

THE PEOPLE VERSUS CONVENTIONAL ENERGY: THE TRANSITION TO COME

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Executive Summary

The past decade has seen growth in the spread of knowledge throughout the world about the dangers of climate change. The majority of the scientific community is in agreement that humans due to burning of fossil fuels have largely caused global warming, and conventional energy companies have been the root cause of this problem. It seems like political and civilian pressure to take climate change seriously and take action will spur oil and gas companies to move toward renewable energy sources. In recent years, some oil and gas companies have acknowledged climate change as a real thing and have invested in research and development toward sustainability and renewable energy. These companies are paying lip service to taking action against climate change by indicating culture changes, but the financial sections of their annual reports actually show that they are not slowing down the production of conventional energy sources. Clearly, the pressure from politicians and civilians has not been enough to make them change swiftly. However, price volatility in the market has a direct effect on their revenue, so increased future price volatility in addition to increased pressure from politicians and civilians might be sufficient to convince oil and gas companies to swiftly change to using renewable sources for energy. Corporations are ultimately most concerned with their bottom line—not public opinion or better outcomes for the planet. Therefore, the strongest argument in favor of moving to renewable energy is a combination of future revenue volatility and public pressure. I hypothesize that large-scale oil and gas companies, such as Exxon and Shell, are planning for a future where renewable energy will overtake oil and gas as the leading energy source. However, they will move slowly toward renewable energy sources until they become more financially enticing. My analysis will show that the increased scientific, political, and private sector pressure on oil and gas companies has resulted in the culture that acknowledges the reality of climate

change and the need for cleaner energy. Yet I also show that the production of conventional energy and therefore these corporations' main sources of revenue are not decreasing based on data from Shell and Exxon's annual reports. I created a table that shows the parallels between oil and gas price volatility and Exxon's revenue. In conclusion, I project that it will take a long time (perhaps more than 40 years) before oil and gas companies transition from conventional energy to renewable energy, unless there is a combination of a continuous increase in political/private sector pressure and oil price volatility to convince them to move more swiftly.

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Introduction

History has taught us that human advancement is inevitable. Human beings will always adapt to their environment and become more innovative over time. This ever-progressing world will continue its advancement as long as the intelligence of the human race retains its influence. The sustained presence of a constant progression of energy sources has allowed for improvements in efficiency in buildings, industrial processes, and transportation. As humanity continues its development of the world, the progression of discovering and developing energy sources by humankind will continue to evolve and advance.

The first knowledge of coal used as an energy source was in 2000 BC, when it was burned for heating and cooking. In the 1590s, the Dutch windmills were the chief agent in land reclamation. The windmills would grind the grain produced on the rich meadows, saw wood, and grind spices. The first natural gas well in the United States was drilled in 1821. During most of the nineteenth century, natural gas was used almost exclusively as a source of light. The 1900s brought the birth of the modern oil industry; this brought vast and swift change around the world, opening the door to the extensive use of automobiles to allow easier transportation as well as the power plants and gas pipelines that powered many homes.¹

Despite the many advantages the oil industry has brought to the world, there are drawbacks as well. The planet is now 2.4°F (1.3°C) warmer than before the rise of the oil industry. The main source of this rise in temperature is emissions of greenhouse gases from combustion of

¹ “Historical Timeline.” Alternative Energy – Procon.org. Accessed December 1, 2019. <http://www.alternativeenergy.procon.org/view.timeline.php?timelineID-000015>.

² Brian Kahn. “This Graphic Puts Global Warming in Full Perspective.” Climate Central, April 19, 2017.

fossil fuels.² Assuming our greenhouse gas emissions continue at their present levels without reduction, existing climate forecasts suggest that our planet will warm by about 7.2°F (4°C) by the end of the twenty-first century.³ In 2018, the mean global temperature is 58.4°F (14.7°C), the warmest it has been in tens of thousands of years, and the CO2 level in the atmosphere is 405 ppm, the highest in millions of years.⁴

The idea of the planet warming at this rate has undoubtedly roused the attention of the scientific community. Many nations have also taken notice and have begun to understand the risks involved in climate change; for example, in 1987 the Montreal Protocol of the Vienna Convention imposed international restrictions on emission of ozone-destroying gases. Other coalitions and treaties have followed. Citizens have also taken action in response to the threat of climate change, including the creation of organizations like 350.org. When it comes to civil society's climate action, 350.org is one of the most outstanding initiatives. This organization started in 2008, and the number of individual donations it has received has increased year over year.⁵

The scientific community, the governments/political figures of many nations, and the people of the world have all taken notice of the harmful effects of climate change, and it is generally agreed that there needs to be action taken against climate change. But what about the corporations that are the root of the cause for climate change: the oil and gas corporations? Do

² Brian Kahn. "This Graphic Puts Global Warming in Full Perspective." Climate Central, April 19, 2017. <https://www.climatecentral.org/news/628-months-since-the-world-had-cool-month-21365>.

