boston petroleum research

2017 Q1

US Gasoline Price – Principal Factors

January 2017

US Gasoline Price – Principal Factors

Executive Summary

Note all price data are in real terms USD 2015 and US gasoline price estimates assume no change to the current fiscal regime.

- The world crude oil price is the principal determinant of the US gasoline price, accounting for 90% of the variation in US gasoline price.
- Over time periods longer than a month, the fundamental supply-demand balance primarily determines the world crude oil price. This balance is subject to long period cyclical imbalances due to the radically different response times of new supply and demand to price signals. Demand responds quickly within a few months, whereas new supply can take a few years (USA light tight oil) to decades (deep-water) to respond. Only OPEC has sufficient spare capacity to act as a rapid response swing producer.
- The period of short-term physical oil market glut, built up since mid-2014, appears to be coming to an end in 2017. This follows agreement (and so far compliance) by OPEC to reduce supply to support the oil price in the $55-60/b range ($2.37-2.49/gal). However, Saudi Arabia requires $80/b ($2.97/gal) to balance its budget.
- The sustainability of Saudi Arabia's policy will be determined by the ability of Saudi Arabia and its Persian Gulf allies (Kuwait, UAE and Qatar) to support expensive social programmes to buy domestic peace and stave off extremist Sunni Islamists with lower oil revenues. We think it quite possible that sometime before or around 2020 Saudi Arabia will attempt to raise the oil price further to $80/b as the need for revenues out-weighs the desire for market share.
- For the next 2 to 3 years, real oil prices are expected to be in the range $55-60/b ($2.37-2.49/gal). However, the interaction between Libya's return to production, potential unrest in Venezuela, OPEC compliance, or lack thereof, and USA LTO production can generate significant volatility in the range $50-70/b ($2.25-2.73/gal) over time period of 2-3 years in the period leading up to the early 2020s.
- After 2022 and into the early 2030s, different macro-economic, ZEV market penetration and geopolitical scenarios generate a wide range of oil price forecasts from $65/b to $120/b ($2.61/gal to $3.93/gal).
- From the mid-2020s onwards different scenarios for the market penetration of ZEVs in the USA, Europe and China have progressively more important influence on the demand for oil and hence its price. Regulatory, technology, comparative costs and consumer preferences as well as the pace of build up of appropriate manufacturing capacity are determining factors.
- After 2030. Supply and demand both "peak" and decline slowly. Periodic disjunctions between declining supply and declining demand cause considerable fluctuations in oil price and economic instability in some scenarios.
- The historically established relationship between world crude oil price and US gasoline price may be perturbed in the future by changes to the regulatory and fiscal regime. For example, the recently mooted Border Adjustment Tax could raise US gasoline prices by 7-12% depending on its impact on US production, refiners and crude oil exports. Likewise, carbon taxes or their equivalent could also raise the price of US gasoline and/or the price of crude oil.
- The geopolitical and macro-economic scenarios generated by our integrated world oil supply-demand-price model provide the basis for this analysis.

