

Jaap Kalkman, Walter Pfeiffer, Sergio Pereira

Are we running out of oil?

Roland Berger Turkey, Middle East & Africa

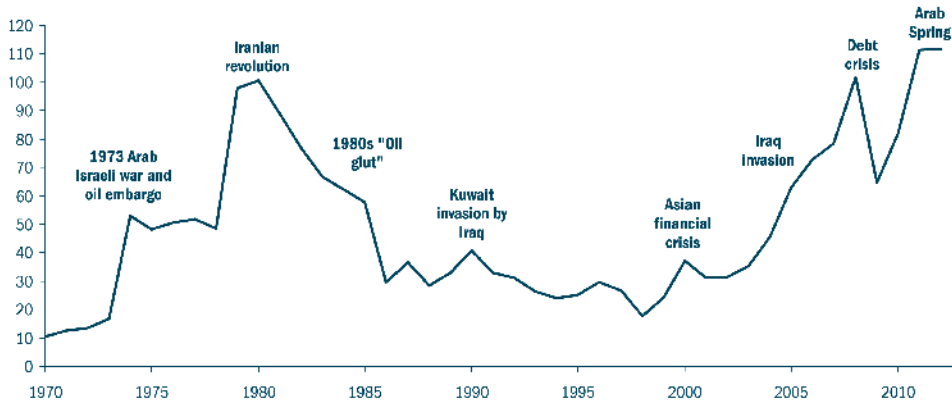


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INTRODUCTION

Three of the ten most valuable companies in the world belong to the oil industry, making it one of the largest industries on earth. Within this massive industry, oil price is considered to be the most important indicator of the direction of industry growth and its global impact. The price has varied considerably over the years and is heavily influenced by global economic and political events including wars and financial crises, which have had an immediate impact on oil price. However, beyond these individual events are long term factors which determine oil prices over decades such as availability of reserves, technology, cost of production and the evolution of demand for oil.

FIGURE 1: EVOLUTION OF CRUDE OIL PRICE [2011 USD prices]



Source: BP Statistical Review of World Energy 2012

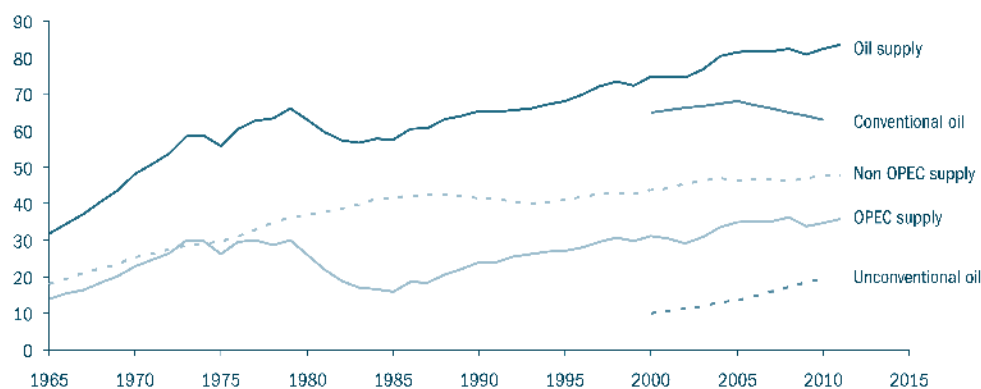
To understand these long term factors, it is essential to study the building blocks of the oil industry: supply and demand. It is the variations (or the anticipated variations) of these which ultimately influence oil price. This report discusses oil supply and demand trends and the impact they are expected to have on oil prices by answering three key questions:

1. Will the world run short of oil?
2. Will demand remain flat in the long run?
3. Can oil prices drop below USD 70 per barrel for a sustainable period?

WILL THE WORLD RUN SHORT OF OIL?

Oil is the most important source of energy we have, accounting for over 33% of total energy consumption, more than any other source. The critical nature of oil provokes questions on how long it can last and what can be done to sustain supply. Production of oil has increased significantly over the last four decades to meet rising demand. However, the source of this has evolved - production from conventional oil sources has been gradually declining in recent years while improved extraction from unconventional sources and increased production by non OPEC countries have more than compensated for this fall.

FIGURE 2: OIL SUPPLY [m bpd]



Source: BP Statistical Review of World Energy 2012

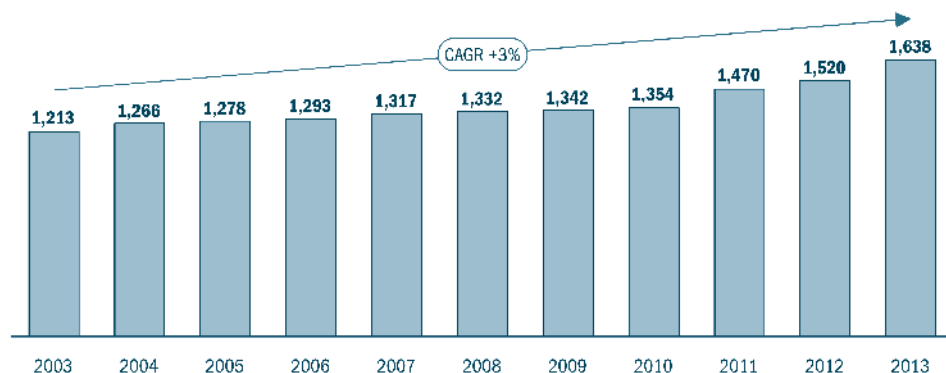
In this evolving production landscape, to evaluate the possibility of the world running out of oil, it is crucial to develop an understanding of the main factors driving oil production: accessible oil reserves, technology, political conditions in oil producing countries and oil price.

Accessible oil reserves

The first prerequisite for the production of oil is the availability of reserves from which oil can be extracted in a commercially viable manner. The total amount of such reserves, both conventional and unconventional, has increased at an annual rate of 3% over the last decade with OPEC countries currently accounting for nearly 74% of world reserves. Furthermore, unconventional sources of oil such as shale oil are accounting for an increasingly larger share of accessible reserves.

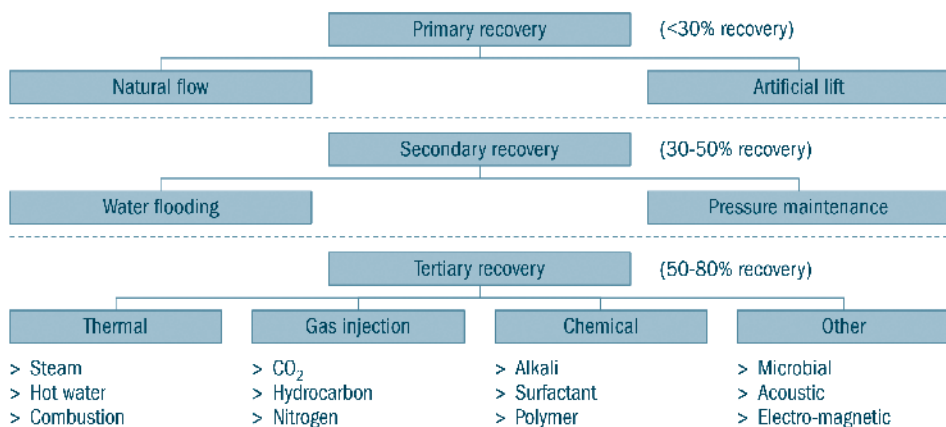
There are various extraction processes used to recover oil from these reserves, each with different associated recovery rates and costs. Secondary and tertiary recovery techniques are more expensive than primary ones and boost the cost of production by USD 20-80 per barrel. While conventional oil can be extracted using primary, secondary or tertiary measures (depending on the reservoir), unconventional sources can only be extracted through tertiary recovery methods, making them relatively more expensive.

FIGURE 3: WORLD PROVEN OIL RESERVES, [bbl bn]



Source: Oil and Gas Journal

FIGURE 4: OVERVIEW OF OIL RECOVERY TECHNIQUES



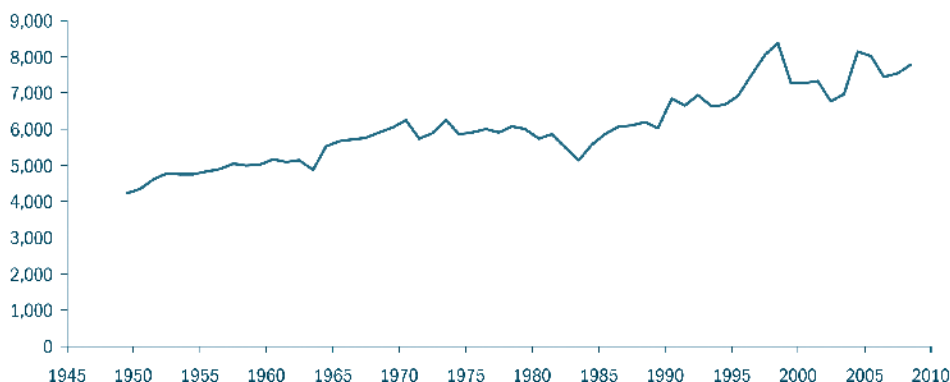
Source: SPE, Oil & Gas Journal, Total, Statoil

Conventional sources of oil

With the gradual depletion of readily available conventional sources, producers have expanded their operations to deeper, further and harsher locations:

- > **Deeper:** Explorers are drilling deeper into the ground in search of oil, clearly indicated by the gradual increase in average depth of exploratory wells across the globe. Development of such deep wells has been encouraged by increasing oil prices and improved technology such as 3D seismic imaging. In 2012, Exxon drilled a 12,376 meter deep well in the Sakhalin Shelf, far east Russia, making it the deepest well in the world.

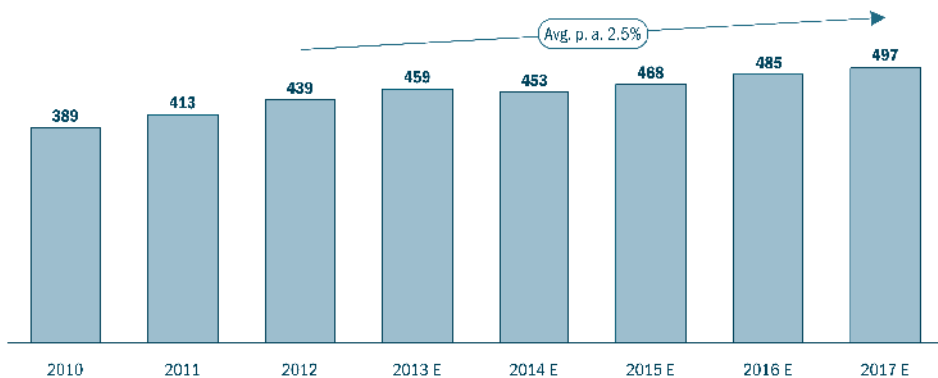
FIGURE 5: U.S. AVERAGE DEPTH OF CRUDE OIL EXPLORATORY WELLS DRILLED [feet per well]



Source: EIA

- > **Further:** Producers are increasingly looking offshore for oil reserves. This is even the case in energy rich countries such as Saudi Arabia where offshore production has taken off in recent years. This phenomenon is reflected in the rising number of offshore rigs in the past few years, and further evidenced by forecasts until 2017. In fact, between 2012 and 2017, the number of offshore rigs is expected to grow at 2.5% per annum, higher than the 1.8% per annum growth expected for onshore rigs.