³ Brian Dunbar. "The Ups and Downs of Global Warming." NASA. Accessed December 2, 2019. <https://www.nasa.gov/topics/earth/features/upsDownsGlobalWarming.html>.

⁴ Michael Marshall. "Timeline: Climate Change." New Scientist, September 4, 2006. <https://www.newscientist.com/article/dn9912-timeline-climate-change/>.

⁵ "2018 Annual Report: Financial Data." 350.org. Accessed December 1, 2019. <https://350.org/2018-annual-report-financials/>.

they acknowledge that climate change exists, and are they taking action toward preventing climate change by exploring new energy sources that avoid harming the environment?

Oil and gas companies are increasing their investments in renewable energy and developing strategies in the renewable sector. Common opinion would say they have little choice but to explore the renewable energy sector due to mounting political and global pressure to develop strategies that limit CO2 emissions. In addition, future oil prices and demand will continue to be volatile. However, common opinion doesn't give substantial backing to that assumption, and analysis of company data is required to determine whether oil and gas corporations are taking significant action toward renewable energy sources. *My hypothesis is that without a substantial combined increase in political and private pressure against conventional energy and volatility of oil prices, oil and gas companies could possibly take more than 40 years to transition away from conventional energy and toward renewable energy as their main energy source for revenue.*

Methods and Results

Collecting data from the financial reports of oil and gas companies such as Exxon Mobile and Shell can provide data that will show whether this hypothesis is supported. For example, financial reports including production earnings over several years can indicate where the revenue is coming from. It can show whether revenue from liquids and gas has been decreasing or increasing over the years and show the number of rigs being drilled over the years. This will indicate whether these companies are trying to limit oil and gas as their main energy sources. The strategic report within the financial report can show what the company is planning for the future, including indications of whether renewables are in their future plans. For example, looking at the prices for West Texas Intermediate (NYMEX) Crude Oil over the last 10 years can provide insight into the effects that oil prices had on the company's decisions toward renewable

energy. Using these data, I intend to conduct analysis to provide support to my hypothesis that large-scale oil and gas companies are moving toward renewable energy sources and planning for a future when they will overtake oil and gas as the leading energy sources. According to the data from the financial reports of major oil companies, their monetary investment and strategies for renewable energy are increasing. This is due to the current snowballing of political and civilian pressure as well as the volatility of oil and gas prices, which have hurt earnings for oil and gas companies. However, the move toward renewable energy sources will move at a slow pace until these corporations see it as more financially enticing.

Mention of the words “renewable energy,” “climate change,” “energy transition,” and “carbon capture, utilization, and storage (CCUS) solutions” was nonexistent in the financial reports of companies like Exxon Mobile and Shell in the 1990s or even early 2000s. But they are common in the 2018 annual financial reports from Exxon Mobile and Royal Dutch Shell. If my hypothesis is true, there should be an ever-growing presence of the subject of renewable energy in the annual reports of large-scale oil and gas companies. While it is heartening that these companies are aware enough of climate change to make mention of it in their annual reports, it is important to consider the substance of what they are writing about in regards to climate change. Do the data from these annual reports indicate that they are planning for a future in which renewable energy will overtake oil and gas as the leading energy source?

I'll first provide data from the Shell annual report and then analyze whether it supports my hypothesis. Shell had a full section in its 2018 annual report dedicated to climate change and energy transition. In it, they recognize that greenhouse gas (GHG) emissions from the use of fossil fuels are contributing to the warming of the climate system, and they state that they fully support the Paris Agreement and its goals. Shell has an extensive research and development

(R&D) team focused on improving the quality of their products and the efficiency of their projects, processes, and operations—specifically, to commercialize new technologies for the transition to a low-carbon energy future.⁶ Shell releases another report, separate from the annual report, called the Sustainability Report. The Sustainability Report goes into detail about the technologies they are exploring to reduce GHG emissions. In 2018, they spent \$986 million on R&D, compared with \$922 million in 2017.⁷ Shell is participating in a pilot project with the Technical University of Vienna and others to implement a new carbon capture process at a biomass power plant. Shell also supports innovation in this space in a number of ways: Shell GameChanger, which works with start-ups and businesses on unproven early-stage ideas with the potential to impact the future of energy; Shell Ventures, which invests in companies that are developing promising technologies that complement Shell’s businesses; and Shell TechWorks, a program that brings into the oil and gas sector proven technologies from other industries.

