

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Washington Headquarters Service, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188) Washington, DC 20503.

PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.

1. REPORT DATE (DD-MM-YYYY) 050-05-2020		2. REPORT TYPE Thesis		3. DATES COVERED (From - To)		
4. TITLE AND SUBTITLE UNCONVENTIONAL OIL AND ITS IMPACT ON THE WORLD OIL MARKET			5a. CONTRACT NUMBER			
			5b. GRANT NUMBER			
			5c. PROGRAM ELEMENT NUMBER			
6. AUTHOR(S) Gay, Justin			5d. PROJECT NUMBER			
			5e. TASK NUMBER			
			5f. WORK UNIT NUMBER			
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)			8. PERFORMING ORGANIZATION REPORT NUMBER			
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Civilian Institutions Office (Code 522) Naval Postgraduate School 1 University Circle, Herrmann Hall Rm HE046 Monterey, CA 93943-5033			10. SPONSOR/MONITOR'S ACRONYM(S) NPS CIVINS			
			11. SPONSORING/MONITORING AGENCY REPORT NUMBER			
12. DISTRIBUTION AVAILABILITY STATEMENT Approved for public release; distribution is unlimited						
13. SUPPLEMENTARY NOTES						
14. ABSTRACT <p>In this paper, I intend to discuss unconventional oil's impact and overall contribution on the world oil market. By definition, unconventional oil is that oil which is extracted or produced by means not normally considered "conventional". Conventional oil at atmospheric temperature and pressure is a liquid that can be extracted utilizing traditional drilling methods and is considered easier since it will flow without added stimulus. Although conventional oil flows more easily, unconventional is becoming more important to the world economy since there is growing concern that conventional oil reserves are being depleted.</p> <p>Within the paper I will discuss the new methods of extracting oil/fossil fuels. I will also discuss some differences with conventional and unconventional oil, and why unconventional is becoming the new norm. I will focus discussions on OPEC, as well as the economic and political impacts that affect, and are affected by, oil prices. Finally, I will talk about the impact that the recent global pandemic is having on the oil market and unconventional oil, along with possible future implications.</p>						
15. SUBJECT TERMS						
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT UU	18. NUMBER OF PAGES 22	19a. NAME OF RESPONSIBLE PERSON	
a. REPORT U	b. ABSTRACT U	c. THIS PAGE U			19b. TELEPHONE NUMBER (Include area code)	

THIS PAGE INTENTIONALLY LEFT BLANK

**UNCONVENTIONAL OIL AND ITS IMPACT ON THE
WORLD OIL MARKET**

Author:
Justin Gay

Professor:
Dr. Shapour Vossoughi

A thesis submitted in fulfillment of the requirements for the Petroleum Management
Certification
in the
School of Engineering

05 May 2020

Abstract

In this paper, I intend to discuss unconventional oil's impact and overall contribution on the world oil market. By definition, unconventional oil is that oil which is extracted or produced by means not normally considered "conventional". Conventional oil at atmospheric temperature and pressure is a liquid that can be extracted utilizing traditional drilling methods and is considered easier since it will flow without added stimulus. Although conventional oil flows more easily, unconventional is becoming more important to the world economy since there is growing concern that conventional oil reserves are being depleted.

Within the paper I will discuss the new methods of extracting oil/fossil fuels. I will also discuss some differences with conventional and unconventional oil, and why unconventional is becoming the new norm. I will focus discussions on OPEC, as well as the economic and political impacts that affect, and are affected by, oil prices. Finally, I will talk about the impact that the recent global pandemic is having on the oil market and unconventional oil, along with possible future implications.

Table of Contents/Outline

-Introduction

-Focal Area I: OPEC & U.S. Unconventional Oil

-Focal Area II: The Economic and Political Impact of Oil Prices

-Focal Area III: The Impact of Oil Prices During a Global Pandemic

-Conclusion

-References

-Appendices

Introduction

The production of shale oil (also known as unconventional or tight oil) has been a popularized process for many years. Since the late 1800s the drilling process of conventional oil has proved successful in its discovery. In more recent years, shale oil has exploited the technological advances in drilling. The process involves horizontal drilling and the hydraulic fracturing (or fracking) of underground rock formations containing deposits of crude oil that are trapped within the rock.¹ In the United States, an abundance of oil rigs and skilled laborers have been able to attribute this extraction method to a widely successful oil boom that has been unmatched in other nations.¹ Between 2007 and 2014 the daily production of unconventional oil expanded nearly 10 times.¹ With this growth, technology regarding this drilling method has become a niche and competitive market.