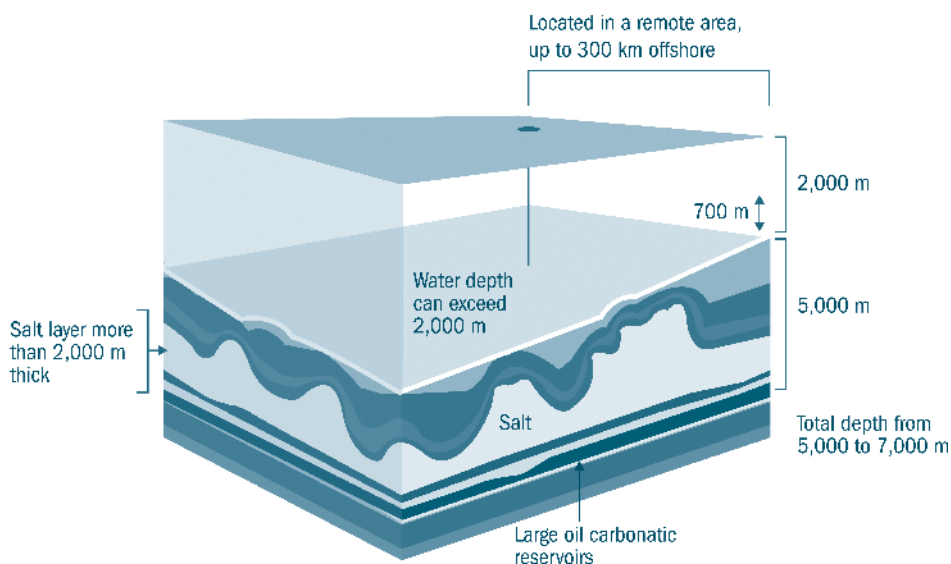
FIGURE 6: GLOBAL OFFSHORE RIG COUNT HISTORICAL AND FORECASTED [# rigs]



Source: Baker Hughes, EIA, Spears

- > **Harsher:** Oil producers are also taking exploration to increasingly harsher environments. This is reflected in ultra deep water rigs and explorations in the Arctic regions. Ultra deep water drilling has led to the drilling of wells beyond 2,000 metres below sea level. For instance, deep water drilling allowed Brazil to discover and extract oil from a huge pre-salt reservoir. Already, over 50 bn barrels of oil have been discovered and more than 11 successful wells have been drilled since 2006. Realizing the role of technology, Brazil has invested over USD 1 bn in R&D for this project alone. Furthermore, the Arctic region, with estimated reserves of over 90 billion barrels of oil, has been attracting attention from oil majors in recent years.

FIGURE 7: DIAGRAMMATIC REPRESENTATION OF DEEP WATER DRILLING IN BRAZIL



Source: Oxford Analytica, Petrobras, Financial Times, Image Halliburton

Overall, the International Energy Agency estimates that there are a total of 2.7 trillion barrels worldwide, around 80 years of current production, of recoverable conventional resources remaining, namely crude oil and natural gas liquids that are likely to be commercially extractable at some point in the future.

Unconventional sources of oil

The advancement of technology has made it both physically possible and economically viable to produce oil from unconventional sources, most noticeably shale oil and heavy oil. This has led to increased explorations for finding unconventional sources, especially in regions where conventional oil reserves have been almost depleted. In fact, unconventional oil has accounted for the majority of total oil reserve increases in recent years.

The size of unconventional recoverable resources actually surpasses that of conventional oil, and is estimated to be around 3.3 trillion barrels, including extra-heavy oil and bitumen from oil sands (accounting for 57% of recoverable unconventional resources), kerogen oil from shale (33%) and light tight oil from shale and other low permeability rocks through hydraulic fracturing (10%). Furthermore, these estimates are regularly revised upwards such as the recent revision by the United States Energy Information Administration which raised the total technically recoverable shale oil reserves in the world from 32 bn barrels to 345 bn barrels following a global assessment of 41 countries.

Shale Oil

Oil and gas from shale has gained significant traction over the past few years given the vast reserves in the USA, Australia, Canada, Poland, Ukraine, Russia, Argentina and Oman. Shale

oil is produced from shale rock through horizontal drilling and multistage fracturing. The USA has pioneered the production of this type of oil and both India and China have initiated pilot projects to explore the same. Typically, the oil recovery rate for shale oil is between 1% and 10%, and the cost of production ranges between USD 50-80 per barrel produced.

FIGURE 8: OVERVIEW OF SHALE OIL IN THE USA

- > Expected budget to develop the Bakken field is estimated at USD 75-100 bn (to reach 3 m bpd)
- > Estimated recoverable reserves: 58 bn barrels
- > Major fields identified, Bakken, Eagle Ford, Wolfcamp, Niobrara, Utica shale etc. (around 17 areas found)



Source: Schlumberger, Zawya, IHS, EIA

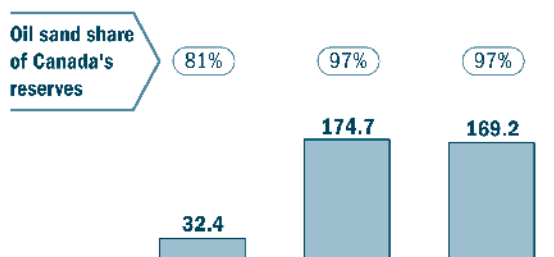
Heavy oil

Heavy oil is crude oil that has high viscosity and usually requires special recovery techniques to allow its flow to surface. Heavy oil is mostly found in Venezuela which accounts for nearly 90% of the estimated 1.9 trillion barrels of global reserves.

Oil sand is another type of heavy oil that is known for having extremely low viscosity and high sulphur content. This oil is extracted using techniques such as steam assisted gravity drainage, cyclic steam simulation and vapour extraction to name just a few. Vast deposits of oil sands have been discovered in Canada, Kazakhstan and Russia, with estimated global reserves being close to 250 billion barrels, 70% of which are in Canada. Depending on the technique used, oil recovery rates typically vary between 5% and 20% and costs between USD 50 and USD 90 per barrel.

FIGURE 9: OVERVIEW OF OIL SANDS RESERVES IN CANADA [bbl bn]

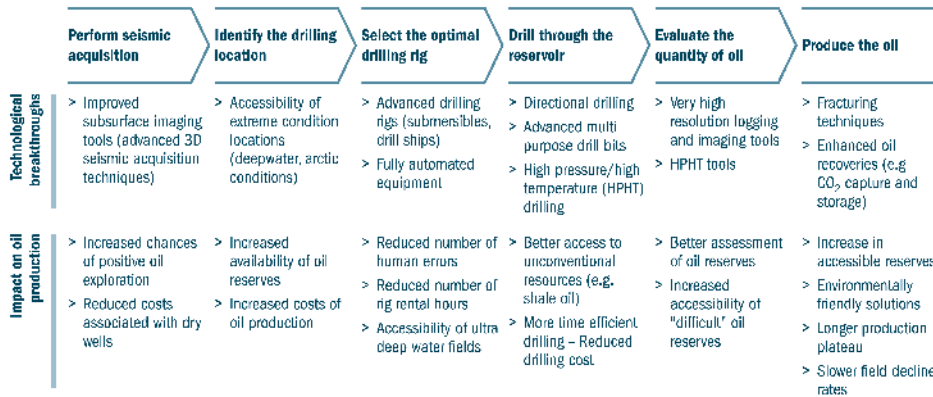
- > Holds 70% of world oil sands reserves
- > Majority of Canada's oil sands exist in Alberta
- > USD 116 bn in oil sands projects are expected between 2008-2017
- > Many production projects in Canada are on hold, pending the deployment of pipelines connecting them to the US



Technology

Improvements in technology have greatly increased oil recovery from 10-40% up to 70% in certain regions. It has played a critical role in both the exploration and production of oil, making it the most important factor in the oil production growth story. Its critical role is illustrated by the fact that technological breakthroughs affect all parts of the upstream oil value chain.

FIGURE 10: ROLE OF TECHNOLOGY IN UPSTREAM OIL VALUE CHAIN

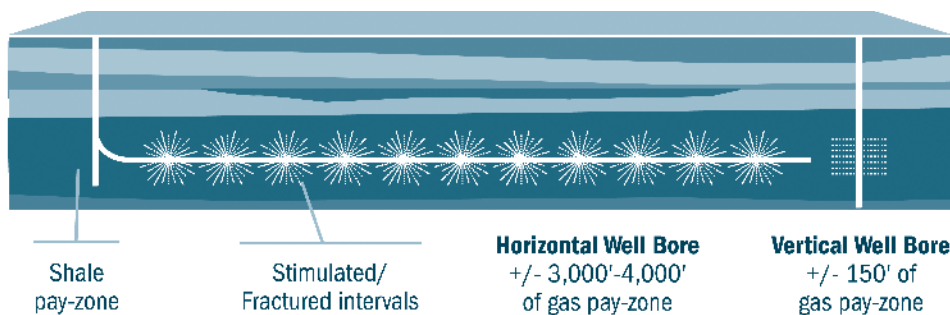


Enhanced Oil Recovery (EOR) techniques use advanced technology to increase oil recovery. However, these techniques, such as injecting CO₂ and polymer flooding, are significantly more expensive than traditional extraction methods, sometimes pushing up the cost of production by as much as USD 80 per barrel. However, recent breakthroughs in EOR technology such as microbial injection promise to offer relatively low cost recovery, i.e. USD 6-10 per incremental barrel vs. the typical cost of USD 10-15 for traditional EOR techniques.

Besides making oil more accessible through techniques such as deep water drilling and hydraulic fracturing, technology also plays a key role in the cost dynamics of the oil industry. The primary goal of technological advancement is an increase in drilling and production efficiency while meeting HSE standards. These advancements are usually associated with very high upfront costs. However, major market participants in the oil industry are willing to bear these large investments because of the expected long term added value and potential future savings.

This effect is clearly illustrated in the case of horizontal and multilateral wells, technological breakthroughs which are significantly more expensive than vertical wells – typically nearly four times as expensive. However, one multilateral well can replace up to 32 vertical wells, leading

FIGURE 11: VERTICAL WELLS VS. HORIZONTAL WELLS



Source: WWSORO, NETL, DMR, US Department of Energy

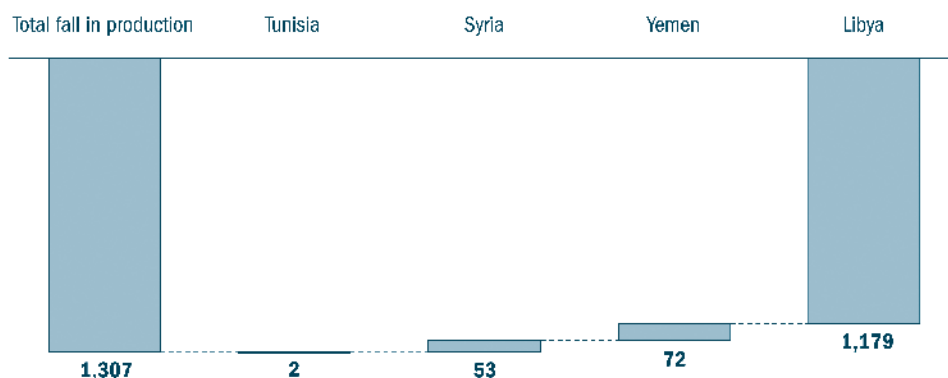
to long term cost savings. Similarly, through-tube rotary drilling results in significant cost and time savings by allowing producers to drill a new well through an existing production tubing of an older well. There are numerous examples of such technological breakthroughs which have led to increased efficiency in the oil production process in the recent past, and it is safe to assume that similar breakthroughs will continue in the future.

Political conditions in oil producing countries

Political stability in major oil producing countries is essential for oil production and is generally brought to light by its absence. The lack of such stability typically has two negative effects on oil production: unsafe operating conditions and decreased investments in production.

Both these effects were observed during the Arab Spring. Production in oil rich nations such as Libya witnessed a massive setback following the political unrest, with a total fall in production of 1.3 million barrels per day between 2010 and 2011. Yet oil markets were relatively unaffected given that increased production from other countries was able to compensate for this shortfall.

FIGURE 12: IMPACT OF THE ARAB SPRING ON OIL PRODUCTION - CHANGE 2010 VS. 2011 ['000 bpd]



Source: BP Statistical Review of World Energy 2012

On the other hand, return to political stability leads to an increase in oil production. This is illustrated in Iraq where relative political stability since the takeover by American security forces has increased total production by over 30%, and led to a six fold increase in oil reserves, facilitated by a significant increase in foreign investments.

While there is no denying that political events such as the Arab Spring have a direct impact on production, there are three key factors which suggest that this effect might not be as prominent in the future:

- > **Diversification of oil production sources:** Increased production from unconventional sources and non-OPEC countries has reduced dependence on a select number of OPEC (oil producing) nations. Therefore, a fall in production from one country due to political instability can be compensated by an increase from the others as illustrated by the increased oil production in Saudi Arabia by nearly 13% in 2011, to compensate for supply loss due to the Arab Spring
- > **Short term effect:** While political instability does inhibit production activities, this impact is typically limited to a short period of time. For instance, while Libyan oil production fell by over 70% during the Arab Spring – from 1.7 million barrels per day in 2010 to 0.5 million in 2011 - it has already recovered to nearly 1.6 million barrels and is expected to reach 1.7 million barrels later this year, all within the span of a little over two years since the Arab Spring
- > **Rising global strategic petroleum reserves:** A 2001 agreement among members of the International Energy Agency mandated all members to maintain stockpiles of oil reserves equivalent to a minimum of 90 days of net imports. However, such reserves have consistently exceeded minimum levels – the US currently has enough reserves to cover 276 days. Therefore, even if there is a short term fall in production, major consumers have the necessary reserves to sustain them

These factors suggest that in the future, political instability, while still a factor, won't be as big an inhibitor to global oil production as it has been in the past.

