Advancing Energy Transitions and Hydrocarbon Industry in India-An Overview

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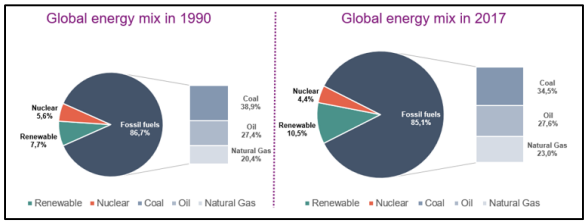
Abstract: The global energy economy is undergoing a rapid transition from fossil fuels to renewables and low-carbon electricity reshaping the geopolitics of energy spectrum. The current transition in the global energy system has been triggered, in the first instance, by concerns over climate change and recognition of the imperative of shifting to a lower-carbon economy. It is obvious that due to increased share of unconventional clean hydrocarbons and renewable energy resources the contribution of Oil & Gas in total energy demand will decrease, and definitely affect the future business framework of oil companies across the world. Though it is not immediate but considering the future impact, oil companies need to develop suitable strategies and align according to the demand of time for a positive sustenance in business. This paper deals only with upstream sector of hydrocarbon Industry.

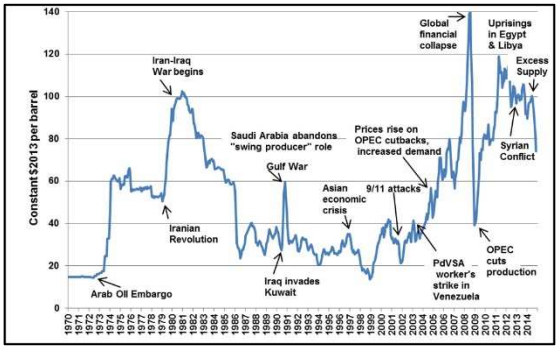
Introduction:

Energy is fundamental to the civilization and to the prosperity of a nation. Access to suitable energy in respect of required demand is the key for steady development of an economy. With time the demand for energy is constantly rising throughout the world. This increased demand is caused in part by the increase in population, and by economic development. The amount of energy a country uses is widely used to indicate or measure the level of development. The level of energy use is directly related to the development of various activities such as manufacturing, provision of services and transport.



Fig, 1. The evolution of the energy mix from 1990 to 2017, Source: "Transition énergétique"- Edmond de Rothschild Financial Group

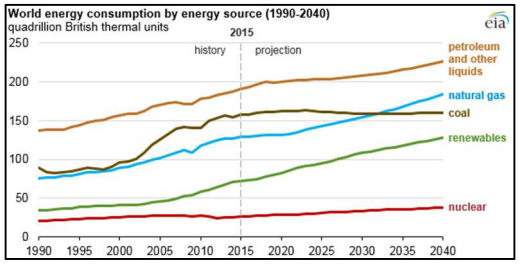
Transformations in energy mix took place in the past from traditional biomass energy about 200 years ago. The history of past energy transitions are the US's shift from wood to coal in the late 19th and early 20th centuries, French adoption of nuclear power on a wide scale in the 1980s. The last transition played a very important role in the total energy mix due to discovery of hydrocarbons, and the share of oil increased quickly in the energy mix. The countries having good reserves of oil got economic advantages and started controlling the oil business thus emergence of oil politics took place.



Fig, 2. History of Oil, Source: Energy Department, USA.

The technological, economic, and geopolitical changes are modifying not only energy spectrum but are also shaping the future requirements of energy consumption. As estimated, the dominance of hydrocarbons in the energy mix will decrease with increase in clean and low carbon energy resources in near future. Energy transition has become part of global agenda especially due to environmental concerns. To check global warming, several countries came together and agreed to reduce the emission of greenhouse gases with adoption of immediate suitable steps. Treaties like Kyoto protocol and Paris agreement were signed with targeted reduction of carbon by 2050.

Energy demand worldwide grew by 2.3% in the year 2018 which is its fastest pace in this decade, due to a robust global economy. The figure below shows the world energy consumption by various energy sources along with the projected consumption upto year 2040.

