



Oil Model⁺²⁰²⁰

Stature, Stability and Price

Jan 2019

Part 1:

Why, How Far and How Long, Fall of Crude Oil Prices from US\$ 100/bbl to less than US\$ 30/bbl was published in Jan 2016

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1. Oil Still Defines Our World

Oil still defines our world, despite all the focus on other forms of energy. It will define our world for at least another 2 decades despite the evolving transition towards gas, electricity and other renewable energy forms. Global oil demand will continue to grow despite the challenges to produce oil at lower cost against fast growing technology of other forms of energy and resistance to oil as an environmentally damaging fossil fuel.

Dependency on oil may reduce due to increase in vehicle efficiency, growth of alternate fuel systems, advancements in electrified vehicles and ban on internal combustion engine, but oil will still dominate as the fuel for global industrial needs, aviation, shipping, heavy road transport, as feed stock for petrochemicals and also power generation (despite the growth in renewables and gas).

Until 2040, the demand for energy globally is expected to grow at a rate of 1.3-1.6%, i.e. around 35% increase in the next 2 decades. However, the growth in the energy demand will primarily be due to emerging markets like India, China, Africa, Middle East, South East Asia and Far East. These emerging markets will define, sustain and allow steady global GDP growth and the demand for energy. The world population is expected to grow to around 9.2 billion by 2040 but the global GDP growth and demand for energy will not be merely due to the increase in population but due to expected uplifting of nearly 1.6-2.0 billion people from poverty into higher economic levels in these countries.

For developed countries, the challenge is not the growth but to sustain the prosperity and life standards as the average growth will be less than 3.0%.

Note:

Before you continue:

Although this article can be read as standalone, reading the Part 1 that was published in Jan 2016 under the title "Why, How Far and How Long, Fall of Crude Oil Prices from US\$ 100/bbl to less than US\$ 30/bbl" will help to further understand and appreciate the world of oil and crude oil prices. You can find Part 1 in www.iwellsmc.com or iwellsmc.com/Why-How-Far-and-How-Long.pdf.

Globally then, the primary key to prosperity will be energy. A country must be able to afford the energy it needs in order to prosper but it must be abundant, constantly available, adequately accessible and cheap. Further, the uncertainties surrounding energy security is a major concern for both the developed and emerging technologies. However, the energy security is a complex term to define. Energy security affects both the energy producers and energy importers and it can be affected by several factors beyond a normal supply-demand relationship. The complexity increases multi-fold when it comes to oil. The world has seen several oil shocks in the last 60 years or so and the industry is still trying to recover from the shock of 2014 when the oil prices crashed from around USD 140 per barrel to less than USD 30.

Today the world is experiencing an evolving transition to move towards gas, electrification, renewables and even banning of internal combustion engines. However, the energy mix scenario in the next 20 years is a complex model that cannot be predicted so easily as the outcome depends on certain critical policy decisions and implementation challenges globally for the scenario considered.

The World Energy Outlook 2016 ("WEO") defines three different scenarios of energy policies namely, (1) Current Policies, (2) New Policies and (3) 450 Scenario.

The description of each of the three policies is beyond the scope of this paper but the dependency on fossil fuels, especially on oil and coal, reduces in all the scenarios until 2040. However, in the case of the Current and New Policies, while the % of demand for oil in the energy mix reduces by 3-4%, the actual volume required increases by around 4-5 million barrels per day due to the overall increase in demand for energy by around 35%. Only in the 450 Scenario, which is primarily focused on decarbonization model, the demand for oil drastically drops by almost 30% in 2040 from the current demand. The 450 scenario is based on starting from a vision to achieve in the future say by 2100 and working back to the present. The name 450 comes from the energy vision to limit the concentration of greenhouse gases in the atmosphere to 450 parts per million of CO₂ equivalent (which is based on limiting the global temperature increase to maximum 2^o C by 2100), Ref: WEO 2016 Report.

Despite the push for the New and 450 scenarios, they are extremely difficult to implement in reality. The balance of growth in energy demand will shift from the developed countries to emerging economies like China, India and other Asian countries. The concern for energy security and challenges to implement the plans for alternate sources of energy by the emerging economies are completely different from that of developed countries due to the difference in the fundamental ways of life to adapt growth and accept change. Hence, while the demand for energy will grow, the future of energy mix will be a major uncertainty despite the policies for new energy scenarios being adapted worldwide.

Despite the incentives and forces to switch from oil and coal to alternate fuels, in practice, oil will stay with only a fraction of its contribution reduced to the energy mix at least for the next 2 decades. Energy equipment for the domestic sector and office buildings may be replaced with an alternate source, electrification of vehicles may see a significant growth to replace Internal Combustion Engines but long lifetime of existing infra-structure for manufacturing, factories, plants, major industrial buildings, aviation, shipping etc require time, massive investment and significant scaling of alternate energy to change. The fact that the renewables like solar and wind power are intermittent and requires a contingency as backup and fossil fuels are the only option as of today's available technology as others like nuclear have no capability to scale up. Mere government policies, agreements in conventions and creating impractical goals will not be adequate to effect the changes.

While it is imperative is that the future requires a major step change from what we did in the past to reduce the global warming, the implementation of such policies require much stronger drive from every participating country, sector and discipline, a massive investment to modify or replace the existing infra-structure and wider acceptance of, not just the governments, but every individual, including politicians, across the globe to accept such change. Even then, the scaling up of the alternate sources to meet the growth in energy demand in the next 20 years will be a herculean task of enormous proportions.

Hence, for all practical purposes, although renewable energy is becoming the fastest growing energy source, the scaling up to meet the energy demand will be inadequate.

Hence, irrespective of efforts on decarbonization model for future energy mix, oil will still hold the power to bring peace or war, poverty or prosperity for at least another 2 decades as it has been doing for the last 4 decades.

2. Oil Prices 2016-2018

In Jan 2016, the oil Brent crude oil prices dropped as low as US\$ 27 per barrel. By end of the year in Dec 2016, the Brent crude rallied up gradually to US\$ 57 per barrel.

Note:

In my Part 1 paper published in January 2016, I predicted the oil price to hover around US\$ 35-40 per barrel from mid-2016 with low probability to reach US\$ 50 per barrel with a variance of +/- 5-10 \$ per barrel by end 2016. No prediction was included for 2017 in that paper.

The whole of 2017, the Brent crude stayed between US\$ 57 to US\$ 45 per barrel but by Nov 2017, the prices rallied further to US\$ 67 per barrel.

Apart from few impacting geo-political factors, the reasons for price rally are (1) OPEC's production cut of nearly 1.2 million barrels helped to reduce the excess supply in the market and (2) improved growth levels of emerging economies like India and China helped to increase import/demand.

The continued rally of oil in the first half of 2018 to US\$ 77 per barrel allowed OPEC and non-OPEC led by Russia to revise their stand to increase oil production by nearly a million barrels a day after the production cut announced in 2016. The deficit in Venezuela's production, concerns on Libya's interrupted supply and the delay in increasing the oil production by some OPEC members and other geo-political events including new sanctions imposed on Iran by USA, the oil market continued its rally to reach a peak of US\$ 86 per barrel by Oct 18.

However, the world oil inventory started to grow due to (1) increased oil production from Jul 18 by OPEC and Russia led non-OPEC countries, (2) record high daily oil production by USA beating both Saudi and Russia, (3) Iraq had signed an understanding with Kurds to start production from Kirkuk which can add nearly 400,000 barrels per day to the oil pool (making Iraq's production to reach the 5 million barrel per day level), (4) demand decreased due to slowed down global economy led by China, which was caused by the trade war between the USA and China and (5) other market sentiments, US\$ currency value, concerns on the oil stature in the near future and other factors.