Oil price

Over the past decade the world has witnessed the beginning of a shift from conventional oil production towards unconventional production, as well as an effort to extract oil from more difficult and expensive resources. This has exerted some pressure from the supply side on oil prices, due to the fact that oil production costs, both to operate current capacity and develop new supply rose sharply, as additional resources became more costly to access.

Given the strong advancement in technology across the oil industry, several new production processes are now viable, commonly known as Enhanced Oil Recovery (EOR) techniques. It is essential to recognize that these techniques are now viable thanks to past investments in developing these technologies, made with the expectation that higher oil prices would provide sufficient return as conventional oil production declined. These expectations have been realized owing to the inability of conventional production to meet growing demand, leading to a need for unconventional sources with higher marginal cost. Given the greater reliance on extraction of this expensive unconventional oil, major oil producing companies will continue to invest in further advancement of oil production technology, given the clear expectation that high oil prices will remain and render investments profitable.

Moreover, following the Macondo blowout (Deepwater Horizon spill in the Gulf of Mexico), technology is becoming crucial to ensure effective health and safety standards are met while maintaining high production efficiency. This additional increase in cost, particularly when

producing from deep water, needs to be incorporated into the final price.

Unconventional oil production requiring EOR methods such as hydraulic fracturing and chemical injections into ground reservoirs (often affecting ground water) have provoked environmental and safety concerns across the world. The impact of unconventional oil derives from the processes used to extract oil and the location. For instance, in Canada the production of synthetic crude oil from oil sands results in emissions ranging from 62 to 176 kg CO₂ eq/bbl of synthetic crude oil (including upgrade), which is significantly higher than the 27–58 kg CO₂ eq/bbl of crude for conventional oil production. On the other hand, deep water incidents, particularly the Macondo incident in the Gulf of Mexico and its effect on the environment, have put drilling activities on the priority list of politicians and environmentalists. These concerns along with wide ranging petitions from environmentalists, have pressurized oil producing nations to introduce legislation to control production from unconventional sources.

FIGURE 13: EXAMPLES OF REGULATIONS ON OIL PRODUCTION TECHNIQUES

Ban on hydraulic fracturing



- > An extraction process, commonly used to produce shale oil, in which water, sand and chemicals are pumped into cracks in oil rich rocks
- > Widespread environmental concerns on a range of issues including ground water contamination by chemicals and air pollution by release of gases trapped in the rocks
- > A number of regions worldwide have banned this process including countries such as France and Bulgaria and areas within countries such as Vermont State in the USA — several others including Germany are considering bans

Stringent standards for deep water drilling



- > The Gulf of Mexico spill in 2010 prompted governments to impose more stringent standards and increase surveillance of deep water drilling operations
- > New regulations include requirements such as certifications for well sturdiness, documentation on condition of the blow out protectors and a minimum of one ROV per rig
- > Increased government surveillance is illustrated by the shutdown of deep water drilling in the Gulf of Mexico following the discovery of faulty bolts in safety equipment in February. It led to weeks of downtime which cost producers millions of dollars

Source: news.cnet.com

Besides these, there are country-specific emission standards for the oil and gas industry which also influence both conventional and unconventional oil production. For instance, the United States Energy Protection Agency is introducing new standards with which it aims to reduce volatile organic compound emissions from nearly 11,000 new hydraulically fractured oil and gas wells every year.

However, there are two sides to the regulations story with several countries easing or planning to ease production regulations in recent years. For instance, several regions have lifted bans on hydraulic fracturing to capture the shale oil and gas revenues it leads to. The United Kingdom suspended the process in May 2011, but lifted the ban in December 2012 with the introduction of new regulations such as mandatory seismic surveys before drilling. Other countries have opted for partial lifting of bans such as the Bulgarian government which initially banned all hydraulic fracturing but now permits the process for extraction of natural gas.

Ultimately, government mandates towards energy security and economic development ensure that oil producing countries are unlikely to introduce regulations which significantly reduce their production.

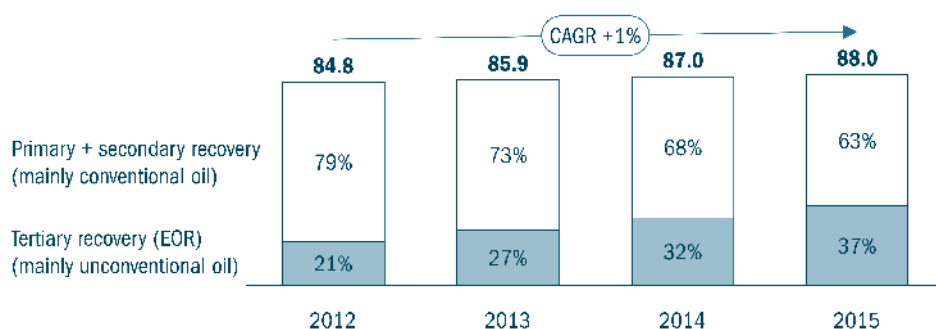
Oil supply will remain strong

The dynamics of oil production represent an ever evolving landscape of increasing explorations, new technologies, political influences and fluctuating prices. A thorough analysis of these factors in the context of answering the critical question "Will the world run short of oil?" provides the following key insights:

- > Accessible oil reserves have increased at an annual rate of 3% over the last decade thanks to increased explorations in deeper, further and harsher locations and technological breakthroughs, such as horizontal drilling which improve accessibility of oil reserves and efficiency of their extraction. Essentially, we're not running out of oil, we're discovering more reserves every year
- > Global oil production has increased at an annual rate of over 1% in the last decade, driven largely by increased production from non-OPEC countries and unconventional sources
- > Unconventional sources of oil such as shale oil and oil sands are expected to drive supply in the future as already seen in the USA, Canada and Venezuela
- > The impact of political instability will be limited in the future due to an increasing number of sources and the short term effect of political events
- > Oil prices will play a critical role in the future by influencing investments in unconventional sources of oil and determining total accessible reserves
- > Regulations against new methods of production such as hydraulic fracturing and deep water drilling will increase but are not expected to hinder overall production significantly

Taking these factors into account, production will most likely continue growing as forecasted, with an increasing share of this production coming from tertiary recovery methods and unconventional sources. Such growth and potential implies that it is highly unlikely that the world will run short of oil anywhere in the near future. In fact, with an expected annual demand growth of 1%, the current proven reserves of 1.6 trillion barrels by themselves are sufficient to meet demand for well over 40 years, not taking into account the expected increase in global oil reserves.

FIGURE 14: OIL PRODUCTION FORECAST [m bpd]

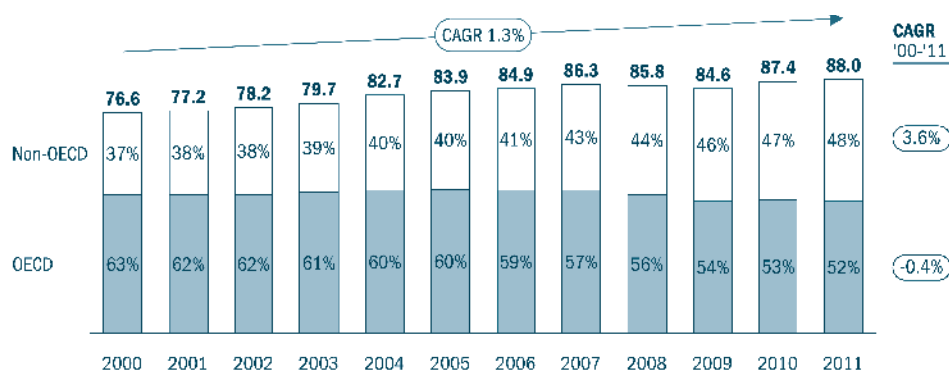


Source: OPEC, EIA, SBI Energy

WILL DEMAND REMAIN FLAT IN THE LONG RUN?

Crude oil today is used to make a variety of products from gasoline to plastics. Global consumption has been rising at an annual rate of 1.3% over the last decade, bolstered by a tremendous increase in consumption by non-OECD countries which has more than compensated for a fall in consumption by OECD countries. In this environment, it is crucial for all oil industry stakeholders to evaluate how long this growth story can last and thereby attempt to answer the question "Will demand remain flat in the long term?"

FIGURE 15: EVOLUTION OF GLOBAL OIL DEMAND [m bpd]



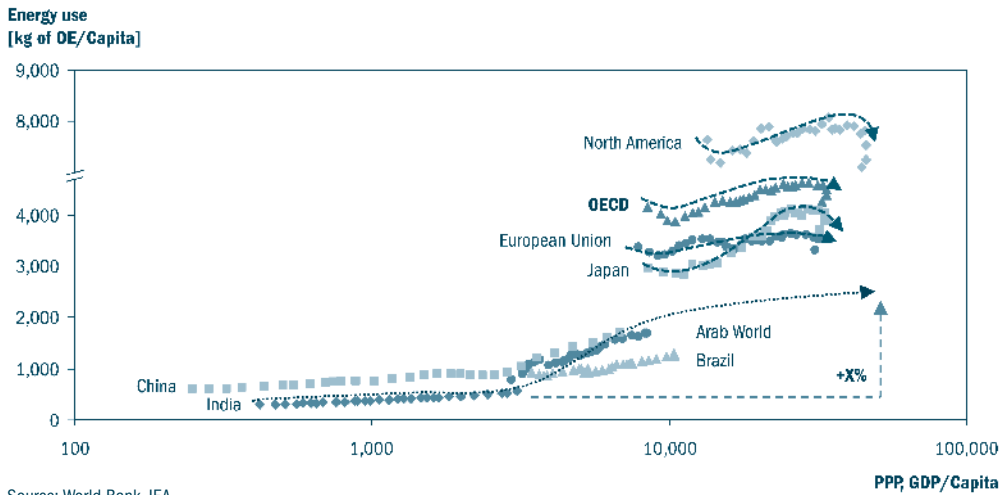
Source: BP Statistical Review of World Energy 2012

Economic growth – Key driver of demand

The primary driver for oil demand is economic development which is very closely related to energy consumption. Therefore, by comparing the energy use per capita, aka "energy intensity", and GDP per capita over the last three decades in developed and developing nations, we can derive a model for oil consumption going forward. Energy intensity in industrialized countries and developed economies reflects a certain "S curve" trend – their consumption per capita increased rapidly with economic growth and is now on a downward trend with deployment of energy efficient technology and increasing environmental concerns. Emerging markets, on the other hand are at the beginning of this curve and are providing plenty of upward potential for demand growth in line with their GDP development. This explains why fast growing non-OECD countries are rapidly increasing their share of global oil demand as their GDP grows.

Clearly, the relationship between GDP and oil consumption has evolved over time. The amount of oil needed to create a unit of GDP has gradually fallen, indicating that as nations develop, they become more efficient in the way they use oil to create an additional unit of GDP. Moreover, developing economies are more efficient in their oil consumption when compared to developed economies' at equivalent GDP/capita levels, indicating a transfer of knowledge over time and across geographies. Therefore, while GDP growth will still lead to an increase in oil consumption in the future, its effect won't be as large as it was in the past.