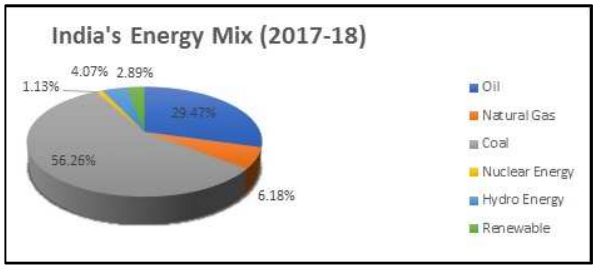


Fig, 3. World Energy Consumption, Source: EIA

Oil will remain a major source of energy even beyond 2040 in the total mix (Fig.3). Being cleane and cheaper, the demand of natural gas will increase at a bit faster rate and the contribution from Coal will decline simultaneously. The renewables will take over a major portion slowly and projected to become approximately 50% of total global demand by 2050 because renewables has the fastest pace of development among all alternative energy resources throughout the world.

The undergoing faster development of electric vehicles (EVs) in transport sector which has been a major energy consumption sector will also catalyze the considerable decline in demand of oil in future. It is estimated that share of EVs may reach upto 25% by the year 2040.

India is the tenth largest economy in the world after the United States, China, Japan, Germany, France, the United Kingdom, Brazil, Italy and Russia. India consisting 18% of the world population and one of the fastest developing country with an estimated economic growth rate of 8% and 4.5% growth in energy consumption for the next decade and hence is always in the focal point of Global Energy Business scenario. India energy consumption is about 36% hydrocarbon based and unfortunately almost 86% is met by import, eating a major chunk of foreign currency and widening the Current Account Deficit (CAD). It is expected that the country will become the world's second largest energy consumer in the next 25-30 years.



Fig, 4. Present Energy Mix of India, Source, InfralineEnergy, 2018

An energy starved country, Indian hydrocarbon Industry need immediate attention towards the ongoing energy mix. The forthcoming impact may be avoided by timely formulation and implementation of policies for continued sustenance of the hydrocarbon industry in India.

Energy Transition:

Energy transition can be defined as a long-term structural change in energy systems. The Energy Transition has been gathering pace and is sometimes described as the approach of a new 'third age of energy'. The transitions have occurred in the past with the gradual evolution of mankind and its energy requirement. The phenomena is still on and will continue in different form and scale on this earth time and again with variable requirements. There are various elements which emerges with time and force the inevitable change. The change can be observed as global energy mix is transforming from conventional energy resources (Coal, Oil & Gas) to unconventional HC and clean energy resources. The major cause behind this dramatic change is the environmental concerns. Following the concern, the shale gas revolution of USA, development of unconventional Oil & Gas sources viz. Shale Gas, CBM, Gas Hydrates, Tight reservoirs etc coupled with development of more cleaner & fast developing natural gas and renewables are the factors responsible for this transition. The renewable are playing an important role and will be the major source of energy supply in near future. Rapid development of electric vehicles in transport sector is one of the major player disrupting the total energy mix. Following are the key elements responsible for energy transition with considerably better future.

The Paris Agreement:

The Paris Agreement entered into force on 4 November 2016. The Paris Agreement brought most of the nations on a common platform of ambitious efforts to combat climate change and adapt to its effects, with enhanced support to assist developing countries to do so. As such, it charts a new course in the global climate effort. Following the agreement several countries started redefining their energy mix moving towards a cleaner source of energy. Following new resources have been added in the past two decades which are more prone to cleaner energy resources and are responsible for present transition in the energy mix.

- *Unconventional HC Resources:*

The 'Shale Revolution' in USA suddenly forced leading oil producing nations to focus on unconventional approach too for finding new source of oil & gas. Unconventional gas in its various forms has also been found in other parts of the world, giving an opportunity for many countries to lower their

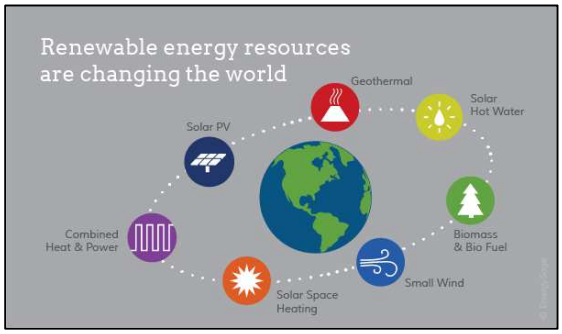
import dependence and strengthen their energy security. India also has good potential of development of unconventionals viz. Shale Gas, Coal Bed Methane, tight gas and Gas Hydrates.

- *Natural Gas*

Being the cleanest fossil fuels natural gas is one of the dominant source of energy in future. The importance of natural gas increased many fold due to its lower carbon content compared to other fossil fuel as well as a range of its uses. Natural gas emits 25% less CO2 than oil, and 50% less than coal. Latest estimates predicts that Natural Gas is available in abundance and will last for more than 100 years from now. It is cheaper and easy for production & transportation.

