

Global Agenda Council on the Future of Oil & Gas

Future Oil Demand Scenarios

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Introduction

The enormous economic contribution of the oil and gas industry to many national economies makes its future of critical importance to the global community. The industry, however, is facing some of the most profound challenges in its history. Despite the fact that oil and gas is likely to be a major source of energy for decades to come, policy-makers and the public are re-evaluating the central role the industry plays in modern life. With rising concerns over future demand and climate change, the industry finds itself in a delicate situation.

The purpose of this paper, prepared by the World Economic Forum Global Agenda Council on the Future of Oil & Gas, is to consider what would be a robust oil and gas business strategy and response to a variety of alternative futures, including one where global energy demand and the mix of fuels in 2040 would be consistent with limiting global warming to 2°C. The council is not advocating or opining on the “realism” or likelihood of any given scenario, but considers what could be a good strategy either in a business-as-usual outcome or if a low-demand growth circumstance indeed emerges.

Background

Since the Industrial Revolution, oil and natural gas have played an instrumental role in economic transformation and mobility in everyday life for the majority of the world's population. Oil was so fundamental to the development of modern society in the industrialized world that the 20th century is often referred to as the “Age of Oil”. Today, oil and natural gas play a pivotal role in the current global energy system. Roughly 31% of primary energy used globally is met by oil-based fuels, and natural gas represents a further 21% of total world energy supply¹.

Since the 1980s, many oil-producing countries and oil companies operated from the assumption that the industrialized world would progressively use up its easy to access oil resources and become increasingly dependent on oil controlled by the Organization of Petroleum Exporting Countries (OPEC), and in particular the vast reserves of the Middle East. Under this long prevailing world view, which lasted from the 1980s until recently, OPEC's petro-power would increase over time and therefore all the oil cartel really needed to do was wait it out for that day to come.

Through the 2000s and up until last year, OPEC took a revenues-oriented strategy, believing that this oil-constrained world had arrived and its oil was more valuable under the ground than out in the market. Oil companies, too, responded to this world view by pursuing a business model that maximized adding as many reserves as possible to balance sheets and warehousing expensive assets.

The US shale boom, digital revolution and Paris climate

¹ International Energy Agency

accords, however, have changed the outlook for the future of the oil and gas industry. Now, with the prospects that major economies like the United States, China and Europe will actively try to shift away from oil – at a time when the costs for producing oil from shale and other kinds of source rock as well as from conventional sources are declining through technological innovation – producers are coming to realize that oil under the ground might someday be less valuable than oil produced and sold in the coming years.

In effect, perceptions have changed from believing a peak in supplies was possible to believing a peak in demand for oil is possible over the next several decades. The recent change in strategy by OPEC has accentuated the possible impacts of such an attitudinal shift in paradigms. Some investors have also become concerned that the value of oil and gas company shares may be overvalued, if warehoused high-cost oil and gas assets could become stranded.

This dramatic shift in expectations is changing the operating environment for the future of oil and gas, regardless of whether it will come to pass or not. Moreover, policy-makers, investors and scientists who met in Paris at the end of 2015 at the UNFCCC COP21 concluded that new efforts are needed if the planet is to avoid catastrophic climate change driven by the accumulation of greenhouse gases in the atmosphere.

Under a scenario where fossil fuel use is reduced to limit global warming to 2°C, oil use may still be relatively stable, but certainly not expand to the same extent as in existing business as usual expectations. The Global Agenda Council on the Future of Oil & Gas considers below strategies that can be deemed to be robust for the industry in a future 2°C world towards 2040 as well as most alternative futures.

Alternative Futures

IEA New Policies scenario

According to the central New Policies scenario of the International Energy Agency (IEA), the need for oil and gas to fuel global economic well-being for an expanding middle class population in the developing world will increase oil and gas demand significantly over the next three decades, in spite of significant improvements in energy efficiency². Given the natural decline that comes in operating the world's current inventory of producing oil and gas fields, industry believes it can sustain its current business models.