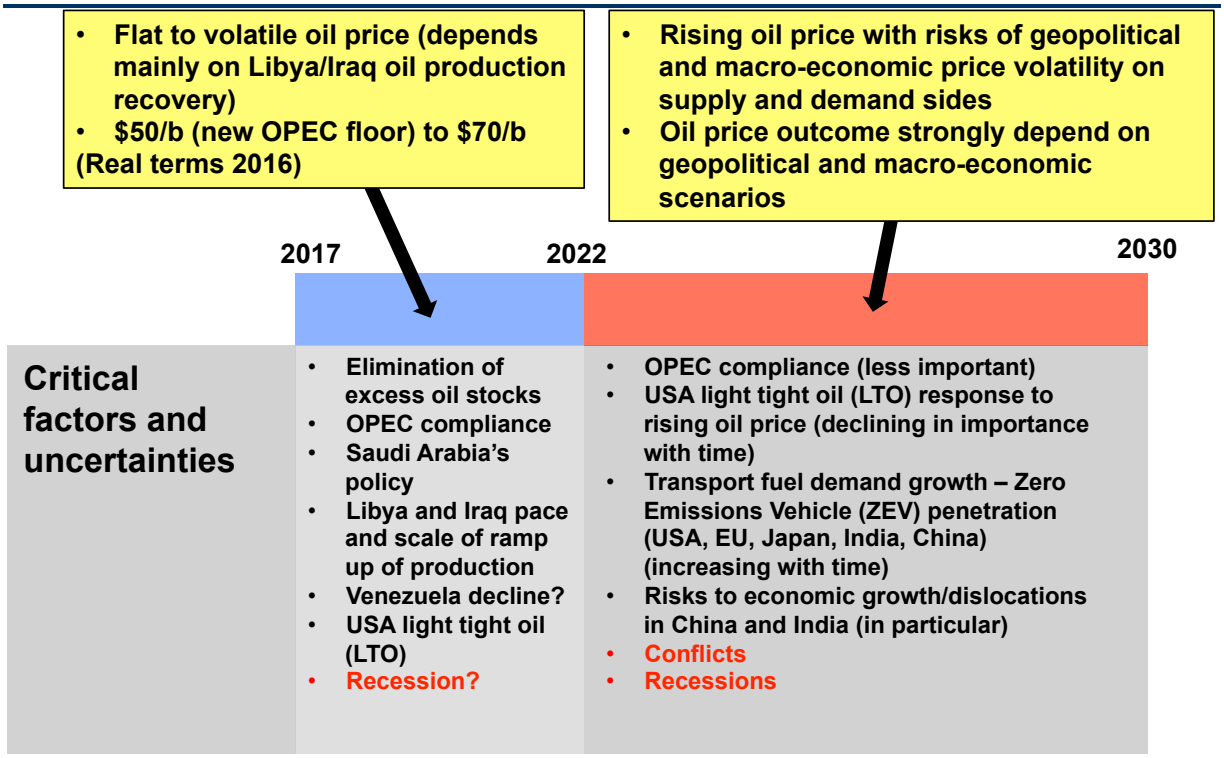

Figure i: Summary of factors influencing the world oil and USA gasoline prices and the basis for scenario analysis.

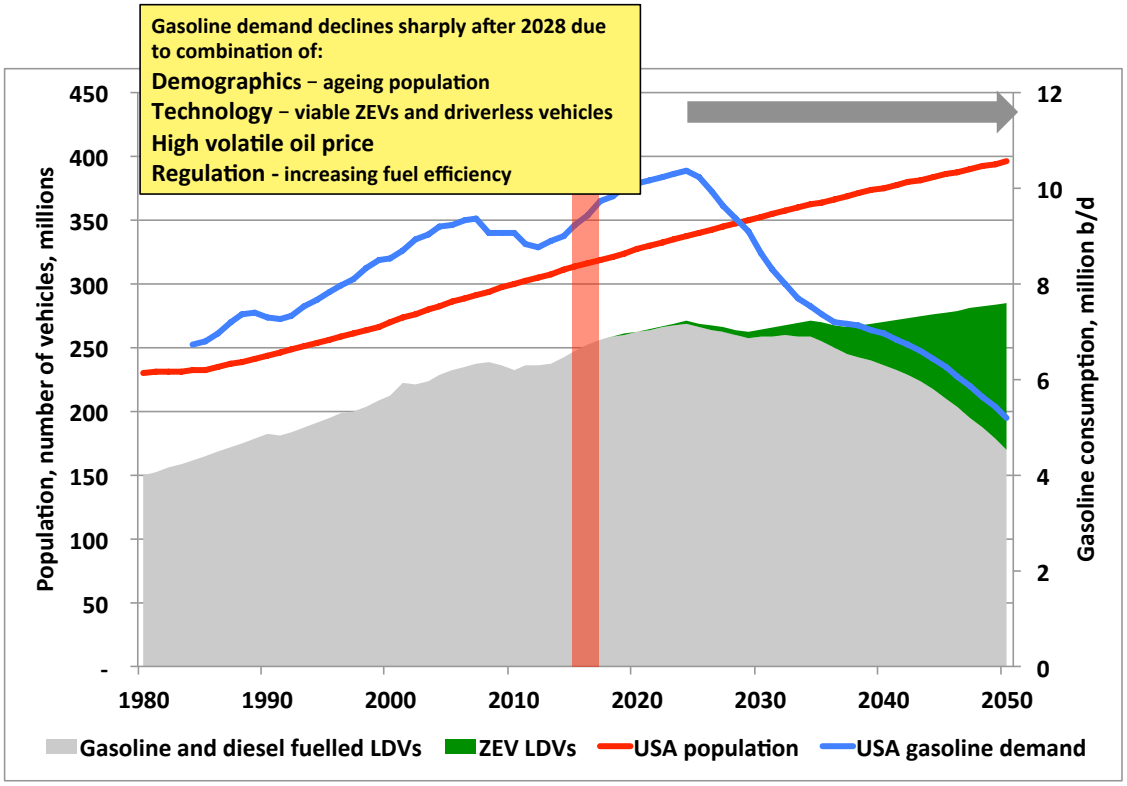

Figure ii: USA LDV, ZEV market penetration and gasoline consumption from a model run for one of the scenarios.

Preamble

This report examines the factors that determine the US gasoline price and how these are expected to evolve over the next 10-20 years. We examine the relationship between US gasoline price and world crude oil price (using Brent as the reference crude) and US crude oil price (WTI reference) as well as other secondary factors. World and US crude oil prices are primarily driven by the interaction between supply and demand. This note reviews the main supply and demand factors likely to influence oil price development.

Other factors that could influence the price of gasoline in the USA are principally regulatory and/or fiscal. The introduction of carbon pricing and/or a carbon tax to mitigate climate change could raise gasoline prices in the USA by 10-20%. In recent months US Republican Party Congressional leaders have aired proposals for a Border Adjustment Tax which could increase the USA gasoline price by 7-12%, depending on the tax level and impact on US domestic production, US crude oil exports and refiners.

The recent decision of the IMO to progressively prohibit HSFO as a marine bunkering fuel, and the pressure on governments to reduce particulates in diesel, are likely to see ramifications for the price of gasoline (5-10% effect). These will arise from the costs of refinery re-configuration as well as an increase in demand for the lighter end of the barrel, lighter sweeter crudes and an increase in their associated price premia.

