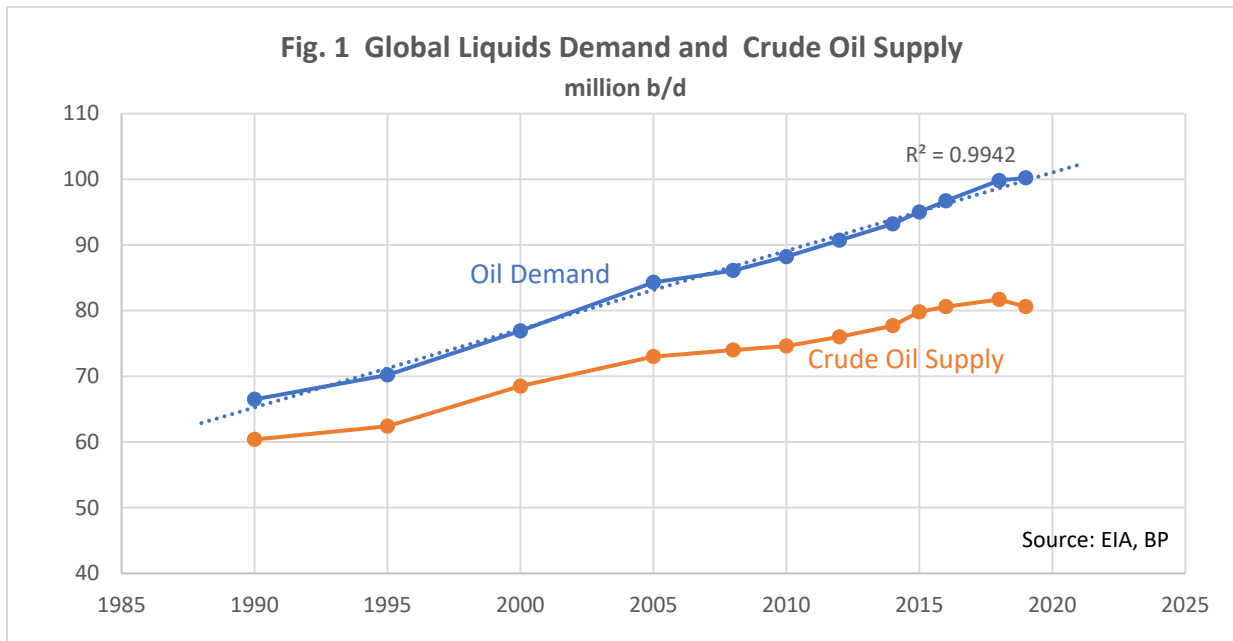


Global Oil Supply Growth at a Crossroads, Exploration Needs a Robust Resurgence

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At the turn of the XXI century, two decades ago, global crude oil output was on a growth path of 1.1 million b/d (mb/d) per year which began to weaken after 2005, dropping considerably to a low of 0.32 mb/d per year through 2010, **Fig. 1**. Output was 73 mb/d in 2005 and had barely increased to 74.6 mb/d by 2010. This plateauing effect is a predictable consequence of reserves depletion. According to Rystad Energy, over that entire decade oil discoveries averaged 8 billion barrels (Bbo) per year of new reserves while oil production averaged 26.4 Bbo per year – a large undesirable production/reserves ratio of more than 3! In fact, since the mid-1980s global oil production growth has been at the expense of using-up the vast reserves discovered in the 1960s. Living off inventory (reserves) for nearly 40 years finally took its toll, ending with the plateau outcome. The inevitable next step is production decline. Exploration is the energy of the oil industry and the only way to build/replace reserves.



Fortunately, just about 2010, with oil output at a flat 75 mb/d, we struck gold – U.S. shale oil production kicked in, thanks to new drilling and completion technology. Global crude oil production capacity regained growth and by 2018 had reached near 82 mb/d. These booming shale

plays have turned the U.S. into a net oil exporter for the first time in 75 years! U.S. crude oil production rose from a low of 5 mb/d in 2008 to 12 mb/d in 2019, a colossal rise.

Going into 2020, global crude oil production is once more slacking off as shale oil production has begun to splutter. According to JBC Energy, 820,000 b/d of new production from several large-scale conventional oil fields – John Sverdrup in the North Sea, Atlantis, Calliope, Bulleit, and Orlov in the U.S. Gulf of Mexico (GOM), Lara and Buzios in Brazil’s pre-salt, and Liza in the new Guyana-Suriname Basin – are all scheduled to start-up in 2020. Likewise, U.S. shale oil plays are also expected to contribute an additional 400,000 b/d to the mix in 2020, for a grand total of nearly 1.22 mb/d. Unfortunately, other oilfield factors can thwart these production increases.

