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Electric vehicles: should oil producers be worried?

Electrification of the global car fleet is underway and it will cut demand for oil. For petroleum producers, the questions are not whether electric vehicles (EVs) will hit the road — they are already visible, in growing numbers, and a lengthening list of countries is promoting them — but how quickly their use will expand and how much oil consumption will be lost by their arrival. The data are, for now, unreliable: a consensus on how this will play out has not yet arrived. But oil producers must pay heed. Although the most sceptical forecasts point to slow EV penetration, with little impact on long-term oil-demand growth, the most aggressive predict a revolution by 2040 — a horizon within the lifespan of many new oil projects. Clues to which is correct will arrive soon. Over the next two years, auto manufacturers will push scores of new EV models into the market. The consumer response by 2020 will reveal whether the land-transport segment remains the foundation of oil-demand growth, or a new source of anxiety for producers.

The onrush of electrification

EVs have a long history, pre-dating even the mass uptake of the internal-combustion engine (ICE). But a new and possibly decisive shift towards electrification of the global car fleet is underway — an outcome of secular trends in mobility and attitudes to pollution, especially in OECD countries; regulation to forestall climate change; technological and chemical advances in batteries; and the stimulus provided by several years of soaring petroleum prices earlier this century.

Momentum has gathered throughout 2017. At the end of April, India — expected by oil-sector forecasters to account for much oil-demand growth over the coming decades — said it wanted the country's car fleet to be entirely electric by 2040. In July, both France and the UK announced plans to ban the sale of ICE cars by 2040. Already, many northern European countries promote EVs with generous subsidies both for vehicles and charging infrastructure.

In Japan, charging points for EVs now outnumber filling stations for ICE cars. Trans-national bodies, such as the Electric Vehicle Initiative, a gathering of 16 countries including both the US and China, are also furthering the cause.

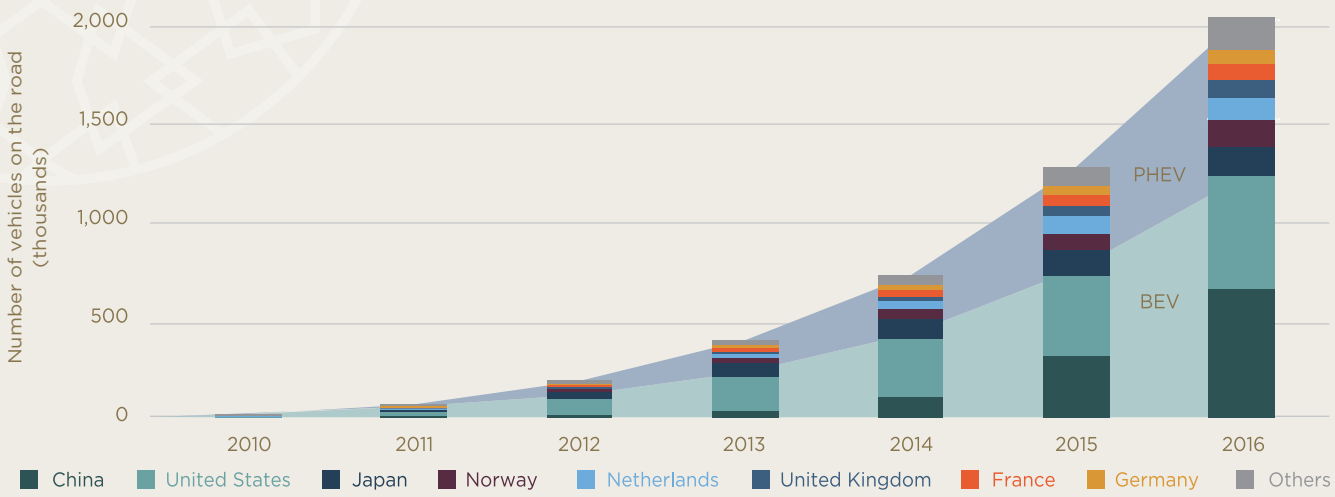
The corporate thrust is at least as significant. Tesla, the EV poster-child, was planning to begin sales of its Model 3 at the end of July, and touts the $35,000 unit as the breakthrough mass-market EV. It should be popular: trade reports say pre-orders already number 500,000, and the company claims it will produce 20,000 per month by December 2017.