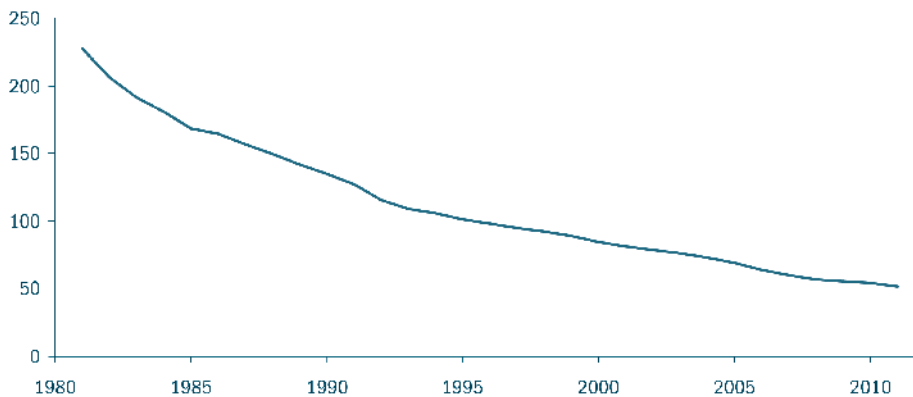
FIGURE 16: EVOLUTION OF ENERGY CONSUMPTION AND PER CAPITA GDP DEVELOPMENT, 1980-2010



Source: World Bank, IEA

This is also apparent by the higher income elasticity of oil demand in non-OECD countries vis-à-vis OECD countries. In fact, a 1% rise in real GDP increases oil demand by 0.5% in OECD countries over the medium to long run, whereas for non-OECD countries, the oil demand increase is closer to 1%. This is clearly illustrated by the global declining consumption of oil per additional unit of GDP created.

FIGURE 17: OIL CONSUMED FOR EVERY CURRENT USD OF GDP CREATED ['000 tonnes]

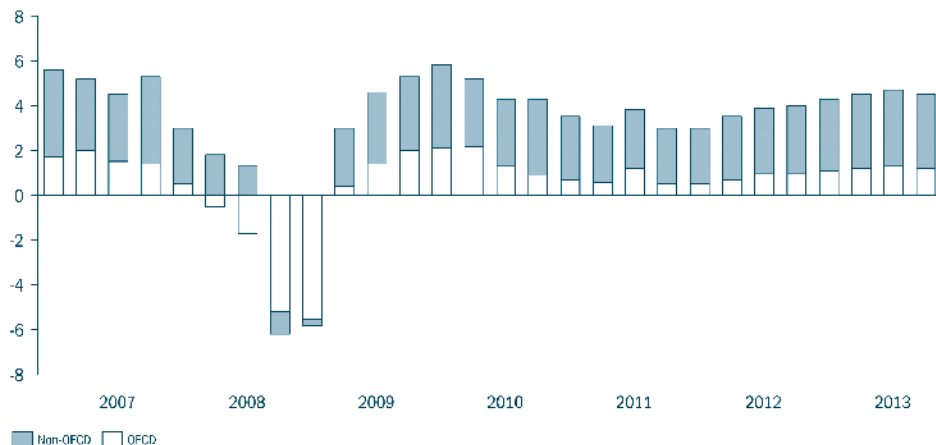


Source: BP Statistical Review of World Energy 2012, IMF

While this does not bode well for oil demand, it is essential to remember that the world economy is recovering from the worst financial crisis since the Great Depression in the 1930s. Hence, significant GDP growth is expected in the future as developed countries exit the ongoing sovereign debt crisis.

Furthermore, one should not forget that GDP/capita is expected to increase substantially in the developing world, which combined with strong population growth will continue to drive oil demand going forward.

FIGURE 18: CONTRIBUTION TO WORLD REAL GDP GROWTH [%]

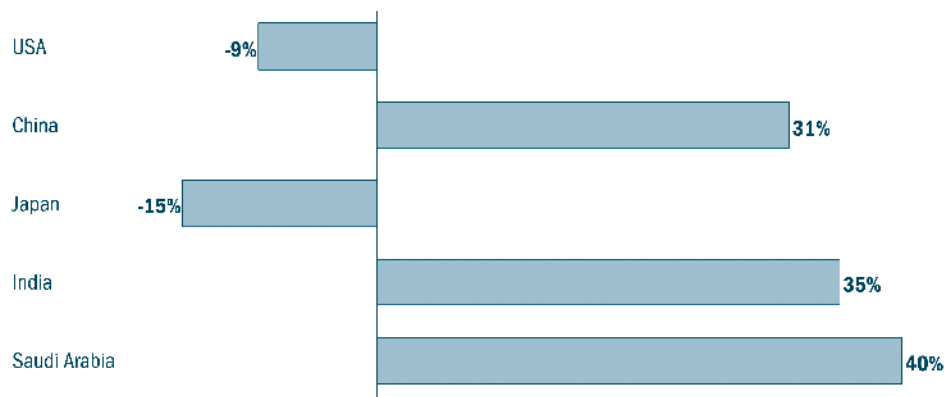


Source: OECD Economic Outlook

Outlook for major consumers

The top five oil consuming nations together accounted for over 45% of global demand in 2012 with the top consumer, the USA, accounting for a quarter of all demand. However, consumption trends have changed substantially over the past five years, particularly given the ongoing financial crisis. Developed economies, such as the USA and Japan have witnessed a reduction in oil consumption between 2006-11, while China, India and Saudi Arabia, have strongly increased oil consumption. In order to predict how oil demand is going to evolve, it is essential to study the outlook for these individual nations:

FIGURE 19: CHANGE IN OIL CONSUMPTION IN TOP CONSUMERS, 2006-2011



Source: BP Statistical Review of World Energy 2012

United States of America

Despite being the largest consumer of oil, the United States has witnessed a 9% fall in consumption in the past five years thanks to a sluggish economy and increasing energy efficiency. The key demand trends here are:

- + Economic recovery following the financial crisis is expected to boost oil demand. Already, there are several signs – rising housing prices, the DOW index crossing the 15,000 mark and jobless rates being the lowest since the crisis began
- The availability of cheap shale gas, slowing population growth and the rising popularity of electric vehicles are expected to hurt demand in the USA

Overall, economic growth is likely to overpower these challenges, leading to a marginal increase of 2% by 2016

People's Republic of China

China is the second largest consumer of oil in the world, with its remarkable economic growth leading to a 31% increase in demand between 2006 and 2011. The key demand trends here are:

- + China still has a relatively low per capita consumption suggesting enormous upward potential. Furthermore, China's economy managed to grow at over 9% per annum during the financial crisis and is expected to continue growing as global demand for its manufacturing industry rises, post the crisis. In fact, OPEC believes that China could overtake USA as the world's leading importer of oil as soon as 2014
- The Chinese government is investing heavily in renewable energy following growing concerns over pollution in its cities – accounting for 25% of worldwide investments in solar power, 37% of investments in wind power and 47% of investments in all other forms of renewable energy

Thanks to continued economic progress, the Chinese demand for oil is expected to increase by almost 15% to 2016.

Japan

Japan's oil consumption has fallen by over 15% in the last five years, largely due to poor its economic performance during the financial crisis. The key demand trends here are:

- + Following the Fukushima disaster, Japan has stopped production at its 22 nuclear reactors and is meeting the shortfall through the import of additional fossil fuels which is likely to boost oil consumption in the short term
- Japan is considered to be one of the pioneers of renewable energy, accounting for over 24% of the world's electric vehicles, second only to the United States. Furthermore, Japan's population is declining which will contribute to a fall in consumption. In fact, the Japanese population is expected to fall by as much as 20 million between now and 2040

Increasing reliance on renewable energy and a falling population imply that Japanese demand for oil is expected to fall by nearly 7% until 2016

India

The Indian economy has been able to maintain its economic growth through the financial crisis ensuring that oil demand grew by over 35% in the last five years. The key demand trends here are:

- + The economy is expected to continue growing thanks to reforms aimed at opening up the economy further. Furthermore, the population is growing at a rapid pace and India is expected to overtake China as the world's most populous country by 2025. Car ownership is also on the rise thanks to technological innovations which produce affordable cars such as the "Tata Nano"
- Reduction of fuel subsidies in India could serve as a roadblock to demand growth. The Indian government cut subsidies for petroleum products by as much 32% for 2013. Furthermore, the government is also shifting towards alternative energy forms through the usage of CNG in public transportation and the launch of several nuclear reactors

Despite the challenges, oil consumption in India is expected to grow by as much as 20% to reach 4.2 million barrels per day by 2016.

Kingdom of Saudi Arabia

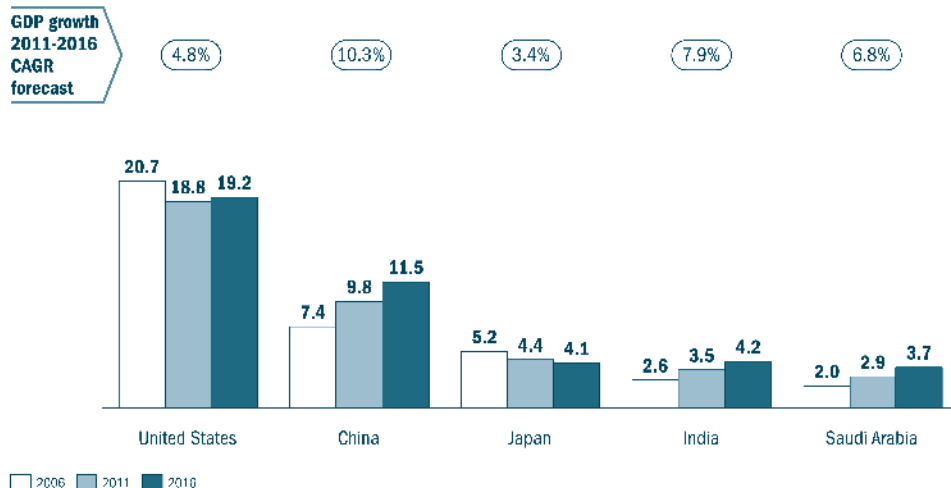
The Kingdom of Saudi Arabia has witnessed the highest growth among the top 5 consumers – a 40% growth in oil consumption between 2006 and 2011. The key demand trends here are:

- + The government continues to heavily subsidize fuel prices, making it the second biggest fossil fuel subsidizer after Iran. Saudi Arabia is also highly energy inefficient – requiring nearly 1.7 times the world average to produce a unit of GDP. This implies that as its GDP grows, its oil consumption will rise much faster than other countries. Furthermore, it has a rapidly growing population, averaging over 3% growth in the last five years. This high growth has led some to believe that Saudi Arabia could become a net importer of oil in the near future
- The government has recognized the oil consumption challenge and has invested in alternative energy forms, particularly nuclear energy with a number of nuclear reactors expected to be operational by 2020

Overall, Saudi Arabia is expected to retain its high growth momentum resulting in a 21% increase in consumption by 2016 to reach 3.7 million barrels per day.

Therefore, all the top five consuming nations, except Japan, are expected to see growth in demand in the short to medium term owing largely to economic growth following recovery from the sovereign debt crisis.

FIGURE 20: TOP OIL CONSUMING COUNTRIES IN THE WORLD [m bpd]

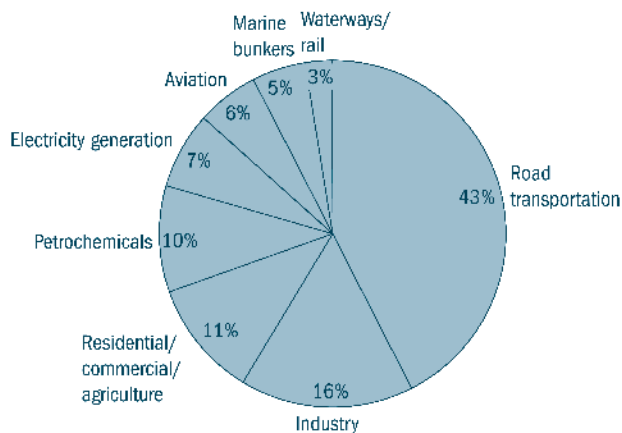


Source: BP Statistical Review of World Energy 2012, IMF WEO 2013, Roland Berger analysis

Outlook for key sectors

Oil is a key input for a variety of sectors and is used for transportation, electricity generation, plastic & fertilizer manufacturing, iron & steel production, along with many other applications. To understand how the development of these sectors will impact the oil industry, it is important to focus on three predominant sectors which account for 69% of total oil demand: road transportation, industry and petrochemicals.

