

## Electric vehicles: The catalyst to further decarbonisation

### Findings

This report looks exclusively at potential oil demand displacement from electric vehicles (EVs) and finds:

- EVs alone could cause peak oil demand by the late 2020's – with annual marginal growth in oil demand (IEA New Policies Scenario) entirely offset by EVs as early as 2027.
- The size of the global EV fleet is the most significant variable determining the potential displacement of oil demand. Base case assumptions in our model mean 1 million barrels per day of oil is displaced for each 60 million EVs in 2030.
- Strongly growing annual mileage per EV due to shared mobility services and other trends mean 1 million barrels per day of oil demand could be displaced by just 48.9 million EVs, all other things remaining equal.
- Alternatively, if the fuel economy of the remaining internal combustion engine (ICE) fleet improves in a 2°C-compliant scenario 1 million barrels per day of oil is displaced for each 82.5 million EVs, all other things remaining equal.



## Electric vehicles (EVs) can disrupt the oil and gas industry

The oil and gas industry is underestimating the speed, scale and impact of future electric vehicle growth.

The annual EV sales projected by oil and gas companies in the 2020s are conservative. So conservative, in fact, that the combined annual sales projections of just the Chinese vehicle original equipment manufacturers (OEMs) and Volkswagen exceed those in oil and gas company scenarios. Many other companies, such as Tesla, also expect millions of EV sales such that overall oil and gas industry projections of EV sales in the 2020s are 75%-250% smaller than targets of the vehicle manufacturing industry. As such, oil and gas companies risk being blind-sided by the electrification of passenger vehicles being driven by the car manufacturing industry.

In this study, Carbon Tracker analysis finds that 2 million barrels per day (mbd) of oil demand could be displaced by EVs in the 2020s. While small in stature, this volume of oil can result in disproportionately large levels of disruption to the industry; it was a 2mbd imbalance in supply/demand that resulted in the 2014 oil price crash. In a feasible, worst-case scenario for the oil and gas industry, 8mbd of oil demand is at risk from EVs by 2030.

## EVs alone could cause peak oil demand by late 2020s

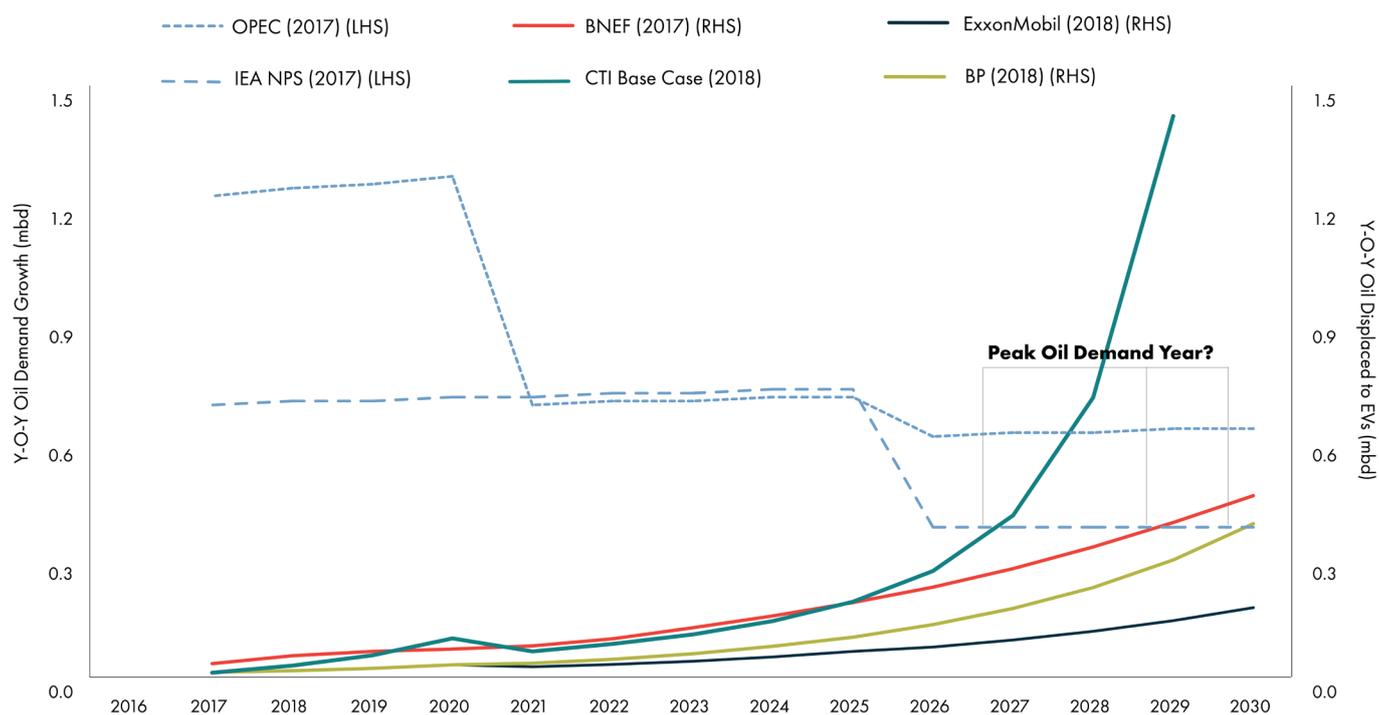
Global oil demand is currently growing above trend at 1.5mbd per year. Most scenarios expect this to slow. Figure 1 below shows that in both the International Energy Agency's (IEA) 2017 New Policies Scenario (NPS)<sup>1</sup> and OPEC's World Oil Outlook 2017 annual oil demand growth is expected to be 0.7mbd from 2020, slowing further from 2025.

