



Peak Demand, Relentless Supply:

A New Framework for the Energy Transition

Paper 2 – Peak Investment

November 2016

Three Fundamental Questions for the Industry : The External View Is Different From The Consensus

Paper 1 discussed two fundamentally different world-views of the energy transition. The industry consensus is that it will be gradual, drawn-out and orderly. The external view was the opposite – the transition is likely to be rapid, sharp and create major disruption.

To analyse this further, this paper concentrates on three core issues facing the industry today, using the framework developed in Paper 1 to form another external view.

Peak demand will not just come by itself. It will raise a number of key issues at the systemic level that will impact incumbent companies.

Three of these are covered below and evaluated using the external view framework – this provides different answers to the ones being assumed today.

When is Peak Investment ?

What is the shape of Demand Post-Peak, and

What will be the Reaction of OPEC?

When is Peak Investment ? - It has probably passed

The industry consensus has it that after the capex reversals of 2015 and 2016, there will necessarily be a rebalancing of investment needed to cover for the expenditure cancelled, and supply gaps that emerge.

That analysis is unlikely to be correct. Peak Investment for oil and gas was probably in 2014.

This is not particularly contentious. From a purely logical perspective, if peak demand is within sight, intuitively, peak investment ought to occur around now. It would be harder to explain why peak investment was well ahead of us, as demand for oil and gas looks likely to decline within a few years, and investments take well over a decade to bear fruit.

Now that Peak Demand has been signaled, will Peak Investment also be called? It is not being discussed, despite being a rational follow-on from Peak Demand.

A review of the previous investment era gives further insight. Another reason that Peak Investment is probably behind us is that the last 10-15 years of spend was high-cost, high-risk and unproductive as it relied on megaprojects that do not allow learning curve effects.

From 2000-2014 annual [oil and gas investment grew](#) at a rate of almost 15% pa: by 2014 oil and gas capex accounted for almost a third of global capital spending at over \$700bn pa. A critical fact to recall in this

however, is that the majority of this spend was by international oil and gas companies in high-cost complex projects (which over-ran and still over-run considerably).

The current era, the last before Peak Demand, is likely to be far more productive as firms translate their previous spend into new output, and divert the majority of their capex into efficient improvement to their historic production base, negating decline rates.

Hence the high-cost tail of the cost curve drove overall spend disproportionately, and forced down productivity dramatically, over 5 times, in terms of barrels of output per dollar invested. The sharp recoil of investment in 2015 and 2016 is almost exclusively due to the high cost players pulling back spend (at ca 25-35% pa). Saudi Aramco, by contrast, has not changed its capital investment plan of ca \$40bn pa during this period. In fact the Saudi pricing strategy to maintain supply was likely aimed at this high-cost production.

Whatever the case, there are three major consequences of this investment “binge” structure in light of a peak demand in 5-15 years and the systemic issues discussed:

- First - any major new project on the drawing board which will take a minimum 10-15 years to start production, will now have to convince management and investors of how it will make money as it provides yet more supply, at very high cost, into an ex-growth market. Following the logic, new megaprojects are timed out - so is most exploration.
- Second - By investing something in the region of 40-70% of the previous capital rate most firms can still invest profitably in existing production, and over-see efficient start-up of new and fully paid-for facilities – the momentum of that \$4trn binge playing out.
- Third - Low cost players such as Saudi Arabia, Russia and the US may resume or even increase investment for strategic or policy reasons – this means that what will likely happen in the next 1-5 years is that overall *investment flattens out* at today’s much reduced level of about \$300-400bn pa, *but supply relentlessly increases* .

In summary, each independent actor will behave rationally by optimizing the use of their capex to maintain or increase production. However, this will provide increased, lower-cost and more productive supply into a market closing in on peak demand.

Of course, OPEC may curb production, or there may be supply shocks. That will not alter the dynamic of the non-OPEC investment structure, in fact it will only accelerate it. Thus production limits by OPEC will only cede market share to non-OPEC producers at higher prices, and allow them to improve their productivity and production potential. It will also hasten the switch to alternative energy sources as discussed below.

In conclusion, from this brief analysis, it is highly likely that 2014 marked the point of Peak Investment for the oil and gas industry (in real terms at least) – which is consistent with a peak demand tipping point around the 2020-2025 mark.