Due to all these factors, the oil prices started to slide in Dec 18 dropping almost by 40% to less than USD 50 per barrel as compared to the price in Oct 18. OPEC had reacted swiftly to the developments, convening a meeting in Vienna, where the group is based. After an extended discussion, OPEC and Russia led other sovereign oil exporter countries, had decided unanimously to cut 1.2 million barrels per day from January 2019 for six months.

The new year 2019 started with a Brent crude price of US\$ 53.8 per barrel.

3. Analysis and Prediction of Oil Price/Stability Models

The oil price volatility is beyond the standard supply-demand model of a commodity. It is a complex web of geo-oil politics governed by tangible and intangible random variables, or a combination of random variables defined by pattern (statistics), process (probability) and dynamic variables (randomness). Without the elements of intangible random variables in to the equation, predictions of oil price/stability models will be utmost a guesstimate. The uncertainty and failure of every such prediction has been proved repeatedly in the world (example: oil prices, stock markets etc) but use of such predictions are continued as reference despite their repeated failures because either the extent of the complexity is under estimated or the prediction models have reached a limit.

Some of the intangible random variables that do not fit in to a pattern based and at least part of process based statistical model are:

- (a) energy security models for (1) developed countries, (2) emerging economies and (3) developing countries – each are different;
- (b) renewables – intensity of the drive and scaling up models;
- (c) natural gas and role of GECF;
- (d) energy poverty – lack of modern technology reach to nearly 1.0-1.5 billion poor people;
- (e) regional stability, controls and sanctions (like US sanctions on Iran or Russia's control of gas to Eastern Europe);
- (f) oil wars and accessibility to oil of very low production cost (example: Iraq's oil fields);
- (g) investment levels and models to discover new oil, develop existing discovered fields, enhance production from depleting fields;
- (h) practical application of economic policies that define the energy mix;
- (i) sustained growth of emerging economies (especially India and China);
- (j) resistance to oil as an environmentally damaging fossil fuel;
- (k) terrorism (ISIS model);
- (l) regional conflicts (religious, strategy, changing environment): and
- (m) others that span the entire regions of oil exporters, importers and other sources of energy mix;

and finally,

- (n) oil traders and futures contracts, their sentiments and fear mechanism for perceived glut or shortages;

It is hence imperative that the “Oil Model^{+ 2020}” is analyzed holistically covering the entire spectrum of tangible and intangible random variables that includes the past, the present, the future and at any time “t”.

The author’s work on the development of the “Oil Model⁺²⁰²⁰” using tangible and intangible random variables is beyond the scope of this paper but with the big data management systems available today, an effective model can be developed with the appropriate ability for real time evaluation and reporting.

4. Renewable Energy

Fossil fuels, especially coal and oil, are termed as environmentally damaging and one of the primary causes for global warming.

Renewable energy by the name itself is replenishable and that means it will never be depleted. The notion that renewables are cleaner energy lacks to address a possible impact and consequence scenario. There is no scientifically proven model that demonstrates the extensive use of wind power and solar energy radiations for power generation does not affect the earth’s natural weather and climatic cycles on earth. The negative effects of such abundant use of solar and wind may not be realized today but in the next few years it might be observed but by then it would be too late.

We are very good at innovation, invention and discoveries but we are unwise and reckless when it comes to application. We don’t understand sustainability and endurance or what future holds. We mindlessly applied the liberalism worldwide, when communism failed in 1990s, without any control with commercial growth as the only goal completely ignoring any possible consequences to our life, ecology, earth and mother nature. We cry today that fossil fuels are one of the primary causes for global warming, but we completely ignore the fact that these are the same exponents of liberalism and growth who acted to promote consumerism mindlessly. If we had acted smartly to work on a sustained growth in the last 30 years, we would not be in the global warming (and warning) situation today. I am not an exponent of fossil fuels, but the fact is we were reckless in applying growth globally as a goal without defining it properly.

Today’s fast fashion industry probably is a major cause of global warming as people are reckless in using fashion because they are cheap. It is not uncommon to observe people gullibly shopping for fashion clothes, bags, foot wear not just once or twice a year but almost every week. They forget conveniently that they are cheap because they are manufactured in harrowing human conditions of poor countries or even developing countries (some so called emerging economies) that turn a blind eye to the unacceptable human exploitation that will not be accepted by the same people who buy and help this industry to thrive. The waste generated by the fashion industry including the disposal of old used fashion materials probably is another major cause for global warming. As long as the fashion industry is commercial and profitable, liberalism and consumerism will flow without any restriction whether it is causing environmental damage or encouraging unacceptable human exploitation and suffering in another place. I brought this into oil story just to allow us to think on what we do recklessly without worrying about any consequence.

Unfortunately, the truth is we will not change in the future. Look at the supporters of Brexit. Both the parties, those who support and those who oppose, have no clue about the future of an isolated United Kingdom or consequences of Brexit on the future generations. If the supporters dream of bringing back the past glory of United Kingdom by getting isolated, then the history is misunderstood as today the world is different than what it was before the second world war. If the opponents dream of continued growth by being part of the EU, then they also have misunderstood reality as the world is different today than what it was when EU was established. Is Brexit good or bad? The truth is today no one knows. Unfortunately, in the modern world of democracy, the majority wins even if they are wrong. That is the reality.

There is now a huge rush towards renewables and as our habit and practice in the last decades, we have no idea today on what the consequences would be in the future for obstructing the natural forces like water and sun light radiation on the nature’s weather cycle systems. I am sure that in future, another new idea would form with a rush to control/sustain renewables.

Some of the tangible negative effects of renewable energy like, (1) disturbance of ecosystems by restricting the flow of rivers by dams for hydroelectric power generation, (2) extensive use of land and associated matter for solar power, (3) effects of windmills on birds and marine life, (4) extensive infrastructure requirement to transport renewable energy that may need fossil fuel support as most renewables are location specific etc, are not considered as major impact on environment.

Hence, setting aside the above listed tangible effects, the effect of converting the naturally flowing solar radiation and wind power on overall climatic conditions on earth's atmosphere needs to be seriously studied. Our mother earth has been stable probably only for the last eleven thousand years called Holocene age despite the occurrence of natural disasters like earth quakes, storms, floods, tsunamis etc. The stability of the earth is one of the major reasons for human population growth and advancements. The reason for such stability is not fully defined except that the mother nature had established a cycle of natural environment that allowed such stability. The instances of occasional (or rather more frequently in the recent years) of natural disasters are due to the earth's requirement to sustain the equilibrium state and the stability. If such natural disasters do not strike and earth's natural equilibrium is disturbed, a major black swan event may occur that might destroy the entire humanity or create a major impact on modern life. However, the truth is despite all the advancements in science, we don't know how nature works as our human life as individuals is miniscule as compared to the nature's geologic time scale.

Hence, in that stable earth's atmosphere for the eleven thousand years or so, the blowing of wind and the radiating rays of the sun have specific role to play. By converting their flow by renewable energy model in a massive scale, what kind of adverse effects are generated? We may not have the answer today, as the exponents of the renewable energy will not like to pursue this research (they may not find even if attempted as the knowledge of nature is inadequate), but sometime in the future, the reality will be observed. This will lead to a quest for either an alternate to renewables or humans across the world may experience a world with significantly different climate and weather cycle models.