FIGURE 21: GLOBAL OIL CONSUMPTION BY SECTOR



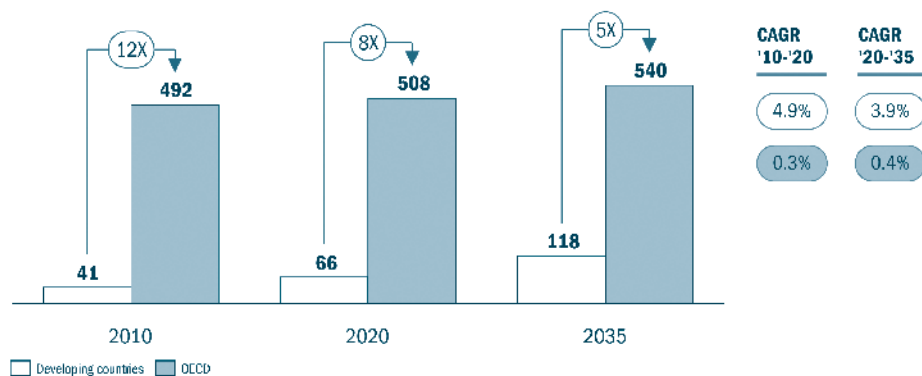
Source: OECD

Road transportation

Road transportation is the single largest consumer of oil, accounting for over two-fifths of total demand. The key driver of oil demand in this sector is the number of vehicles on the road. Economically developed countries have significantly higher per capita car ownership as compared to developing countries. Yet in the recent past, rising income levels and better

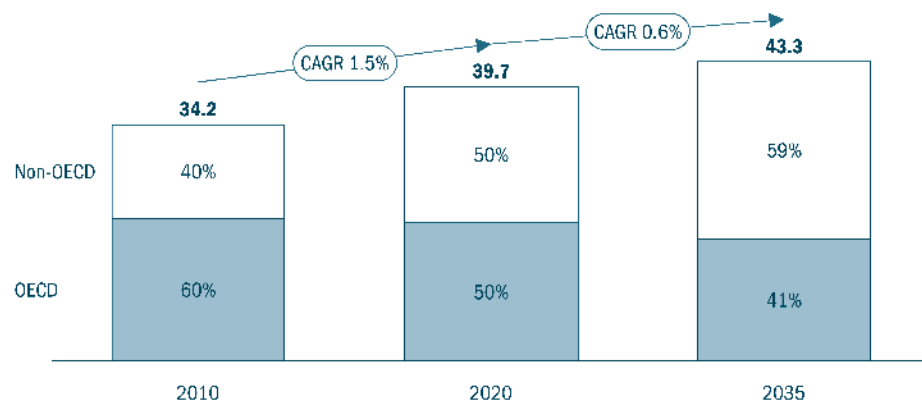
technology, which leads to cheaper vehicles, have resulted in a dramatic increase in car ownership in developing nations. This trend is expected to continue in the long run, leading to robust growth in oil consumption in the road transportation sector.

FIGURE 22: CAR OWNERSHIP PER CAPITA IN OECD VS. DEVELOPING COUNTRIES
[vehicles '000 people]







A counter argument is the fact that technological advancements in the auto industry are improving oil consumption rates, with lighter vehicles, more efficient engines and a complete replacement of the combustion engine with electric and CNG engines. While the widespread adoption of these technologies is predominantly in developed economies, the long term impact it may have on the market remains unclear, but will undoubtedly curtail oil demand in this sector.

FIGURE 23: FORECAST OF OIL CONSUMPTION IN ROAD TRANSPORTATION [m bpd]







Rise of electric vehicles

Electric vehicles (EV) are potential game changers in transportation, a sector which represents the largest share of oil consumption. Global electric vehicle sales have more than doubled in 2012 – approximately 113,000 units vs. 45,000 units in 2011 with a majority of electric vehicles in OECD countries. This rapid growth can be attributed to four key drivers:

Wider charging network	More efficient batteries	Government support	Greater choice of electric cars
			
<ul style="list-style-type: none"> > Around 50,000 charging points globally – >15,000 in the USA > Estonia launched the first nationwide fast charging network in 2013 > Car manufacturers such as Nissan also building networks 	<ul style="list-style-type: none"> > The cost of electric car batteries has gone down by over 50% in the last four years while also bringing down charging times and increasing ranges 	<ul style="list-style-type: none"> > Promotion through investments in infrastructure and R&D along with financial incentives such as subsidies, development grants and tax cuts 	<ul style="list-style-type: none"> > The global top selling electric cars are the Nissan Leaf and the Mitsubishi i-MiEV > Increase in competition leads to investments, customer awareness and lower prices

Source: IEA

Owing to these drivers, electric vehicles are expected to continue their rapid growth in the future. However, at the moment there are four key challenges to EV adoption:

Long charging times	Low ranges	High prices	Safety concerns
			
<p>Electric cars can take a very long time to recharge – from half an hour to half a day depending on the battery and charging unit</p>	<p>The popular Nissan Leaf on average runs just 75 miles on a full charge which is still less than a fifth of the range of a comparable gasoline car</p>	<p>High battery costs mean that electric vehicles are more expensive to purchase than comparable regular cars – even with government subsidies</p>	<p>High profile fire accidents in the USA and China along with product recalls have raised concerns about the safety of electric cars</p>

Source: EPA

If electric car manufacturers can overcome these challenges whilst matching the performance of regular gasoline powered vehicles, they could represent a significant threat to oil demand. However, even once these challenges are overcome, there are significant infrastructure and legacy constraints that could delay the widespread adoption into the distant future.

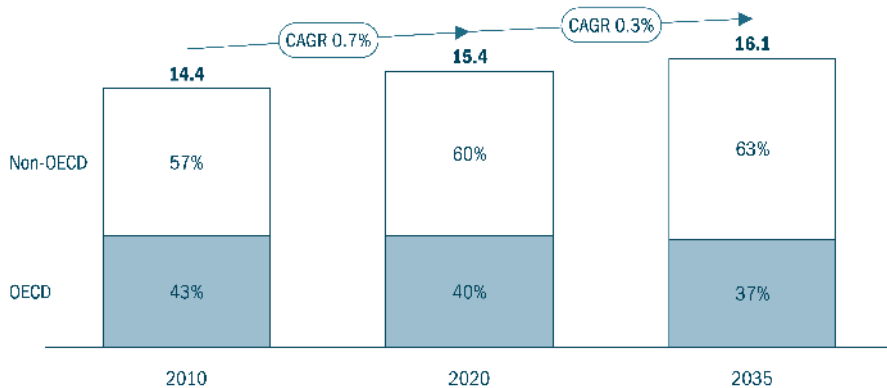
Industry

Oil demand in the industrial sector represents a diverse group of activities including manufacturing, mining, cement, construction, iron and steel. Demand for oil in the industrial sector varies significantly across geographical regions, with non-OECD countries already consuming more oil than OECD countries in this sector. This is largely due to the global shift of manufacturing from developed economies to developing economies, evidenced by the fact that energy intensive industries, such as steel, iron and cement, are becoming more prevalent in developing regions while economic activity is shifting increasingly towards service sectors in developed economies. For instance, while industries account for over 45% of GDP in China, they account for less than 20% in the USA.

This is further reinforced by a trend of increased oil utilization in the industrial sector in developing countries and an opposing trend in developed economies, where alternative sources are increasingly being used. Many mature markets have shifted from oil to natural gas due to cost benefits, as well as the ability to manage supply risks more effectively.

Therefore, strong oil demand growth is expected in developing parts of Asia and other emerging markets, in line with increased industrial activity. Hence, oil use in this sector is expected to continue growing in the future, albeit at a slower rate

FIGURE 24: FORECAST OF OIL CONSUMPTION IN INDUSTRY [m bpd]



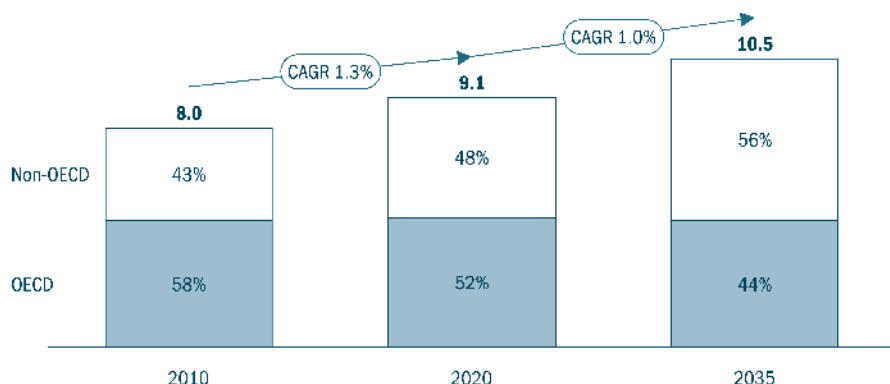
Source: OECD, OPEC

Petrochemicals

Oil use in the petrochemical sector accounts for 10% of total oil use – both as feedstock and as energy to transform feedstock into final goods. Oil demand growth from the petrochemicals sector will be coming mainly from Asia and the Middle East in the next two decades, in line with significant capacity additions in these regions. For instance, world capacity for ethylene, a key primary petrochemical, is set to increase markedly through to 2015 as both China and the Middle East deliver 31 million tons in new capacity. Increasing substitution of materials by plastics in industries like automotive will lead to higher demand for engineered plastics.

Furthermore, per capita consumption of plastics is significantly higher in developed countries as compared to emerging economies – 90 kg of plastic consumed per person per annum in the United States compared to just 5 kg in India. This hints towards rapid growth in plastic consumption in emerging economies which will further boost oil demand for petrochemicals.

FIGURE 25: FORECAST OF OIL CONSUMPTION IN PETROCHEMICALS [m bpd/day]



Source: OECD, OPEC

Oil demand inhibitors

The previous analysis clearly indicates that oil demand is set to continue growing. However, there are external factors that could inhibit this growth. In particular, government regulations and technology could pose a threat to oil's dominance in the energy sector.

Regulations

Government regulations on a variety of issues, from biofuel usage to emission reduction can influence oil demand. This impact can be direct or indirect depending on how it influences consumer behaviour.

FIGURE 26: REAL BIOFUEL BLENDING TARGETS (T) AND MANDATES (M) IN SELECTED REGIONS

Country/region	Current	Current status	Future
Argentina	E5, B7	M	n.a.
Australia ¹⁾	E4, B2	M	E5-6 (2011), B5
Bolivia	E10, B2.5	T	B20 (2015)
Brazil	E20-25, B5	M	n.a.
Canada ¹⁾	E5-8.5, B2-3	M	B2 (2012)
Chile	E5, B5	T	n.a.
China ¹⁾	E10	M	n.a.
Colombia	E10, B10	M	B20 (2012)
European Union ²⁾	B5, 7.5 *	T	10% renewable in transport
India	E5	M	E20, B20 (2017)
Indonesia	E3, B2.5	M	E15, B20 (2025)
Japan	500 ml/y (oil equivalent)	T	800 Ml/y (2018)
Korea	B2	M	B2.5 (2011); B3 (2012)
Norway	3.5% biofuels	M	5% (2011) poss. alignment with EU
Peru	E7.8, B2	M	B5 (2011)
Thailand	B3	M	9 ml/d ethanol (2017), B5 (2011)
Uruguay	B2	M	E5 (2015), B5 (2012)
United States	48 bn l	M	136 bn l (2022)

- > Support policies for biofuels are driven by energy security concerns, coupled with the desire to sustain the agricultural sector, revitalize the rural economy and, more recently, to reduce CO₂ emissions in the transport sector
- > One of the most common support measures is a blending mandate – which defines the proportion of biofuel that must be used in (road) transport fuel – often combined with other measures such as tax incentives
- > More than 50 countries, including several non-OECD countries, have adopted blending targets or mandates, and several more have announced biofuel quotas for future years

B= Biodiesel (B2= 2% biodiesel blend) F= Ethanol (F2= 2% ethanol blend)
 1) Only in certain provinces 2) Currently each member state has set up different T and M

Source: IEA, Deutsche Bank

Direct impact: Regulations which are put in place with the intention of controlling oil consumption have a direct impact. These are typically legislated to achieve energy security or emission reduction targets. There are two prime examples of such measures:

- > Biofuel blending mandates: These define the proportion of biofuel that must be used in road transport fuel. More than 50 countries have adopted blending targets or mandates and several more have announced biofuel quotas for future years
- > Reduction of fuel subsidies: Recent initiatives by several countries such as India, Nigeria, Jordan, etc. to remove fuel subsidies have led to an increase in fuel prices which in the long term is expected to lead to a significant reduction in oil demand.