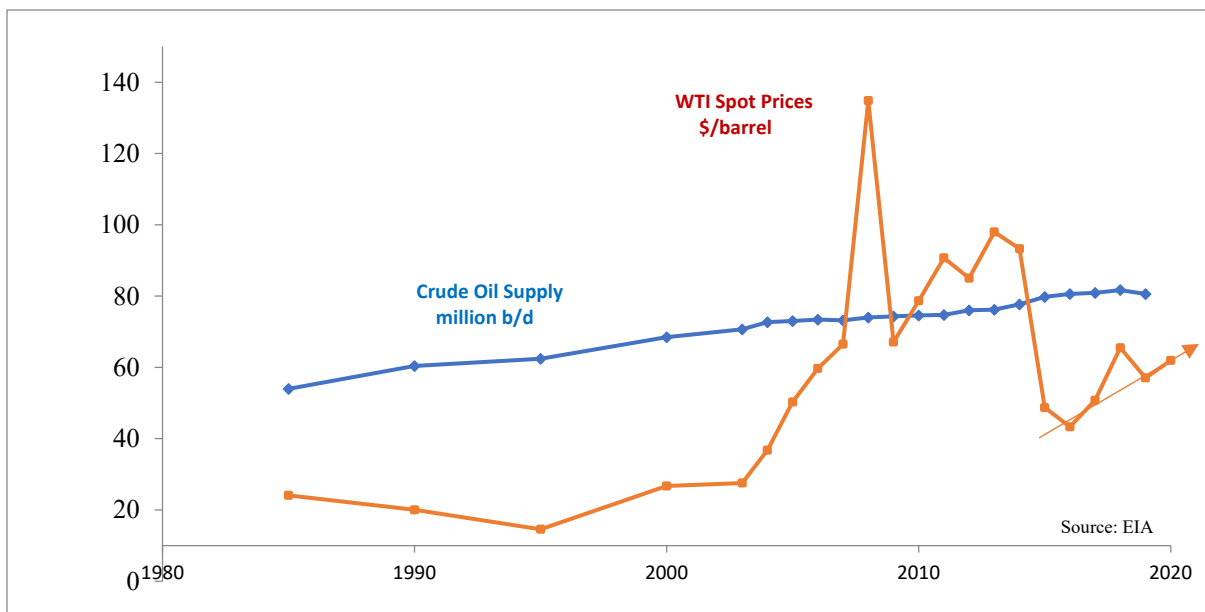
We must remember that the thousands (40,000+) of existing conventional oil fields worldwide, most of which are mature and on round-the-clock decline, are losing production capacity at a rate of about 1.5 mb/d each year. Additionally, unconventional oil fields (shale plays) decline much more rapidly than conventionals. Their brisk decline, in conjunction with very low recovery factors (3-7%), have shaken profitability and already have investors shying away. This landscape accounts for the observed weakening shale oil output during 2019 and for the uncertainty surrounding the near future. Also, it should be noted that the new conventional oil fields going on production in 2020 were discovered 5 (Liza) – 10 (John Sverdrup) years ago, so there is an intrinsically large lag time required for development, in particular for frontier discoveries. Whatever reserves we discover today, at best will appear as new production in the second half of the decade!

On the demand side, **Fig. 1** shows the historical trend of global oil (petroleum liquids) consumption. Markedly, the trend has been stable – a straight line ($r^2 = 0.994$) – clipping along at a growth rate of 1.1 mb/d per year since the 1990s. This is surprisingly different from the lackluster story we have been reading. Global oil consumption reached an all-time high of 100.2 million b/d in 2019 and could continue to grow until around 110.3 mb/d in 2035, according to BP. Petroleum liquids consist mainly of crude oil (80%), NGLs (12%), refining gains (2%), and biofuels. Crude oil, including condensates, is the component that is produced at the well head and is the only component that grows or declines in partnership with the volume of reserves. Crude oil has had a diminishing role in the total supply mix over the past three decades. In 1985 it accounted for 91% compared with 80% today. NGLs is a strong component of today’s supply mix, with a current contribution of 12 mb/d, up from 8 mb/d in 2010 – a growth rate of 440,000 b/d per year, 64% of which comes from the U.S. shale revolution.