Renewable energy, hence, is not truly renewable as consequences may be irreversible.

Hence, the author strongly believes that despite the renewables being the fastest growing energy source today, the growth levels will not be sustained or even reduced in the long term as realization of scaling difficulties or effect of consequences will strike in the next 15-20 years and the energy mix will remain balanced.

5. Oil Challenges and Politics – Before 2017

There is enough oil and gas under the earth that will provide us enough energy for the next hundred years while the renewables and other forms of energy gather dominance gradually. But the abundance of oil and gas is not in the areas of large concentration of people who actually need it. The mother nature deposited the oil and gas as a non-renewable source, in remote areas, challenging environments and within few political powers that will dominate the energy market of the current and the future.

While the environments impose various degrees of technological and economical challenges, the powers that own the oil and gas fields create the geo-political uncertainties, constant concerns to energy security and extreme volatility to the cost of crude oil.

Oil politics is not new. It is a dominant factor for nearly hundred years in the world of politics, wars, peace, prosperity, poverty and global growth.

Up until 1970s, the world of oil was ruled by a cartel ran by the "Seven Sisters", (1) Exxon, (2) Mobil, (3) Chevron, (4) Texaco, (5) Gulf Oil, (6) Shell and (7) BP. The seven sisters controlled more than 90% of world oil market manipulating the oil prices at will using the production concessions acquired from countries that had the oil including the Middle East and Africa.

Starting in early 1970s, one by one, all of the major oil producers of the Middle East, nationalized the oil and gas industry which stripped the dominant role of the Seven Sisters. The same strategy was followed by other nations across the world. Today the Seven Sisters, in different and merged forms of organization, are called International Oil Companies ("IOCs") but they control less than 15% of the world oil. The National Oil Companies ("NOCs") hold the majority of world oil reserves. Saudi Aramco became

the biggest NOC. It controls almost 11% of daily world oil production and around 16% of world oil reserves.

By around late 1950s, the international political scenario was changing rapidly. The worldwide decolonization and post events of World War II created several new independent states and a post war developing world. In this changing world landscape, the major oil exporters formed the Organization of Petroleum Exporting Countries (“OPEC”) in 1960, to end the cartel of Seven Sisters and create a cartel of their own. Thus, the popularly known as OPEC was formed which was inaugurated in September 1960 by five founding members namely Iran, Iraq, Kuwait, Saudi Arabia and Venezuela. OPEC currently has 15 members and operates from Vienna, Austria.

The OPEC’s role in the world oil market was undoubtedly established by the 1973 Arab embargo to the USA (which played a major role in forming the basis of US Energy Security Policy that we experience even today) and during the 1979 Iranian revolution. Further OPEC’s role to control/curtail production to improve the oil prices during the 1986 crash due to oil glut or the 2014 crash due to geo-oil politics and to increase production in a short time to fill the gap in the supply induced by the 1992 Gulf War or during the recent Libyan crisis, established Saudi as the world’s swing producer which still holds until today.

Outside of OPEC, Russia is a dominating non-OPEC oil exporting country with 10% of world reserves and daily production equivalent to that of Saudi Arabia. Russia exercises its own influence on the geo-oil politics as a dominating force independent of OPEC, especially after Putin had come to power.

USA is one of the leading producers of oil but due to high internal consumption, it still stays as one of the leading net importers. Both USA and China play a major role in the demand for oil being the top two net importers followed by India.

The world experienced a series of oil shocks in the last sixty years or so. Let us review them briefly as below.

5.1 Oil Shocks

Starting with the Arab oil embargo to export oil to the US, the world has experienced the extreme effects of oil shocks and its influence in our daily life.

(a) Arab Embargo – 1973

In October 1973, the Organization of Arab Petroleum Exporting Countries (OAPEC) declared a ban of oil export to the US for supporting Israel in the Yom Kippur War with Egypt, Jordan and Syria. The oil prices soared by more than 400% from US\$ 2.90/bbl to US\$ 11.65/bbl by early 1974. This created one of the worst recessions and spiked inflation worldwide but more especially in the US. This embargo seriously damaged the trust in OPEC as a reliable exporter of oil and America’s entire energy security policy of the future including a ban to export indigenous crude were casted by that experience.

(b) Iranian Revolution – 1979

The second major oil shock was experienced in 1979 when Shah of Iran was overthrown by Ayatollah Khomeini by Iranian Revolution. The revolution caused Iran’s oil output to decline by almost 4.5 million barrels of oil per day. Fear of continued disruption amidst a growing world economy pushed the oil prices up almost doubling the price by early 1980.

Russia made gains in this troublesome period in the middle of the cold war and invaded Afghanistan in 1980 to support their puppet Marxist Government.

The disturbance in the Middle East in 1979-1980, apart from triggering another oil shock, created a significant impact on world politics in the middle of the cold war era whose effects are reverberating even today.

(c) Iraq and Iran War – 1980-1988

Saddam Hussain, the President of Iraq, declared war on Iran in 1980. The war raged for 8 years which created a worldwide concern that the Middle East was unstable and unreliable in the long term.

(d) Oil Glut – 1986

The world experienced a collapse of oil prices in 1986 from US\$ 30/bbl to less than US\$ 10/bbl. This created another major recession in the world especially the US. Although the demand for oil was growing, the oil glut was due to increased oil production from non-OPEC producers and increased output by Saudi Arabia to retain its market share. Although OPEC agreed to curtail production to move the prices higher towards the end of 1986, the damage was already done. The world has not forgotten the devastating effect of the 1986 oil glut which created huge unemployment, recession and running several businesses out of existence.

(e) Fall of Soviet Union – 1989-1992

The crash of oil prices also triggered the collapse of Soviet Union between 1989-1992. Although the collapse is attributed to a democratic momentum that destroyed Berlin Wall in 1989, overthrow of communism across Eastern Europe and Gorbachev's unsuccessful attempt to democratize Soviet Union, the fall of Russia's economy due to the low oil prices contributed to the start of the collapse. The collapse of Soviet Union brought an end to the cold war which was raging for more than 47 years from the end of World War II.

(f) Persian Gulf War – 1990-91

Saddam ended the 8-year long war with Iran in 1988. Just two years later, he decided to invade Kuwait in 1990. Kuwait was captured within hours and by doing so Saddam controlled almost 20% of world oil and a substantial coastline of the Persian Gulf. The US fearing that Saddam's next target would be Saudi Arabia went on offensive immediately to push him out of Kuwait by Operation Desert Storm with allied troops from more than 37 countries supporting the effort. If Saddam invaded Saudi Arabia, he would have had control of more than 41% of world's oil and significant power to disrupt peace in the Middle East especially for Israel and to push global oil prices higher.

(g) Asian Economic Crisis - 1998

The Asian economic crisis of 1998 started a slide in the crude oil demand and the oil prices dropped to a single digit number per barrel. The world's spare capacity grew close to 5 million barrels of oil per day. However, the situation changed within 3-4 years with the regrowth of the economy supported by oil crisis in oil producing countries like Venezuela, Nigeria and Iraq.

5.2 Events Post Year 2000

The September 11, 2001 attacks on the World Trade Centre created a profound effect of US foreign policy and in general on the world towards the Middle East. At the same time, Russia's new President Putin took control of some of Russia's biggest oil companies and declared that Russia will arise again with substantially increased oil production. Fearing the worst after the September 11 attacks, Saudi Arabia and other OPEC members increased oil output. However, as the market's surplus increased, the prices crashed. Saudi Arabia requested Russia to cut down production, but Putin refused. OPEC then had to cut down production significantly to maintain the oil prices above a certain level which helped Russia to gain high revenues without the need of a cut in their production.