While all of this growth from unconventional oil production is great in the short term, there are concerns about its viability in the long run. Production of unconventional oil is only profitable if the price of oil surpasses the marginal cost, and even though there have been indications that the previously high initial cost of unconventional oil production has been on a substantial decline, the price of oil has also been declining.¹ What is often overlooked is the fact that conventional oil comes in various forms which cannot be easily substituted by unconventional oil due to characteristic differences. Lutz Kilian explains on conventional oil: “The quality of crude oil can be characterized mainly along two dimensions. One is the oil’s density (ranging from light to heavy) and is typically measured based on the American Petroleum Institute (API) gravity formula; the other is its Sulphur content (with sweet referring to low-Sulphur content and sour to high-Sulphur content).”¹ Exhibit 1 provides an overview of

how commonly quoted crude oil benchmarks (including West Texas Intermediate (WTI) and Brent oil in the North Sea) can be characterized along these dimensions.

Unconventional oil reserves are explored in three main forms: oil sands from Canada, shale oil from the U.S., and heavy oil from Venezuela, and the development of these reserves have affected the business strategy of the Organization of Petroleum Exporting Countries (OPEC).² Even though unconventional is not a major export, it does replace conventional oil imports, which decreases the demand for oil in global markets, affecting the price of oil. Supply, demand, economics, and the political environment are all major drivers of the price of oil. Supply is usually dictated by OPEC countries, but with the U.S. producing enough oil to become a net exporter and increasing the global supply, prices are bound to lower if demand is not equal that supply. This means OPEC cannot change its production strategy without collaboration from the U.S. We'll look at OPEC, the impact unconventional oil has on OPEC's influence, the economic and political factors which influence oil prices, as well as how everything has changed with the recent global pandemic. All of this is in an effort to show the influence unconventional oil has on the global oil market.

Focal Area I: OPEC & U.S. Unconventional Oil

The Organization of Petroleum Exporting Countries (OPEC) is not ready for the rise of unconventional oil and what it will do to their control on the price of oil. As of 2019, OPEC included 14 countries (Exhibit 2). OPEC boasts the world's lowest production cost per barrel and maintains roughly 75% of the world's conventional oil reserves. The power of OPEC with regard to oil pricing resulted from the lack of energy sources and dearth of practical alternatives economically feasible in the energy sector.³ OPEC's goals were to increase revenue for its members by setting the oil supply to ensure it was lucrative, and to make sure that the manipulation of oil prices was not so high that conventional oil substitutes would become attractive to the world market.² When there is excess oil supply OPEC tends to slow production, and when there is a shortage of oil OPEC tends to increase oil prices in order to sustain their production levels.³ When they tried this tactic in 2015 due to hydraulic fracturing efforts driving down oil prices, innovative technology enabled U.S. producers to extract oil they were unable to attain before at a lower cost, which eventually led to the United States becoming the top oil producing country.⁴

While the countries of OPEC combined produce more oil than the United States daily, the U.S. recently achieved the title of the world's leading oil producing nation ahead of Saudi Arabia (OPEC's leading producer) (Exhibit 3).³ This helps the U.S. limit OPEC's power over oil prices because when the price of oil goes up, U.S. oil companies produce more oil in order to yield more profits. As production increases domestically for the U.S., the demand for OPEC oil will diminish as well as their influence on oil prices.³ While not directly related to unconventional oil, a couple of additional influences on the price of oil include Arab nation

budgets and their necessity for high oil prices in order to fund their government programs, and the increasing demand from developing countries like India and China.³ The global shift to clean alternative energy sources, discord among OPEC members (ex. Qatar withdrawal from OPEC), and tense dealings between Saudi Arabia and the United States are also significant challenges OPEC will have to manage moving forward, distracting them from focusing on dealing with the rise of unconventional oil.⁴

U.S. shale and sand-based oil extraction accelerated crude oil production in 2009 after a near 40-year decline and doubled the country's production levels just a decade later.⁴ OPEC's current strategy to curb the effects of U.S. production is to partner with Russia and a few other major oil exporters to form OPEC + which will coordinate production and sharing a charter. In doing so however OPEC could have their hands tied in situation where Russia doesn't agree, and it puts members who are friendly to the United States in an unfavorable situation dealing with both the U.S. and Russia who are known to be at odds.⁴ Economically speaking, if OPEC never maintained the concept of spare production theoretically the market would stabilize on its own, but since that is not the case there will continue to be a battle over oil price variabilities between OPEC and non-OPEC countries.²