Established marques are following suit. Volvo's announcement in early July that all its vehicles would be electric or hybrid-electric (HEV) from 2019 was on trend. Almost all major auto manufacturers either offer or plan to offer a widening array of EV units. Early adopters of the technology in Western countries have so far faced limited choice for pure battery-electric vehicles (BEVs): BMW's i3, Nissan's Leaf, Chevrolet's Bolt, Ford's Focus Electric, Honda's Fit, Renault's Zoe and of course Tesla's early luxury-brand offerings, among others. But from around 30 BEVs available globally now, the number will increase to more than 100 in the next two years.

High growth...

EV penetration of the global car fleet so far has been startling in growth terms, but modest in absolute numbers, and uptake has spread unevenly (see Figure 01). The International Energy Agency (IEA) says the stock of EVs rose by 60% globally in 2016, after 77% and 85% growth in 2015 and 2014, respectively. In 2016, the total stock hit more than 2m vehicles for the first time. Consumers registered 750,000 new EVs (mostly BEVs) last year too — although year-on-year growth was 40%, the first time it has fallen beneath 50%.

FIGURE 01: **EVOLUTION OF THE ELECTRIC CAR STOCK**



Source: IEA

In absolute terms, the biggest EV market is now China, where government policy supports domestic EV manufacturing and hefty subsidies for buyers are in place. It accounted for 40% of EV sales globally last year and the country's EV fleet now accounts for about a third of the world's total, says the IEA.

Beijing's plan is that China will dominate the manufacturing of battery packs and EVs themselves — both for its own market and for export. It is a strategy reminiscent of that pursued by Chinese manufacturers in solar photovoltaics, and it may have a similar deflationary impact on construction costs.

The penetration of EVs in other countries has also been impressive. In Norway, generous state support in the form of tax exemptions and preferential access for zero-emissions vehicles, alongside growing opposition to diesel pollution, has yielded a 29% market share for EVs. The Netherlands (6.4%), Sweden (3.4%), France and the UK (both 1.5%) also offer growing markets.

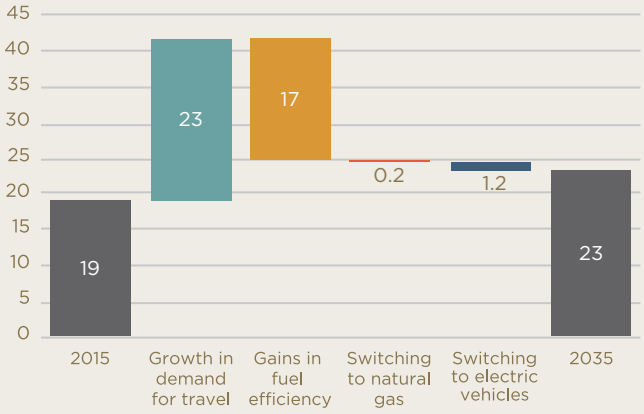
...From a low base

Despite their rapid rise, however, EVs still account for just 0.2% of the world's total stock of light-duty vehicles (almost 1bn). For oil producers, the impact on fuel consumption has been negligible — easily outmatched by the rising numbers of ICE vehicles, especially in the developing world. But what of the future?

Consensus is lacking. Most recent oil-industry forecasts now accept the advent of EVs, but presume their impact will be insignificant. BP's most recent forecast projects the world's car fleet will double to 1.8bn by 2035 (including a trebling of the fleet in non-OECD countries), reflecting a doubling also of demand for car travel. EVs would number 100m by 2035, or just 6% of the fleet (and three-quarters of them would be BEVs). Cars accounted for 19m b/d of oil demand in 2015, BP says, but the doubling of the fleet will not double fuel demand, thanks to an increase in average fuel economy from 30 miles per gallon to 50mpg (see Figure 02).

This efficiency improvement will cost 17m b/d of otherwise expected oil demand, while EVs by 2035 will remove just 1.2m b/d. In total, this calculation yields an increase of 4m b/d in demand from cars. ExxonMobil's predictions are roughly in line with this. It expects ICE cars, especially gasoline, to remain the most popular form of transport "due to their cost functionality and increasing fuel efficiency". Oil demand from cars will, however, peak in the early 2020s at almost 25m b/d, it believes, before declining gradually and modestly in the years to 2040.