High cost supplies will not now be required to meet declining demand. The Peak Investment era is concluded. Megaprojects and exploration enter history. For non-OPEC producers, the new era, the last before peak demand, is one of more productive capital, and relentlessly increasing supply from the prior era's exceptional spend.

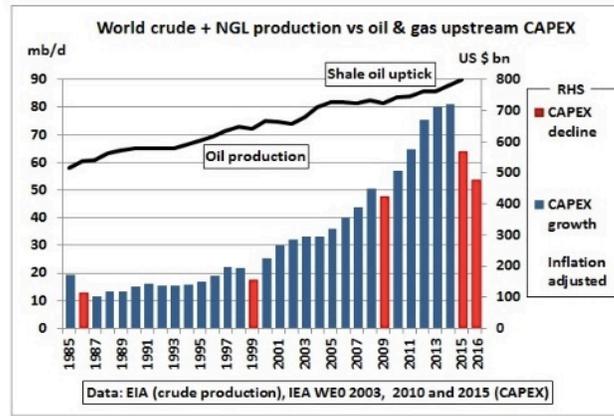


Fig 4: Upstream investments vs oil production

What is The Shape of Demand Post-Peak: Gas Squeezed in the Middle, Oil's Plateau and Decline

Peak demand occurs – then what? The concept of residuals gives an outline of what might happen for the main sectors.

Let's start with gas.

Gas – The Uncertain Residual

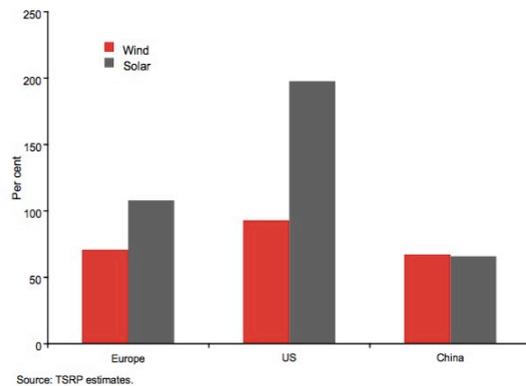
[Chatham House](#) sum up the likely outcome of gas below:

“The markets available for new gas supplies are the uncertain residual of aggressive policies to use renewables (e.g. wind and solar), governments’ policies on nuclear and their attitude to legacy coal generation.

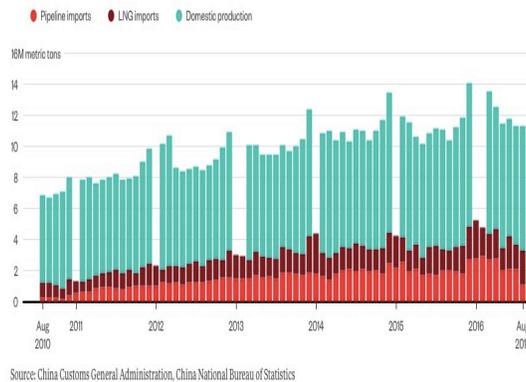
There are developed countries where electricity demand is not growing and within which the promotion of renewables, without a managed exit for coal, neither creates room for gas nor the profitability that power companies need to make the necessary investments.

In developing countries, where access to power is important and demand is growing, it is for the gas producers to persuade governments that gas has a place (particularly where imported coal is very cheap) and achieve volumes sufficient to fund infrastructure investment.”

This analysis is outlined in the two charts below.

Chart 20: The cost of solar and wind relative to gas, 2016E

China's natural gas consumption has gone sideways over the past three years



China has a limited local resource of gas. It therefore has the choice to import it and build the lasting infrastructure to accommodate, or move toward renewables for its enduring electricity requirements.

This has prompted strategic investments in solar and wind which are now cost-competitive with gas. China's stated policy is to have 30% of its electricity supplies from renewables by 2020, and they dominate incremental growth in market share as they displace alternative forms. The weak demand for gas in China over the past three years shows the impact of being a residual form of energy.

India will also confront the same choices, as it has large home-grown coal capability, and may wish to avoid committing to gas as a fuel for the long-term as it observes the viability of renewables exhibited by China.

In all major markets – the US, EU and Asia - gas will need to confront this dilemma of peak demand and increasing supply options. It had been assumed that gas would be a bridge between coal and renewables, but that anticipated fast rates of coal decline, and slower adoption of renewables in growth markets such as China.