The IEA projects that oil demand will rise by 14% from 2014 demand of 90.6 million b/d to reach 103.5 million b/d by

² The same view is embedded in the base case or central scenarios of most recent oil company outlooks, such as ExxonMobil's Energy Outlook, BP's Energy Outlook or Statoil's Energy Perspectives.

2040 in the New Policies scenario. Overall, the global system will still be dependent on oil and natural gas for the majority of the energy required to fuel economic activity, with fossil fuels generally representing roughly 75% of total primary energy use in 2040, according to the IEA. But this forecast is looking more questionable in light of changing global economic conditions, technology innovation and shifting demographic trends.

Under a scenario where fossil fuel use is restricted to limit global warming to 2°C, oil use would be significantly more limited. The IEA's 450 scenario (consistent with a 50% probability of less than 2°C global warming) projects global oil demand to rise slightly to 93.7 million b/d in 2020 but thereafter fall to 74.1 million b/d by 2040; by comparison, coal consumption would fall 38% over that period and natural gas demand would rise 16%³.

Statoil Renewal scenario

According to a 2°C Renewal scenario developed by Norwegian oil firm Statoil and assuming accelerated clean technology transitions, for instance, oil use would be roughly 15% lower than today at below 80 million b/d by 2040 and coal use would drop by some 50% to only 14% of primary world energy demand. Under the Statoil scenario, natural gas would rise to 24% of primary energy, up from 21% today. Statoil's Renewal scenario describes a mix of policy, regulatory, behavioural and technological developments that brings about a 40% decline in CO₂ emissions from energy use between 2012 and 2040.

The Statoil Renewal scenario includes much tighter energy and climate policies than those implied by full implementation of all national pledges for reductions targets submitted at the COP21 climate negotiations in Paris. It includes global pricing of carbon and a rapid phase-out of all government subsidies for fossil fuels. In the Renewal scenario, households shift to rooftop solar in many locations in the world, and electricity – increasingly distributed via smart, decentralized, efficient and consumer-centric infrastructure – represents more than 30% of final energy consumption by 2040, up from just under 20% today.

The Statoil scenario also posits that cost improvements, innovation, new business models and new regulatory paradigms push renewable energy to 57% of the power sector penetration, up from 21% today⁴, propelled by cost-effective storage solutions, smart grids and natural gas turbines as swing producers. Coal use in China and India is rigorously curtailed in the scenario through direct government intervention.

Finally, the Statoil Renewal scenario includes extensive adoption of electric vehicles. This allows oil share in private road transportation to drop to less than 30% in the key regions such as Europe and North America. Eventually the same momentum spreads to Asia where oil's share of private road transport is above 50%. Overall, investments in

new technologies allow global energy intensity to fall by 2.7% a year by 2040, limiting oil and coal's share of the global energy mix by 2040.

High-tech scenario

The Statoil Renewal scenario compares to other oil industry low-carbon scenarios that also posit low oil intensity under robust technology breakthroughs and penetration rates. Another energy company scenario considers outcomes where oil intensity of the global economy falls from a 0.46 ratio relative to one unit of real GDP to 0.26, a 43% reduction in oil intensity, with alternative fuel capturing 19% of transportation energy by 2030, up from 6% currently, and electric vehicles (EVs) reaching 6% of total vehicle stocks. Under this scenario, which assumes EVs and hybrid plug-in vehicles reach 17% of new global light duty vehicles sales by 2030 and a 50% drop emerges in EV battery costs, utility scale solar power and stationary electricity storage. Oil demand peaks prior to 2020 and falls to 86.5 million b/d in 2020 and falls to 74.6 million b/d by 2030, under this high tech, high penetration scenario that also includes pro-renewables policies that promote growth in wind and solar electricity to 16% of global electricity generation, up from 3% currently. The scenario projects that advanced vehicles and other energy efficiency policies produce a global energy mix that increasingly converges with Germany's high penetration rate of renewables and peaking of oil demand growth.