Focal Area II: The Economic and Political Impact of Oil Prices

To understand why oil pricing is so important one must understand the major political and economic factors oil has a direct effect on. Over the past 100+ years, even as technology improves and alternative means of energy are discovered, oil's usability is unrivaled which has made it a powerful commodity. Oil is power, it is universal, unique, and it is rare.⁵ Oil is not only power in the form of energy, but it is also a powerful commodity when trying to assert or

maintain political dominance.⁵ Having consistent access to oil at the lowest price possible will allow a nation to thrive economically, politically, and militarily, given its many uses and applications. The universal application of oil extends to almost every part of our daily lives, from technology to transportation, including the supply chain for food we eat. There is no true substitute for oil, which makes it unique, and it is rare because it is actually being depleted at an “alarming rate” according to scientific calculations.⁵ “...there is no surprise just how much international, geo-political concern and conflict arise regarding oil and the companies that supply it around the globe. Over the years we’ve witnessed numerous rows being raised on the international scene, some merely escalating into confrontations quelled by “quid pro quo” agreements while others have led to boycotts, United Nations censures and in some cases invasions and all out wars!”⁵

There are advantages on each side for high and low oil prices. The advantage of being able to obtain oil at lower prices means a nation that have an abundant quantity to fuel its needs, and those who don’t have to fear going without oil can wield more political might.⁵ For those countries who sell oil as a primary economic means, it can be a stabilizer and bring prosperity to the nation. Higher oil prices could also help with investments in infrastructure, technology, and defense of the nation.⁵ Evidently, a nation’s economy, security, political stability and even their currency exchange centers on oil. “The very political success or failure of any ruling regime and the very survival of its citizens is dramatically affected, not simply by the mere possession of oil, but by effectively controlling the price of this all-important fuel.”⁵

Oil price changes accurately affect the economy at all levels from family budgets to corporate earnings all the way up to a nation’s Gross Domestic Product (GDP).⁶ As we’ve seen

within just the last 15 years, spikes or drops in the price of oil can send the global financial market in disarray. Oil prices can change for a number of reasons, including visceral reactions to what is published in the news, shocks to the stock market, and changes in the laws. Oil prices have fallen from \$105/barrel in 2014 to ~30/barrel in March of 2020, where much of the recent decline is due to the pandemic and an expected decline in consumer demand for oil.⁶

Politics, namely geopolitical/international politics, have a major impact on oil prices and the strategies of OPEC. That fact that many OPEC countries are politically unstable themselves and are not on great terms with Western countries due to terrorism or noncompliance with international laws, explains why these countries generally face sanctions from the U.S. as well the U.N.⁶ Sanctions and conflict can produce fluctuations in the price of oil. Examples that have caused fluctuations are the Iran-Iraq war, Arab oil embargo which caused the 1973 oil crisis, the Persian Gulf War, and the U.S. announcing withdrawal from the Iran Nuclear Deal as well as restored sanctions on oil exported from Iran. The basic reason for fluctuation is the disruption of the supply of oil.

According to Prableen Bajpai, the supply of crude oil is also determined by external factors, which might include weather patterns, exploration and production (E&P) costs, investments, and innovations (including those that made the exploration and extract of shale oil possible).⁶ She also notes that other important factors affecting demand for oil include both personal and commercial transportation, population growth, and seasonal changes, i.e. when oil use increases during busy summer travel seasons and when more heating fuel is consumed in the winter seasons.⁶ No matter what the environment is, economics and politics affect the

supply and demand of oil which in turn affects the price of oil. This can even be seen during the recent global pandemic.

Focal Area III: The Impact of Oil Prices During a Global Pandemic

In recent news, the world was crippled with the presence of a pandemic that has affected everyone around the world. As world leaders, the United States has been facing the continuous economic battle head on but has seen dilapidating numbers in the oil market. In an article published by NBC News the reported price of oil sank to about \$20 a barrel as of April 2020, with the national average of gas prices decreasing to under \$2 a gallon; the lowest it has been in 16 years.⁷ Although these fallen gas prices may be the only upside for Americans in this pandemic, it comes at the hand of a struggling oil market that will reportedly have a long-term negative affect because of the country being under quarantine. With businesses outside of “essential needs” closed to the public and small businesses in dire need of loans to avoid a catastrophic financial crisis, the current economy of the United States is enduring a major impact on the American oil industry. In late April, President Trump stated that he was working on a plan to provide federal assistance to the oil industry. Unfortunately, this potential aid has come with some backlash from those that don’t believe the free market should receive assistance over some other industries. Additionally, the oil industry hadn’t seen the unemployment increase that has crippled and put many other businesses out of commission.⁸ In response to a tweet issued by President Trump, a Greenpeacer stated “Trump’s tweet today lays out in the open what his administration has been hinting at for weeks: He is ready to use federal funds—including taxpayer money—to bail out fossil fuel companies hit by a

combination of market shocks, their own risky business decisions and low demand due to covid-19.”⁸