The world crude oil price is the principal determinant of the US gasoline price, accounting for 90% of its variation. The geopolitical and macro-economic scenarios generated by our integrated world oil supply-demand-price model provide the basis for this analysis.

Figure 1 shows the superior performance of our scenario approach and numerical models compared with various consultants, multilateral agencies and the principal international banks. The actual oil price outcome from 2014 through to 2017 is within our envelope of uncertainty from one of our scenarios made nearly three years ago.

Finally, our analysis shows that there is no evidence for the oft-mooted causal relationship with the value of the US Dollar driving the world oil price. In fact, the data point to major trend changes in the value of the US Dollar being driven by major trend changes in the oil price.

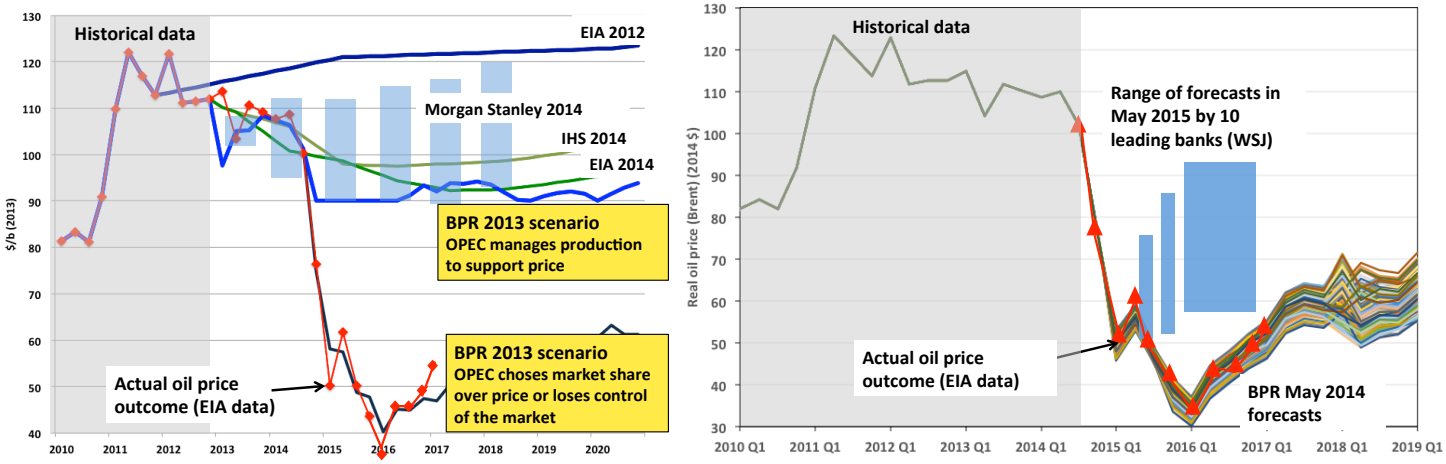

Figure 1: Comparison of our scenario forecasts with those made by the EIA, IEA, IHS and leading international banks.

Relationship between the Prices of Crude Oil and US Gasoline

The price of US gasoline is mostly driven by the world market oil price, for which Brent is the most reliable indicator, partly mediated by WTI, the light crude bench mark price set at the Cushing trading hub (Figure 2). The non-linear relationship between the price of crude oil and US gasoline, shown in Figure 2, is the result of the fixed and price-variable "costs" in the refining, marketing and distribution of gasoline as well as the average US taxes (some $0.48/gal).

The remaining 10% of US gasoline price variation is mostly due to very short-term factors – weather, refinery and distribution problems (Figure 3).