Shell’s Sustainability Report includes a great deal of literature in favor of promoting sustainability and limiting global warming—but the data from the annual report tells a different story. Per data from the annual report, Shell crude oil and natural gas liquids available for sale is higher in 2018 (600,186 barrels) than it was the previous two years (2017 was 595,539 barrels, and 2016 was 576,170 barrels). Shell’s natural gas available for sale is also higher in 2018 (3,241,721 standard cubic feet) than it was the previous two years (2017 was 3,117,049 standard cubic feet, and 2016 was 3,037,161 standard cubic feet).⁸

Furthermore, there was other data in Shell’s annual report that can be taken as contradictory to plans to limit global warming. In Shell’s 2018 annual report it was stated that Shell had 342

⁶ “Disclaimer.” Shell Annual Report 2018. Accessed December 1, 2019. <https://reports.shell.com/annual-report/2018/?accept=1>.

⁷ Ibid.

⁸ “Developing Technology.” Shell Sustainability Report 2018. Accessed December 1, 2019. <https://reports.shell.com/sustainability-report/2018/sustainable-energy-future/developing-technology.html>.

sites where drilling activities were under way or firmly planned for the next 20 years. This was the highest number in the last three years (2017 was 341, and 2016 was 324).⁹ Table 3, from the Shell 2018 annual report, shows the projected projects and wells for the next 20 years.

When the data from Shell's annual report is analyzed, the first takeaway was that Shell is being proactive in public relations to show that their culture is changing in a way to deliver energy in a more responsible way. With Shell's literature about sustainability, energy transition, and concerns about climate change included in their annual report, they are projecting the idea that they are planning for a future where renewable energy will overtake oil and gas as the leading energy source. Shell's increased budget in R&D and company acquisitions in renewable technologies reinforces Shell's culture shift to transition to cleaner energy.

However, although Shell has acknowledged that climate change is a real threat and that they would like to work to prevent it, according to data in their annual report, the amount of Shell crude oil and natural gas liquids available for sale is the highest in recent years. Also, Shell has more drilling activities under way or firmly planned for the next 20 years than in previous years. These data points convey the fact that Shell is not slowing down on using conventional energy in the future, which could increase the harmful effects on climate change.

These data points are telling because the annual report is the most important document that a corporation publishes. This document can have great consequences for decision-making by current or potential shareholders.

Another example is Exxon Mobile. As I did with Shell, I'll first provide data from the Exxon annual report and then analyze whether it supports my hypothesis. In the Exxon Mobile 2018 annual report there is a small section that details new technology aimed at a goal for lower-

⁹ "Disclaimer." Shell Annual Report 2018. Accessed December 1, 2019. <https://reports.shell.com/annual-report/2018/?accept=1>.

emission fuels. It's true that sometimes the content of the literature is more important than the amount of literature. But even in this case, the content of the literature does not indicate that Exxon is serious about transitioning to renewables since there is no mention of renewable energy being a future source of revenue. Although there is mention of obtaining clean energy through a conventional energy source, Exxon is investing to capture growth in demand of lower-carbon solutions.¹⁰ There are only four paragraphs in a 118-page report about Exxon investing in research to develop scalable and affordable technologies to meet the growing demand for lower-emission fuels, identify economic CCUS solutions, and reduce the intensity of existing manufacturing processes. Although Exxon does not get into specifics about the actual projects that will lower emission of GHG, I was able to find an interesting project online. Exxon Mobil is looking to secure between 100 and 250 megawatts of delivered solar or wind power in Texas, according to reporting from Bloomberg.¹¹ They will use this energy to power their oil and gas operations in the area. Exxon feels that the lower cost of operations due to renewable energy can give them a competitive advantage in the oil and gas market.

There was no substantial literature in the annual report that would indicate a swift transition from conventional energy to renewable energy. Per data from the annual report, net liquids production available for sale in 2018 was more than 7 percent higher than in 2014, although in 2018 it was 1 percent lower than in 2017. Exxon's natural gas production available for sale has been decreasing year over year at around 4 percent annually since 2014, so there has been a noticeable decrease in natural gas production available for sale.

¹⁰ "2018 Financial and Operating Review." ExxonMobile. Accessed December 2, 2019.

<https://corporate.exxonmobil.com/-/media/Global/Files/annual-report/2018-Financial-and-Operating-Review.pdf>.