- *Renewables*

Renewables have emerged as a technologically feasible, economically attractive and sustainable choice that increasingly can meet the energy need of many countries, corporations and citizens. Renewables are the fastest-growing energy source in various part of the world and it is estimated that they could account for 14% of all energy consumption in 2040.



Fig, 5. Renewable Energy Resources

- *Electric Vehicles*

The world is propelling fast towards a post-oil future when electric batteries will drive the world. A futurist and clean energy expert, Toni Seba, has predicted that electric vehicles would destroy the global oil industry after a decade. By 2030, 95% of people won't own private cars which would wipe off the automobile industry, he says.

Impact on Hydrocarbon Industry

Presently Oil and gas supply about 57% of the commercial energy the world consumes, and their combustion accounted for roughly the same proportion of global CO2 emissions. The oil and gas industry will continue to play an important role in this portfolio and hydrocarbons will account for 44% of the total energy mix in 2050. Development of unconventionals, renewable energy resources and Electric vehicles are the major elements behind reducing the share of oil & Gas in future energy mix. The ongoing transition will have major impact on the economies purely based on oil business today. An accelerated transition though would pose a significant challenge for IOCs, disrupting their business models and undermining their profitability due to falling oil price. It is predicted that on the basis of current scenario the oil demand will plateau by 2023 and will continue by 2030 and decline thereafter. If the transition to renewables and low-carbon electricity happens faster than the energy establishment anticipates, the implications for exporters of oil and for the geopolitics of oil will be very serious.

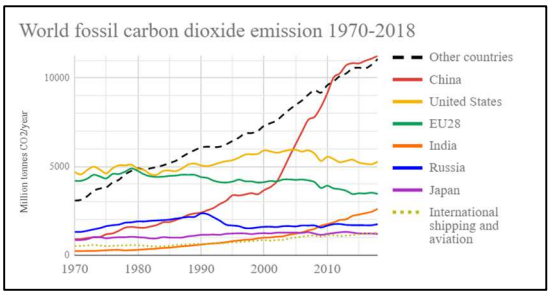
India is the third largest oil consumer in the world, after the US and China. As per Wood Mackenzie estimate India will soon surpass china to become second largest oil demand center soon. In India's energy mix, oil share is approximately 30% of total demand, of which country produces around 22% of its total demand. Rest of the demand are fulfilled by import. As on 31 March 2018, India had estimated crude oil reserves of 594.49 million tons (MT) and natural gas reserves of 1339.57 billion cubic meters (BCM). In the last few years the oil & Gas production is almost stagnant or very close to declining trend though its consumption and imports have been rising every year.

Another two major steps viz transition to electric mobility and faster development of renewables in the country will reduces the share of Oil & Gas in the total energy mix impacting the business of Oil & Gas Industry in the country. Towards transitioning to electric mobility, the new policy initiative of GOI have mandated to have 30% of all vehicles as EVs by 2030. It is a known fact that, today India is one of the countries with the largest production of energy from renewable sources.

Discussions:

Energy systems do not change overnight, but as we move into the next decade, the need for sustainable, reliable and affordable energy sources are ever more apparent. The era of transition and transformation in the energy mix of the globe has begun about two

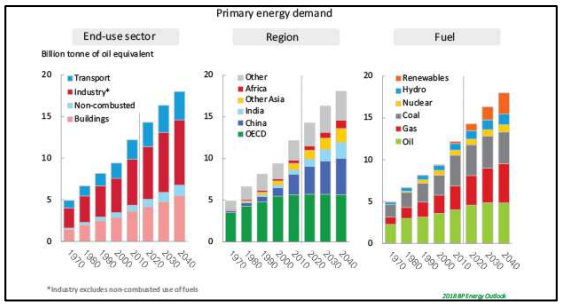
decades ago, but the necessity has been realized in recent years. The biggest challenges of present time are, to fulfill energy demand and at the same time reduce carbon emissions. And it will require many forms of energy to play a role. It is well known that the largest source of greenhouse gas emissions is from human activities in the form of burning fossil fuels for electricity, heat, and transportation. About 87% of total CO2 emission are from fossil fuels only, i.e Coal, Oil and Gas and major source of global warming. According to the most recent data from the Global Carbon Project 2018, the top five countries that produce the most CO2 are China, U.S., India, Russia, and Japan (fig. 6).