Renewables (solar, wind, others) is the newcomer to the global energy mix and have soared from ‘insignificant’ two decades ago to 11.2 mb/d of equivalent oil in 2018 – also equivalent to the production potential of 7 X Prudhoe Bays – and growing at a robust rate of 850,000 b/d per year over the last decade. It is the world’s fastest growing energy source, with huge sums of money flowing into it – \$282 billion last year, led by China (\$83 bn), U.S. (\$55 bn), and Europe (\$54 bn). In response to a persistent increasing global energy demand, NGLs and renewables have been taking up the slack in the global oil supply.

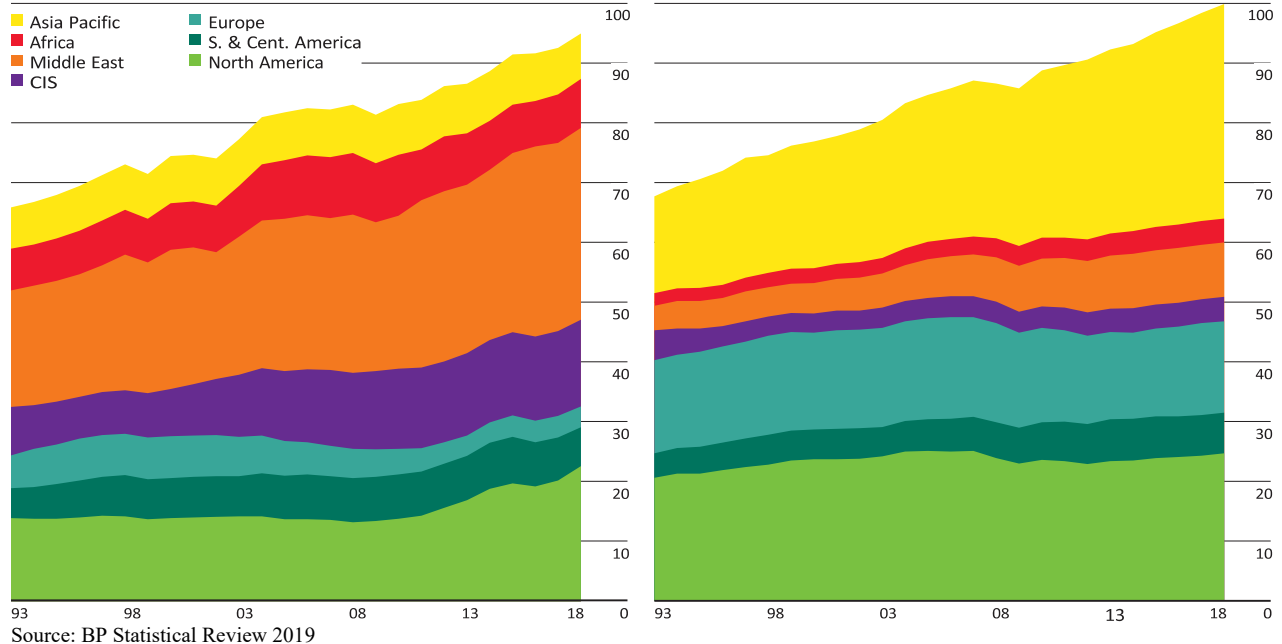
We have seen that oil demand and supply both follow stable trends so why do crude oil prices behave in a roguish pattern as shown in **Fig. 2**. The short answer is demand and supply trends shown here are tempered using annualized averages whereas oil prices reflect oscillations of daily events (operational, political, etc.) melding with investors' perceptions; in summary, it is a blend of macro and micro forecasting. That said, we observe that oil prices have been increasing slowly from a low of less than \$40/barrel after the 2014 crash, now (end of 2019) trading around \$62/barrel, and are set to pop in late 2020. However, following a meeting of OPEC countries on March 6, 2020, without an agreement on future production levels, oil prices crashed to a new low of \$31 WTI. This obviously would set-back any pop to late 2021.

Fig. 2 Crude Oil Supply and WTI Spot Prices



At this point, the ensuing discussions will most likely be better assessed if we take a side-by-side look at the regional breakdown of both global oil production and consumption over the last 25 years, **Fig. 3**. The sustained growth of both trends is impressive. Global oil (petroleum liquids) consumption grew from 89 mb/d in 2010 to a little over 100 mb/d in 2018, an above average growth rate of 1.38 mb/d per year. Asia Pacific, which accounts for 36% of global consumption, also boasts the most notable regional growth; it increased from 28 mb/d in 2010 to 36 mb/d in 2018, a growth rate of 1.0 mb/d per year. On the supply side, over the same period, growth was concentrated in the U.S. (5.2 mb/d), Saudi Arabia (2.1 mb/d), and Canada (1.6 mb/d) while production declined sharply in Venezuela (-1.3 mb/d), Europe (-0.8 mb/d), Mexico (-0.7 mb/d), and China (-0.3) mb/d.