Of course, policies can shift due to geopolitics, and gas is often sold in long-term contracts thus mitigating short-term effects. However, as Chatham House notes, new markets for available for gas supply post peak demand are an “uncertain residual”.

Oil – Only One Competitor, But ...

Peak demand for oil will be caused by the dual processes of [“efficiency and substitution”](#).

The future growth of oil demand is heavily dependent on the transport sector, especially in China and India, and on their passenger car segment: in the EU and US sales are flat or in decline. Projections are further dependent on these markets developing roughly in line with OECD driving habits, ownership rates and fuel usage.

Clearly the biggest factor for oil demand and its decline post peak is the penetration rate of EVs into the transport market, especially China, where the bulk of future growth is expected.

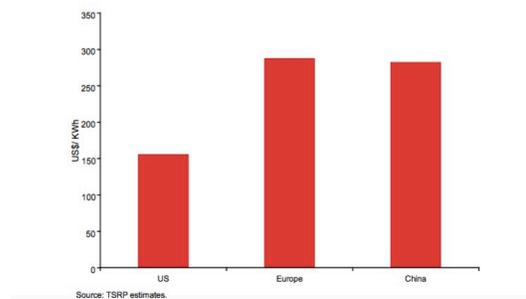
The external analyst view is that the trajectory of EV growth in China is significantly under-estimated. China's pivot to renewable fuels and electricity as an alternative to imported oil and gas also shapes policy in the transport sector.

However the industry consensus is that EVs still make up a small percentage of overall fleets decades from now.

The incremental change argument paints a different picture.

China is on target to sell about 400-500,000 EVs in 2016, which is indeed only about 2% of total vehicle sales. However, it represents around 30% of the growth in sales from 2014, increasing at a rate of over 150% from 2015. The pattern of driving is different in China from the US, allowing lighter vehicles and shorter ranges. This results in break-even battery costs being higher in China, and so EV adoption rates being quicker than the US – see chart from TS below. The new generation of car drivers in China may never really get to know gasoline models.

Chart 23: Battery price at which electric vehicles can compete with petrol cars, 2016E



China is therefore developing mid-level “good-enough” EVs to service the market, whilst the US and Europe continue to perfect the technology. Adoption of Chinese EVs is likely to be at the high end of projections, and as the US and Europe develop technical solutions they will likely move to China, via JVs, for mass uptake.

A compounding factor is that as renewables mature in China, relative to the modest-scale oil and gas industry, the lobbying apparatus of the renewables industry is likely to be more dominant in determining the future energy path. This is another significant difference to EU and especially US assumptions on penetration and growth of the standard combustion engine.

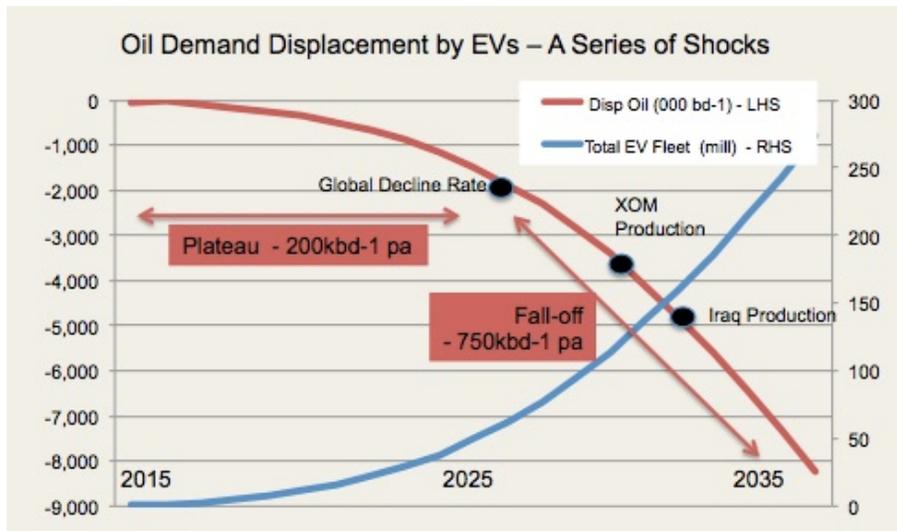
What does adoption of EVs mean for post-peak demand? The industry, and some external analyst, assumptions is that peak will be followed by quite a wide plateau as EVs remain small percentages of the global fleet. What can go wrong?