¹¹ Emma Foehringer Merchant. "Exxon Is Looking to Buy Cheap Renewable Energy." Greentech Media, August 29, 2018. <https://www.greentechmedia.com/articles/read/exxon-reportedly-eyeing-clean-energy-contracts>.

In Exxon's 2018 annual report it was stated that Exxon had 623 net wells drilled—the highest number of net wells drilled in the last three years. In 2017, 504 net wells were drilled and in 2016, 508 net wells were drilled. Yet, it is a substantially lower number compared to 2014 and 2015 where 1,326 and 1,196 wells, respectively, were drilled.¹²

When I analyze the data from Exxon's annual report, my first takeaway is that Exxon details little in regards to sustainability, energy transition, and concerns of climate change. There is mention of Exxon investing in lower-carbon solutions, but there needs to be substantial strides in technology for the near future. However, based on the data, Exxon has increased the liquids available for sale. Even though natural gas production available for sale has decreased in recent years, it still is not enough to make a meaningful impact against climate change. Net wells drilled has seen a huge recent decline from 2014 but has leveled off the last three years. The data does not indicate that Exxon is moving away from conventional energy in favor of renewable energy, especially since the sales of oil and gas have recently risen.

Most businesses hope for stability when it comes to the prices of the goods they sell. It is difficult for a business to be sustained in a market full of price volatility. The negative effects of price volatility can lead a company to change their strategy or, in a worst-case scenario, file for bankruptcy. Oil and gas companies have experienced some extreme price volatility over the last 50 years. The most notable periods of oil price volatility were in 1973/74, 1979/80, 2003–08 and 2014–16.¹³ These sudden price plunges can wreak havoc on cash-strapped oil companies. For example, in 2015, there were 44 oil and gas producers filing for protection with combined debts

¹² "2018 Financial and Operating Review." ExxonMobile. Accessed December 2, 2019. <https://corporate.exxonmobil.com/-/media/Global/Files/annual-report/2018-Financial-and-Operating-Review.pdf>.

¹³ "World Trade Organization." WTO. Accessed December 1, 2019. https://www.wto.org/english/res_e/publications_e/wtr10_forum_e/wtr10_kilian_e.htm.

of \$17.4 billion. The companies that avoided bankruptcy had to strategize to withstand the price volatility.

The fact that so many companies go bankrupt during periods of oil and gas price volatility is evidence that oil price changes have a correlating effect on oil and gas companies' revenue. Table 1 illustrates the link between oil/gas prices and oil/gas companies' revenue; I used Exxon Mobile as an example. In the chart the trend between average West Texas Intermediate (avg. WTI) crude oil price and Exxon oil production revenue is nearly symmetrical between 2015–18. In 2015, the avg. WTI crude oil price went down 48 percent from the previous year, and in that same time frame, Exxon oil production revenue went down 58 percent.¹⁴ In 2018 the avg. WTI crude oil price went up 28 percent from the previous year, and in that same time frame, Exxon oil production revenue went up 21 percent. In the chart, it is possible to see that the trend between average gas price and Exxon gas production revenue is almost parallel between the years 2015–2018.¹⁵ In 2015 the avg. gas price went down 50 percent from the previous year, and in that same time frame, Exxon gas production revenue went down 51 percent. In 2017 the avg. gas price went up 17 percent from the previous year, and in the same time frame, Exxon gas production revenue went up 22 percent. This is high fluctuation for such a short time frame, which can cause great stress for companies with regards to budgeting, forecasting, and strategic planning.

Analyzing the data from Table 1, it is clear that the price of oil and gas has a direct effect on an oil and gas company's revenue. When there is high-unexpected volatility in the prices, it

¹⁴ "WTI Crude Oil Prices - 10 Year Daily Chart." MacroTrends. Accessed December 1, 2019. <https://www.macrotrends.net/2516/wti-crude-oil-prices-10-year-daily-chart>.

¹⁵ "Natural Gas Prices - Historical Chart." MacroTrends. Accessed December 1, 2019. <https://www.macrotrends.net/2478/natural-gas-prices-historical-chart>.

makes it difficult to plan and forecast effectively.¹⁶ Some major oil and gas companies, such as Exxon Mobile, can withstand rare waves of price volatility. However, as shown in 2015 when 44 oil and gas producers filed for bankruptcy, not all can withstand this price volatility. But what if these waves of price volatility become more common? Can major oil and gas companies like Exxon withstand frequent drops of more than 50 percent in oil and gas revenue? The answer is probably no. If there is a scenario in the future where oil price become more frequently volatile, then oil and gas companies will be forced to diversify their portfolios and increase their budgets for R&D into alternative energy sources with less price volatility. There are currently renewable energy sources that can provide more stable pricing, such as wind and solar.¹⁷ Thus, budgets in R&D may increase for oil and gas companies to better explore the transition to an alternate energy source.