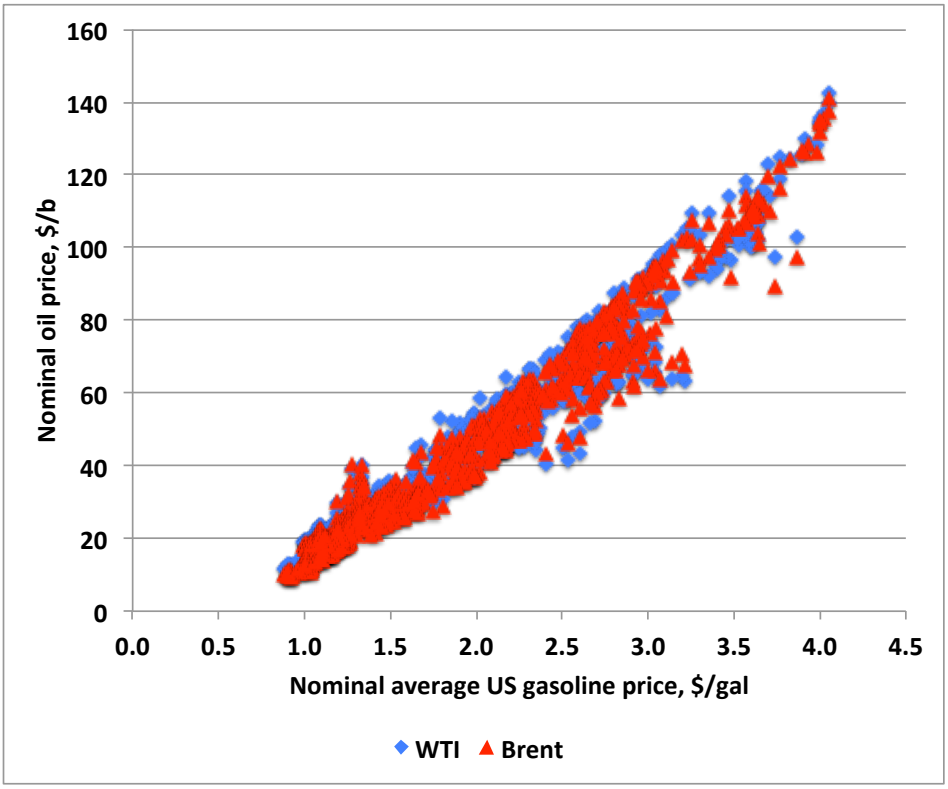

Figure 2: Plot of weekly data for average US gasoline price (including federal and average local taxes of some $0.48/gal) and Brent and WTI crude oil price (data from the EIA). The dataset excludes the December 2010 to August 2015 period when WTI crude prices were anomalously low due to a glut of light tight oil at Cushing, the WTI trading hub, and insufficient take away pipeline capacity from Cushing (all data nominal).

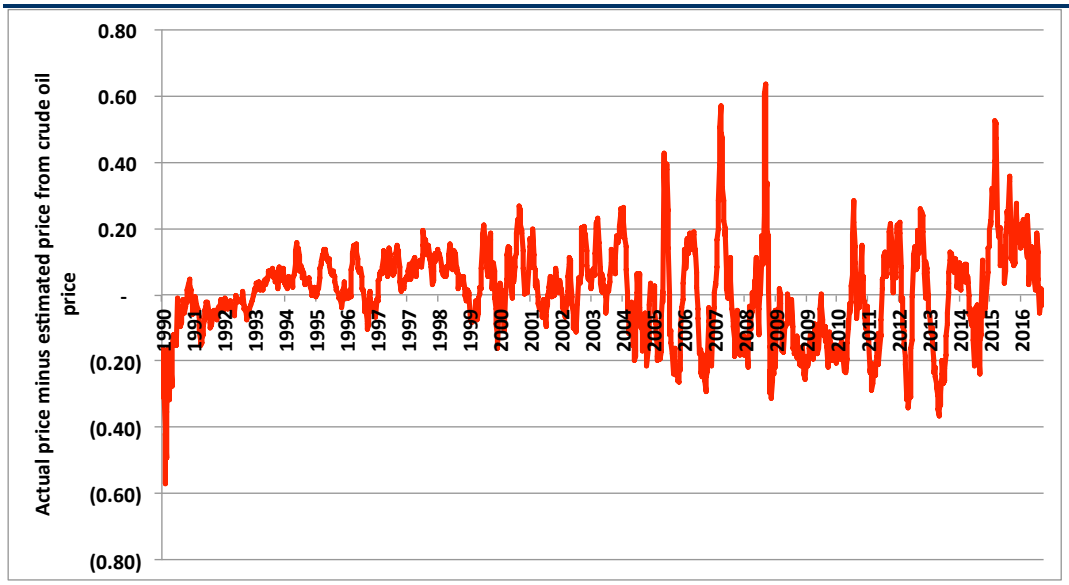

Figure 3: Plot of residuals (in US gasoline price) after removing the crude oil effects from the data shown in Figure 1) (data in nominal terms).

Critical Factors and Uncertainties and the Future Oil Price Pathway

Figure 4 summarises the critical factors in determining the future oil price pathway that we have identified and built into a suite of scenarios. We have identified two main phases in the price pathway.