There are significant societal pressures for governments to curb oil consumption, particularly regarding its negative impact on the environment and high CO₂ emissions. However, while governments have many tools at their disposal to curb oil consumption, specific actions will take into account the impact these regulations may have on overall economic development.

Indirect impact: There are other legislations which were not intended to reduce oil consumption, but indirectly impact its demand, such as:

- > Incentives for greener technology: Legislation and incentives to encourage the development of green technology are already prevalent in developed economies. Further action to support the clean tech sector could lead to a fall in demand, if the incentives are successfully launched
- > Public transport: Governments promote the use of public transport for the dual purpose of reducing oil dependency and easing road traffic congestion. They do so through a variety of measures such as subsidizing public transportation, spreading awareness on environmental benefits of public transport and indirect methods such as high taxes on cars and expensive fees at road tolls and car parking

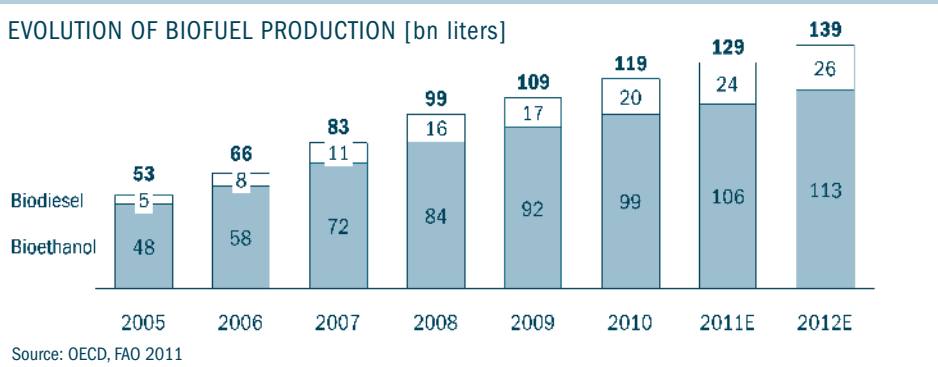
While there have been an increasing number of regulations attempting to inhibit the consumption of oil, these are largely restricted to developed economies. This has been achieved either through the legislation of biofuel blending mandates or the promotion of more environmentally friendly transportation methods and "greener" energies. In addition, in certain developing regions, the reduction of fuel subsidies could be a game changing regulation, reducing oil demand substantially in the long run. Yet any fall in demand due to the price increase is expected to be compensated by the rapid economic development these emerging countries are currently witnessing.

Technology

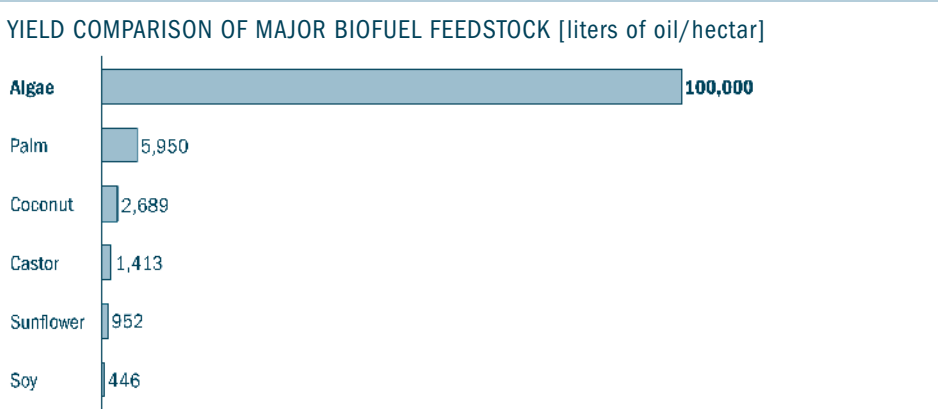
While technology is an enabler of oil production, it typically serves as an inhibitor on the demand side. Essentially, it hinders demand for oil in two forms: efficiency and alternative energy forms.

Algae based biofuel revolution

The most common forms of biofuel are bioethanol and biodiesel, which are primarily used in road transportation as a substitute for petroleum fuels such as gasoline and diesel. Biofuel production has seen rapid increase in recent years, which is largely due to favourable government regulations with blending mandates requiring a minimum level of biofuel usage in road transportation.



Biofuel can be produced from a variety of feedstock: food crops, cellulosic biomass and algae biomass, which are also referred to as third generation feedstock. The production of biofuels from algae is considered to be a game changer owing to the extremely high yield compared to other feedstock. Other benefits include the ability to grow in harsh conditions, non-arable land and a wide variety of water sources (fresh, brackish, saline and wastewater). It also presents potential environmental benefits with its ability to recycle CO₂ and other nutrient waste streams.



However, cultivation of algae and extraction of the oil is currently expensive –ranging anywhere between USD 0.75/l to more than USD 5.00/l, excluding costs to convert the oil to biofuel. Significant R&D investments are needed to be able to realize commercial production of algae based biofuels. The past few years have seen such investments both from governments, such as the USD 100 m investment from the US Department of Energy in 2009 and from private energy players such as Exxon's USD 600 m investment in algae biofuel research. Several other oil/chemical players such as Chevron, BP and Dow have established strategic partnerships to fund algae research. If these investments lead to a technological breakthrough which results in low cost production of algae biofuels, it could further curtail the demand for crude based oil.

Efficiency

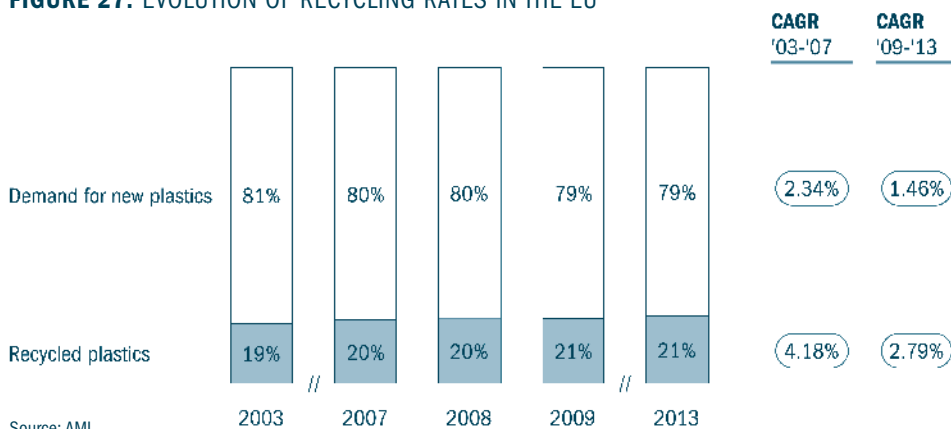
Better technology leads to improved efficiency in energy and material usage which in turn leads to reduced oil consumption. This effect is observed in all major industries in which oil is consumed:

- > Road transportation: in recent years, a number of efficiency improving measures have been developed which could reduce the impact of the rising number of vehicles on oil consumption. A few examples of these are:
 - Diesel engines which offer ~20% better fuel consumption than conventional gasoline engines
 - Hybrid and plug-in vehicles which run partially or completely on electric power
 - CNG vehicles which produce lower emissions, are easier to maintain and relatively safer
 - Other efficiency measures such as maximum speed limits for heavy trucks, labeling of the rolling resistance of tires, etc., resulting in reduced energy consumption

- > Industry: technological innovations have enabled industries to be more energy efficient while at the same time improving their productivity. Two prime examples of such an impact are:
 - District cooling and heating which improves energy efficiency by almost 50%
 - Membrane technology in desalination and water treatment requires significantly less energy than traditional thermal purification methods

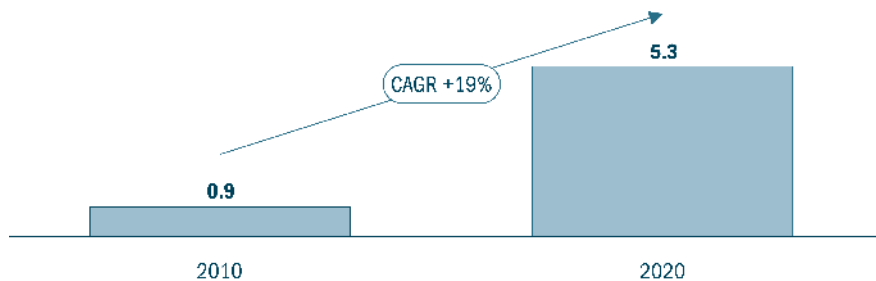
- > Petrochemicals: changing market dynamics in both the demand and supply side will restrict demand growth:
 - Recycled plastic has substantially increased its market share, particularly in developed economies. Cost effective technology and more efficient sorting processes, combined with environmental concerns on the use of plastics has supported this trend
 - Technological breakthroughs have enabled cheaper production of plastics which do not use crude oil as a raw material. Instead, they use renewable biomass such as fats and starch. Several large corporations, including Pepsi and Coca-Cola, have already invested in this technology as part of their sustainability programs.

FIGURE 27: EVOLUTION OF RECYCLING RATES IN THE EU



- > Others: In addition, there are a variety of technological innovations which curtail energy consumption and have an indirect impact on oil consumption:
 - Development of smart houses/buildings which use insulation and are designed to consume less energy for heating and cooling
 - Widespread adoption of energy efficient appliances and light bulbs require less energy to operate

FIGURE 28: BIOPLASTICS MARKET FORECAST - GLOBAL BIOPLASTIC DEMAND [m tonnes]



Source: AMI

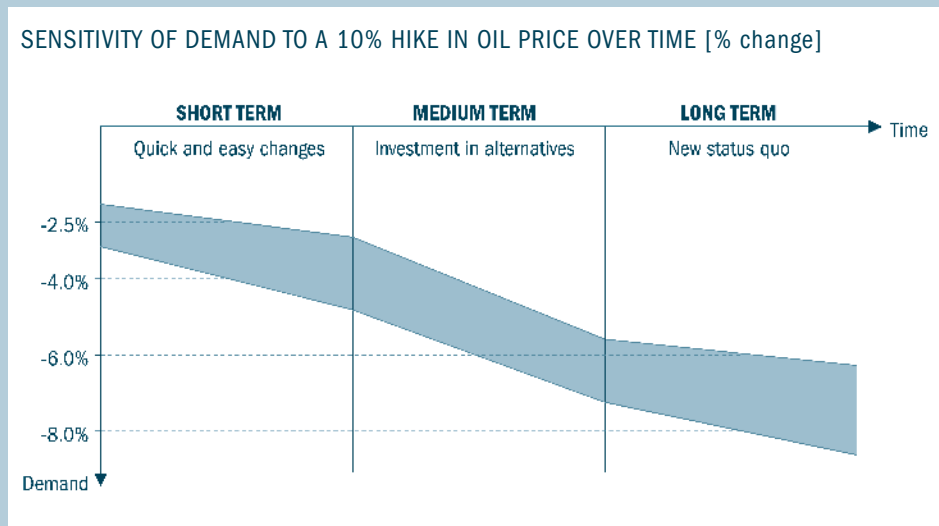
Oil substitutes in the energy sector

Technology has a major impact on oil demand through the role it plays in the development of alternative energy and other substitutes. Oil currently accounts for over a third of world energy consumption and its demand is dependent on how the other sources of energy perform in the future. There are four major sources of energy which are potential substitutes for oil:

- > **Coal** consumption increased by 5.4% in 2011 making it the fastest growing fossil fuel. The majority of this increase was driven by increasing consumption in China and other non-OECD economies. However, limited reserves along with a fundamentally different mode of usage means that coal is unlikely to significantly replace oil demand
- > **Natural gas** production has been increasing steadily over the years, with a 2.2% increase in 2011. In recent years natural gas from unconventional sources such as shale gas has led to a significant increase in production. Its vast reserves and the fact that it is the cleanest burning hydrocarbon make it a real threat to oil in the long run
- > **Renewable energy** including solar, wind, geothermal, hydro, biomass and other forms of energy which are naturally replenished, account for almost 11% of global energy consumption, with significant growth expected in the future thanks to favourable government regulations. For instance, the EU targets a 20% share of energy from renewable sources by 2020. However, nascent technology and high production costs are serious challenges to renewable energy adoption
- > **Nuclear** power is a constant and reliable source of power which currently accounts for 6% of world energy consumption. It is also cheaper to produce and more established than renewable energy. However, following the Fukushima disaster, there has been a significant government backlash with a number of countries such as Germany and Switzerland targeting complete independence from nuclear power