These data points indicate that oil and gas prices have direct impact on oil and gas companies' revenue. If oil and gas companies are not able to make the profits they expect or need to continue operating, a transition away from conventional energy is likely.

It is clear that oil prices can influence a company to switch strategies, but is there a more powerful force that can persuade companies to change their whole strategic outlook? Pressure from political regimes, citizen organizations, and the scientific community can also have great influence on oil and gas corporations.

The Obama administration is a prime example of politics having a great impact on oil and gas companies by creating measures to protect the earth from the negative effects of climate

¹⁶ "Oil Price Volatility: Causes, Effects, and Policy Implications." Council on Foreign Relations. Accessed December 1, 2019. <https://www.cfr.org/report/oil-price-volatility-causes-effects-and-policy-implications>.

¹⁷ Dominic Dudley. "Renewable Energy Will Be Consistently Cheaper Than Fossil Fuels By 2020, Report Claims." Forbes Magazine, January 13, 2018. <https://www.forbes.com/sites/dominicdudley/2018/01/13/renewable-energy-cost-effective-fossil-fuels-2020/#194797db4ff2>.

change. The Obama administration was part of the Paris Agreement, the first global agreement for tackling climate change, in which many countries collectively agreed to reduce their carbon emissions. In 2009, the Obama administration imposed new regulations for automobile emissions and, since then, automakers have been required to dramatically improve fuel efficiency. Since there has been broad compliance with this ruling, with a few exceptions, it has had a large impact on per capita emissions. President Obama also pushed US households and businesses to use less energy by applying simple measures to improve efficiency. One of these measures was to replace the common but terribly inefficient incandescent bulbs with LED lights. In addition, the Obama administration invested billions in renewable energy.¹⁸ The money that was invested brought about an industry that is changing the landscape of the global energy sector and has provided millions of jobs in the renewable energy sector. President Obama also persuaded the Department of Energy to invest \$34 billion in renewables, which turned a profit. In 2015, more than \$4 billion in investments was committed by a private sector coalition led by the White House.

It may have taken a while, but support in the private sector has been growing. The concern about climate change has spread, and more and more people have come to understand the growing risks of climate change. In the wake of this growing concern, different initiatives have popped up during the last couple of decades, especially after the Rio 92 conference and, more recently, the Paris Agreement. When it comes to climate action taken by civilians, 350.org is one of the most outstanding initiatives. The US-based NGO was born in 2008 through the partnership made between a group of university friends and environmental activist author Bill McKibben. The name “350” relates to 50 parts per million—the safe concentration of carbon dioxide in the

¹⁸ “7 Ways Obama Helped Protect the Planet From Climate Change.” Global Citizen. Accessed December 2, 2019. <https://www.globalcitizen.org/en/content/7-of-obamas-biggest-climate-change-victories/>.

atmosphere. Regular people who wanted to fight against climate change have found refuge with 350.org. The organization uses the power of online campaigns, grassroots organizing, and mass public actions to oppose new coal, oil, and gas projects, fighting for a 100 percent clean energy goal. The organization also fights against the oil and gas industries and exerts pressure on them to change to a clean energy. Every year this organization gains more support and donations, which allows them to fight harder against oil and gas companies.¹⁹

As more organizations like 350.org gain steam, protests will become more frequent. In September 2019, millions of young people raised their voices at protests around the world in a massive display meant to demand urgent action on climate change. Some of the first rallies began in Australia and then spread from the Pacific Islands to India and Turkey and across Europe as students kicked off what organizers were calling a Global Climate Strike.²⁰ The protesters marched to demand that governments and businesses commit to a goal of net-zero carbon emissions by 2030. The Global Climate Strike called for a swift transition from fossil fuels to renewable energy, with their message aimed at major GHG emitters like Exxon, Shell, and other oil and gas companies.

Not only is climate change currently being combated on the political and private sector fronts, most importantly the scientific community is fighting it. The scientific community had to first band together and agree that climate change is a real threat in order to convince political figures and private citizens of its validity. The international scientific community has formed the Intergovernmental Panel on Climate Change (IPCC). The IPCC's mission is to provide scientific

¹⁹ Carolyn Fortuna. "Top 10 List of Best Nonprofits Fighting for Climate Change Fixes." Green Living Ideas, November 27, 2019. <https://greenlivingideas.com/2017/01/19/top-10-list-best-nonprofits-fighting-climate-change-fixes/>.

