India's Energy Trilemma - – How Oil and Gas will mitigate it?

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Abstract

The theme of the conference talks about "Energy Trilemma" – Energy Affordability, Energy Reliability and Environmental Sustainability. The key thought here is "energy transition" which means a phased changeover wherein the phases would be driven by choice and available technology. The mass movement towards non-fossil energy sources can only be achieved when access, security and sustainability of such alternative sources can be assured.

Indian Prime Minister Shri Narendra Modi declared on 01 November 2021 at COP26-Glasgow that "India will achieve the target of net zero emissions by the year 2070" which is almost 50 years from now.

India is the third largest energy consumer in the world after USA and China. As per BP Energy Outlook 2020, the share of India in global energy demand is set to grow from 6% to 12% by 2050. The oil consumption is expected to double from 5 million barrels per day by 2050 and gas consumption will increase five times over current level of 58 billion cubic meters/year, despite Rapid Transition Scenario of India, as envisaged in BP Energy Outlook 2020.

It can be said that Oil and Gas have the ASAP characteristics i.e Affordable, Safe, Available and Practical, a new acronym of looking at it. No alternative, available or currently under development, can beat it on all these four characteristics combined, especially in large and fast growing economies like India.

This paper analyses the challenges of India in moving towards net zero, which are also applicable to the world and why the addiction to oil and gas is currently near impossible to break. This path can be covered by new technologies / fuels, only when the energy provided by them can be used on a mass scale throughout the world and is almost as convenient as ASAP hydrocarbons.

In conclusion, this applied research paper brings forth how and why oil and gas remains the anchor fuel in India's energy basket, in the foreseeable decades, which allows time for new technology / fuel development for mass consumption and energy transition. It attempts to draw the attention to the huge amount of undiscovered hydrocarbon potential in India, which is a critical resource, for fulfilling the energy requirements of India and to lessen the huge import bill of oil and gas. It is crucial for the government and companies to focus on realizing the full hydrocarbon potential of Indian sedimentary basins.

Introduction

The Indian Prime Minister, in an announcement at COP26, made a firm commitment that based on 500 GW of non-fossil electricity, India will achieve net zero by 2070. This in itself is quite a stiff target to achieve net zero targets. However, net-zero pledges around the world do not sufficiently explain the "net" component—how much carbon will be captured and through what means. It remains to be seen how the developed countries actually achieve their net-zero targets by say 2050 (which is what the major number of countries have committed) which will trigger the developing countries to follow. Energy transition can also be understood as an ongoing societal, economic, technological and behavioral shift in how energy is produced and consumed, in the countries around the world.

The point to be noted is that natural gas and crude oil is used for a variety of important energy needs of the society ranging from fuel to electricity to petrochemicals. This makes it quite complex for the alternatives, currently available or being pushed like

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EV, wind energy, solar energy, to replace these hydrocarbons (or fossil fuels) to fulfill all the important functions catered by hydrocarbons.

As conclusion, Ghadikolaei et al (2021), state that governments, researchers, and producers of Alternative Fuel Vehicles (AFVs) around the world are trying to find some solutions for replacing gasoline and diesel vehicles (for light- medium-, and heavy-duty applications) with AFVs to reduce air pollution and GHG emissions followed by dependency in the fossil fuels consumption. However, almost all the solutions are related to the technical and complicated aspects' side, like improvement in technologies, but there is rare attention to the human behaviors side (like knowledge, education, promotion, environmental issues, etc.) which is a critical point for the increase in the number of AFVs in the global transportation sector.

Alsayegh (2021), concludes that results show that electric vehicles (EVs) are indirectly fuelled, mainly from fossil-fired power stations through electric grids. This is an important aspect which is often overlooked by advocates of EVs. The initiative as well as the push towards EVs is fraught with dangers of hiding the use of fossil fuels from the public eye, in the transport sector, till alternate means of generating electricity are there, which have the ASAP characteristics. The widespread acceptance and usage of EVs is yet to be witnessed.

Nino (2021), states that while current attention is focused on achieving the transition from fossil fuels to renewable energy sources, the most substantial consequence of global change over the next 20 to 40 years will be the dominance of natural gas as the most important fuel source. This considering that, when comparing the amount of carbon dioxide emitted by different fuels with the same specific heat, natural gas is 25.57% less polluting than gasoline and 27.46% less than diesel, thus gas natural is a substantially cleaner energy than oil and also has a strong development in infrastructure globally.

Data

"India's oil demand to grow 8.2% year-on-year to 5.15 million barrels per day in 2022. With expected economic growth of 7.2% in 2022 & rapid containment of Omicron in the near future, oil demand is set to recover"- **Figure 1**.