Effect of oil price on demand – Elasticity

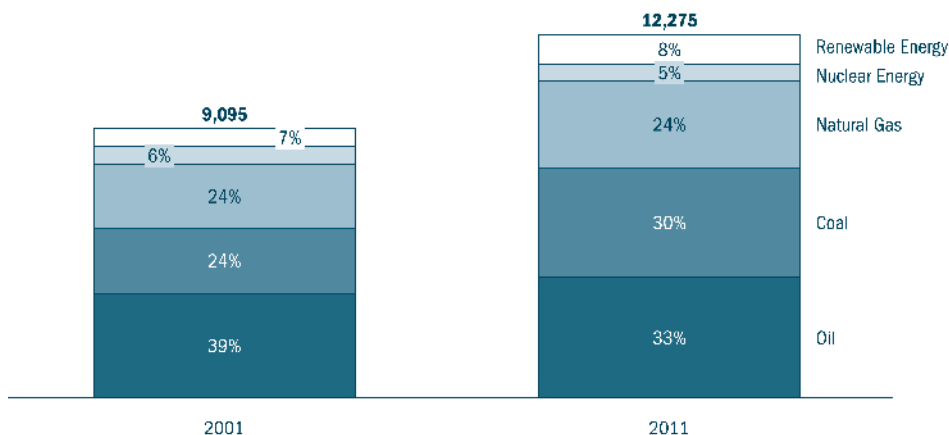
Price elasticity of demand has been the subject of various studies, with results suggesting that it depends largely on the timeframe and the geography in which it is observed, as well as the volatility of prices. Nevertheless, in general, oil demand is highly inelastic to any price changes in the short term, which means the sensitivity of oil demand to changes in price is particularly low. Oil demand is more responsive to price changes in the medium to long run, given the lag in demand to adjust to these price changes. Price volatility is also an important factor, with consumers being less responsive to price changes when volatility is high, compared to when volatility is low, due to limited predictability of prices and the lag effect in demand adjustment.



While there are various studies to quantify this effect, overall empirical evidence suggests that a 10% rise in petrol prices reduces petrol demand by 2.5% to 4% in the short term and by 6% to 8% in the long term. However, this varies by country and sector, as well as expectations of the development of oil prices in the future.

A comparison of the primary energy mix between 2001 and 2011 illustrates that coal and renewables gained a 7% market share to the detriment of oil. However, in absolute terms, oil consumption grew by 15% over the same period, owing to the rapid increase in total energy consumption. The demand for energy is expected to continue, therefore ensuring that oil consumption will grow despite the increasing use of other energy forms.

FIGURE 29: PRIMARY ENERGY CONSUMPTION BY FUEL TYPE [m tonnes of oil equivalent]



Source: BP Statistical Review of World Energy 2012

Demand will remain robust

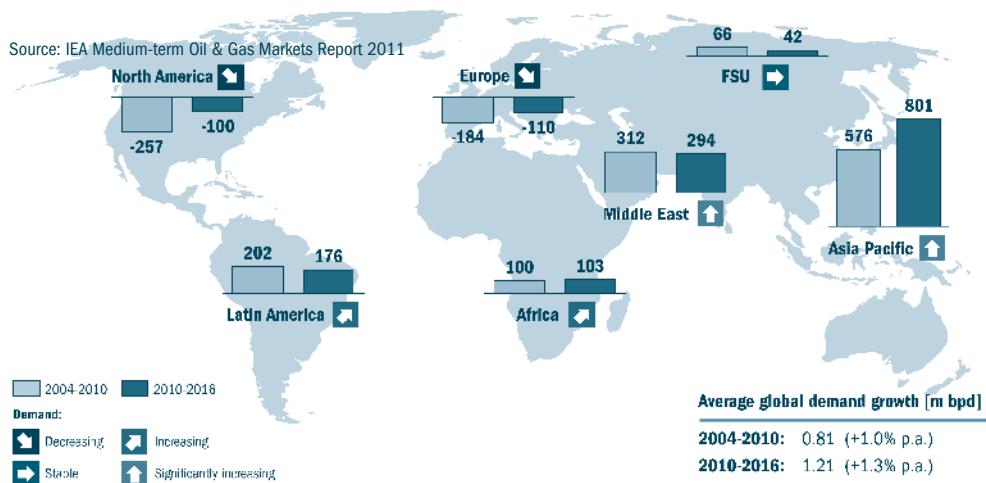
Change in oil demand is the sum of the positive impact of economic development and the negative impact of government regulations and better technology. Upon studying the impact of these key factors while seeking to answer the question "Will demand remain flat in the long run?" the following observations emerge:

- > Oil consumption has been growing at an annual rate of 1.3% over the last decade due to the increase in consumption from emerging economies
- > GDP growth, particularly in non-OECD countries, will drive oil demand in the future but it will not be as effective as in the past owing to increasing energy efficiency
- > Significant consumption increases are expected from all the major consumers of oil thanks to anticipated economic growth in the short term – Growth in China and India appear particularly promising
- > Demand in the road transportation sector will grow rapidly in the coming years due to higher car ownership in developing economies. Electric vehicles can pose a serious threat to oil consumption provided they overcome significant challenges such as low ranges, long charging times, infrastructure requirements and legacy constraints
- > The Industrial sector will continue to increase its consumption of oil, given the development of energy intensive industries such as steel and cement in developing economies. Similarly, the petrochemicals sector will see increasing consumption thanks to a rise in global demand for end products such as plastics, despite bio plastics and greater efforts to recycle

- > The impact of regulations to control oil use will largely be restricted to developed nations while economic considerations limit their impact in the rest of the world
- > Technological improvements have led to increased efficiency in all sectors in which oil is consumed, while also supporting the development of alternative sources. Alternative energy forms carry significant potential but face serious individual challenges, such as security concerns over nuclear power generation and the high cost of production applying to renewables, which reduces their impact in the short term. However, technological breakthroughs such as commercially viable algae fuels can pose a threat to oil demand in the long term
- > Demand is highly inelastic to price changes in the short term and hence price rises will only reduce oil demand minimally

These factors indicate that, unless there are technological breakthroughs which make renewable and electric vehicles more adoptable, total oil consumption will continue growing, albeit at a slightly lower rate. Furthermore, they also hint towards a global split in demand trends between developing and developed countries, which is reflected in our forecasts. Hence, the prospect of oil demand flattening anytime soon is highly improbable.

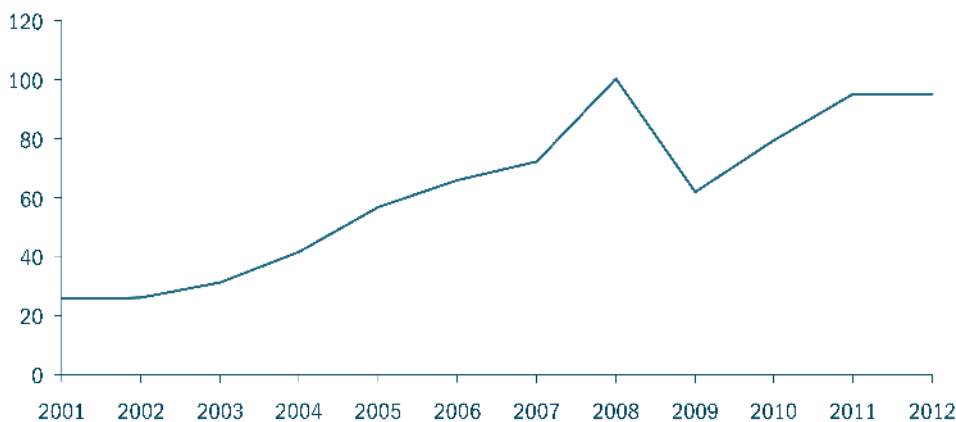
FIGURE 30: AVERAGE ANNUAL GLOBAL OIL DEMAND GROWTH ['000 bpd]



CAN OIL PRICES DROP BELOW USD 70 PER BARREL FOR A SUSTAINABLE PERIOD?

The price of oil constitutes one of the most influential figures in the world as it impacts nearly all aspects of everyday life. It has grown gradually over the last decade and is currently stabilizing around the USD 100 per barrel mark. A key question for producers, traders and end users is "Can oil prices drop below the USD 70 per barrel mark for a sustainable period?" as this influences the outcome of nearly all long term business decisions.

FIGURE 31: OIL PRICE EVOLUTION [USD/bbl]



Source: EIA

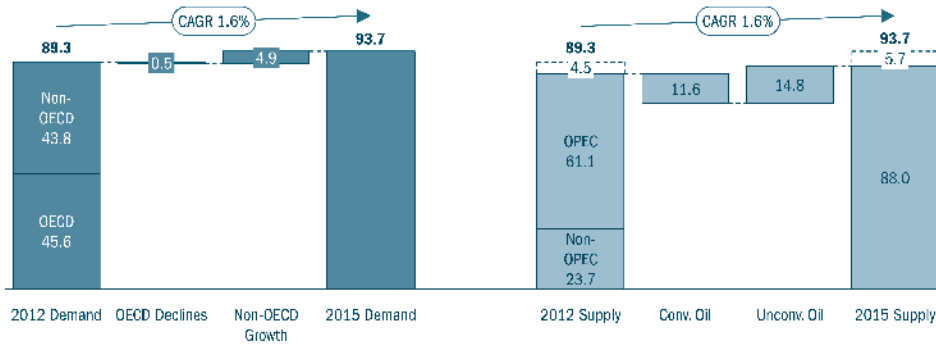
Oil price movements are based on a vast array of elements, which can be broken down into two overarching factors: supply-demand balance and marginal cost of production.

Supply-demand balance

Oil price is determined by supply and demand in the market, both of which depend on various drivers, including the expectation of oil price changes. In general, higher supply and lower demand leads to lower oil prices and vice versa. This is illustrated in the 2008 financial crisis which saw a dramatic fall in demand which in turn led to a nearly 70% fall in crude prices in the second half of 2008.

As discussed previously, oil demand is expected to continue increasing in the future. OECD demand for oil is decreasing as they shift towards renewables, other energy sources and more efficient technology. However, fast growing GDP per capita in emerging economies, combined with strong population growth in these same regions, has increased their industrial and economic development, leading to higher demand for oil. Therefore, overall oil demand is expected to increase in the future, and supply is expected to meet this increased demand, albeit at a higher price, given the need to rely on ever more expensive unconventional oil sources.

FIGURE 32: DEMAND SUPPLY BALANCE FORECAST 2012 VS. 2015 [m bpd]



--- Differences between demand and supply due to consumption of non petroleum additives and substitute fuels

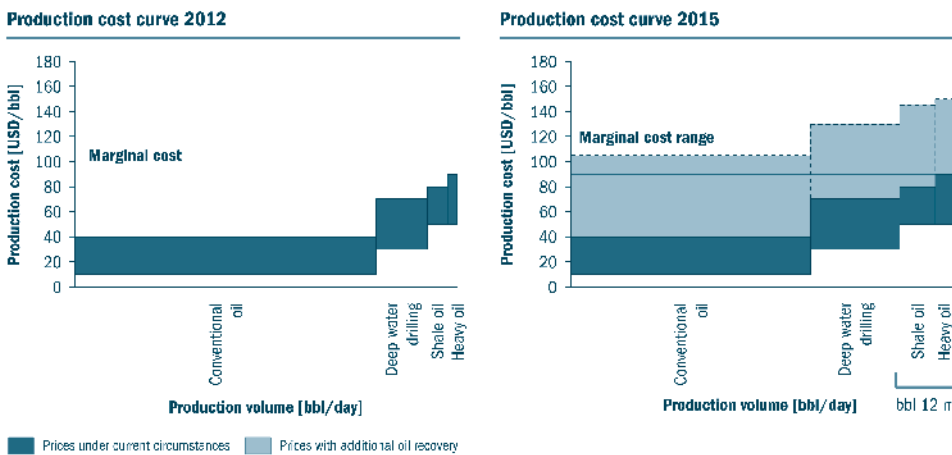
Source: BP, EIA

Marginal cost of production

Development of new production capacity is becoming more expensive as easily accessible resources have been depleted. It has been illustrated that production is shifting from conventional to unconventional oil, which is more difficult and expensive to produce. Oil price is set by the marginal cost or more simply the cost of producing the last barrel of oil, aka the "marginal barrel", required to meet demand. In 2012, the marginal cost of oil was between USD 90-95 a barrel, produced mainly in Canada, which set the average oil price per barrel for 2012 at USD 95. This cost of producing the last barrel of oil needed to meet demand sets the price for oil since if the price is lower than the marginal cost, further production would not be economically viable.