UC Davis scenario

A similar scenario study by University of California Davis found that several emerging factors could bring about a temporary peaking of demand in transportation in the next decade or so. The UC Davis study notes that the age of information technology and big data is bringing revolutionary changes to daily life with potentially dramatic consequences for energy savings. Exponential gains in productivity are expected in several areas including transportation logistics, industrial equipment and mobility services. This technological progress – coined by consultants McKinsey & Company as the “resource revolution” – is arriving just as previously breakneck economic growth in Asia and Latin America is experiencing headwinds. The two factors combined is one of the reasons oil prices have fallen over the past year and a half, in addition to the supply growth that explains much of the sudden downward price momentum. But the impact of the technological revolution could be longer lasting, according to UC Davis forecasts.

Massive urbanization might curb the viability of private car ownership in the places expected to be the new centre of oil use such as India, Indonesia and the Arab Gulf. UC Davis research shows that car ownership and use tends to peak in urban China and India after megacities reach a sufficiently high level of traffic congestion. Increasingly, cities around the world are seeking smarter designs to transport systems and penalties and restrictions to car ownership. China's commitment to an industrialization programme pushing itself to be the world's major exporter of solar panels and advanced vehicles, including the

³ International Energy Agency, *World Energy Outlook 2015*.

⁴ See Statoil's Renewal scenario presented in *Energy Perspectives 2015*. Click [here](#)

production of 5 million electric vehicles a year, is another variable influencing future oil demand trends.

Industrial internet

The industrial internet also holds promise for dramatic energy efficiency gains across many sectors, reducing the requirements for oil. Use of information technology, nano-scale material science and biology with industrial technology is expected to yield exponential gains in productivity in coming years, reducing the requirements for energy in ways that could mushroom quickly. Information technology software is allowing for optimized routing, timing, loading and information sharing in a manner that will lower energy use.

Combining remote sensors, communications technology, cloud-based computing and industrial machinery, incredible gains are expected in operational productivity and efficiency that will lower the amount of fuel needed to undertake economic activity. According to GE, a doubling of the rate of energy productivity via the industrial internet could produce a reduction of energy consumption equivalent to 12 billion barrels of oil between now and 2030. Big data analytics applied to aviation navigation operations is already dramatically reducing fuel demand, with the aviation sector able to shave 10 to 20% of its jet fuel demand via big data analysis and planning. Smart phone applications are eliminating partial loads for trucking of freight and optimizing urbanites propensity to use public transportation and car sharing systems. Similar advancements applied in the rail industry that allow more locomotives to run at faster speeds and with greater efficiency is lowering fuel requirements by 5%. Manufacturing via automation and 3-D printing and other advances are also expected to lower fuel requirements. Through these technologies, the decoupling of energy use and economic growth will accelerate, lowering the energy intensity of global output.

UC Davis scenarios found that these emerging trends – efficiency technologies for advanced vehicles, logistics planning and freight, changes in urban transportation patterns that caps personal vehicle ownership and congestion, and slower than expected economic growth in key Asian economies – in combination could bring about a temporary peaking of oil demand in transportation in the next decade or so. Population growth and expanding wealth effects, without strong policy interventions, could eventually overwhelm these improvements, UC Davis found, allowing oil demand in the transportation sector to reach 55 to 60 million b/d by the 2040s, compared to 52 million b/d in 2015. This outlook contrasts to the IEA Current Policies scenario of 75 million b/d for transport oil demand by 2040 (based on today's policies only) and ExxonMobil's 2015 Energy Outlook of about 69 million b/d by 2040.

ExxonMobil energy outlook

While ExxonMobil's Outlook posits that oil demand from the light duty vehicle private transportation will decline in the industrialized West and flatten or decline elsewhere over the coming decades, the forecast anticipates oil demand

from the freight transportation sector to grow significantly in the developing world.