²⁰ Scott Neuman and Bill Chappell. "Young People Lead Millions To Protest Global Inaction On Climate Change." NPR. September 20, 2019. <https://www.npr.org/2019/09/20/762629200/mass-protests-in-australia-kick-off-global-climate-strike-ahead-of-u-n-summit>.

assessment reports on climate change impacts, future risks, adaption, and mitigation options. Leading scientists publish reports through the IPCC, and those reports are considered the most reliable source of information on climate change.²¹ Political figures and organizations in the private sector use these reports as references for policy-making and to establish the validity protests of and other actions against climate change.

The consensus of the scientific community is powerful, as most people do not have time or capacity to research climate change. Therefore, it is important that most of the scientific community agrees that climate change is a real and growing problem. Ninety-seven percent of climate change reports written by scientific experts conclude that global warming is happening and that humans are the cause.²² As more experts publish reports on climate change, there is more ammunition for politicians and those in the private sector to combat non-believers.

It is obvious that political regimes, citizen organizations, and the scientific community can have great influence on oil and gas corporations. The Obama administration played a big role in regulating the energy industry. President Obama was a strong advocate for clean energy; during his time in office he banned offshore drilling in the Arctic and placed additional rules and regulations on the fossil fuel industries—particularly on the coal industry. During his eight years in office, he brought the coal industry to its lowest production and revenue. Research has shown that coal is more detrimental to the environment than natural gas, which is why the coal industry was his first priority. But what if Obama had remained in office for another eight years or if his successor had the same ideology as he regarding clean energy? The oil and gas industries would have been the next area of focus now that the coal industry is practically nonexistent.

²¹ Dantas, Thales. “Organizations Fighting Climate Change: A Quick Guide.” Medium. October 9, 2018. <https://medium.com/@thalesetd/organizations-fighting-climate-change-a-quick-guide-2e700d96dc52>.

²² “Climate Science Glossary.” Skeptical Science. Accessed December 2, 2019. <https://skepticalscience.com/global-warming-scientific-consensus-intermediate.htm>.

The private sector is gaining momentum in joining the clean energy revolution. As more organizations like 350.org emerge, there will be more public support for transitions to clean energy.²³ It all starts with the people; they are the ones who can cause a domino effect. The more people who join organizations like 350.org to advocate for taking action against climate change, the more voters there will be for candidates who share Obama's climate ideology. Therefore, more politicians in office will push for clean energy and will inevitably be in support of harsh regulations on companies that produce oil and gas. These politicians will also give support to clean energy companies, which may allow them to challenge the oil and gas companies in the energy market.

Political influence and pressure from the private sector are powerful tools in persuading oil and gas companies to transition to renewable energy, but political figures and private citizens will not back actions against climate change unless they have hard data that shows that the danger of climate change is real. Reports from the IPCC are critical for anyone who is not a scientific expert. Reports from the scientific community will influence the number of political figures, organizations, and private individuals who are in support of renewables and who advocate taking action against climate change. Over 95 percent of the scientific community acknowledges that climate change is real and that GHG from oil/gas emissions is one of its main causes. This evidence makes it very difficult for oil and gas companies to refuse to acknowledge that climate change is real.

The oil and gas companies are greatly influenced by politics, the private sector, and the international scientific community. I asked my mentor, Mathieu Brotons, Engineering Project Manager at SBM Offshore, several questions related to this method, and Table 1 shows his

²³ "2018 Annual Report: Financial Data." 350.org. Accessed December 1, 2019. <https://350.org/2018-annual-report-financials/>.

answers, which provide support for its use. When I asked about politics, Mr. Brotons responded that subsidies, bans, and regulations all affect the oil and gas industry. He also indicated that the scientific community is well respected and, finally, that SBM Offshore is striving to develop innovative solutions in our renewable energy product line. Therefore, oil and gas companies may transition to renewable energy if political figures, private sector organizations, and the international scientific community continue to exert pressure.

Discussion

Historically coal has been a leading source of energy, but over the past couple of decades, it has been increasingly replaced by cheaper, cleaner energy sources. It has mostly been replaced by natural gas, but even some renewables have now surpassed coal as more commonly used energy sources.²⁴ Even though natural gas and renewables have been available for more than just a couple of decades, it takes time to overthrow a leader in the energy market, mainly due to market power, financial resources, infrastructures, corporate stability, political power, the support of citizens, and other factors that ensure its dominance over other potential rising energy sources.