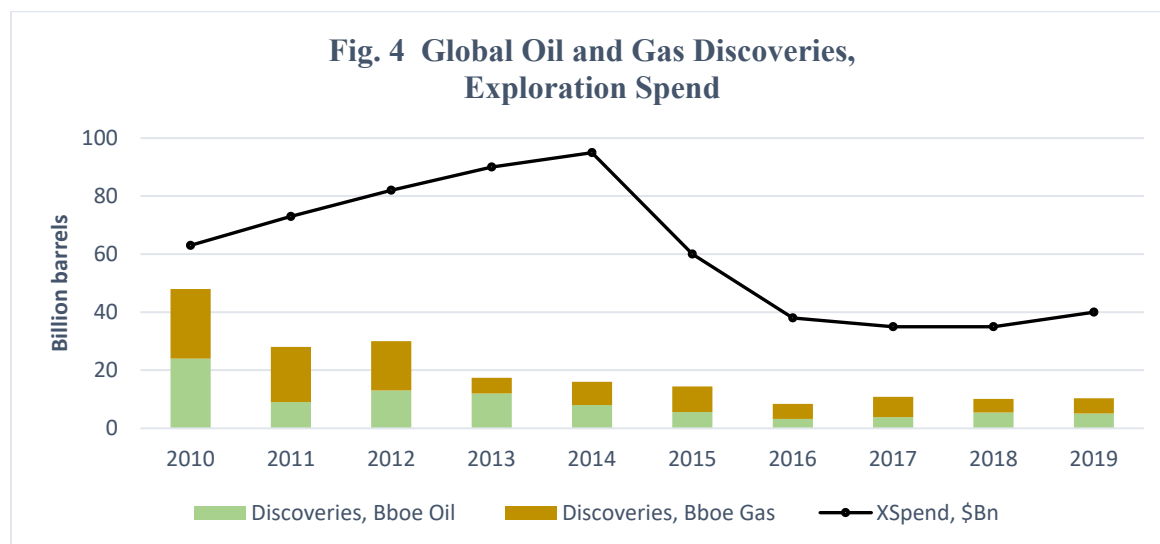
Fig. 3 World Oil Production (LHS) and Consumption by Region, million b/d



A 20/20 Look at Exploration Trends

The oil market continues to see a strong demand, a slowing down of U.S. shale output, and conventional oil at a crossroads as the three top producers – the U.S., Russia, and Saudi Arabia – have been producing near their peak since 2014. In the meantime, as shown in **Fig. 4**, the *size* of oil and gas discoveries have been on a constant shrinking trend prior to and over the last decade, with oil reaching a low of 3.2 Bbo in 2016. Likewise, the *number* of discoveries has been diminishing over the decade. In 2014, there were 400 discoveries; this dropped to a level of 200 during the period 2015-17, further dropping to 140 in 2018. The current production/reserves ratio is now beyond critical: more than 6!

Over the last decade, 193 Bboe of oil and gas were discovered, 46 % being oil. Offshore has emerged as the preferred province for exploration, accounting for 75% of all oil and gas discoveries. Offshore typically holds larger reservoirs with high well-productivities (**Ref. 3**), in the range of 10,000 b/d to 30,000⁺ b/d, both important factors for making potential discoveries lucrative.



Source: Rystad Energy, Wood Mackenzie

Table 1 summarizes the size and location of the Top Ten conventional oil discoveries in 2017 and 2018. They represent over 75% of the corresponding total discoveries. Offshore discoveries are highlighted with an asterisk. Two regions, North America (29%) and South America (35%), together account for 64% of all major oil discoveries; additionally, the North American region accounts almost entirely for the massive development of unconventional (shale plays) over the decade.

Table 1 Top Ten Oil Discoveries in 2017, 2018

2017			2018		
Field	Location	Reserves	Field	Location	Reserves
		mbo			mbo
Eridu	Iraq	900	Stabroek*	Guyana	1,900
Zama*	Mexico (GOM)	800	Ballymore*	U.S. (GOM)	545
Stabroek*	Guyana	560	Putu/Stony Hill	U.S. (Alaska)	200
Neptune*	Russia (Sakhalin)	537	Triton*	Russia (Okhotsk Sea)	200
Horseshoe	U.S. (Alaska)	500	Ayashsky*	Russia (Sakhalin)	190
Olgin*	Russia (Latev Sea)	400	North Obskove*	Russia (Siberia)	190
Marlim*	Brazil (Pre-salt)	300	Dover*	U.S. (GOM)	183
Halifax*	U.K. (North Sea)	250	Roc*	Australia	180
Marlim Sul*	Brazil (Pre-salt)	200	Messoyakha	Russia (Siberia)	140
Ixachi	Mexico	200	Kalimba/Afoxe*	Angola	130