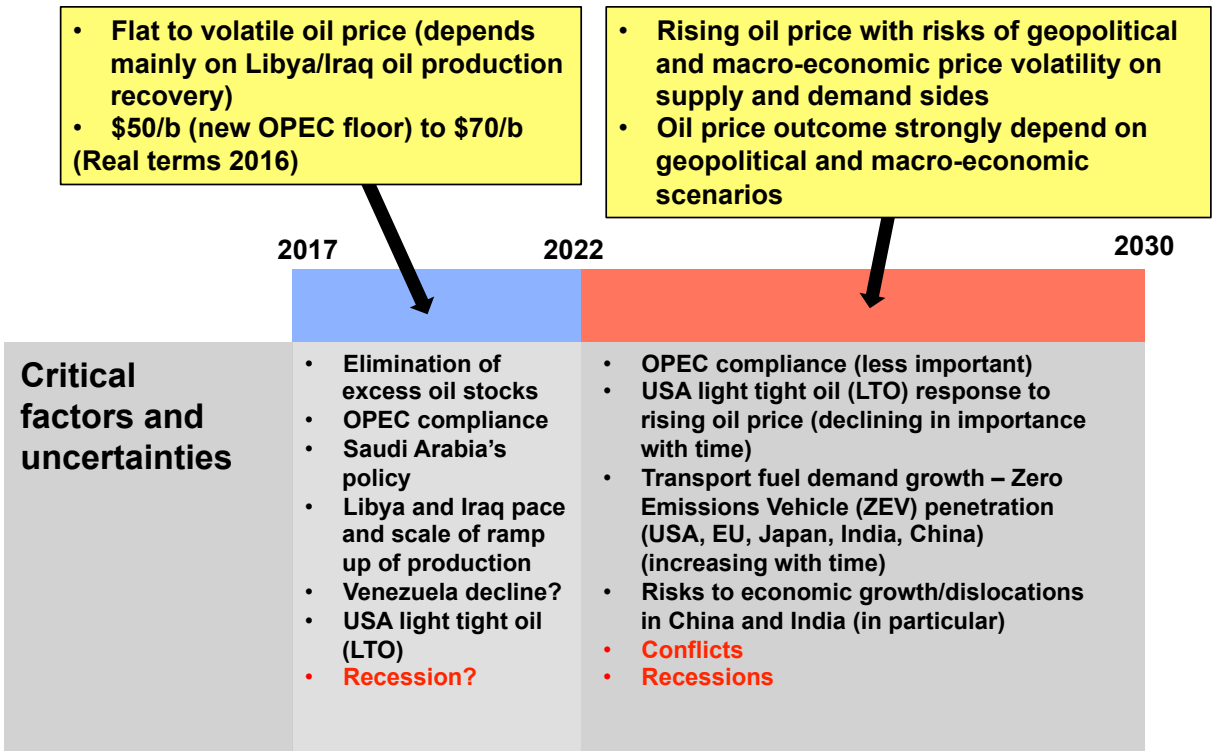

Figure 4: Summary of factors influencing the world oil and USA gasoline prices and the basis for scenario analysis.

Short to medium term (2017 to 2022)
The response of Saudi Arabia and OPEC compliance will be the main determinants of the world oil price. We believe that at some point before 2020, Saudi Arabia may have to go further than simply try to keep the oil price in a $55-60/b channel in order to balance its budget. Saudi Arabia's budget requires $80/b to be in balance.

Other critical factors in the degree of price volatility in this period are: the pace and scale of recovery of production in Libya from current levels of 800,000 b/d to full capacity of some1,500,000 b/d; and the potential for supply decline sin Venezuela due to civil unrest and failure to pay suppliers.

USA LTO is a price taker with significant time lags, some 6-12 months, between price signal and production response. The three principal producing areas (Permian, Bakken and Eagleford) have similar but slightly different cost of supply curves. The Permian basin has a lower cost of supply than the other two areas. Consequently, drilling rig numbers have recovered somewhat in the Permian basin but are still near lowest levels in the Bakken and Eagleford. We forecast that the recovery of drilling rig numbers in the Permian basin through the latter part of 2016 and early 2017 will cause a significant rise in Permian LTO production in 2017 (Figures 5 and 6). The Bakken and Eagleford are unlikely to see much production recovery until 2018-2020 due to their higher cost of supply unless the oil price rises above $60/b for a sustained period. Depending on the timing and scale of any further rise in oil price, USA LTO production could be back to previous 2015 peak levels before 2020 and on a rising trajectory.

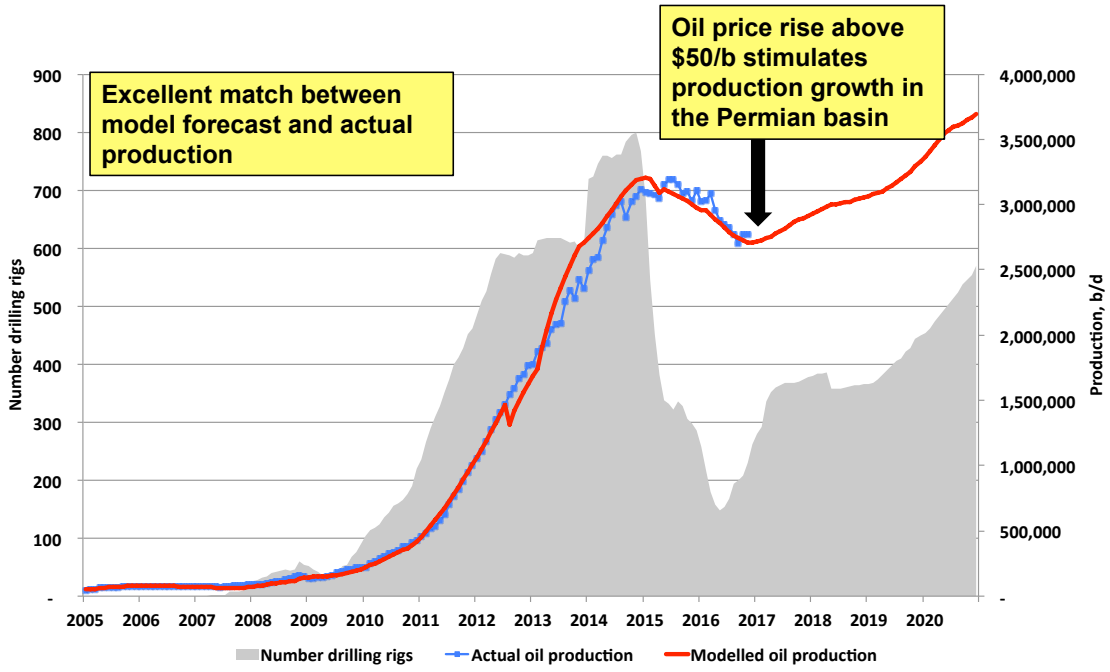

Figure 5: The actual production and modeled response of light tight oil production from the three principal USA light tight oil basins – Bakken, Eagleford and Permian basin (one scenario outcome only)