It is important that cleaner energy is overtaking coal as an energy source, as scientists have measured global temperatures for over 100 years and these data show that the earth is getting hotter. Human activity is largely responsible for the increased global temperatures because of burning fossil fuels. Even though burning natural gas results in nearly half as much carbon dioxide per unit of energy compared with coal, it is still not renewable, and is not 100 percent clean energy. Therefore, even with natural gas as a leading energy source, the earth will continue

²⁴ Dana Nuccitelli. "Natural Gas Killed Coal – Now Renewables and Batteries Are Taking over." The Guardian. Guardian News and Media, January 29, 2018. <https://www.theguardian.com/environment/climate-consensus-97-percent/2018/jan/29/natural-gas-killed-coal-now-renewables-and-batteries-are-taking-over>.

to get warmer, and the effects of climate change will persist. As long as the earth's temperatures continue to rise, politicians, the private sector, and scientists will continue to advocate for clean energy and solutions to end climate change. They will maintain pressure on oil and gas companies to transition to renewable energy sources.

The ideology of most successful politicians and organizations is based off of facts, data, or opinions from experts in the international scientific community. One cannot overstate the importance of the scientific community in promoting action against climate change because of the knowledge they share with the public. The scientific community influences the agendas of politicians and the formation of organizations in the private sector through speeches, reports, and other publications. As more information about climate change from the scientific community spreads to the private sector, there will be more people aware of the risks and more support for organizations and protests that are aimed at taking action against climate change. As the support for these organizations and protests grows, more politicians will make climate change part of their agendas. The politicians who speak for the people in support of taking action against climate change will win seats of office at the local, state, and federal levels. Once these politicians take office, there will be more policy aimed at limiting global warming, such as subsidies for renewable energy companies, regulations that directly affect oil and gas companies, bans against oil and gas drilling in certain areas, oil and gas import/export limitations, trade agreements, and so on.

Now that most of the scientist community has agreed that climate change is real, it is difficult for oil and gas companies to deny that global warming is happening. Some major oil and gas companies, such as Shell and Total, have acknowledged that climate change is real in official statements. Others, such as Exxon Mobile, are not as subtle about acknowledging climate change

is real. In the past, even the most liberal oil and gas companies would have never acknowledged climate change as a real thing. In both Shell's and Exxon's annual reports there is mention of funds being allocated to R&D for cleaner energy sources. For example, Exxon currently uses wind turbines to generate power for their oil and gas production projects. This indicates that these corporations do see the potential cost efficiency of renewable energy. Shell, on the other hand, is investing large amounts of money in buying out companies that are trying to find technology solutions in the renewable energy sector.

The annual reports of major oil and gas companies do show that money is being invested into renewable energy, and there is obvious direct acknowledgement that climate change is real and that we need to replace fossil fuel production with cleaner energy sources if we want to protect the earth. However, the Shell report contains more content indicating that it is much more entrenched in sustainability and clean energy R&D than Exxon Mobile. This makes it seem that Shell may be on a quicker path to transitioning from conventional energy to renewable energy than Exxon Mobile.

Yet, look at the financial figures in both Shell's and Exxon's annual report, one can see that both companies are investing less than 1 percent of their budgets in the renewable sector. Also, no revenue from renewables is shown on the annual reports for either company. There is also no slowing down of production or decrease in revenue from conventional energy sources. This indicates that political and civilian pressure on oil and gas companies to take climate change seriously and take action on transitioning toward a renewable energy sources have led oil and gas companies to pay lip service to this by presenting cultural changes. Although they are also

pouring some of their budget into R&D, it is less than 1 percent of their total budgets.²⁵ Civilian and political pressure is seemingly not enough to persuade oil companies to swiftly transition away from conventional energy sources and move toward renewable energy sources.

Diving deeper into the financial statements of Exxon's annual report, I noticed some volatile fluctuations in their revenue over the past five years. My research brought me to the conclusion that the prices of oil and gas had major effects on Exxon's revenue over the last five years. Table 1 shows that price determines oil and gas companies' revenue. Price volatility in the market has a direct effect on revenue, so increased future price volatility might be an incentive to move toward renewable sources. Since, of course, for most companies, the bottom line is the most important driver in their business.