FIGURE 02: **BP-ENERGY-OUTLOOK DECOMPOSING CHANGES IN LIQUID DEMAND FROM CARS**



Source: BP

OPEC's outlook is more bullish for oil producers. The reference case in its World Oil Outlook (2016) predicts that "non-conventional powertrains passenger vehicles" (which includes HEVs, fuel-cell, natural gas-fired and others) will number 141m cars by 2040, or 22% of the total fleet. But EVs themselves will account for just 6.7%. It expects the transportation sector to provide one-third of the 16.4m b/d growth in oil demand over the next 23 years.

Only in two other scenarios does OPEC consider EVs a threat to oil-demand growth. In Scenario A, efficiency improvements across the board–including EVs–would cut 2.5m b/d from the oil-demand forecast for 2040 (meaning it would come

in at 106.9m b/d, not 109.4m). In Scenario B, which imagines full implementation of policies necessary to meet the Paris Agreement's goals, oil demand would peak at 100.9m b/d (compared with around 96.4m b/d in 2017) and decline to 98.3m b/d by 2040: 11.1m b/d lower than in the baseline.

The IEA, mixes forecast with advocacy, and offers a range of projections. Its RTS scenario — the deployment of policies already being pursued — sees just 60m EVs on the road in 2030 (or just about 3% of the total). B2DS, a scenario that "falls within the Paris Agreement range of ambition", projects that EVs will number more than 200m in 2030, or more than 11% of the total.

If the IEA's forecast is difficult to pin down, that from Bloomberg New Energy Finance (BNEF) offers the plain view that EVs will upturn the established order in the oil market. By 2040, it believes that more than half of new car sales and a third of the global car fleet, or 530m vehicles, will be electric — the true inflection point will come in 2025, BNEF thinks, after which uptake will be rapid and BEVs fast overtake HEVs. If this forecast bears out, the impact on oil demand will be dramatic: 8m b/d of foregone fuel for transportation (see Figure 03).

Understanding the change

Navigating these varied forecasts will be critical for oil firms throughout the value chain. If BP and ExxonMobil are correct, oil-demand growth will reward investment in petroleum, from upstream to downstream. Take BNEF's outlook seriously — or assume other countries follow the example of Norway, the UK, France, Japan, Sweden, and others, or listen to the EV boosterism of Tesla boss Elon Musk — and spending billions of dollars on projects for petroleum-based transportation looks risky.

Within the oil industry itself, the anxiety has become palpable: few executives have as publicly endorsed or even acknowledged the shift as Ben Van Beurden, Shell's leader. He said in late July his next car would be electric (a Mercedes-Benz S500e).

Understanding the shifts underway in global mobility takes oil companies into the unfamiliar realm of behavioural economics. High oil and fuel prices are not the only drivers behind the disruption. Consultancy McKinsey talks of four "megatrends" underway in the auto industry, which it refers to as ACES. They will "drive more change over the next decade than has occurred over the last 50 years". The first trend (the A in ACES) is towards "autonomous" mobility — and EVs contain the central control unit to facilitate this. The second is "connected" — the convenience of car-grid solutions and cost-effective load bearing in the electricity network. The third is "electrification" itself — the move away from liquid fuels, while lower battery costs improve the economics. The final letter, S, stands for "shared" — another megatrend in which consumers prefer access to multiple vehicle types.

Electrification is the most disruptive of these for the oil market. Consumer demand is now shifting towards e-mobility. McKinsey's recent research shows that although only 3-4% of car-buyers in the US and Germany at present purchase an EV, almost all buyers are now aware of the technology, half consider themselves "familiar" with it, and as many as 44% (in Germany; 29% in the US) consider buying. This suggests a large pent-up base ready for the scores of new models that will come onto the market imminently.