Therefore, as illustrated earlier, given the greater reliance on unconventional oil sources such as shale and oil sands, the marginal cost of production will increase, and the balance

FIGURE 33: PRODUCTION VOLUME VS. PRODUCTION COST



Source: EIA

between supply and demand will naturally occur at a higher price. In 2015, with the increasing use of tertiary extraction methods, the production cost of all sources is expected to increase leading to an increase in marginal cost and in effect oil price.

Conditions necessary for prices to fall below USD 70 per barrel

The analysis conducted so far clearly indicates that the largest share of new supplies are drawn from expensive unconventional sources of oil and demand is likely to continue growing, albeit marginally slower than in the past. Given that marginal cost determines the final market price, the following conditions are necessary for oil prices to fall below USD 70 a barrel:

Increase in conventional oil production

The increase in low cost conventional oil production is the most apparent means to lower prices as it directly brings down the marginal cost of production. In fact, there have been a few recent occurrences which suggest the possibility of this scenario occurring, including:

- > Increased political stability in OPEC countries such as Iraq and Libya
- > Increased exploration and development activities in smaller OPEC producers, namely Ecuador, Algeria, Angola and Nigeria

However, it is unlikely that major oil producers will allow such a scenario to occur as it directly cuts into their margins. The strategic behaviour by OPEC will ensure members abide with agreed production rates and major OPEC producers such as KSA will decrease their production rate to restore balance. While OPEC is an imperfect cartel - it does achieve its goals if only partially and it is still very relevant to the oil industry. Ultimately, the control exerted by major oil producing nations over this condition implies that it is very unlikely to occur, particularly when taking into account many oil exporting nations depend on price-cost considerations as a pre-requisite to government spending.

Furthermore, some non-OPEC producers will refrain from increasing production as they would like to have their reserves last as long as possible.

Increase in deep water oil production

Deep water drilling as discussed earlier is the drilling for oil at depths below 1000 m beneath sea level. Technological breakthroughs have allowed such drilling to be more efficient and commercially viable.

There have been several recent events which suggest that an increase in such oil extraction is plausible:

- > Successful E&P campaigns in Brazil
- > Increased deep water E&P activities in the Caspian sea: Kazakhstan, Turkmenistan, Azerbaijan and Iran
- > Other successful deep water developments: mainly Angola, Indonesia, Malaysia, Australia, Mexico & USA

An increase in deep water oil production is dependent on investments, technological advancement and the development of required know-how and expertise. There is evidence to suggest that significant progress has been made in all three aspects:

- > Large investments have already been made as reflected in the significant increase in deep water rigs – 60 new deep water rigs commissioned between 2008 and 2012
- > Technology was developed to allow deep water operations in the toughest environments (e.g. arctic ultra deep water drilling)
- > Know-how and expertise were developed by multinational companies such as Shell, BP, Total etc. and have been transferred globally through their international operations and network

These promising developments suggest that there is a fair likelihood of witnessing an increase in deep water oil production. However, while production costs are not as high as unconventional oil, they are still greater than standard conventional oil.

Decrease in oil demand

A decrease in oil demand will also lead to a fall in oil price, and there are a few developments which might lead to this scenario:

- > Significant increase in the use of biofuels – algae based fuels appear very promising in the long term but there are no commercially viable plants yet in operation
- > Strong shift of road transportation towards hybrid, electrical and gas powered vehicles, particularly given the investments currently being made by large manufacturers in this sector
- > Drafting and approval of new regulations limiting the use of oil, particularly in the utilities sector

Yet as these reductions are primarily observed in OECD countries, they are likely to be offset by increasing demand from emerging economies. Furthermore, the high cost of electricity generation using renewable sources and the recent spotlight on the risks posed by nuclear energy make short term reduction of oil dependence nearly impossible.

High oil prices are here to stay

The analysis conducted on both the supply and demand of oil, as well as the potential for disruptive technology, allows for the following key takeaways on oil price:

- > Oil price has tripled over the last decade and is currently stabilizing around the USD 100 mark
 - > Demand is expected to grow at 1.6% per annum over the next couple of years and supply will increase to meet this demand through expensive unconventional sources of oil
 - > The marginal cost of production is set to increase as expensive tertiary extraction methods are used to produce the "marginal barrel". Significant increases are expected in the production costs of both conventional and unconventional oil
 - > An increase in conventional oil production and decrease in oil demand is very unlikely
- Therefore, rather than a sustained oil price below USD 70 per barrel, we see three realistic scenarios:

- > **Reference case scenario:** Robust growth in non-OECD countries, particularly China and India leading to an overall increased demand for oil, resulting in oil prices between **USD 100-120**
- > **High oil price scenario:** Very high demand for oil in non-OECD nations, combined with a constrained supply and low investments in EOR technologies could lead to a sustained higher oil price between **USD 120-170**
- > **Low oil price scenario:** Slow non-OECD growth and reduced market power of OPEC producers to stabilize price and production could lead to a slight fall in prices between **USD 80-100**







FIGURE 34: OIL PRICE FORECAST [USD/bbl]



Source: EIA

Given the scenarios illustrated above, the lowest price forecast in the near future scenarios is around USD 80 per barrel. Therefore, we believe it is highly unlikely that prices will fall below USD 70 for an extended period of time.

FIGURE 35: OVERVIEW OF RADICAL EVENTS WHICH CAN LEAD TO A DECREASE IN OIL PRICE

Event	Description
 Algal biofuel cost reduction	Algal biofuel yields more energy per unit area than any other biofuel crop but is the most expensive to produce; hence a major reduction in capital and operating costs of algal biofuel would significantly impact oil demand, supply and pricing
 Renewable energy breakthrough	A major market breakthrough in a renewable energy source such as solar energy is more likely to take place through capital cost reductions or technological improvements; this scenario would affect oil demand, supply and pricing
 Shift towards nuclear power generation	An increased interest in nuclear power is not very likely to occur after Japan's 2011 tsunami and earthquake that almost caused a nuclear meltdown; but a shift towards nuclear power generation for major oil consuming nations would alter oil demand, supply and pricing
 Electric cars performance improvement	A major technological improvement enabling electric cars to run for longer distances without recharging would allow these environmental friendly vehicles to gradually replace current cars, thus impacting oil demand and supply
 Oil recovery improvement	Major improvements in oil recovery techniques that could decrease the production cost or increase the recovery rate, specifically for unconventional oil, would affect the marginal cost of oil ¹⁾ as well as its supply
 Environmental regulation or deregulation	Oil producing nations have different views on the extent of usage of secondary and tertiary EOR; hence, a major change in regulation trends in main oil producing nations would have significant ramifications on oil supply and pricing

1) Cost of producing the most expensive additional barrel of oil

History is full of radical events that changed the face of industries forever, and some of these potential "game changers", as well as their expected impact on the oil industry, have been

analyzed and incorporated into our model. An epic breakthrough in technology could have a significant impact on oil prices in the long run, and once again completely change the dynamics of this market.

CONCLUSION

The oil industry is one of the most complex industries in the world. It is extremely dynamic and is generally a good indicator of the health of the world economy. This report analyzes the key drivers and trends in the oil sector, covering supply, demand and price, along with expectations of what they mean for the industry in the future. Three key questions were tackled which oil producers, investors, businesses, governments and end users around the world are interested in answering.

The first question, which has been a topic of discussion in the industry for decades, is: "Will the world run out oil?" Given our research, this is very unlikely to occur in the medium term, and improbable in the long term. Total accessible reserves are increasing every year thanks to increased explorations for both conventional and unconventional oil and improved technology such as horizontal wells. Political instability, while still a factor, is not expected to have a huge impact on the future of oil supply. Furthermore, rising oil prices are making production from unconventional sources viable leading to an even more diverse source of supply. Non-OPEC countries and unconventional sources of oil are expected to continue driving growth in total oil supply in the future.

But given this promising outlook in oil supply, the question is "Will demand stay flat in the long run?" Once again, research indicates that this is also highly unlikely. Demand has been growing at an annual rate of 1.3% over the last decade. Rapid GDP growth after the financial crisis, low regulation in emerging economies and challenges faced by alternative energy sources mean that demand is expected to continue growing. Non-OECD countries are expected to account for a larger share of demand growth in the future, given lower economic growth and higher oil efficiency usage in OECD countries.

The final question answered is "Will oil prices drop below USD 70 per barrel?" Once again the answer is no. Increasing demand and supply along with the rising marginal cost of production, thanks to expensive tertiary extraction processes means oil prices are expected to continue rising in the future and expensive unconventional oil production.

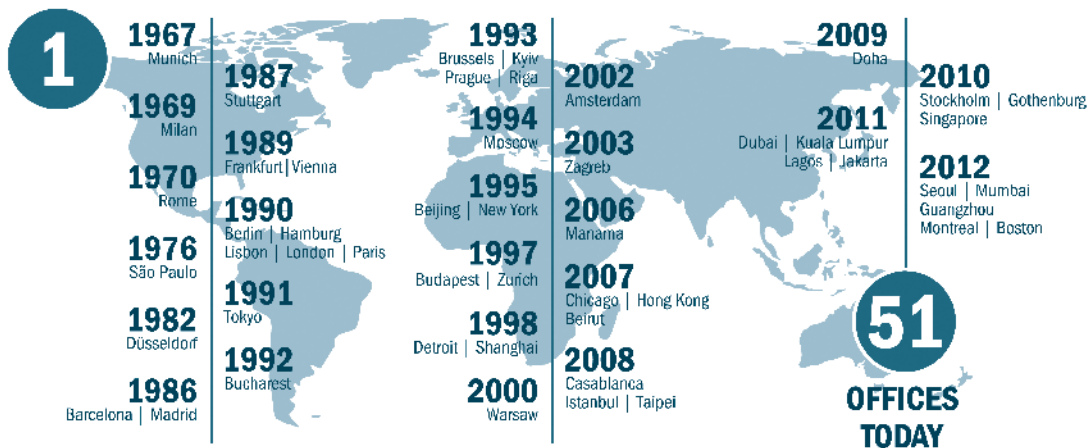
While these are expected outcomes, black swan events which change the dynamics of an industry may occur. Therefore, we also analysed potential game changers which might prove one or all of our predictions wrong. In particular, technological innovations such as a biofuel revolution triggered by algae based feedstock, cheaper and more accessible renewable energy and an increasingly consumer friendly electric car industry are real threats to oil consumption on the long run, which may lead to lower demand and therefore lower prices. Ultimately, we hope that an understanding of the trends and risks associated with the oil industry will enable producers, businesses and governments alike to develop effective and sustainable strategies that can withstand these black swan events while delivering maximum results.

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MARKET POSITION 2012

Germany	# 2
Growth regions China and Russia/CEE	# 2
Core markets in Western Europe	# 3
World	# 4

OUR EXPERTS



Jaap Kalkman

Senior Partner
Al Thuraya Tower No. 01/1204
Dubai, U.A.E.

Phone: +971 4 44 64 080
E-mail: jaap.kalkman@rolandberger.com



Walter Pfeiffer

Partner
Bockenheimer Landstraße 2-8
Frankfurt, Germany

Phone: +49 211 4389 2226
E-mail: walter.pfeiffer@rolandberger.com



Sergio Pereira

Senior Consultant
Almoayyed Tower, 21st Floor
Manama, Bahrain

Phone: +973 17 5679 50
E-mail: sergio.pereira@rolandberger.com

OUR TEAM



Hani Tohme

Consultant
Almoayyed Tower, 21st Floor
Manama, Bahrain

Phone: +973 17 5679 50
E-mail: hani.tohme@rolandberger.com



Hilal Tetik

Consultant
Al Thuraya Tower No. 01/1204
Dubai, U.A.E.

Phone: +971 4 44 64 080
E-mail: hilal.tetik@rolandberger.com



Prateik Pothuneedi

Consultant
Al Thuraya Tower No. 01/1204
Dubai, U.A.E.

Phone: +971 4 44 64 080
E-mail: prateik.pothuneedi@rolandberger.com

Amsterdam
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Bucharest
Budapest
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Doha
Dubai
Düsseldorf
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