Fig.1: Oil on the Boil (Source: OPEC March 2022 Report)

"The vision of natural gas-based economy in India has led to significant increase in gas consumption; however, the domestic production needs to be complemented with LNG imports reaching upto 50%" – **Figure 2**.

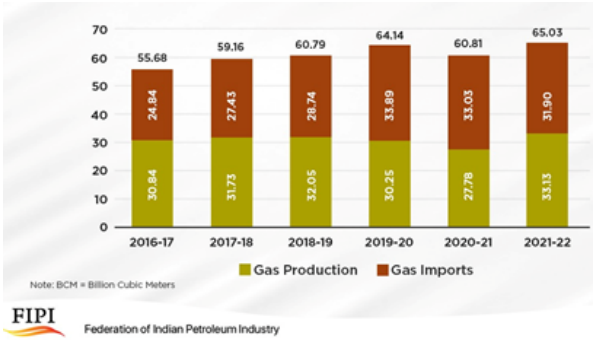

Fig.2: Domestic Gas Production and LNG Imports (BCM) (Source: PPAC, MoPNG, India)

"Amid growing global uncertainty, India's petrochemical sector has emerged as an island of hope. India's strong market fundamentals will drive rapid growth in petrochemicals demand" - **Figure 3**.

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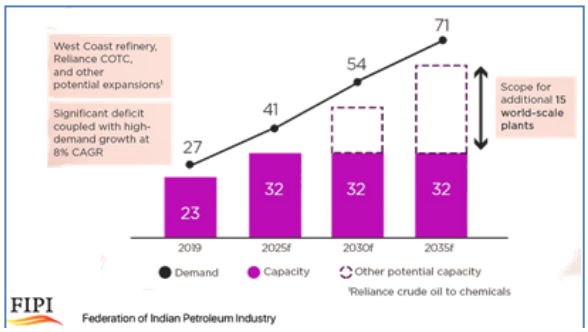

Fig.3: Petrochemicals Supply & Demand in India (MMT) (Source: Nexant; Kearmey Analysis)

"In contrast to other major countries, in India, the oil and gas will continue to meet the base-load energy demand for the foreseeable future" – **Figure 4.**

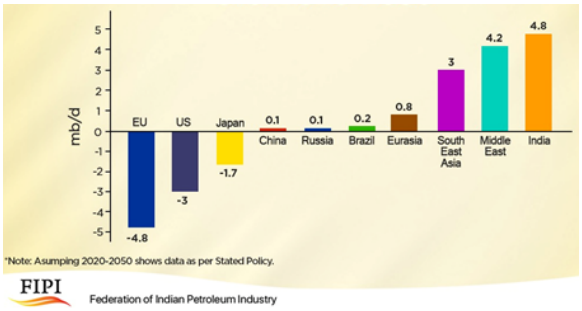

Fig.4: India Takes Lead in Change in Oil Demand over 2020-2050 (Source: IEA World Energy Outlook 2021)

As per data of Directorate General of Hydrocarbons (DGH), Ministry of Petroleum & Natural Gas, India, the current position in the twenty-six sedimentary basins in the country for conventional hydrocarbons resource potential is as under:

Basin	**Resource Potential (In-place MMTOE)***	**Undiscovered (%)**
Category-I (7 basins)		
Krishna – Godavari (KG)	9555	79
Mumbai Offshore	9646	50
Assam Shelf	6001	69
Rajasthan	4126	77
Cauvery	1964	85
Assam-Arakan	1633	89
Fold Belt (AAFB)		
Cambay	2586	30
Total (I)	**35511**	**67**
Category-II (5 basins)		
Saurashtra	1325	94
Kutch	898	92
Vindhyan	632	100
Mahanadi	651	88
Andaman	371	99
Total (II)	**3877**	**94**
Category-III (14 basins)		
Kerala-Konkan	1245	100
Bengal-Purnea	828	100
Ganga-Punjab	128	100
Pranhita-Godavari (PG)	95	100
Satpura-South Rewa-Damodar	63	100
Himalayan Foreland	44	100
Chattisgarh	25	100
Narmada	18	100
Spiti-Zanskar	11	100
Deccan Syneclise	11	100
Cuddapah	5	100
Karewa	4	100
Bhima-Kaladgi	3	100
Bastar	1	100
Total (III)	**2481**	**100**
TOTAL	**41,869**	**71**

* MMtoe – Million Tons Oil Equivalent Conventional Hydrocarbons

Notes:

1. Category- I Basins: commercially producing; have reserves to produce; also have contingent and prospective resources.

2. Category- II Basins: discoveries yet to produce commercially; have contingent resources; also have prospective resources.

3. Category- III Basins: yet to have a discovery; have only prospective resources.

4. Saurashtra, Kutch and Bengal-Purnea are under upgrade.

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Discussion & Analysis

EVs / AFVs may not prove to be the real alternative to gasoline powered automobiles unless the energy to power them comes actually form non-fossil fuel sources. Further there is very little movement in finding alternatives to heavy transport vehicles, defence vehicles (including warships, submarines, fighter aircrafts etc), long distance train and aircraft travel etc, as far the transport needs of mankind is concerned.