The problem isn't just an American problem however, it is an international. The global pandemic has had many global affects to supply, demand, and geopolitics which have had, and will have, lasting effects on the price of oil. Part of the supply issue actually revolves around geopolitics and the desire to have as much oil market share as possible. According to Daniel Yergin, OPEC+ split up because there was disparity in their coalition's goals: Saudi Arabia wanted oil prices high to balance its budget and urged deep cuts in oil output to put a floor on its price, while Russia didn't need prices as high to balance its budget and preferred to keep its production agreement as is then reevaluate in the summer.⁹ Since the plan for major producers to cut production failed, Saudi Arabia increased its production, as well as Russia, but this increased production in supply is being met with a harsh decline in demand. In early April 2020 the estimated decline in demand was 20 MMbpd (million barrels per day), or 20 percent globally, and due to this IHS calculated that nearly every available gallon of storage space globally would be fully by late April or early, leading oil prices to plummet and producers to shut down wells because they won't be able to dispose of the oil.⁹

Last year, the U.S. produced and consumed the largest share of oil as shown in Exhibits 4 and 5. While it is unlikely the U.S. significantly drop as the top consumer, the interruptions to shale oil production could lead to the U.S. to lose its top spot as an oil producer and exporter of oil. The plummet in oil prices are making it difficult for shale oil producers to sustain their business. Shale oil producers need to drill new wells in order to maintain production, but they currently have to reduce their budgets, including an estimated 2.5 million in job loses, because

they have to reduce or stop drilling altogether.⁹ The U.S. could literally drop from producing 13.1 MMbpd in February to 3 MMbpd by the end of the year according to IHS Market calculations.⁹ This shows that not only does oil production affect oil prices, but oil prices themselves can affect production.

With the daily growing pressure of the Covid-19 pandemic, the future for many industries seems far from clear. However, experts believe that the shale industry will peak again, but it may take some time. Joe Carrol of World Oil.com states “The comeback trail would be long and steep and as many as 70% of the 6,000 shale drillers may go bankrupt and one-third shale patch workers are expected to lose their jobs.”¹⁰ With the current use for oil and gas on a daily decline, the oil industry is expected to continue to see the worst of days. Production at some of the United States most profitable wells has slowed as much as a combined 660,000 barrels a day to curb the American output.¹¹ The optimism displayed by industry experts comes on the heels of a plan to decrease the oil production to provide a bench under oil prices to rely on a stable recovery.¹¹ There are also talks of big oil companies potentially buying smaller independent oil companies, but that would not happen unless it was profitable. Exhibit 6 show that profitability still needs to remain in the 40s for shale oil to be viable. Unfortunately lenders are not making more financing available to producers so many will have to ask for protections from their creditors, and some banks are even setting up operations to seize and run failed producers.¹² The biggest issue is the uncertainty right now with oil prices, so while those companies stop drilling and continue to go out of business, if there is no certainty on the outlook of oil prices shale oil might not reemerge until mid-century.¹³

While the global oil market is frustrated there are talks about being the transition to newer more reliable energy sources. The fact that Saudi Arabia, Russia, the U.S., the rest of OPEC+ and the G20 are starting to collaborate in an effort to lessen the current oil shock shows the significance of this time and provides an opportunity to take advantage for future benefit.¹⁴ Oil and gas are still pivotal elements for an economy to thrive, even providing revenue to finance “green” infrastructure”; so with previous fears of energy transition already happening, now may be the time to “reboot the system” with a systemic approach including renewable energy and cutting fossil fuel emissions, which helps build human capital for a future energy system.¹⁴ This would be a long-term strategy, but just as higher oil prices lead to a shale oil boom, lower oil prices can turn everyone away from oil altogether. Exhibit 7 shows that renewables are the only energy source projected to have a positive demand amid this global pandemic. As this pandemic continues to unfold there will be many different innovations and agreements that were once thought to be impossible. However, shale oil will be important if the U.S. ever intends to regain control of the oil market, and its ability to obtain unconventional is all dictated by its price in the global market.

Conclusion

Unconventional Oil has had a significant impact on the global oil market. It has led the U.S. to become the leading global producer, ahead of OPEC countries, giving us a say in the control of oil pricing. Economic and geopolitical factors such as supply and demand, financial markets, and international relations can all have an effect on the global oil price. With the current global pandemic, the oil industry is undergoing an unforeseen shock that may have lasting implications. If the U.S. wants to remain a top oil producer and maintain its say on oil

pricing, it has to find a way to salvage its shale oil producers amid this pandemic. While renewable energy may be gaining traction, oil and gas are still the dominant means of energy production and its price is not only important to consumers, but also to producers who need the right price to continue operations. If shale oil producers can find a way to remain profitable, the U.S. can remain the world's leading producer of oil and keep its influence on the global oil market.