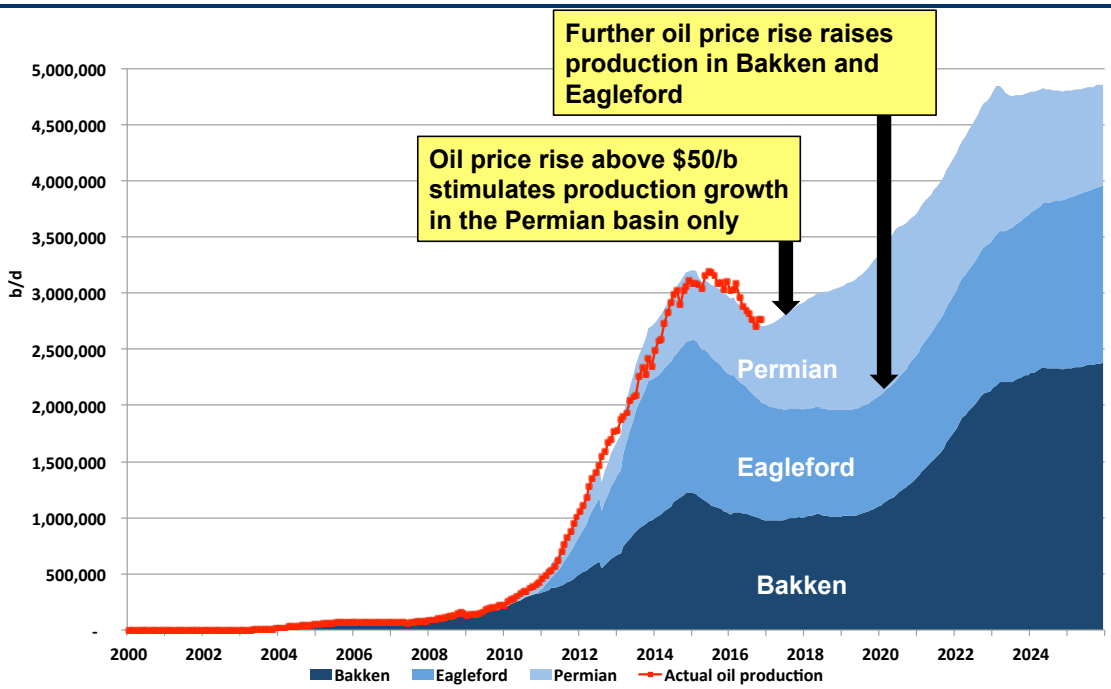

Figure 6: Modeled differential responses of the Permian basin, Bakken and Eagleford to a rise in oil price (one scenario outcome only).

The interaction between higher production levels in Libya and USA LTO is critical to the degree of price volatility in this period. If Libya is slow to return, the oil price can rise significantly precipitating an increase in USA LTO production. However the significant time lag between price signal and USA LTO response means that this additional production can rapidly drive the oil price down again. This process tends to produce 2-3 year "waves" of price oscillation between $55 and $70/b. This is equivalent to a +/- $0.3/gal variation in US gasoline price.

Long term (2022 to 2030 and beyond)
Demand growth steadily outpaces supply growth, exacerbated by lack of investment and deferred oil development projects and exploration in non-OPEC countries due to the low oil price period between 2015 and 2017. There is a steady erosion of spare production capacity throughout this period accompanied by a degree of price volatility in some scenarios depending on the interaction between OPEC and USA LTO. Towards 2030, US gasoline prices exceed $4/gal (real terms 2015) in some scenarios.

After 2030, non-OPEC oil production starts a more or less terminal decline at the same time as global demand also peaks and declines. (Figures 7, 8 and 9) This latter trend is driven by: demographics, economic maturity of major consuming countries, displacement of oil as a transport fuel by then mature and cost effective technologies and consumer behaviour. Figure 8 shows the outcome from the model for one scenario for USA light duty vehicle (LDV) mix of conventional and ZEVs and the resultant gasoline demand. The interaction of closely matching supply and demand after 2030 as both decline causes considerable price and economic volatility in some scenarios. Other scenarios show that this period can be traversed without significant volatility.