A typical example of industry analysis is shown [here](#), which also analyses projections by [BNEF](#) and [Goldman Sachs](#).

Using total change, rather than incremental change, its reference case assumes EVs make up 1% of the global pool in 2020, 6% in 2030 and 19% in 2040. However, in incremental terms, this means EVs will be dominating all pool growth before 2030, and very rapidly replacing conventional cars.

The analysis is open but sanguine about the fact that by 2030, 3.5mbd-1 will be displaced, and 14mbd-1 lost by 2040 (greater than Saudi production today). The upper case has 7mbd-1 displaced by 2030.

The chart can be represented as shown below showing the cumulative impact of EV growth on annual oil demand (bd-1).



The assumptions on the detail of annual growth rates can be debated and challenged, but the systemic shape of demand and the implications are clear whether or not the dates change by 2-3 years.

As indicated in the chart, there is a plateau region from today until about 2025 when the incubatory growth period of EVs is still under way, and displacing fuel demand by 200k bd-1 per year. This is a noticeable demand shock already, especially if top-level demand peaks in the same period as is likely.

By 2025 the aggregate demand displaced per annum is now 2mbd-1, which is the equivalent of the managed decline rate of current production.

This means that in 2025 or earlier, the existing global oil production infrastructure in place, even after annual decline, is sufficient to meet the current annual demand. No further new sources of production are required, only the prudent management of current resources.

And of course, after 2025 demand then continues to decline even quicker due to the exponential nature of EV uptake. After this point, even capex invested in field decline management may not be necessary.

Like gas, oil is now a residual, but dependent on the consumer behavior of EV purchasers, especially in China.

The EV market grows exponentially, and so oil demand declines exponentially. As the EV market share reaches just 6%, demand decline is already 3.5mbd-1, or about the same as removing ExxonMobil's current global production requirement. As the curve moves on, demand after 2030 starts to decline around 1mbd-1 per annum or higher.

The penetration rate of EVs, and uptake may differ significantly from this – but the policy vectors in China and the EU suggest that the structure of demand post peak will have these features: short plateau, then steeper decline.

This all occurs within the next 5-15 years, or quicker, but the oil industry is still relying on the same total percentage projections to propose that the change will be moderate, manageable and have limited impact on current business models and valuations.

To put this in perspective then, this demand displacement is the reverse of equivalent supply shocks. Imagine the consequences of Exxon agreeing to remove its entire supply from the oil market over a period of just a few years. And BP following suit a few years later. And so on.

The trajectory of Chinese EV uptake, and the investment by auto manufacturing companies suggests the, industry needs to have a plan for a more rapid decline of oil demand post 2025, and be transparent on the genuine risks it poses to their business models.

The Reaction of OPEC to Peak Demand – A Move to the End Game

OPEC has acknowledged that Peak Demand will occur, and has now [published](#) a scenario assuming it arrives 2029, and slowly plateaus thereafter.

The analysis above regarding oil demand challenges this assessment, but OPEC adheres to the consensus model.

Rather than add to op-eds on OPEC's strategy, this section will use the external framework to look at what OPEC would likely do if it accepted the major premises of the analysis so far.

That is:

- There is Peak Oil Demand ca 2025-2030;
- Demand will decline continuously after this, perhaps steeply due to EV exponential impact
- Many non-OPEC producers will still be supplying strongly for the next several years as stated in their business plans and national strategies – conventional supply may be relentless

- China (and likely India) is investing strongly in renewables to avoid a long-term future of oil dependence, rapidly reducing demand for liquid fuels

Given this, the role of OPEC, lead by Saudi Arabia, is as a low-cost provider of transport fuels which are now a residual between declining over-all demand and the growth of EVs. If it chooses to preserve this resource, by restricting supply, it may produce short-term price improvements, but it has three substantial negative consequences:

- It will encourage the continuation of non-OPEC business models of production investment, ie more supply encouraged by the narrative of “rebalancing”
- It will reduce overall conventional demand due to price rises, and policy responses from consumers
- It will accelerate the introduction of EVs as China and other actors seek to rapidly move away from the long-term dependency on an erratic energy source – they now have viable alternative energy choices they did not have before, and have yet more evidence why energy security requires alternative sources

The emergence of the EV market in to its high-growth phase is a major energy event. It marks the integration of the transport market with the wider energy sectors of power and heat via electricity, and so it shifts oil toward being a long-term buyer’s market.