ExxonMobil's 2040 Outlook projects that the world will reach 1.7 billion cars by 2040, up from 825 million in 2010. However, fuel economy improvements in passenger cars will offset the steep rise in the number of vehicles and thus, ExxonMobil forecasts that global light duty passenger car demand for fuel will peak in 2020 at 23 million barrels a day of oil equivalent. By contrast, the ExxonMobil Outlook anticipates energy demand in commercial transport – mainly oil – will expand by 70% between now and 2040, with global economic expansion, supported by growth in China and India. Key growth markets will see demand expansion of 3 million b/d of oil equivalent for heavy duty vehicles, while global oil demand from aviation, marine and train could rise by 7 million b/d of oil equivalent over the same time frame.

Many uncertainties remain as the impact of new technologies such as drones, autonomous vehicles and digital mobility services are hard to assess and could widen oil use or dampen oil use, depending on how such technologies are applied. Urbanization also remains a wild card since on the one hand greater wealth creation might encourage car ownership and commercial transportation demand, as calculated by ExxonMobil and other baseline forecasts, while preliminary studies on urban density and congestion hint that a saturation level for demand is also a possibility. Energy use behaviour patterns of millennial generation populations have also been difficult to forecast using traditional methods.

Shell scenario

Shell's scenarios team has considered the pathways to achieve a world with net-zero carbon emissions by the end of the century under a future population of 10 billion. To achieve a net-zero emissions world, Shell believes a larger deployment of hydrogen for transport, storing energy and thermal fuel for furnaces will be needed. Shell predicts electricity will become the most "prominent" energy carrier, growing from one-fifth of energy consumed by end-users to at least half. Energy efficiency will need to grow exponentially, through lighter, more fuel efficient cars, advanced lighting, improved industrial processes and intelligent design and recycling. Industrial, agricultural and urban development practices and consumer behaviour will need to undergo major changes driven by policies that will shape, incentivize and mandate efficiency and lower energy intensity via placing a value on avoiding emissions and full removal of distorting subsidies.

Strategic Implications

If industry and markets become more confident in the concept of a peaking, or at least a flattening, of oil demand growth, a change in investment and production strategies is likely to emerge, both among private companies and within OPEC itself. That means even if oil markets tighten in the next year or two, players will have to think twice about delaying the development and production of reserves, lest they disadvantage themselves over the longer time horizon. Only parties that have no choice (lack of finance,

geopolitical barriers, inability to organize investment due to bureaucratic failures, etc.) will be left out of the calculation whether to consider the remaining “carbon budget” for global oil production in deciding how much and when to invest to monetize existing reserve holdings. Companies will also have to consider when it no longer makes sense to continue exploration for new resources in high cost, long lead time environments as countries with large, low cost reserves more aggressively pursue a market share-oriented strategy for their remaining oil and gas assets.

In this possible environment, to continue to attract investors and capital, the oil and gas industry as a whole must develop a value proposition that is consistent with its core production not growing as overall production growth may not be possible for all players. To deliver bottom line value growth with stable top line production, standardization, repetition, low cost solutions and manufacturing processes will probably play a key role in reducing costs and increasing margins. This will partly be driven by consolidation in the industry, and partly by competitive pressures and cooperation between the industry and its suppliers. This is a fundamental change for an industry geared towards tailor-made solutions to seek competitive advantage.

To balance cost challenges against the possible need for new reserves, a leaner and more efficient industry is required both in execution and operation. Companies will need to be prepared to deliver significant volumes of oil and gas at competitive returns, even if prices remain low and carbon externalities are priced more accurately. The industry will undergo a new technical revolution, with significantly higher levels of artificial intelligence and automation and remote operation and management. BP estimates conservatively in its Technology Outlook 2015 that improvements in subsurface imaging, drilling and completions, and use of digital technologies could contribute to a further 25% reduction in the cost of producing oil and gas by 2050. The new leaner environment will impact the supplier industry, including local content in host nations, and adversely affect national revenues achievable from the oil sector.