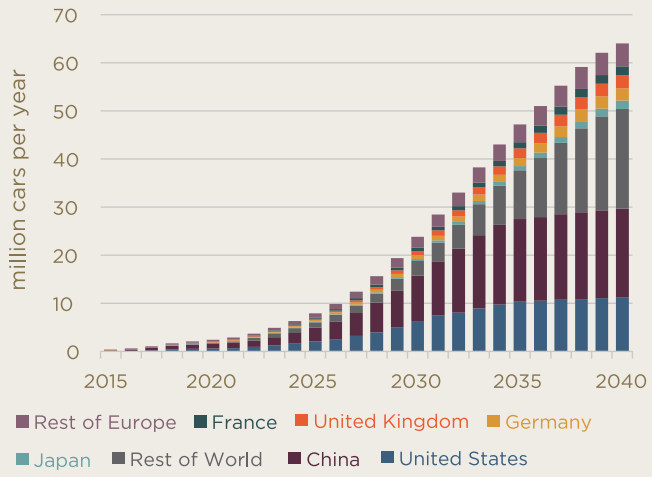
Alongside this growing preference for electric mobility are other trends, says McKinsey: faster-than-anticipated improvements in key technologies; increased urbanisation, "creating more pull for green mobility", and accelerating regulatory forces at national, regional and city levels.

Other unquantifiable changes in consumer behaviour are coming to bear on the transportation sector. Mainstream discourse often compares the EV arrival with the rapid penetration of personal computers, mobile phones or even the ICE automobile itself: disruptive technological changes that brought a revolution to their sectors.

Detractors point out the drawbacks to the analogy: for many consumers, a car is the second-biggest purchase they will make, after a house, so the switch from a functional ICE vehicle to an EV is more significant than the purchase of a cell-phone. The Ford Model T and other early ICE cars promised far bigger changes to mobility than an EV — especially those EVs that, at present, cannot match the range of a gasoline- or diesel-powered car.

Nonetheless, EVs — especially the premium brands — have broken the image of the technology as primarily a green alternative. New models promise buyers torque, speed, and technological wonder.

FIGURE 03: **ANNUAL GLOBAL EV SALES BY MARKET**



Source: Bloomberg New Energy Finance

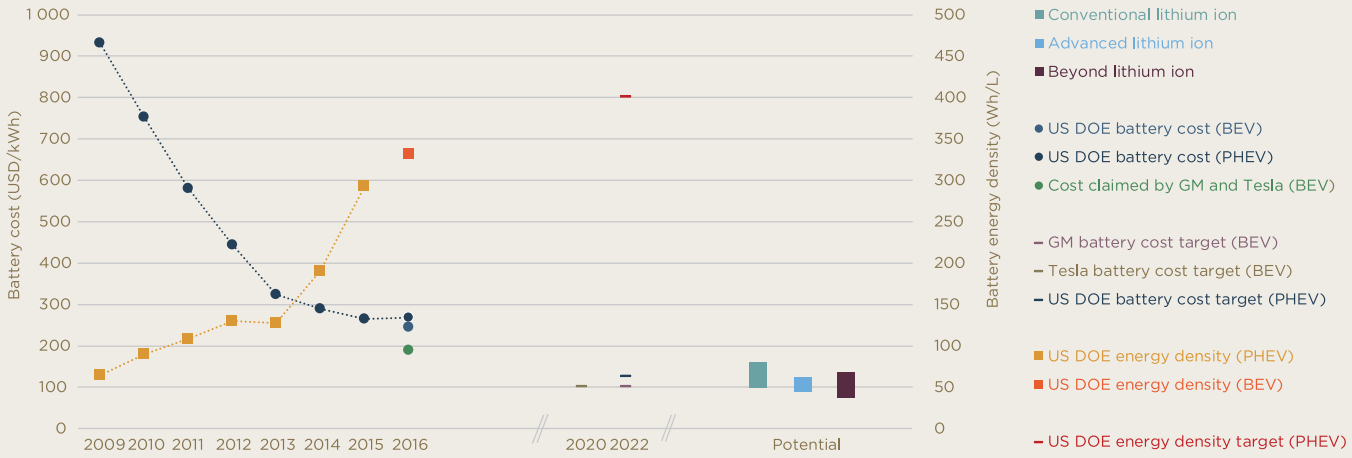
Barriers to mass penetration

For all the fanfare, EVs still face some headwinds: range anxiety, price, the infancy of the supply chain and supporting infrastructure, and the advantages of the incumbent technology.

Range and price are connected: a factor of battery technology (see Figure 04). As batteries have become denser and cheaper, ranges have risen (also helped in some models by "range extenders", a small gasoline motor). The most powerful iteration of the highest-selling BEV globally, the Nissan Leaf, promises up to 200km on a charge. But other battery-electric cars run much shorter distances. Tesla's Model S claims a range of more than 500km, breaking what the auto-industry considered a key 300-mile benchmark. The new Model 3 will offer a range of 215 miles (about 350km), much less than an economical ICE sedan.