* Offshore

Source: IFPEN, Rystad Energy

Exploration spending reached a low of \$35 billion in 2017, remained about the same level in 2018, then showing a thin increase to \$40 billion in 2018. Total oil discovered in 2017 was 3.8 billion barrels, 20% higher than the all-time (since the 1940s) low of 3.2 billion barrels discovered in the previous year. Russia had a good year with two major discoveries totaling a billion barrels. Mexico also had a good year with two major discoveries: Zama in the GOM and Ixachi, a gas condensate field onshore in the Veracruz Basin; together they hold over 1 billion barrels of recoverable liquids. Zama is of particular importance for Mexico because it's the first oil field discovered by a private company in 80 years, and it's the first giant oil field discovered in the country since the 1980s. Iraq also had a big one, Eridu with almost a billion barrels, located west of Basra. Guyana's Snoek and Turbot together added 600 million barrels of oil reserves to the prolific Stabroek block. The U.S. had a key giant oil discovery, the Horseshoe field in Alaska.

In 2018, global oil discoveries show a remarkable recovery with a sizable 42% jump to 5.4 billion barrels, compared with the 3.8 billion barrels discovered in 2017. Guyana is the front leader adding five major discoveries with almost 2 billion barrels of light oil – Longtail, Ranger, Pacora, Hammerhead, and Pluma – to the almost legendary Stabroek block. The U.S. follows with discoveries totaling over 1 billion barrels: Ballymore and Dover with 750 million barrels in the deepwater (160-2,000 meters) GOM, and Putu/Stony Hill, in Alaska. Russia is the third leader with four major discoveries varying in size from 140-200 million barrels. Discoveries in 2019 are looking to grow compared with 2018. Twenty-six discoveries sized around 100 million barrels and more have been recorded (Rystad Energy), with offshore leading the way.

Large investments in E&P are required to stave off a looming supply crunch in this new decade as discoveries are clearly drying up, **Fig. 4**. Global exploration spending was at a high of \$95 billion in 2014; took a big hit following the 2014 oil price crash, dropping to a low of \$35 billion in 2017 where it remained flat through 2018, but has since slowly moved up to \$40 billion in 2019. Hopefully, it has bottomed out and is poised for an upswing. To that end, Rigzone recently reported that offshore rig demand is forecast to rise from 473 units in 2019 to 550 units in 2021, an increase of 16%. Much to that industry's success, drilling costs have been reduced between 30-40% and productivity increased during the downturn. During the past three years 95 high impact exploratory wells have been drilled globally with an above average success rate of 42% ! Thirty more of these wells are scheduled for 2020.

Hotspots for Oil Exploration

Worldwide, conventional crude oil production is certainly on the decline, consequence of a continued deficit of discoveries, insufficient to replace production from as far back as the 1980s. Likewise, the explosive U.S. shale oil production that spouted up a decade ago has entered a sustained downturn mainly because of its distinctive reservoir characteristics together with borderline breakeven oil prices, that sway profitability and investors. Crude oil remains a critical

component of the growing global energy mix and deficits will definitely echo on oil prices which have already began to pick up. Exploration is on the rise again for the first time since the global recession.

Where should we look for new oil? From a geologic point of view, there are many prospective areas around the world. Michael Daly, a prominent explorationist, has provided an excellent geologic dissertation (**Ref. 4**) on ‘future trends in oil and gas exploration’. However, at this juncture we need to focus on the areas that have been recently attracting investors, and the soundest indicator of these preferred hotspots would be licensing activity which has been on the rise in the last three years. This criterion points to the Eastern Mediterranean (mostly gas), deepwater Gulf of Mexico, Caribbean, South America, West Africa, and East Africa (mostly gas).

Some closing thoughts. Oil and natural gas are the most popular fuel sources of world energy consumption together accounting for more than half (57%) of the energy mix and will remain so for decades to come. Oil alone accounts for one third (34%) and urgently requires large and prompt investments to placate an ongoing decline. Prompt because discoveries take 5-10 years to reach the start-up production point, and large because just replacing the reserves we are now producing, circa 30 Bbo per year, is a huge challenge. Exploration spend in the good years usually hovered above 20% of total E&P capital expenditures but recently this percentage has dropped to single digits. Finally, as critical as investments are, success is highly dependent on the deductive reasoning prowess that distinguishes the explorationist. Exploration is a unique science.

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