References

- ¹ Lutz Killian. "How Has Shale Oil Affected the Global Oil Price?". *World Economic Forum*. (14 Jan 2015). <https://www.weforum.org/agenda/2015/01/how-has-shale-oil-affected-the-global-oil-price/>
- ² Ali SA, Suboyin A, Haj HB (2018) Unconventional and Conventional Oil Production Impacts on Oil Price: Lessons Learnt with Glance to the Future. *J Glob Econ* 6: 286. doi: [10.4172/2375-4389.1000286](https://doi.org/10.4172/2375-4389.1000286)
- ³ Rakesh Sharma, "OPEC vs the US: Who Controls Oil Prices?", Investopedia, 09 Mar 2020, <https://www.investopedia.com/articles/investing/081315/opec-vs-us-who-controls-oil-prices.asp>.
- ⁴ Andrew Chatzky, "OPEC in a Changing World", Council on Foreign Relations, 02 Jul 2019, <https://www.cfr.org/backgrounder/opec-changing-world>.
- ⁵ "The Oil Industry and its Effects on Politics", OilPrice.com, 22 Oct 2009, <https://oilprice.com/Energy/Oil-Prices/The-Oil-Industry-And-Its-Effect-On-Global-Politics.html>.
- ⁶ Prableen Bajpai, "Top Factors That Affect the Price of Oil", Investopedia, 16 Mar 2020, <https://www.investopedia.com/articles/investing/072515/top-factors-reports-affect-price-oil.asp>.
- ⁷ Martha C. White, "U.S. Set to Lose Title as Top Oil Producer as Demand Plunges and Gas Drops Below \$1 per Gallon", NBC NEWS, 30 March 2020, <https://www.nbcnews.com/business/energy/u-s-set-lose-title-top-oil-producer-demand-plunges-n1171981>.
- ⁸ Will Englund, "As Price of Oil Drops, trump Orders Plan to Help U.S. Energy Companies", The Washington Post, 21 April 2020, <https://www.washingtonpost.com/business/2020/04/21/trump-oil-company-help/>.
- ⁹ Daniel Yergin, "The Oil Collapse: A Pandemic and a Price War Have Together Brought Energy Markets to a Crisis", Foreign Affairs, 02 April 2020, <https://www.foreignaffairs.com/articles/2020-04-02/oil-collapse>.
- ¹⁰ Joe Carroll, "Experts See a Future for Shale: 'Rocks Don't Go Bankrupt'", World Oil, 29 March 2020, <https://www.worldoil.com/news/2020/3/27/experts-see-a-future-for-shale-rocks-don-t-go-bankrupt>.
- ¹¹ Catherine Traywick, Kevin Crowley and Sheela Tobben, "Shale Slowdown May Take 2 MMbpd of U.S. Crude Off the Market", World Oil, 02 May 2020,

<https://www.worldoil.com/news/2020/5/1/shale-slowdown-may-take-2-mmbpd-of-us-crude-off-the-market>.

¹² Jennifer Hiller and Liz Hampton, “Oil in the Age of Coronavirus: a U.S. Shale Bust Like No Other”, Reuters.com, 15 April 2020, <https://www.reuters.com/article/us-global-oil-shale-bust-insight/oil-in-the-age-of-coronavirus-a-u-s-shale-bust-like-no-other-idUSKCN21X0HC>.

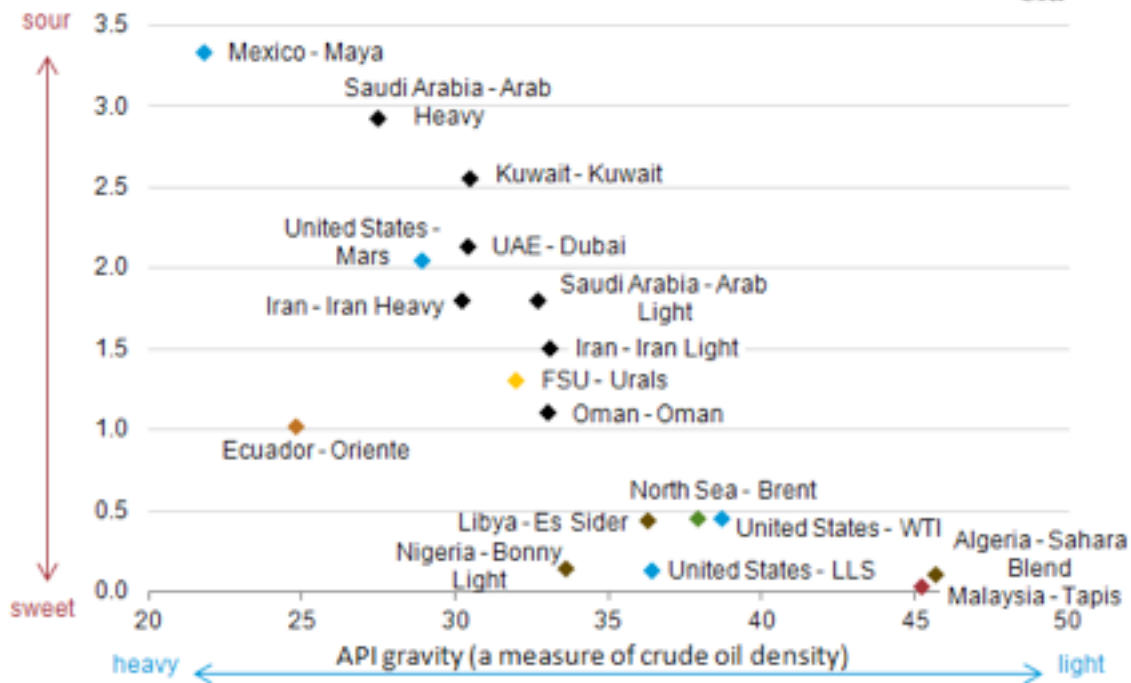
¹³ Haley Zaremba, “Permian Bankruptcies Could Fuel A Buying Spree For Big Oil”, OilPrice.com, 29 April 2020, <https://oilprice.com/Energy/Crude-Oil/Permian-Bankruptcies-Could-Fuel-A-Buying-Spree-For-Big-Oil.html>.