By 2002, due to a yearlong strike in Venezuela, nearly 2.5-3 million barrels per day of oil production was disturbed. In 2003, Nigeria faced an oil crisis due to emergence of militant groups and confrontations due to local and state elections. By March 2003, due to the invasion on Iraq to oust Saddam by the US and allies, an additional nearly 2-2.5 million per barrels of oil per day from Iraq was stopped. The oil prices hovered between US\$ 25/bbl to US\$ 40/bbl without spiraling up uncontrolled during these critical periods due to Saudi Arabia pushing oil production up by almost 1.1 million barrels per day and with other OPEC producers extending support to boost the production. Once again Saudi Arabia proved to be the leading Swing Producer to control the oil prices. Saudi Arabia also demonstrated its intention and willingness to prevent uncontrolled escalation of oil prices. This brought a good will from Saudi to US amidst the turbulent period between September 11 attacks and until Saddam's execution.

With no major geo-political issues in the world post 2003 and due to growing economies of Asia especially India and China, a steady increase of oil prices was seen from 2003-2007. The oil prices increased from an average of US\$ 27/bbl to US\$ 70/bbl during this period. However, from August 2007, although there was no obvious geo-political disturbance in the world, the oil prices soared to US\$ 140 per bbl by June/July 2008. Most of the oil importing countries suffered significant import bill problems

to meet the country's demand but Saudi as well as Russia did not act to increase production to control the rising prices. Probably Saudi and other OPEC countries expected the growing world economy would tolerate the increasing oil prices and decided to benefit from high revenues.

The industry enjoyed a profitable run with +USD 100 per barrel for nearly seven years except for a short break in 2008-2009 during the worldwide economic meltdown in 2008-2009. However, from June 2014 the oil prices started dropping drastically and reached as low as USD 28 per barrel in January 2016.

The drop-in oil prices in 2014-2015 was a major shock from which the industry has not recovered yet. The possible causes for such drastic drop in oil prices is beyond the scope of this paper but please read Part 1 "Why, How Far and How Long, Fall of Crude Oil Prices from US\$ 100/bbl to less than US\$ 30/bbl" that analyses the most likely scenario. You can find Part 1 in www.iwellsmc.com or iwellsmc.com/Why-How-Far-and-How-Long.pdf.

Now the future.

6. Oil's Future and Prominence of Gas

The future of oil depends on how gas transforms the balance in the energy mix.

Oil's relative position in the energy mix in the future will be governed, in addition to the renewables, by the growing prominence and influence of gas as cleaner fossil fuel.

Hence, one needs to understand the growing gas dominancy to fully appreciate the oil challenges.

Based on 2018 estimates, in volume terms, however, the increase in gas production is expected to grow by 47% from the current production of 0.34 Tcf per day to 0.51 Tcf per day. However, the contribution of gas to the energy mix is expected to increase only by around 3% to 27%. The volume increase is high as compared to the share in total energy mix due to the overall increase for energy demand by nearly 35% by 2040.

However, unlike oil, gas is not a global commodity due to the lack of extensive and expensive infrastructure to pump and transport the gas. Unlike oil, gas can be shipped only in a liquefied form which requires incredibly expensive processing facility and specialized LNG tankers. Approximately 60-70% of world gas production is consumed within the country of production, 20-30% crosses international borders if pipelines exist and only 10-15% are transported to intercontinental shipment through LNG tankers.

If the challenges to transport gas to long distances in pipeline or in a liquified form at affordable capital costs and sale prices are overcome, then gas will gradually turn in to a fuel of the future. The influence of Russian led Gas Exporting Countries Forum ("GECF") on regional and global gas prices hence would become a major factor for gas price mechanism as that of OPEC for oil.

The global natural gas resources base can last for about 60 years at the current production rates supported by the technological innovation that allowed the additional extraction of natural gas in unconventional rock formations like shale, tight sands and coal beds.

However, between Russia, Iran and Qatar, who combinedly holds 55% of world gas reserves, gas can be produced at the current rate of their production for another 93 years.

Thus, OPEC as well as the world of oil, will face significant challenges from GECF, a fully functioning organization from 2010. GECF members, currently with 12 countries, committed to foster the consistent growth of natural gas usage, promote the expansion of natural gas utilization in different sectors, and encourage GECF dialogue with all market players and stakeholders, to promote gas as a driver for environmentally friendly economic growth and social development (www.gecf.org).

6.1 Why GECF cannot be Ignored?

Between Russia, Iran and Qatar, they hold more than 55% of the world gas reserves. Russia holds around 1,788 tcf (trillion cubic feet), Iran 1,194 tcf and Qatar 843 tcf, a total of 3,825 tcf against the world total of 7,044 tcf.

Russia and LNG

Please refer Section 7.2 for discussions on Russia's gas. Briefly, Russia with 1,788 Tcf of gas, has 2 LNG plants operating currently with capacity of 21 MT per year. Additional capacity of 6.8 MT is under construction with expected completion date of 2019. Russia has plans to construct an additional 67 MT capacity by 2023/2024. Currently, Russia's LNG export is small as compared to that of Qatar or Australia, but it is gearing up to be one of the top LNG exporters within the next 5 years.

Qatar Gas as LNG

Qatar, with an estimated reserve of 885 Tcf of gas, is the third largest natural gas country in the world. It accounts for around 13% of the world's total natural gas reserves. Unlike Russia that pumps gas through pipeline, Qatar supplies gas as Liquefied Natural Gas ("LNG") through tankers.

With 8 LNG plants, Qatar has an annual capacity of 77 MT currently, and an additional 33 MT capacity plant is being constructed with a start date of 2024/2025. Unlike Russia, currently Qatar is producing/exporting 77 MT per year of LNG and has planned to increase the production to the maximum capacity in the next few years. Qatar is exporting nearly 0.78 Tcf of gas through pipelines.

Iran Gas - Undeveloped

Although, Iran holds the world's second biggest natural gas reserves with 1,187 Tcf, most of these reserves remain undeveloped due to international sanctions and delays in field development. Iran does not have LNG facility but exports 0.46 Tcf of gas per year through pipelines.

Other Major GECF Countries with High Gas Reserves

Other countries with significant gas reserves are:

- (a) UAE – 215 Tcf. With only one LNG plant of capacity 5.6 MT of LNG, UAE is exporting nearly 6 MT per year. UAE is producing gas only for domestic use and is not exporting any gas through pipeline now. The deficit gas for domestic use is imported from Qatar (despite the sanctions imposed on Qatar).
- (b) Venezuela – 202 Tcf. The country is still a net importer of gas to feed the demand due to lack of infrastructure and investment scale to increase production. There is no LNG facility in the country.
- (c) Nigeria – 199 Tcf. Most of the country's associated gas is flared due to lack of infra-structure to market the natural gas produced as associated gas from oil fields. The country has one LNG facility with 6 trains with capability to produce 22 MT of LNG per year. Nigeria exports nearly to its full capacity of LNG but does not have much exports through pipeline.
- (d) Algeria – 159 Tcf and is the largest gas producer of Africa. With 4 major LNG plants, the country's capacity is 24 MT of LNG per year.

Hence, as mentioned earlier, if the challenges on capital costs and long distances transportation are overcome, then gas will become a global commodity like oil. When that occurs, the GECF countries will impart significant influence on the energy mix.

Oil will face further challenges, if the oil exporting countries move towards gas-based economy, for attracting the necessary investment to oil as gas development would take priority.