Fig, 6. Historical annual CO2 emissions for the top six countries and confederations. Source: Wikipedia

To curb the release of greenhouse gas several initiative in the form of 'International Treaty' has been taken, first *Kyoto Protocol* adopted in December 1997, followed by *Paris Agreement* in December 2015. The treaty has been signed by 197 countries and ratified by 185 as of January 2019. This reinforces the decarbonization measures already in place in several parts of the world, primarily in Europe. Meanwhile, technological advances have increased the competitiveness of solar and wind energy technologies, batteries and electric cars. According to the IPCC, to limit global warming to 1.5 degrees, CO2 emissions will have to be reduced by 45% by 2030. The study that energy demand forecasts are inconsistent with meeting Paris Agreement targets using currently available and economic technologies and that, barring a radical change in tendencies, significant volumes of oil and gas will be required well after 2050. However, there will be growing political, societal and financial market pressure to accelerate decarbonization. This poses a major challenge for International Oil Companies, whose current business models and technologies are incompatible with full decarbonization, but whose future depends on them being part of the solution.

Global demand for energy has risen at a 2.8% per annum (pa) CAGR since 1900, and has sustained a similar 2.2% annualized pace of growth so far in the 21st century (Fig 7). Assuming even a lower energy consumption of 1.7% CAGR, by 2050, global energy consumption will surpass 100,000 TWH (Terawatt Hours) pa. This will be driven mainly by population growth, rising incomes and decreasing poverty.



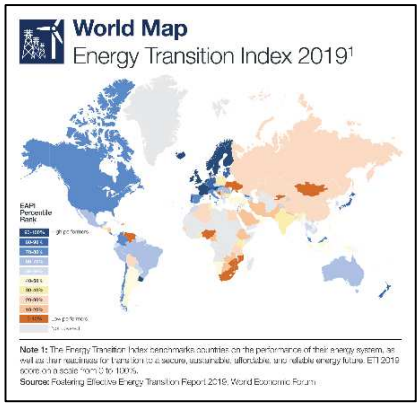
Fig, 7. Primary Energy Demand, Source: BP Energy Outlook, 2018.

The figure above explains the estimated energy transition from three different perspectives each of which helps to illuminate different aspects of the transition: the sectors in which energy is used; the regions in which it is consumed and produced; and the consumption and production of different fuels.

Now the question is how does this transition have the potential to reshape the geopolitical landscape and how does it compare to the impact of the last transition from traditional biomass energy 200 years ago? Shifting from the present fossil fuel based economy to low carbon energy sources will require intensified technology, huge investment and a suitable business strategies for the countries depending upon natural resource availability and its geographical position. It is assumed that almost every country will be able to harness renewable energy. Under the stated policies scenario the IEA said that demand for oil would slow over the next decade, before flattening by the 2030s. The transition will pose threat to countries purely based on oil business and are not ready for immediate transition. With the reducing demand of oil, the oil price game will also lose its importance and the role of OPEC will also be forced to change gradually. The geopolitics of oil over the past 120 years have played a central role in international relations. Indeed, some would argue that geopolitical rivalry over access to, and control of, oil supplies has been the source of much of the conflict witnessed in the 20th century (Yergin, 1991). As the relative importance of fossil fuels declines, a geopolitical shift in the frequency and location of conflict is likely to occur. Following the Paris Agreement, countries around the world are upping the share of renewables in their energy mixes.

The top ten countries ready for transition, leading the list of 115 countries are Sweden, Switzerland, Norway, Finland, Denmark, Austria, UK, France, Netherland & Iceland (Fig 8).

The map below indicates the current energy transition index in different parts of the world.



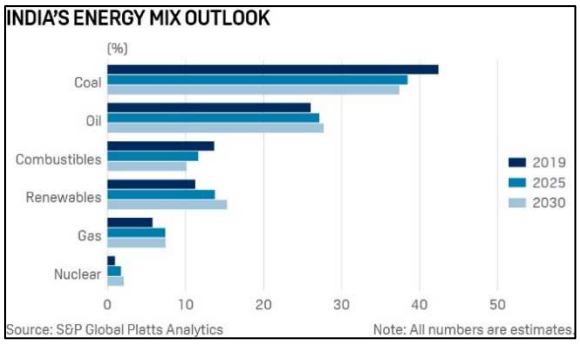
Fig, 8. World map showing Energy Transition Index, 2019, Source: World Economic Forum, Geneva

Continuous increase in demand of energy basically comes from fast-growing developing economies. Namely China, India, Indonesia, Korea, and Thailand are the leaders. Considering the impact of energy transition several forecasts state that there will be considerable decline in oil demand by 2050. At the same time the present growth rate of unconventional and renewable resources are not meeting the requirement as meant for 2050, meaning oil will still have good share in the energy mix even beyond 2050. But the scenario may change with time due to impending pressure for decarbonization and concurrent technological advancement.