¹⁴ Roberto Bocca, “As Coronavirus Shocks the Energy Sector and Economy, Is Now the Time for a New Energy Order?”, World Economic Forum, 26 April 2020, https://www.weforum.org/agenda/2020/04/energy-oil-gas-electricity-sustainability-economy-covid19-coronavirus-pandemic-market-stability/?fbclid=IwAR3EFirH7Q5wYT_g1hhJ_vh6zAR8H8tWxkRpHxgRQTYKRegk92XQMVf3qcA.

Appendices

EXHIBIT 1

Density and sulfur content of selected crude oils



Source: US Energy Information Administration.

Notes: MARS refers to an offshore drilling site in the Gulf of Mexico. WTI = West Texas Intermediate. LLS = Louisiana Light Sweet. FSU = Former Soviet Union. UAE = United Arab Emirates.

EXHIBIT 2

OPEC Membership, 2019

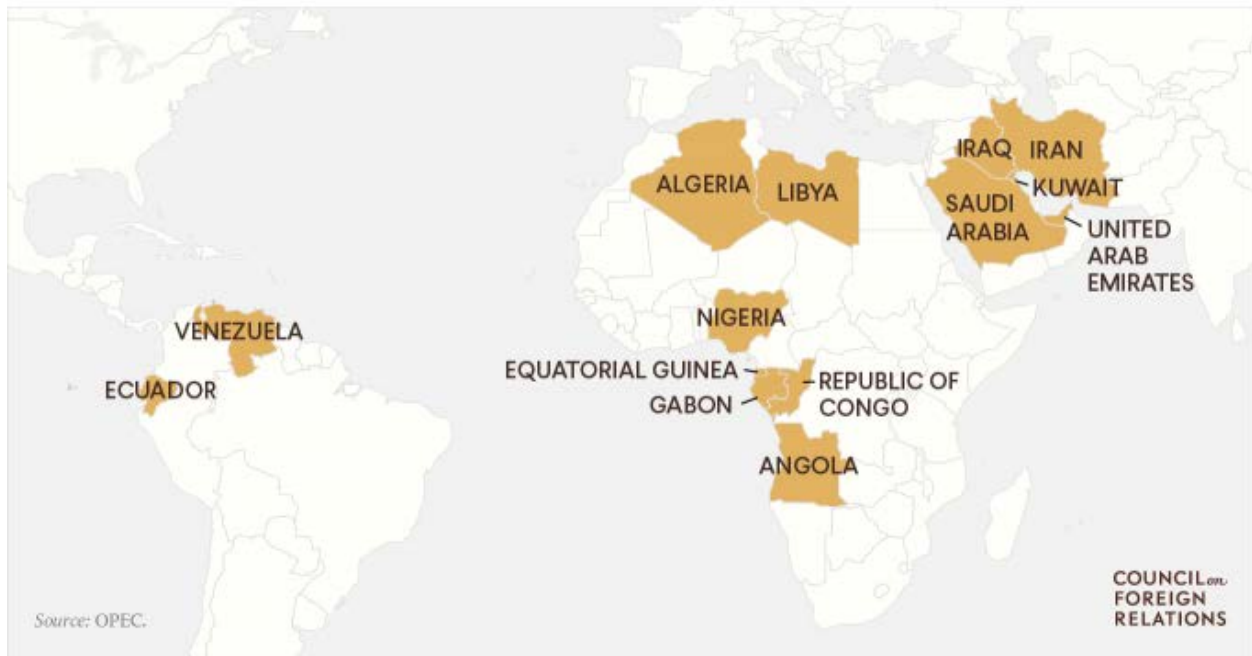
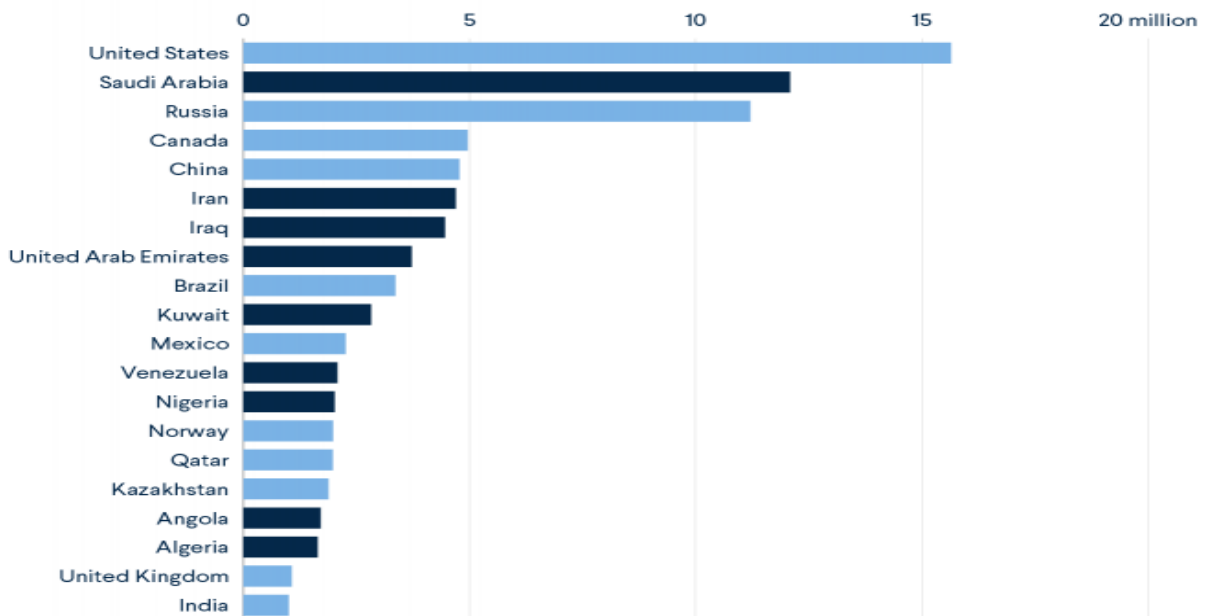


EXHIBIT 3

Largest Producers of Petroleum and Other Liquids, 2017 (barrels per day)

● OPEC members ● Non-OPEC



Note: "Other liquids" includes biodiesel, ethanol, and additional liquids produced from coal, gas, and oil shale. "OPEC members" refers to 2019 member states.

Sources: U.S. Energy Information Administration.

COUNCIL on FOREIGN RELATIONS