If the gas becomes available at affordable prices, the oil importing countries will also switch to gas due to the pressure of adapting to cleaner fossil fuel and new energy policies.

Hence, GECF or gas prominence cannot be ignored by oil exporting countries in the long term.

6.2 Non-GECF Countries

Out of the non-GECF countries, the countries with larger gas reserves are only the following:

USA

USA holds nearly 320 Tcf of gas reserves which is only 4.6% of the world total. However, USA is the world's leading gas producer with close to 71 bcf of gas per day. As USA is also the largest gas consumer of the world, it is not a leading exporter like Russia or Qatar.

Saudi Arabia

Saudi holds nearly 308 Tcf of gas reserves but it only 4.4% of the world total unlike its dominance in oil. Currently Saudi is producing gas only for domestic use. It is not exporting any gas now. Saudi does not have any LNG facility but is planning to build adequate capacity to become LNG exporter in the next few years.

Turkmenistan

Despite holding nearly 347 Tcf of gas, Turkmenistan is not a leading player in the market due to lack of infra-structure, facilities and investment. The country does not have LNG facility but among the Caspian and Central Asian countries, Turkmenistan is the leading gas exporter. The country exports nearly 1.4 Tcf of gas mainly to China and aims to increase the gas production to around 2.5 Tcf by 2020.

Australia

Although Australia has only around 112 Tcf of gas, it is one of the leading LNG exporters, next to Qatar. Hence, Australia plays a very critical strategic position for LNG supply to South and East Asian countries due to proximity and demand. India and China will move from coal to gas as the demand for reducing coal-based energy increased and the environment policies shift towards gas. Australia exported nearly 74 MT of LNG last year only 3 MT less than that of Qatar. With the existing infra-structure and sanctioning of new projects, Australia is well poised to be the top three of LNG exporter of the future.

6.3 Gas Model⁺²⁰²⁰

Based on the discussions above, the "Gas Model⁺²⁰²⁰" will be under the control of Russia led GECF. The non-GECF countries do not have a united front for gas like Russia has for oil. Russia leads non-OPEC sovereign oil exporters in parallel to OPEC and a similar front does not exist today in parallel to GECF.

Hence, GECF and its role in the future of geo-gas politics cannot be ignored.

7. Geo-Oil Politics – Current and Immediate Future

The regional and global political scenario may not have direct impact on the oil demand or oil prices, but they contribute as key elements that disturb consistency and reliability of energy security and that creates a fear in the market players leading to surge or drop in oil prices.

Covering the complete global scenario is beyond the scope of this report but I have made an attempt to discuss major elements that will have immediate effect or long-term consequences to the new world order.

7.1 Middle East

Middle East will continue to play a major role in oil affairs mainly due to abundance of oil and the extremely low cost of production. The IOCs will not ignore the prospects of the Middle East and the attempts to gain the oil concessions that were lost during the nationalization process will be given a new thrust as sustaining/discovering/enhancing production of oil in other parts of the world becomes more and more difficult and expensive.

USA's fast growth to exceed the daily production of Saudi and Russia as the world's leading producer of oil will not last beyond 8-10 years depending on how hard the tight oil is extracted. Hence, OPEC

and Russia (as the leader of Non-OPEC Sovereign countries) will continue to impose influence on oil prices, market and availability.

However, the Middle East and OPEC have their own conflicts and issues that, although regional, can significantly impact the global energy stability.

From a strategic perspective, Saudi Arabia will not prefer to antagonize Russia. Saudi knows that unlike the past, it cannot be the only swing producer anymore with the support of OPEC members alone. Many OPEC members are already at maximum capacity or suffering from production declines from aging fields or instability due to political or other reasons. Hence, it is not easy anymore for Saudi to confidently make promises for production cuts or increase. It would hence require Russia and the group of non-OPEC oil exporters led by Russia to support Saudi and OPEC to manipulate oil production to control the volatility in oil prices. Between OPEC and Russia led sovereign oil exporters, they will have nearly half of world oil production at their control. So, Saudi may not share the sentiments of USA against Russia in the newly developing "Strategic War", a new form of cold war, between these two countries where China may also be playing a key role by its strategic alliance with Russia as a competitor to the USA.

Instead Saudi's challenges would be Iran, Turkey and Qatar (recent developments).

Saudi's issue with Iran is beyond religious differences (Sunni vs Shia). It is political, economic, dominance in the politically unstable landscape and a struggle for exercising control over the Islamic countries.

Brief History:

The friction between Saudi and Iran started in 1979 when Shah of Iran was over thrown by the revolution led by Ayatollah Khomeini. Iran, a Shite powerhouse, became a staunch anti-American which was a close ally of Saudi, a state ruled by Sunni Muslims. Various events led to formation of Gulf Co-Operation Council ("GCC") in 1981 consisting of six countries Saudi, UAE, Qatar, Oman, Bahrain and Kuwait where Iran was not part of it.

Saudi's support of Iraq during the 8 years long Iraq-Iran war created further differences. After the fall of Saddam in 2003, the biggest war threat from Iraq was eliminated for Saudi Arabia but at the same time Saudi and Iran became the two main regional powers.

Iran's influence has increased in the last decade despite the sanctions imposed by USA and struggling economy (except for 2 years when the sanctions were lifted in 2016 by Obama). The ousting of Saddam in Iraq in 2003 paved the way for Shiite's power in the country. The claimed defeat of ISIL caliphate in Iraq had strengthened the Shia hands in the country. The civil war in Syria is won by Baath regime, an ally of Iran. The Houthi Shiites rebels staged a coup in Yemen and have expanded their control in the country. Although USA's recent sanctions on Iran starting Nov 18 might reduce Iran's influence in the region, the situation today is vastly different than what existed in the 1980s and 1990s.

Turkey's relationship with Saudi was volatile but the ties became stronger when Saddam was ousted in 2003 as both Saudi and Turkey were concerned that Saddam less Iraq would fall into the hands of Iran. They were also worried about growing Iran's influence on Lebanon and Syria. The trade exports of Turkey to Saudi also flourished between 2003 and 2012. However, it took a sharp turn during the Arab spring especially with the events unfolded in Egypt. While Saudi, ruled by Sunni Muslims, pursues Wahhabi school of thought, Turkey follows the Salafi sect of Muslim Brotherhood. In Egypt, in the first election held in 2012 after the ousting of Hosni Mubarak (a Saudi ally), Mohamed Morsi was elected as the President. Morsi is from Salafi form of Islam that pursue the Muslim Brotherhood. Morsi and the rise of Muslim Brotherhood was welcomed by Turkey, but Saudi opposed him. The rift in Turkey-Saudi relationship intensified, when in 2013, Morsi was ousted by a coup and Saudi's ally Abdel Fatah el-Sisi became the new President.

In 2017, the relationship took another hit when Saudi and Turkey were standing on opposite sides over the Qatar crisis. When Saudi led Middle East countries including UAE, Bahrain and Egypt imposed sanctions on Qatar, Turkey expanded its engagement with Qatar offering friendship, food to withstand the imposed sanctions and sending military troops to its base in Qatar. Turkish relationship with Saudi

was further stressed since Oct 2018 when Saudi Journalist Jamal Khashoggi was killed by some hitmen inside Saudi Consulate in Istanbul.

Now with Qatar walking out of OPEC, the uncertainty of its effect still lingers in the air. Although Qatar is still in the GCC, it is clear that Qatar is distancing from Saudi's influential dominance of the OPEC as well as GCC. Strategically between Qatar, Iran and Russia, they hold 55% of world gas reserves, a very strong reason to ally to establish GECF as powerful and influential for gas as that of OPEC for oil.

