

## *Changing Oil Market Fundamentals and the Implications for OPEC Production Strategy*

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Since the industrial revolution, oil has been key to economic growth and human mobility. Roughly a third of the world's total primary energy consumption is met by oil, with natural gas taking up a further 21%. Prevailing oil demand projections indicate a strong source of growth in oil consumption will arise from the transportation sector as the multitudes of the world's poor move into the middle class in the coming decades.<sup>1</sup>

Still, in recent years, there have been two dramatic changes impacting oil markets. First, recent evidence from the slowing of many of the BRICS economies and now sluggish growth in China is raising questions about the longer term trajectory for global oil demand. Oil use has already peaked in the OECD through efficiency improvements and government regulation. The question is whether that trend line is soon to spread to major developing economies as well as technological advances and automation proliferate more rapidly than expected across the globe. At the same time, the world is also experiencing a structural shift in the oil production industry. New technologies and techniques have led to an increase in recoverable production of oil from shale and source rock, particularly in the non-OPEC regions (Huppmann and Holz 2015).

We examine projected global oil demand sensitivity to slower economic growth in the developing world in addition to other important trends including wider adoption of improved logistics and shipping through big data, ridesharing-induced reductions in travel, congestion in high population regions, and advances in vehicle efficiency, among other factors. There are many oil scenario projections which evaluate oil demand under various policy environments as well as projections that set emissions or fuel use targets and solve for the requisite future fuel consumption to satisfy such targets. By contrast, we are evaluating various non-policy-driven states of the world which may result in reduced oil demand to analyze the sensitivity of oil demand to another dimension of consumption uncertainty.<sup>2</sup>

We find that the one of the most sensitive element influencing oil demand forecasting outcomes is uncertainty about vehicle adoption rates. Reducing non-OECD vehicle saturation levels and speed of private ownership adoption rates by 25 percent can reduce projected 2050 oil consumption by approximately 13 percent. This is roughly the same impact as a 20% reduction in GDP growth rates for all countries. Twenty percent lower GDP yields a 12 percent reduction in 2050 projected oil consumption. We examine the combined effect of reduced vehicle adoption, slower global growth, as well as 20 percent reduction in passenger car vehicle miles travelled (VMT) and 20 percent fuel efficiency improvement in road freight, air, and shipping and find the combined effect could yield a 34 percent reduction in 2050 projected oil consumption. This combination scenario produces a near term peak in oil demand into the 2030s but eventually rising population impacts produce a resumption in oil demand growth.

The persistent element of long term growth in oil consumption appears to be driven by developing countries and Southeast Asian nations. Current levels of vehicle ownership in these nations are very low compared to OECD nations. As a significant portion of these populations move into the middle class and purchase vehicles, their consumption of oil will increase dramatically. However, some analysts are increasingly questioning whether the ASEAN economies will converge with the United States.<sup>3</sup> Should this Asian migration to the middle class happen more slowly or elevates only a small portion of the middle class to vehicle ownership, the consequences on oil demand would be profound.

Another large source in oil demand forecast uncertainty is rates for vehicles miles traveled (VMT). Emerging technologies are reshaping personal transit. While smart phone-assisted ridesharing services may have an ambiguous impact on VMT, the services offering "algorithmic carpooling", a function which pairs riders travelling in similar directions into the same vehicle, can certainly lead to large reductions in VMT. Further, ridesharing has the potential to enable greater use of public transit allowing travelers to rely on ridesharing to go the last mile. Lastly, the contribution of autonomous vehicles to VMT is surrounded in great uncertainty. Autonomous vehicles can provide large efficiency gains due to optimized driving behavior and aerodynamic advantages that result from vehicles being able to follow each other more closely. On the other hand, autonomous vehicles have the potential to drastically reduce the inconvenience of driving allowing passengers to work or relax during long commutes resulting in more

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frequent and farther travel.<sup>4</sup> To test the possible impact of autonomous vehicles on demand trends, we consider adjusting the baseline VMT assumptions from a 30 percent increase to a 50 percent decrease which we attribute to emergent technologies. A 30 percent increase in VMT yields a 12 percent increase in projected 2050 oil consumption and a 50 percent VMT reduction yields a 20 percent reduction in 2050 projected oil consumption. A substantial reduction in VMT significantly reduces the crude oil consumption growth rate and when combined with other demand reducing scenarios or policy interventions could result in a permanent peak in oil consumption by 2050.

