	Reliance BP Mobility Ltd.	Mr. Harish C Mehta	Chief Executive Officer
51	Reliance Industries Ltd.	Mr. Mukesh Ambani	Chairman & Managing Director
52	SAS Institute (India) Pvt Ltd.	Mr. Noshin Kagalwalla	CEO & Managing Director-India
53	Schlumberger Asia Services Ltd.	Mr. Vinay Malhotra	Manging Director
54	Scottish Development International	Mr. Kevin Liu	Head of Energy Trade, Asia Pacific
55	Secure Meters Ltd.	Mr. Sunil Singhvi	CEO-Energy
56	Shell Companies in India	Mr. Nitin Prasad	Chairman
57	Siemens Ltd.	Mr. Guilherme Vieira De Mendonca	CEO (Siemens Energy - India)
58	SNF Flopam India Pvt. Ltd.	Mr. Shital Khot	Managing Director
59	South Asia Gas Enterprise Pvt. Ltd.	Mr. Subodh Kumar Jain	Director
60	Sun Petrochemicals Pvt. Ltd.	Mr. Padam Singh	President
61	THINK Gas Distribution Pvt. Ltd.	Mr. Hardip Singh Rai	Chief Executive Officer
62	TotalEnergies Marketing India Pvt. Ltd.	Ms. Ahlem FRIGA-NOY	Country Chair
63	University of Petroleum & Energy Studies	Dr. S.J. Chopra	Chancellor
64	UOP India Pvt. Ltd.	Mr. Mike Banach	Managing Director
65	VCS Quality Services Pvt. Ltd.	Mr. Shaker Vayuvegula	Director
66	World LP Gas Association	Mr. James Rockall	CEO & Managing Director

FEDERATION OF INDIAN PETROLEUM INDUSTRY

CORE PURPOSE STATEMENT

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

SHARED VISION

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

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