With the expected economic growth, India will naturally demand enormous amounts of energy to meet its growth objectives. Energy consumption in India has almost been doubled since year 2000, although per capita consumption is only around a third of the global average. Today, the major fossil fuels account for more than 90% of India's total primary commercial energy supply.

In the present scenario E&P industry in India is undergoing transformation and disruption phase. New approaches are being sought to respond to balance the supply and demand dynamics, environmental issues and the costs associated in developing unconventional or alternative resources. In the present hostile crude price scenario, emerging energy forms like renewable sources and the challenges like failure in discovering giant oil fields, E&P companies in India needs to take cautious step ahead to sustain its business in future. India's energy mix reflects a clear trend towards gas and renewables, but there is no imminent danger to demand for oil per se, at least next twenty to thirty years. However, E&P companies are under pressure to prepare for low cost in operation along with option of greater mergers and acquisitions of energy companies and diversification in various other energy sectors and re-orient the future business strategy. As far as policies and regulations are concerned, the upstream sector are driven with Government's vision and target. GOI has taken several steps for development of, Oil & gas industry and renewables including solar power to curb the carbon emission. India has committed to achieving a 40 per cent share of non-fossil-fuel-based sources in its installed capacity by 2030 (Fig.9).

A plateau in demand and cheaper resources will lead to tough competition between energy sources where supply exceeds demand. There will be an increased need and opportunity to serve energy systems with a flexible mix of sources and carriers, and to identify and exploit synergies between these.



Fig, 9. India's Energy Mix, 2050. Source: S&P Global BP Energy Outlook, 2019.

Way Forward:

In the present dwindling situation in energy mix, certainly sources that are economically viable, easily accessible and environment friendly will sneak their way to the top of podium by next two decades. The prime task would be to understand and identify the issues, overall economic outlook, the economics of various energy forms, rate of technological change, changing social preferences followed by exploring various assumptions and then monitor how the energy transition unfolds in the years ahead,

India will, for the foreseeable future, continue to rely heavily upon oil and natural gas to support the

economy, national security, and energy security. Oil companies needs long term strategies for its survival. Acquisition of new acreages in India and abroad, accelerating exploration in frontier areas, induction of state of the art technology, collaboration with MNC's, enhancing production through various IOR/EOR measures etc are few measures suggested for better future of oil companies in India. Aligning the existing business model for the right mix of growth options in both conventional and alternative/renewable energy will help Indian Oil companies stay firm in business. Additionally, Energy conservation, emissions reduction and Carbon capture and storage (CCS) practices would help companies to become energy leader in the country.

Another strategy can be adopted by upstream oil companies in India would be to diversify in midstream and downstream sectors along with acquire/collaborate with the companies engaged in alternative/renewable energy generation to secure the position as leader in energy sector rather than to be identified as E&P Company only. Considering the iterative taken by GOI, more thrust also to be given to the natural gas development in the country.

Acceleration in R&D approach for new innovations resulting into cost saving and leading in E&P business. Implementation of project management in E&P sector for value addition, risk mitigation and future sustainability are smaller but crucial areas need to be focused. Constitution of a multidisciplinary team to review periodically the dynamics of energy transition globally and suggest measures, deduce policies for corrective and timely action.

5. Conclusions

The oil and gas industry has always changed, and has caused changes in the societies in which it operates. The oil and gas business continues to be one of the most dynamic and critical industries in the world. The challenges and opportunities that the industry has before it are being addressed by technology, capital investment, and talent management. It will be exciting to see what the future brings for this industry and the impact it will have on the worldwide economy. The transition to a lower carbon economy requires everyone to be involved, from individual consumers to global corporations, and from local authorities to national governments. The energy industry is already well into the transition, due to advances in renewables, unconventionals, digital technologies, electrification and the world's growing desire for cleaner, lower-carbon energy. In India, oil and gas is not going anywhere in the foreseeable future at least for the next 30-40 years. Indian oil companies are required to become a diversified energy entity in country with all adoptable variables for its longer and stronger sustenance. Oil companies have diverging views on current energy transition and choosing different way to address the issue. Only time will spell which strategy will work successfully to address the disruption issue and how the Indian oil companies will play constructive role in developing new and more climate friendly energy source with self-sustenance in future.

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