To demonstrate it can maintain the value creation proposition for investors in the face of growing uncertainties, industry will need to embrace strategies that can create value under any scenario, including shortening project cycle times, minimizing product losses, including methane leakage, and increasing recycling and reuse of inputs such as water, heat and steel. Already, leading companies are moving in this direction. Such strategies align industry more closely with technical solutions that will be attractive to society as a whole.

The more challenging environment for oil and gas investment increases the stakes for addressing above ground risks that prevent or delay resource development. Even with more stringent climate policies, oil will remain the dominant fuel for transportation for the next two to three decades. And yet, oil and gas industries are often met with

sharp resistance around the world in many communities that have experienced negative environmental, social and geopolitical consequences from oil and gas exploration and development. Oil and gas companies have set expectations among their stakeholders that they can operate without negative environmental impacts, but in many cases, actual performance has fallen short of these expectations.

The negative image of the oil and gas industry adds to existing challenges for the industry to raise capital from institutional investors who can often find the business highly speculative and risky. Consumers are also questioning whether oil and gas will remain a reliable fuel source and desire a transition to cleaner sources of energy. Companies that ignore these challenges run the risk that it will be their balance sheet assets, and not competing oil reserve assets, that get stranded in the long run. By addressing these risks systematically, the industry would be able to ensure that markets value and finance oil and gas in an orderly transition to reflect changing demand outlooks, unlike coal mining which is suffering from overcapacity and a sudden decapitalization out of alignment with intermediate demand in contrast to a longer term negative outlook. For oil and gas leadership, failure to address above ground risks will run higher competitive risks going forward as delays will be critical to ultimate resource development, which needs to be planned in a time scale when oil demand is still stable and robust.

Eventually, players who remain competitive in the oil and gas industry will have to consider whether it can be more profitable to shareholders to develop profitable low-carbon sources of energy as supplement and ultimately replacements for oil and gas revenue sources, especially to maintain market share in the electricity sector. This will require a change in the oil and gas industry investors' mindset. To develop this second leg of the oil and gas industry's activities, the oil and gas industry may find new opportunities by addressing the technological challenges associated with the different parts of the renewable space, as well as how one can develop efficient combinations of large-scale energy storage and transportation solutions in a world with a lot of variable renewable electricity. To the extent that the oil and gas industry is able to establish efficient combinations of storage-based fossil fuel sources, it can simultaneously protect the value of its oil and gas reserves while also improving the profitability of renewable electricity.

Furthermore, it is necessary to engage in a dialogue with regulators on what could be efficient framework conditions for stable and reliable electricity supply. Capacity payments, cost-sharing mechanisms, revenue modulations to compensate for periods with zero or negative electricity prices, etc., are issues to consider as well as business partnerships for flex-fuel technologies to ease infrastructure transitions. The industry can benefit from partnerships and joint ventures between oil and gas companies and firms from other industries such as electricity, biomass, automotive, mobility and mining companies. To improve resiliency to rising carbon pricing, the oil and gas industry

may want to partner with vehicle manufacturers and other energy using equipment manufacturers to improve the carbon efficiency of end-use energy to allow for lower emissions even when using fossil energy.

Increasingly, oil and gas companies are evaluating how to manage climate change-related risks, including carbon asset risk. CO2 pricing will serve to reward and punish different players in the market according to their carbon efficiency. Shareholders are increasingly favouring companies who are testing their strategies against a fuller range of possible future carbon-constrained scenarios and developing broad strategic alternatives to maximize shareholder value in line with uncertain risks.

Many companies now develop annual GHG price forecasts for company-wide use in long-range planning and evaluation of projects and have increased their disclosure to offer investors and stakeholders additional insights into the processes and procedures used to manage climate-related risks. Transparency on strategic elements of the company's response to carbon pricing resilience and the uncertainties facing long-term oil demand will contribute to improving the industry's attractiveness with customers and stakeholders, in addition to promoting orderly adoption of policies that will ensure a smooth transition in the face of policies promoting a lower carbon future.

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