Both BEVs and HEVs remain expensive, but this should also change — one reason for the excitement around the new

FIGURE 04: **EVOLUTION OF BATTERY DENSITY AND COST**



Source: IEA

Tesla. At $35,000 for a base model, its price tag is comparable to the average spent in the US on a new ICE car. Still, the BMW i3, a small luxury unit with just a 33 kilowatt-hour battery (less than half the Tesla Model 3's), costs more than $40,000 in the US. The battery pack, which accounts for almost half of an EV's cost, is to blame. Yet between 2010 and 2016, battery-pack prices fell by around 80%, from $1,000/kWh to around $227/kWh, says McKinsey. Tesla has reportedly eked out further reductions, reportedly achieving a cost of under $190/kWh.

Full production from its own Gigafactory battery plant, in Nevada, should deliver economies of scale. In the EV industry, the holy grail is a battery-price tag of $100/kWh, but that is some way off. Parity between EV and ICE car prices can be achieved "within the next decade", says McKinsey. BNEF believes EVs will be "price competitive on an unsubsidized basis by 2025".

Even the chemical composition of EV batteries, which are getting denser, a decade hence is difficult to predict. But assuming the technology follows today's path, huge expansion of the supply chain will be necessary — both for manufacturing the units and supplying the electricity. For example, lithium-ion battery demand, predicts BNEF, will rise from 21 gigawatt-hours last year to 1,300gWh in 2030. Yet plans underway now will delivery supply of just 270gWh in 2021.

The upstream will also be complex and the makings of a new mining boom for raw materials is visible, as demand rises for cobalt, nickel, manganese, graphite, copper and aluminium — all used in Li-ion batteries. Roskill, a metals consultancy, noted recently that a "complicated, and often long, supply chain from mine to battery, with generally slow reaction times in the upstream, are also a risk to the battery industry".

At the same time, the increase in electricity demand from EVs will be significant. BNEF predicts a rise from 6 terrawatt-hours in 2016 to 1,800tWh in 2040, or around 5% of forecast global power demand. Some will consider such structural shifts as improbable; others will see opportunity.

The other main barriers to EV penetration are considered to be charging infrastructure and the dominant position of ICE vehicles. Yet last year charging points sprouted more quickly than EVs themselves: the IEA says growth in such infrastructure was 72%, compared with 60% for the increase in the global EV stock.

IHS Markit, an energy consultancy, predicts that the EV charger market will grow from more than 1m units in 2014 to 12.7m units by 2020. Public policy will need to support this development, as well as the creation of smart metering or other technology to prevent overloading of the grid.

A less noticed speed bump for EVs is simply the durability of ICE vehicles. Recent research suggests that while zero-emissions vehicles may constitute the bulk of new-vehicle purchases, the older ICE stock would linger on for up to 15 years. The implications of this are difficult to predict, but matter for oil producers. Will EVs displace fuel demand in the quantity and as quickly as forecasters like BNEF predict? Or will EVs only add to the total vehicle stock, echoing a common criticism of Norway's high EV-penetration level: that many of the country's EVs are used as second cars. If EVs reduce demand for gasoline and diesel, will this prolong the cost advantage of ICE cars?

Conclusion

The oil industry can no longer shut out the noise from deep in the downstream. A transition in the transport sector is underway. It remains unpredictable and the obstacles to mass uptake of EVs are significant. But never before has the potential threat to oil's dominance come so directly from the stalwart of oil demand: drivers. As auto-manufacturers release scores of new EV models in the next few years, consumers will, simply by their choice of new engine, show how real this spectre is.

Among oil-focused companies some winners can emerge. Even if oil demand goes into moderate decline, the new transportation era, if it is spreads as deeply as its boosters believe, will offer opportunity for energy suppliers. The spread of charging infrastructure and the supply of electricity appear tailor-made for integrated majors with a presence downstream and in natural gas.

Furthermore, if longer-term oil demand growth starts to flatline, the price pressure should reward producers who can extract their oil cheaply, as well as those that can remain close to the markets, mostly in the developing world, that still show greatest thirst for older drivetrains.