Qatar was the first Arab state to join OPEC after it was founded in 1960 and it will be the first to leave. Qatar had announced on 3rd Dec 2018 that it will exit from OPEC effective 1st Jan 2019. Qatar has no dominance in OPEC as it ranks 11th among the 15 OPEC members, producing a mere 600,000 barrels of oil per day contributing to less than 2-3% share of the OPEC's output. Qatar has little or no influence or use for OPEC. Hence, Qatar's exit is not about economics or manipulation of geo-oil politics. It is more political primarily aimed at the dominance of Saudi Arabia, the most influential member of OPEC and the Gulf Co-Operation Council ("GCC").

In the Qatar crisis, the other members of the GCC like Oman and Kuwait played neutral. Oman traditionally stayed neutral and is not expected to join the embargo. It is gaining economically as Qatar is using Oman's Sohar port for its cargo management instead of Dubai's Jebel Ali due to the embargo. Also, Oman is poised to make further economic gains when the new port Duqm at Oman's central coast is opened. Oman's closeness to Iran was also under a radar by both Saudi and the USA as it continued to maintain ties with Iran. Oman has openly moved to make ties with Israel, the first Arab state to do so. The Israeli Prime Minister Netanyahu visited Oman in Oct 18 to probably cast strategic ties. A question lingers if Oman can be a mediatory between Israel and Iran as it did between USA and Iran in 2013. Oman's relationship with Israel might cool off Washington leaders who were upset due to Oman's closeness with Iran.

Another development is the Israel's changing relationship with UAE. The latest milestone occurred on 27th Oct 18 when Israeli's Culture and Sports Minister Miiri Regev listened, with tears flowing, to the Israeli National Anthem "Hatikva", played for the first time in the history, at Abu Dhabi Grand Slam. The anthem was played when Gold Medal was awarded to Israel's Sagi Muki of Israel for winning the Judo competition in 82 kg category. This of course does not indicate a major change to diplomatic and trade relationship between UAE and Israel, but it at least shows the changing trend towards Israel as a nation.

Further, within the Middle East and Mediterranean, Israel's recent discovery of Leviathan gas field with 16 tcf of gas has high potential, when the field comes online in 2019, to change Israel's political relationships not only with the neighbouring countries like Egypt and Turkey but to the entire Middle East.

The recent announcement of Trump to withdraw the American troops from Iraq and Syria stating that ISIS had been nullified, despite the concerns that it may not be so, had created a new regional uncertainty.

Hence, the Middle East is undergoing some significant political changes as well as challenges and their effect on oil politics and stability is yet to be seen but it may be significant as the history unfolds.

7.2 Russia

Russia is one factor that cannot be ignored irrespective of the global positions of USA or China and other major factors like Middle East, Europe and other emerging economies.

Today's Russia is not the old Soviet Union. It is smaller geographically and probably militarily as compared to Soviet Union. Many states of Soviet Union moved away as separate countries after the collapse of Soviet Union and the end of cold war and joined NATO or EU or both. So, Russia may not have the advantage of a cold war era with the US and other Western Countries. Russia may not be willing too as it now has huge trade relationship with the Western, Middle East and Asian Countries unlike the Soviet Union that was isolated from the free world in the cold war era.

However, Russia is strong and highly influential in the new era of Energy based world economy.

Let us review what Russia has in its hold:

- 25% of world gas reserves at 1,788 Tcf.
- 5.5% of world oil at 80 Billion Barrels.
- Unlike Saudi who currently dominates only on oil supply and Qatar on LNG, with domestic consumption far less than that of USA, Russia is a leading exporter of both gas and oil.
- Russia holds a monopoly for gas supply to Eastern Europe and a leading gas exporter to Turkey and Germany.

- Russia produces oil at similar rates to Saudi and the USA and exports close to 5.1 million barrels per day (the second highest in the world after Saudi that exports nearly 7.0 million barrels per day).

- Russia produces nearly 67 Bcf of gas daily only 2nd to USA which produces 74 Bcf. Unlike USA, most of Russia's gas is exported. The other countries are far behind with Iran at 29 Bcf, Canada at 18 Bcf and Qatar at 17 Bcf.

Beyond the statistics and numbers,

- Russia holds a strong strategic position to control the energy security and energy economy of certain East European countries, especially Ukraine.
- Russia leads the non-OPEC sovereign oil exporters.
- Russia leads the GECF (Gas Exporting Countries Forum).

Russia and Eastern Europe

Most of the landlocked East European countries depend on Russia's gas, especially Ukraine and other neighbours. Further to the West, Germany is the largest importer of Russian gas followed by Turkey as the second largest. Currently Russia pumps most of Turkey's gas through Blue Stream pipeline with balance of its gas through another aging pipeline through Ukraine and Eastern Europe.

Now Russia is building another new pipeline called Turk Stream that has a 930 km offshore section across the Black Sea to the Turkish border. Nord Stream another pipeline that runs under the Baltic Sea pumps most of Germany's gas. Both these streams will allow Russia to transport gas to Western Europe without running through Ukraine and other Eastern European countries. This plan will make many of the East European countries lose significant revenue due to the loss of transit fees when gas is pumped in pipeline running through their countries.

As the planned route bypasses central and eastern European countries, they stand to lose lucrative gas transit fees. Beyond that, with the means to directly deliver gas to its most important buyers, Germany and Turkey, Russia has the ability to shut off existing pipelines leading through Eastern Europe. The land locked Eastern European countries that depend solely on Russian gas for their energy will be left without any choice other than pay any exorbitant rate for gas that Russia would demand.

Earlier, whenever Russia closed the pipeline to hurt Ukraine's economics (without gas flowing through the pipeline, Ukraine loses significant gas transit fees), it also affected rich buyers like Germany and other Western European countries. Hence Russia had to compromise due to the pressure from its own gas exporters like Gazprom and importers to open the lines. With the direct offshore pipelines like Turk Stream and Nord Stream, Russia can now permanently hurt Ukraine or sanction gas sales according to its game plan. Although Putin says the Turk Stream and Nord Stream pipelines are economical, it is not difficult to understand that the move is politically strategic to keep a control on Ukraine and other East European countries that depend on Russia's gas.

Russia Beyond Eastern Europe

Critically from a political standpoint, unlike USA or Saudi, Russia strategically has ties with Saudi, Qatar and Iran.

Already Russia, as the leader of non-OPEC sovereign oil exporters, is working in alliance with Saudi and OPEC to oil production cuts or increase to play the market forces.

Russia already has strong influence on oil and gas (through pipeline market). With its existing capacity of 94 MT of LNG (apart from the gas through pipelines), it can associate closely with Qatar on LNG market. Although it is exporting only 12 MT of LNG today against Qatar's 77 MT, with the already existing capacity, Russia can expand the LNG exports in short term with lesser investments, unlike Saudi that needs significant investment probably in hundreds of billion US dollars as the country does not have any LNG facility as of today.

Russia, if plays the cards effectively, will hold the future of both oil and gas, as the leading influence.