A combination of political and private sector pressure along with continued price volatility occurring simultaneously will speed up the process of oil and gas companies transitioning from conventional energy source to renewable energy sources. Without sustained pressure and increased volatility, we can expect a longer time frame for the transition to renewable energy sources. Although, as the Shell and Exxon annual reports showed, there are differences in company culture. Companies such as Shell are much more aggressively accepting energy sustainability culture and are pouring more effort into renewable R&D. Therefore, Shell is likely to transition away from conventional energy to renewables before Exxon does. But even with Shell's progressive nature regarding renewable energy, they are still around thirty years away from offering renewables as their predominant energy product. Yet if we want to avoid the increase of global warming, oil and gas companies must immediately transition from conventional energy sources to renewable energy sources. The only way for this to happen is to

²⁵ Ron Bousso. "Big Oil Spent 1 Percent on Green Energy in 2018." Reuters. November 12, 2018. <https://www.reuters.com/article/us-oil-renewables/big-oil-spent-1-percent-on-green-energy-in-2018-idUSKCN1NH004>.

immediately increase the number of voters for politicians in favor of renewable energy. Once those politicians are in office, they need to create policies that cause oil and gas price volatility. At that point oil and gas corporations' revenues will be affected long term, and they will have no choice but to transition from conventional energy to renewable energy sources.

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Appendix A: Tables

Table 1: Average Crude Oil Price and Average Gas Price versus Exxon Oil and Gas

Production Revenue, 2015–18

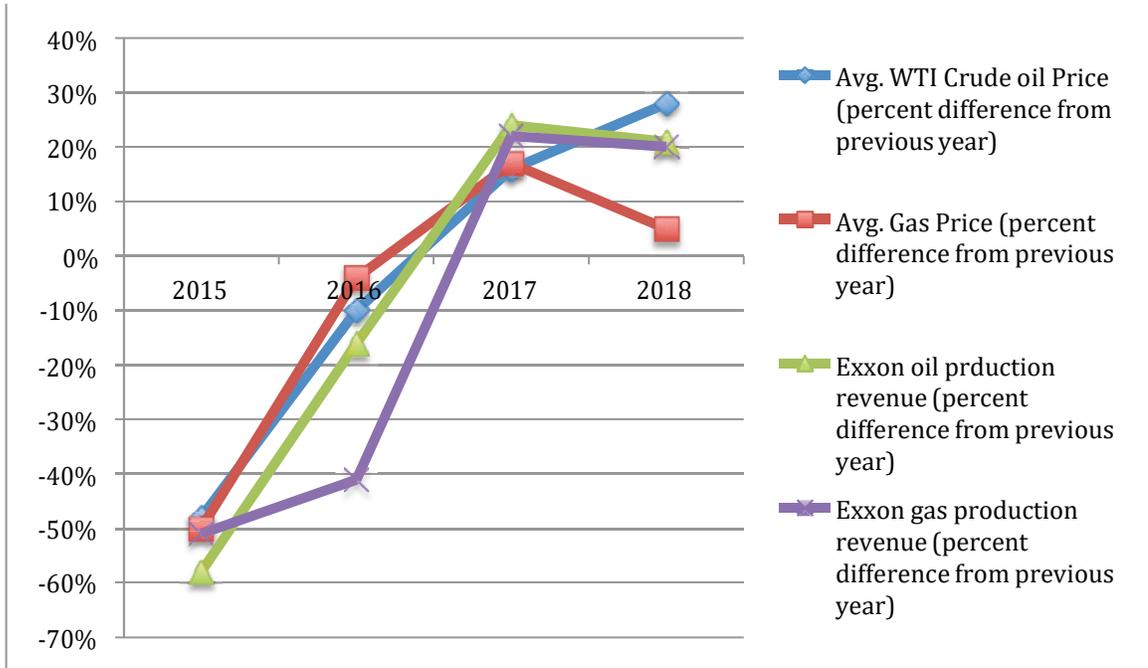


Table 2: Questions for Mathieu Brotons, Engineering Project Manager at SBM Offshore

Question	Answer
Do politics play a role in the oil and gas industry?	Politics can play a role in all industries, not just oil and gas. Subsidies, bans, and regulations all can have effects on the oil and gas industry.
Does the international scientific community have an influence on SBM Offshore?	Being a company with many engineers, we have great respect for the experts in fields related to our industry. We monitor and take into account the latest facts, opinions, and other reporting from the international scientific community.
Do you foresee renewable energy technology developing extensively in SBM Offshore's future?	SBM Offshore has been focusing extensively on offshore renewable energy development by our technology group. We are striving to develop innovative solutions in our renewable energy product line. We have made great progress in our technology for offshore wind and wave.

Table 3: Shell 2018 Annual Report—Projected Projects and Wells

	Projects		Wells
	Number	\$ million	Number
Between 1 and 5 years	44	3,645	180
Between 6 and 10 years	12	1,059	143
Between 11 and 15 years	4	238	16
Between 16 and 20 years	–	–	3
Total	60	4,942	342