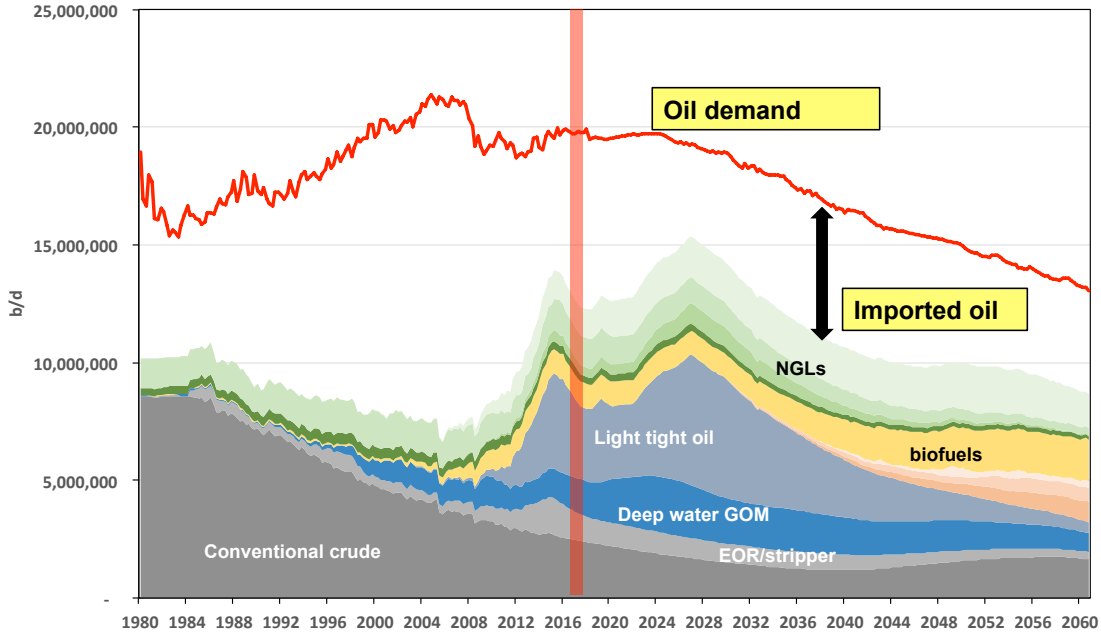

Figure 7: USA oil supply and demand extracted from the model run for one of the scenarios.

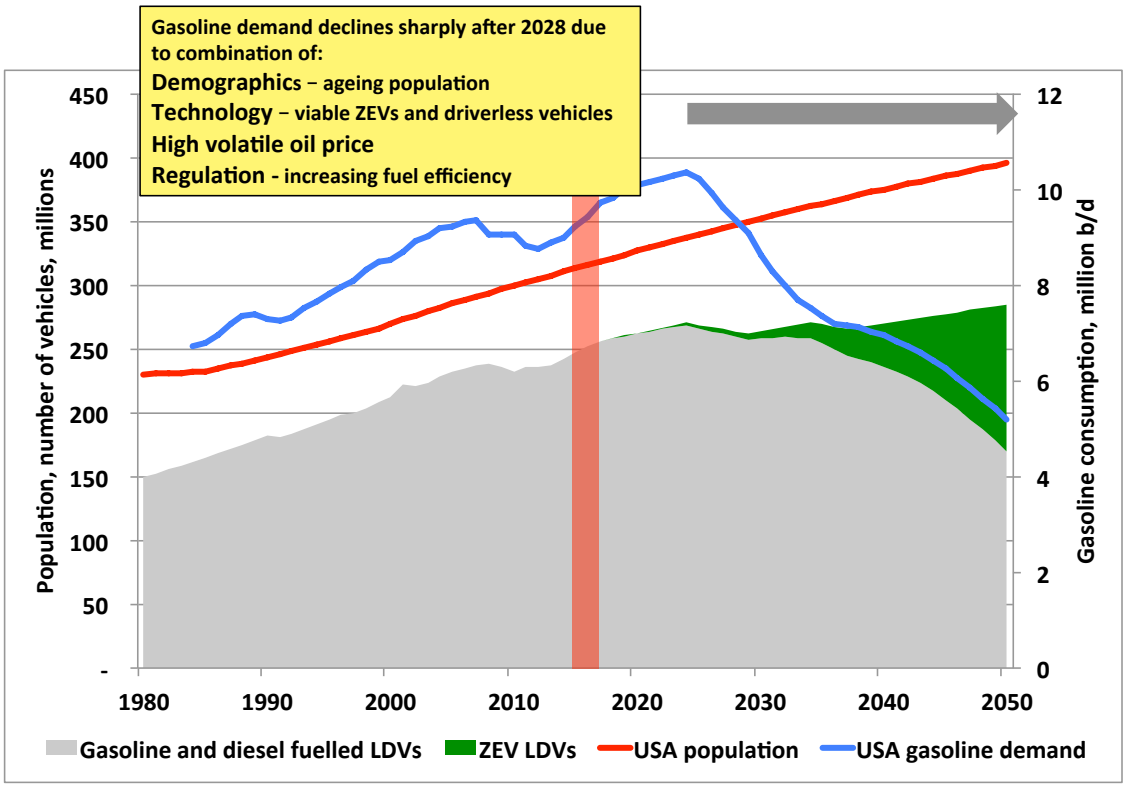

Figure 8: USA LDV, ZEV market penetration and gasoline consumption from a model run for one of the scenarios.