Motivated by our projections of uncertain or reduced future oil consumption levels and new evidence of greater recoverable non-OPEC reserves through new drilling techniques, we model optimal resource extraction (Hotelling 1931, Gilbert 1978) on the part of the OPEC in a cartel and fringe setting (Salant 1976, Huppmann 2013). OPEC responds to a variety of factors including geopolitics, competition from non-OPEC supplies and market conditions. In this study, we focus specifically on the market condition of how OPEC can be expected to manage sudden shifts in demand trends. We select this focus because in the future, OPEC may be facing a structural downward shift in oil demand. In past history, OPEC has had marked difficulty as a cartel during periods of demand downturns. In 1997, when Asian economies took a sudden downturn, OPEC heavyweight Saudi Arabia refused to cut production to support oil prices in an effort to force Venezuela to abandon a major oil production capacity expansion program. The result was a collapse of oil prices to \$9/bbl from \$20/bbl and the fall of Venezuela's government in 1998. In another earlier example, global recessionary pressure between 1982 and 1986 prompted Saudi Arabia to initiate a price war against non-OPEC producers, again unleashing a free fall in oil prices from \$34/bbl to \$8/bbl. These historical events provide a window into the challenges facing the cartel today and in the future. The possibility that oil demand might structurally shift from a continually rising trajectory to a flattening or even declining profile over the next few decades changes the calculus for OPEC and all oil producers.

Following a dominant player versus fringe theoretical framework, we find that in the presence of declining demand for oil instead of stationary demand, the optimal resource extraction path on the part of OPEC changes materially. A declining oil demand outlook will prompt OPEC to hasten their production in the near-term, thus crowding out a portion of fringe supplies. This has the effect of delaying the event in which fringe supplies are exhausted. The incentive for OPEC to strategically defer production is diminished in a world of declining oil demand. Both an increase in non-OPEC reserves and a decrease in oil demand outlook shift the optimal OPEC extraction path in favor of elevated near-term production. This finding fits with recent developments of increased production from shale resources in non-OPEC, an unexpected slowdown in oil demand (i.e. demand is increasing at a reduced rate) and a decision by OPEC to end its apparent production restraint. Even when faced with large budget shortfalls due to depressed oil prices, our research suggests that perhaps abandoning oil production restraint is the best course of action for OPEC members who may seek to prevent an eventual depreciation or even stranding of large resources.

In conclusion, we find that technology and global economic patterns are creating a new sense of uncertainty about long term oil consumption trends. This newfound uncertainty has clear and present consequences in the near- and intermediate-term oil market. In the context of an exhaustible resource, a change in demand outlook from steadily increasing growth to a stagnant or declining demand outlook in the long-term has implications for present day oil production strategy and can possibly explain the apparent of end OPEC's production restraint strategy.

### Footnotes

<sup>1</sup> IEA World Energy Outlook 2015, ExxonMobil: The Outlook of Energy, BP Energy Outlook, to name a few.

<sup>2</sup> To undertake these scenarios, we adjust the modeling architecture of the New Policies case of the 2014 mobility model of the International Energy Agency.

<sup>3</sup> A recent Economist magazine article for example says "the gap between the rich and the rest is closing ever more slowly". "Daily Chart: Developing economies are catching up ever more slowly." *The Economist*. June 14, 2016, <http://www.economist.com/blogs/graphicdetail/2016/06/daily-chart-7>

<sup>4</sup> Brown, Gonder and Repac (2014) find that impact of autonomous vehicles on energy demand could range from -75% to +50% while Wadud, MacKenzie and Leiby (2016) find the impact to range between -40% to +100%.E

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