1. If Russia makes strategic alliance with Saudi on oil, both these countries together will hold nearly 24% of world oil reserves and 20% of world's daily oil production. Most critically, they together export nearly 12.6 million barrels of oil per day after the domestic consumption.
2. If Russia makes strategic alliance with Qatar on gas, both these countries together will hold nearly 37% of world gas reserves and 23% of world's daily gas production. Most critically, they together export nearly 33 Bcf of gas per day (29% of world gas export) after the domestic consumption.
3. If Iran joins the gas alliance with Russia and Qatar, the three together will hold 55% of world gas reserves. This cartel can impart significant influence on the growing gas share in the future energy mix.
4. USA, although a leading producer of oil as well as gas, will see a sharp decline in the next 8-10 years in the oil production when the tight oil peaks (depends on how hard the oil is extracted).
5. China, despite the push for renewables and gas, will depend on oil imports for sustaining its economic growth.
6. Hence, the world oil importers will depend on the Middle East, especially OPEC and Russia for oil supply to meet the demand.

Hence, Russia's ambition to impart its influence on the world of energy security and economy based on fossil fuel will play a major role in oil prices and geo-oil politics of the future, which cannot be ignored.

7.3 US and China

China, with import crossing 9 million barrels per day, is the leading oil importer. Hence, China is a key consumer of oil and a major player in the demand for oil. If the Chinese economy declines, it will reflect on the global oil demand.

Unlike the US sanctions on Iran that started in Nov 18, the trade war between US and China has a major role to play in the world economy and demand for oil.

Brent Crude oil prices rallied up from USD 66 per barrel from the beginning of the year 2018 reaching close to USD 79 per barrel in May 2018. With a steady worldwide growth especially the emerging economics of India and China, OPEC announced in June 2018 that it would increase production for the first time since 2016 by nearly a million barrels per day.

However, with a month later, in Jul 18, USA announced the trade policy on certain imported Chinese products worth billions of US Dollars. China retaliated with its own restrictive trade policy on imported products from the USA. Within few weeks of this, the oil prices dropped by nearly 7%.

The prices picked up again, followed by US announcement of fresh sanctions on Iran starting in Nov 18, disturbed output from Libya and Venezuela and news that some OPEC members are already pumping at full capacity and some others are struggling to compensate the depleting old oil fields.

In the meantime, the production from Saudi, Russia and USA kept on increasing. USA reached its highest production level of nearly 11.0 million barrels of oil per day, thanks to the shale oil. With the oil inventories growing, US also announced that the troops will be withdrawn from Iraq and Syria stating that ISIS had been nullified. Iraq agreed with Kurds to start production from the Kirkuk field which will add another 400,000 barrels per day to Iraq's daily production.

Beyond the continuing trade war between the USA and china, that affected China's growth, strengthening US Dollar also contributed to a drop in the oil prices.

Combined with raising inventories and a slowed down global economy, the oil prices crashed in Dec 18 to less than USD 50 per barrel from the 4 year high of nearly USD 86 per barrel in Oct 18.

USA would expect China to cut the import from Iran to honour the sanctions imposed by the USA on Iran. But if China holds its stand to import oil from Iran despite the pressure from USA, it may create further decline in the relationship between the two countries resulting in an extended trade war.

Markets will be able to absorb and adjust shocks of Iran sanctions but a continued trade war between USA and China will have a long-term effect on oil prices.

7.4 US, China and North Korea

The North Korean model and its effect on new world order is uncertain but a threat hangs in the air. However, North Korea, due to its size of economy, cannot create major impact on the world economy whether by growth or decline unless it decides to take a drastic action that triggers a global war of nuclear proportions. North Korea will not be willing to take that risk but if that happens, the world will become different anyway. The world needs to assume that common sense will prevail among the world leaders to avoid any such major conflict.

7.5 Europe

Uncertainties surround the European Union due to various regional issues like Brexit, raising anti-EU sentiments in Italy and its falling economy, uncertainty of EU's stand on the USA-China trade war issues, financial trouble of many EU members etc.

The uncertainty and concern zooms on Russia's strategy for gas supply to the East European countries, especially Ukraine, after the Turk Stream and Nord Stream pipelines are commissioned to supply gas directly to Turkey, Germany and Western Europe.

Europe's growth rate is not a key factor for global energy demand in the next 20 years and hence the political disturbances of Europe would not create a major effect on the new world order dominated by USA and emerging economies, unless dramatic events like a war or total economic meltdown or a black swan event ensues.

7.2 Emerging Economies

There is no single classification or proper definition of emerging economies. The list of countries designated as emerging economies or economies in transition varies by different agencies that rank them using defined qualifying criteria. The number of countries vary from as low as 20 to as high as 29 depending on the agency and the qualification criteria applied.

There are few countries that are common in every list. Irrespective of the position of the countries in the ranking and percentage of GDP growth, from a volume perspective, India and China lead the emerging economies list. A decline of economy in either of these two countries would disturb the world's average growth, as observed in Q4,2018 with respect to oil prices when China's economy slowed down due to the trade war with USA.

From the world order of geo-oil politics, the political landscape of South and East Asia has regional conflicts and disturbances and the two major players India and China have their own issues with their neighbours. China may seem to be a key player in the new world order but as China is a leading net importer of energy today with high GDP growth model of 6.5- 7.0% projected until 2022, one can expect that it will not voluntarily engage in any activity that would disturb its energy security or growing economy. Both India and China will act to protect the rights and the security of their country but will not be the exponents of a global disturbance at least in the next decade unless provoked, like the trade war with China initiated by the USA.

For any of the emerging economies, global stability will be the main goal. A world of continued disturbance and uncertainty will not serve their goal of growth. While some regional conflicts or border issues cannot be avoided altogether, from a strategic point of view, none of the emerging economies

would be interested to be a threat or disturbing factor for energy security as sustaining their long-term growth plan is far more critical.

Hence, most likely the emerging economies will continue to be the leading contributors of world's growth in the next 20 years.

8. How Far?

Today oil is not scarce. It is abundantly available especially due to the technology of extracting tight oil from shales and producing oil more cost effectively from complex environments. The definition of oil peak today is different from what it was in the 1990s. The peak of supply of oil is not in the near future. The dynamics of energy mix and demand for oil is changing in the new world order of renewables, gas and global warming.

It is important to understand that many large oil exporters cannot survive at the cost of extraction with only a margin. Many of the oil rich nations rely heavily on oil revenues for financing their other economic policies, social reforms and budget provisions. There is hence a significant difference between cost of oil production and revenues required through oil sales. Without making major reforms to shift away from oil-based economy, these countries need oil prices far higher than the cost of production.

The 2014 oil shock, when the oil prices dropped from US\$ 140 to US\$ 30 per barrel, was an eye opener for several of the oil rich nations including the largest oil exporter Saudi Arabia. The oil exporters had realized that the future of the country's economy cannot be sustained by depending only on oil revenues and hence started to expand the focus for non-oil based economic reforms.

Dubai is one of the best examples of developing a non-oil based economy.

At the same time, the oil producers and exporters have recognized that the days of sustained US\$ 100 per barrel is over, especially with the abundance of oil, changing dynamics to oil contribution to the energy mix and declining demand for oil. The oil importers like USA, China, India etc can shift to alternate sources of energy if the oil prices cross a threshold limit that makes the other sources economical and attractive. Hence, both OPEC and non-OPEC exporters have realized that a balance must be sustained to ensure that oil is an attractive option at the right price and such right price must be adequate to provide revenues needed to sustain their budgets based on oil revenue.

USA demonstrated that by applying the technology and optimization, the cost of even tight shale oil production can be reduced significantly. Some Operators worldwide have proved that even oil production from deep water areas or complex environment can be reduced significantly by application of efficient extraction and production practices. The major oil rich nations, with cost of production already very low, never looked at cost reduction by efficiency and optimization but post 2014, world over, almost all oil companies, whether IOCs, NOCs, small and medium independents, are engaged in cost reducing efficient practices.