EXHIBIT 4

The 10 largest oil¹ producers and share of total world oil production² in 2019³

Country	Million barrels per day	Share of world total
United States	19.51	19%
Saudi Arabia	11.81	12%
Russia	11.49	11%
Canada	5.50	5%
China	4.89	5%
Iraq	4.74	5%
United Arab Emirates	4.01	4%
Brazil	3.67	4%
Iran	3.19	3%
Kuwait	2.94	3%
Total top 10	71.76	71%
World total	100.63	

¹ Oil includes crude oil, all other petroleum liquids, and biofuels.

² Production includes domestic production of crude oil, all other petroleum liquids, biofuels, and refinery processing gain.

³ Most recent year for which data are available when this FAQ was updated.

Source: US Energy Information Administration

EXHIBIT 5**The 10 largest oil¹ consumers and share of total world oil consumption in 2017²**

Country	Million barrels per day	Share of world total
United States	19.96	20%
China	13.57	14%
India	4.34	4%
Japan	3.92	4%
Russia	3.69	4%
Saudi Arabia	3.33	3%
Brazil	3.03	3%
South Korea	2.63	3%
Germany	2.45	2%
Canada	2.42	2%
Total top 10	59.33	60%
World total	98.76	

¹ Oil includes crude oil, all other petroleum liquids, and biofuels.