OPEC therefore, rationally, needs to ensure the plateau of demand post-peak is as long as possible to allow adjustment of its economy and finances. To make gasoline and diesel attractive it needs to guarantee oil pricing is moderate and stable to maintain its appeal against rising substitution by electricity.

It can only achieve this by having control over market-share, and longer-term, stabilized relationships with customers. Curbing supply and forcing up prices to importer nations and their consumers will only hasten the move to alternative sources, and undermine the credibility of any longer-term supply relations.

OPEC therefore probably needs to begin to enter it’s end-game, It needs to quickly leverage its low-cost resources to extract maximize value from them. In turn this implies it will need to (rapidly) increase supply to achieve two core objectives.

First, ensure transport fossil fuels remain abundant and attractively-priced for as long as possible – extend the plateau; and second, remove high-cost competitors for the world post-peak where it will need to dominate market share and buyer relationships – maximize value in the decline.

As a matter of wider geopolitical policy, the oil demand chart indicates that even with a well-executed strategy as above, the market fades to very little some time after 2045. With Saudi Arabia having a reserves to production ratio of about 70 years, and a Saudi Aramco IPO soon to be placed on the international market, a strategy to manage such a system level threat is required as a matter of urgency.

A doubling of Saudi output, for example, would reduce the ratio to about 30 years, but the consequences could be substantial. A simultaneous industrial strategy pivot way from oil as a main revenue resource is presumably also a priority.

The wise IPO investor may want to see the detailed answer to this system level risk.



Summary – over page.

Note - The final paper in this series will cover possible energy industry responses to these key issues

*To Sum Up – The External View on Major Post-Peak Issues***Peak Investment – In the Past – a higher productivity era lies ahead; less capital, more output**

It is highly likely that in real terms the oil and gas industry has passed a peak of capital investment. With peak demand a growing reality, and relentless supply from both conventional and non-fuel forms of energy, most firms will use investment to optimise current production and decline rates, and efficiently transform new assets into stable output. This can be done over the medium term at far lower levels of capital than in the past – no megaprojects for example. Investment by low cost players such as OPEC and US onshore may increase, however, for strategic or policy reasons. In aggregate though the high-end of the investment curve is gone, so the total sector spend will decline, while supply increases.

Shape of Demand Post Peak – Gas An Uncertain Residual, Oil Plateaus Then Sharp Decline

Both Gas and Oil become residuals between flattening demand and alternative sources of energy.

Gas is an “uncertain” residual between legacy coal infrastructure and policies and investment in renewable forms of power. It had been assumed that gas would form a bridge to renewables from more polluting coal. However, the persistence of the coal market especially in Asia, and the rapidly growing alternative of more home-grown renewable technology, especially in China, suggests this market opportunity for gas supply could be much narrower than expected.

For oil the major threat to future demand is the speed of adoption of EVs. On mid-case scenarios, peak demand is followed by a 5-10 year plateau, and then a steep decline as the exponential development of the EV fleet displaces significant volumes of oil demand over a relatively small period of time.

As China is one of the leading users and developers of EVs this removes demand growth quickly and accelerates the decline. The incumbent industry still perceives EVs as a small percentage of the overall fleet over time – this misperceives the exponential shape of the demand decline curve as the transport market now integrates with the wider energy market via electricity, leaving oil as a rapidly declining residual.

OPEC’s Reaction Post Peak – Entering the End Game with Increased Supply

If the oil and gas market demands follow the shapes post-peak as outlined, OPEC faces a world of declining oil demand in a relatively short space of time. It moves to a buyer’s market, and oil becomes a residual as the wider energy market of electricity displaces its consumption at an exponential rate.

OPEC needs to extend the plateau phase of demand contraction, and dominate market share in the steeper decline phase by establishing long-term, stable relationships. This all suggests it needs to move to maximize the current value of existing resource by rapidly increasing production to ensure oil is seen as an abundant cheap fuel in the energy transition phase. Curbing supplies will hasten the arrival of alternative energy, and undermine long-term confidence in OPEC as a seller in an increasingly buyer’s market