Hence increase of oil prices beyond the threshold limit will result in excess oil supply in the market as oil producers will pump more oil attracted by the higher price. This will lead excess oil inventories and decline in prices. If the oil production is cut to reduce the oil inventories to increase the prices, then the demand for oil will decline at higher oil prices. This will force the oil producers to increase the production to reduce the price. Hence, this is a vicious cycle of a game that requires a continuous strategical approach to sustain the oil prices within the threshold limit and keep the energy mix balanced.

However, we as humans have never learnt the art of keeping a balance and hence oil volatility cannot be altogether avoided or prevented.

9. Conclusions

As discussed in Section 3, statistic models based only on pattern or probability populated data without considering random intangible variables, oil price predictions will fail as happened in the past.

Hence, I developed a holistic "Oil Model⁺²⁰²⁰" using a combination of the pattern, probability and intangible random variables to predict the future of oil in the next 5 years with a variance model. This is

not done using a big data software model. Oil Model⁺²⁰²⁰ is done by the application of strategic thought process that limits the iterations to apply human intelligence directly rather than analyzing output of a computer model that is populated with assumptions, numbers, patterns and variables. Even the 5 years prediction can be at best only a guestimate despite the best of predictive model applied but as near future it will at least have a better basis than the far future that no one knows.

What might happen in reality is the following:

- (a) Global energy demand will continue to grow between 2-4%, primarily contributed by the emerging economies as an average for the next 5 years.
- (b) Coal will continue to be dominant in the next 5 years, especially due to huge consumption, cheap and abundant availability in India, Indonesia and China. The shift from coal to gas due to changing environmental policies may continue to expand but any significant effect will take place after 2025.
- (c) Global demand for gas will continue to increase but challenges to transport gas in pipeline or in a liquified form as LNG at affordable capital costs to long distances where it will be needed will restrict the growth of gas at least in the next 5 years.
 - Except Qatar, Australia and USA, no other country has the capacity and capability to increase LNG exports in a short time in the next 5 years.
 - Russia has the installed capacity for LNG plant but requires massive investment to extend the already bountiful gas through pipeline market to LNG also. It may take some time.
 - Other countries with LNG plants like Nigeria will continue to grow but in a pace that will be inadequate to replace oil.
 - Countries that have gas, but no LNG plant, like Saudi Arabia, will need massive investment and time, at least 5 years, to export LNG.

Hence, a sharp surge in the LNG market can be seen only after 2025 and not in the next 5 years. Hence, LNG at least in the next 5 years cannot replace the demand for oil.

- (d) In the countries that suffer from energy poverty, especially the developing countries including India (despite an emerging economy) at least a billion people have no access to electricity or the means to use modern equipment. They will use only solid bio-mass or cheaper kerosene or LPG for cooking and other needs. Kerosene and LPG are a refined product of oil.
- (e) The demand of oil in the shipping, aviation, industries and plants, major buildings, as raw material for petrochemicals will continue to grow. Other sources of energy cannot replace oil in these sectors at least for the next 5 years.
- (f) Attempts to reduce significantly the oil's presumed effect on environment by advanced technological innovations to improve efficiency will progress considerably.
- (g) In the next 5 years, tight oil production in the US will grow steadily that would considerably reduce the import demands of the country. This will be a reversal of the history after USA became net importer of oil in 1953. This would affect the oil producers who relied on the USA for exporting oil for the last 5 decades forcing them to look at new and emerging markets.
- (h) Middle East as a whole will continue to be a major player in the oil market and geo-politics primarily due to the low cost of production and the abundancy of oil.

However, OPEC's influence will seem to impart lesser influence in the next 5 years mainly due to high oil production in the USA and Russia's continued production at similar levels as Saudi. OPEC's oil demand will reduce by almost 1.0-1.2 million barrels per day between 2019-2023 mainly due to the increase in US production levels. Beyond 2023, when tight oil in the USA peaks (depends on how hard the oil is extracted), the demand for OPEC oil will increase.

If OPEC and Russia tie-up together to manipulate the oil market to steady the prices at comfortable levels, they will sustain the prominence with influence on oil prices, market and availability.

- (i) In the next 5 years, crude oil will still be a dominant factor but there will be enormous challenges to keep the oil flowing to meet the demand against,
- the depleting reservoirs (the world average is around 2.5-3.0 million barrels per day every year);
 - to manage the resistance to it as the environmentally damaging fossil fuel;
 - the massive investment needed to discover new oil, enhance production of the depleting reservoirs through enhanced recovery techniques and develop the discovered fields to increase production compensate the depletion; and
 - finally, but not least, the extreme geo-oil politics, especially between the oil rich nations.

9.1 Oil Demand

Although the % contribution of oil to the global energy mix will reduce, from a volume perspective, in the next 5 years, the demand for oil will most likely increase from the current demand of 98-99 million barrels per day to around 100-101 million barrels per day or at worst will be at the same level as today. This will seem to be a small increase but if the replacement required to compensate the depletion of nearly 2.5-3.0 million barrels per day every year from existing aging old oil fields is included, the investment and work load to sustain the demand levels are not small.

9.2 Oil Prices and Where We Go from Here?

Unless an unforeseen geo-political disturbance or any other global/regional event creates a short supply of oil, the following is predicted:

Most Likely Case

If the fundamentals hold, if OPEC and Russia led non-OPEC sovereign oil exporters maintain the 1.2 million per day production cut from January 2019 through to July 2019 diligently, and if all the other equations sustain as balanced, then

1. the oil prices in 2019 will stay at the US\$ 50-60/bbl level until mid-Q2, 2019, with a variance of +/- US\$ 5.5/bbl;
2. it may then gradually increase up to US\$ 60-70/bbl level by end of Q3, 2019, with a variance of +/- US\$ 7.2/bbl;
3. The average for the whole year will be around US\$ 63-68 with a variance of +/- US\$ 6.5/bbl;

Low Probability Abnormal Case

If fundamentals are changed significantly either due to geo-political events or global uncertainty or disturbance to the system, then

1. there is a low probability for the price to go above the US\$ 80/bbl mark towards early Q3, 2019.

Or

2. there is a low probability for the price to go down below US\$ 45/bbl mark during the first half of 2019.

However, these low probability events will be preceded by activities either regional or global. It cannot happen drastically. Hence, close monitoring of the world order in terms of geo-oil politics and/or global economy trends will provide adequate warning for the potential occurrence of these low probability events.

Black swan events are not considered.

10. Acknowledgements

The author sincerely expresses thanks and appreciations for the documents listed in the References (at the end of this report) and all the articles in the World Wide Web that were referred to.

Any omissions or errors in this report are purely that of the Author's and not of any documents listed in the References. Any appreciations for this report shall also go to the authors of the documents listed in the References.

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11. Further Contacts:

For further discussions or presentations

J. Muthu Kumar
Managing Director
+91 98400 40227
+971 55 2720723
jmk@iwellsmc.com
www.iwellsmc.com

iWells Management Consultancy: iWells is specialized in drilling oil and gas wells with focus on well optimization, technical and operational integrity, effective drilling execution strategies, risk mitigation and prevention, integration of multi-disciplined approach to deliver complex projects through a defined well delivery process and establishing Integrated Project Management concepts in the industry.

J. Muthu Kumar, Managing Director, iWells: + 31 years of experience upstream oil and gas project management as project delivery leader with core expertise in well construction and project delivery.

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