Natural Gas (a fossil fuel) has to be accepted as an anchor fuel in the progress of energy transition for decades to come, till we are able to find or make some energy source which can have the similar ASAP characteristics.

Oil and gas industry have to become the balancing force in the conflicting choices of energy transition, else it would be really challenging for alternative energy sources to become viable and achieve the ASAP characteristics for global acceptance.

The petrochemical demand is estimated to grow rapidly in India and will require increased inputs of oil and gas as feedstock in the decades ahead. The oil demand in India shows no sign of abating and with the rapid economic growth being witnessed in India, the oil demand is likely to double to 10 million barrels per day by the year 2050, as envisaged in BP Energy Outlook 2020. The yearly gas consumption in India is around 65 billion cubic meters (3.6 above) and is expected to go up 5 times, beyond 300 billion cubic meters per year by 2050, as envisaged in BP Energy Outlook 2020.

It is necessary that the explorationists working in Indian sedimentary basins carry out a critical study of the Yet-To-Find (YTF) hydrocarbon resources which are forecasted as around 70% of the total. The new age techniques and technologies need to be deployed by the geo-scientists along with a fresh outlook to either validate or correct the YTF figures. The new production which emerges out of such efforts will help in a myriad ways – improve domestic oil/gas availability, reduce import burden, support the efforts towards energy transition by acting as an anchor energy source and help develop substitutes in the long run. The only way to manage the "Energy Trilemma" – Energy Affordability, Energy Reliability and Environmental Sustainability, is by ensuring the availability of required hydrocarbons over the next 50 years to have a sunrise of net-zero thereafter.

Conclusions

Indian economy has been on a high growth trajectory for almost a decade now and the aspiration to be 5 trillion USD economy within this decade, requires massive amounts of energy to fulfill its requirements, in the years to come.

The emerging fact is that oil and gas will continue to be the bedrock of India's energy mix along with coal. In contrast to coal which is used solely for electricity generation, oil and gas has multiple uses, including electricity generation. The requirement of oil is projected to double and the gas requirement is projected to increase 5 times in India, from the current levels, by the year 2050. This has been scientifically backed by studies done by many agencies.

EVs / AFVs have been introduced in India since few years now, but with very little penetration in the transport sector. Though some small developed countries (in terms of population and geographical area) have shown good transition to EVs, it remains a miniscule share in most of the countries. The long haul transport sector is totally dominated by oil and gas, with no viable alternative on the horizon currently. Though there has been tremendous shift to gas based vehicles in India as well as globally, due to its cleaner fuel qualities than oil and proven ASAP characteristics i.e Affordable, Safe, Available and Practical.

On one hand, this resistance needs to be overcome by constructive interactions amongst all the stakeholders in the society including governments. On the other hand, the world needs to demonstrate an alternate energy source to oil and gas (or fossil fuels) which would have the ASAP characteristics, for the global population to adopt it. Energy transition would be of little use, if the majority of global population does not become a part of actual net-zero initiative, which

is of immense urgency now, due to the severe ill effects being felt around the world.

There is an urgent agenda for all the oil and gas companies operating in India, especially the NOCs viz ONGC and OIL, to realign their exploration business to focus on the Yet-To-Find (YTF) hydrocarbon resources, which are around 70% of the total estimated hydrocarbon potential of the country. More importantly, the immediate step is to work on the YTF in Category – I basins which itself is 67% of the resources therein. Discoveries are more likely in these category- I basins, which have been under active E&P for almost 50 years now and should yield good successes. Further NOCs will have to lead the way to exploring the YTF in Category – II (94%) and Category – III (100%) basins.

It is necessary that either the YTF is discovered and exploited or the YTF figures are re-validated based on such exploration efforts. This will lead to a true picture of country's YTF hydrocarbon resources as well as clarify the true potential of Indian sedimentary basins. This will also play a vital role in supporting India's path to net-zero as oil and gas will be the anchor energy sources to help develop viable alternate energy sources with ASAP characteristics.

Additionally, there exists good potential of CBM, Shale gas/oil and gas hydrates in the country, which needs focused exploration attention on fast-track basis to truly realize its potential, else these resources will just remain in the domain of probability and possibility.

India has committed to a net zero target by the year 2070 and is rapidly putting in place the required systems like gas based economy, ethanol blended gasoline, massive renewable energy projects, hydrogen fuel mission etc. There will be turmoil in the percent shares amongst the different types of energy sources in the ever increasing energy requirements of India, but oil and gas will continue to the ringleaders in its energy basket for decades to come.

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