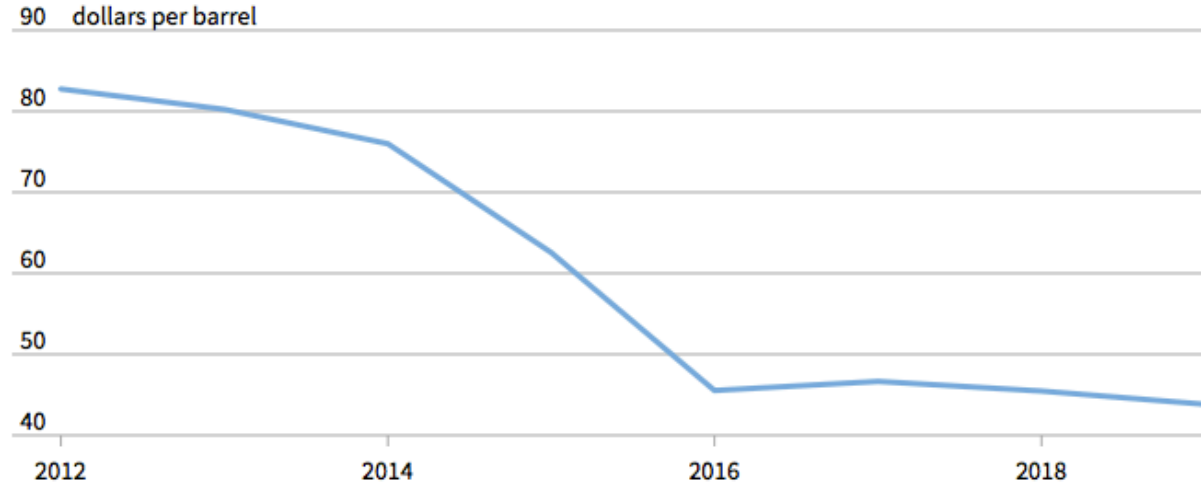
² Most recent year for which data are available when this FAQ was updated.

Source: US Energy Information Administration

EXHIBIT 6

Oil prices needed to profit in U.S. shale

The oil price needed to turn a profit in shale has dropped, but most producers still need prices in the \$40s.

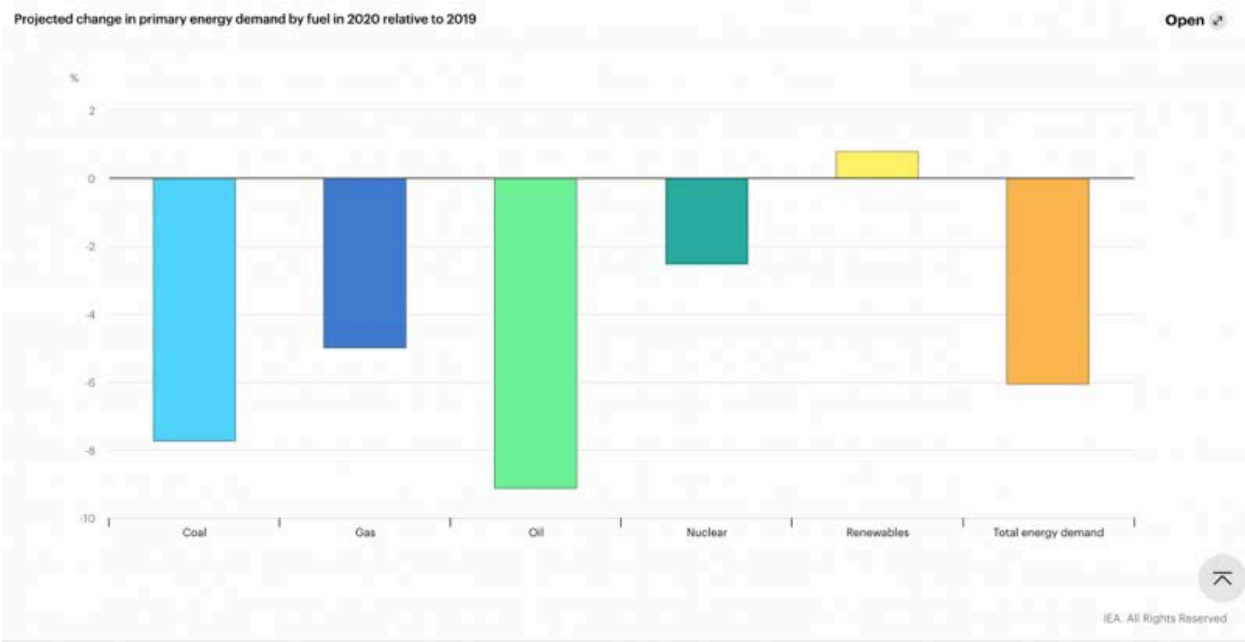


Note: Average per-barrel price needed to break even across all U.S. shale fields

Source: Rystad Energy

Jennifer Hiller | REUTERS GRAPHICS

EXHIBIT 7



IEA (2020), Global Energy Review 2020, IEA, Paris <https://www.iea.org/reports/global-energy-review-2020>