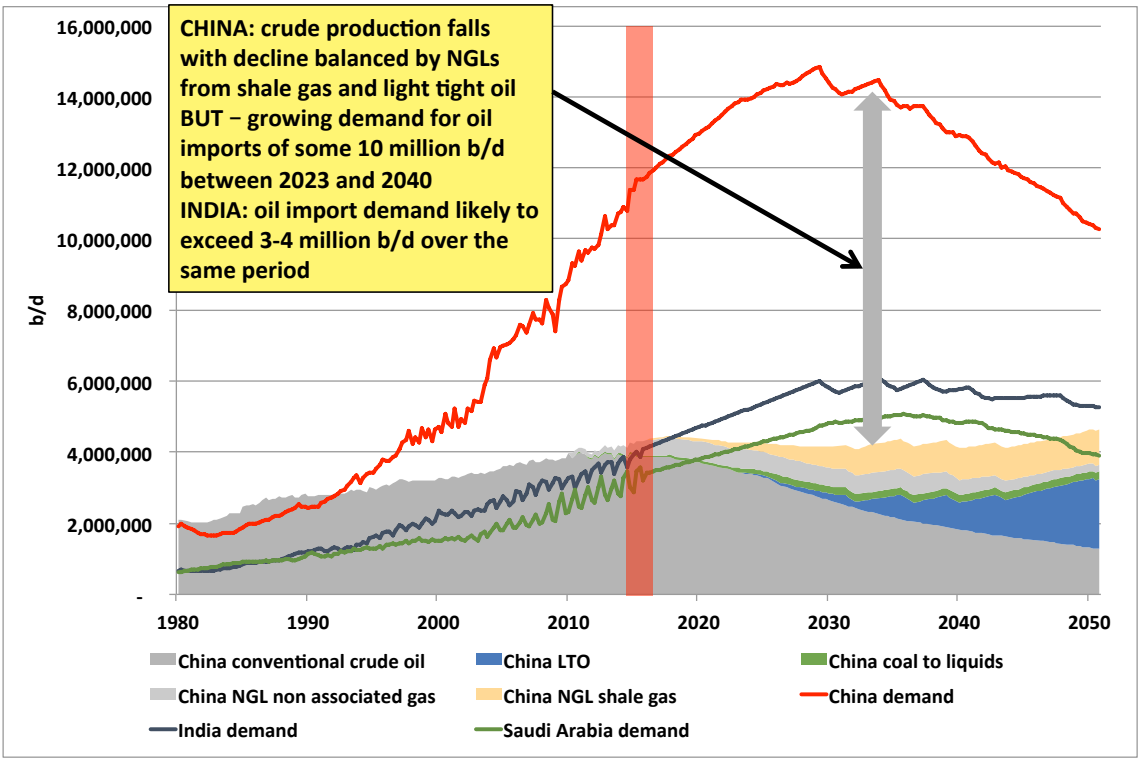

Figure 9: China supply and China, India and Saudi Arabia demand from a model run for one of the scenarios.

The main demand for imported oil is from the USA, China and India. For the USA light tight oil production expands steadily through the period to 2030. However, after 2035 US light tight oil goes into decline. This generates significant but reducing requirement for imported oil in the USA to 2030. Thereafter, the requirement for imported oil stabilizes at around 4 million b/d as production declines together with demand (Figure 7).

Whilst China's crude oil production is expected to fall steadily throughout the period 2017 to 2050, indigenous light tight oil and NGLs, mainly from shale gas, could maintain China's overall production level (Figure 9). Demand from China is expected to continue to grow with an import requirement of 10 million b/d by the mid 2020s. This assumes some switching from gasoline and diesel in particular to ZEVs. This displacement of oil as a transport fuel accelerates in the post 2030 period. Despite the decline in China's demand, import requirement is likely to remain high throughout the period to 2050. The high level of oil import demand and volatile oil prices are likely to move China more rapidly towards electrification of its vehicle fleet than the USA. Unlike the USA, where a legacy fleet has to be slowly replaced, in China the expansion of ZEVs can be directly to new vehicle buyers. This will speed up the displacement process, provided adequate vehicle and battery manufacturing capacity can be developed.

Whilst India is a smaller market than China for imported oil, its level of imports in the 2030-2040 period is likely to match that of the USA.

For much of the 2020s and early 2030s, the tendency for the oil market to segment into Atlantic and Indian Ocean/Pacific Ocean markets will be reinforced by the major expansion of production from Brazil, and potentially by oil sands production from Canada and Venezuela. Some 5 million b/d of additional production could be generated by Brazil in the

late 2020s. After the mid 2030s, this market segmentation cannot be sustained and Middle East sourced oil will be required to balance the Atlantic segment.

This analysis also shows that OPEC and Saudi Arabia remain in control of the oil market. Some commentators and analysts have taken the view that USA LTO has displaced OPEC as the swing producer. The data tell a different story. Saudi Arabia and OPEC's market power were amply demonstrated in November 2014 and early 2015, when Saudi Arabia's policy drove the oil price rapidly downward. Within three months, Saudi Arabia was able to raise production by over 1 million b/d. The analysis of USA LTO shows that it is a price taker with a high cost of new supply, ranging between $40/b and $90/b. US LTO also has a long response time – taking 2 to 3 years to decline by 1 million b/d. Any significant recovery of USA LTO production is predicated on a rise in oil price at the discretion of OPEC and Saudi Arabia and it will take several years to restore 1 million b/d of US LTO production.