Figure 1 shows that annual marginal growth in the IEA NPS is entirely offset by EVs alone from as early as 2027, which would result in peak global oil demand. Oil demand post-2025 in the OPEC scenario is higher than the NPS and so the peak occurs later. Similarly, peak oil demand occurs later than 2027 if the number of EVs is assumed to grow more slowly than in CTI's base case, e.g. an oil and gas company scenario.

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<sup>1</sup> The International Energy Agency is the most referenced authority on energy scenarios. The New Policies Scenario is its central scenario that outlines the current energy and emissions path society is on. Assuming compound annual growth between given data points, the NPS projects just 12.8m EVs on the road by 2025, rising to 280m by 2040.

Figure 1: Peak oil demand - When might annual marginal oil demand growth be offset by EVs?<sup>2</sup>



Source: IEA WEO 2017, OPEC WOO 2017, BNEF 2017, BP 2018 Energy Outlook, ExxonMobil 2018 Energy Outlook, CTI analysis 2018

NB: This chart is illustrative because the IEA NPS and OPEC oil demand scenarios include a modest number of EVs which will marginally serve to constrain oil demand growth. This can not be isolated and removed, so there is some double counting of EVs in the chart.

## Achieving 2°C needs more than EVs

To stand a chance of limiting global warming to +2°C or below, above pre-industrial levels, global oil demand needs to peak as soon as possible. One leading 2°C scenario, the IEA Sustainable Development Scenario (SDS) 2017, requires oil demand to peak in 2020. Figure 1 shows that EVs could peak global oil demand by the late 2020s, under certain assumptions. Clearly, oil demand will need to be curtailed in oil consuming sectors other than just the road transport sector to have a better chance of being 2°C compliant, e.g. aviation, shipping and petrochemicals.

We believe that the potential growth of EVs, and emerging mobility solutions around their use, could be the catalyst needed to drive decarbonisation across oil consuming sectors. We believe that a peak in oil demand will have drastic impacts for the sector as investors reject the proposition of merely standing still.

<sup>2</sup> Oil demand displacement figures (RHS) for BP and ExxonMobil are calculated using Carbon Tracker's base case assumptions for the intensity of EV use and the assumed efficiency of ICE vehicles, which are not disclosed by the companies. BNEF publish its own oil demand displacement figures.

# Introduction

The oil and gas industry has largely dismissed the threat from EVs on two grounds:

- The size of oil demand displaced by EVs will not be large enough to disrupt industry business models<sup>i</sup>; and
- Even a peak in oil demand should not be a concern for investors because oil demand will still be sizeable.

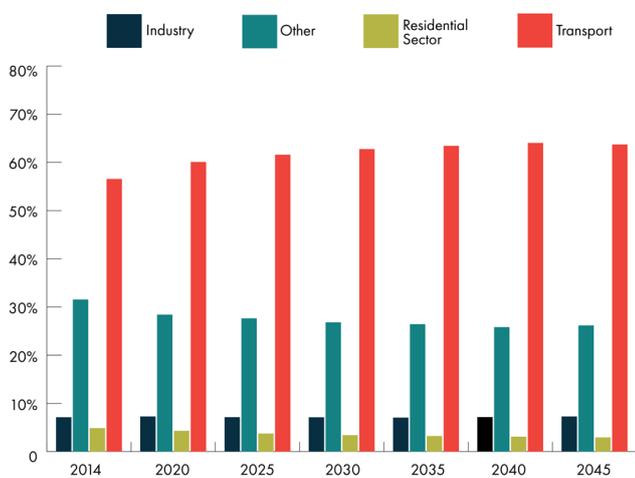
This note argues that EVs could displace a material amount (<2mbd) of oil demand in the near-term and that given the volatile nature of the global oil market, this demand displacement could significantly disrupt oil and gas company business models. Furthermore, we believe that when global oil demand peaks this will fundamentally alter investors’ approach to the industry.

We explore these themes by conducting a sensitivity analysis of the amount of oil demand that could be displaced by EVs in the future.

## Setting the scene

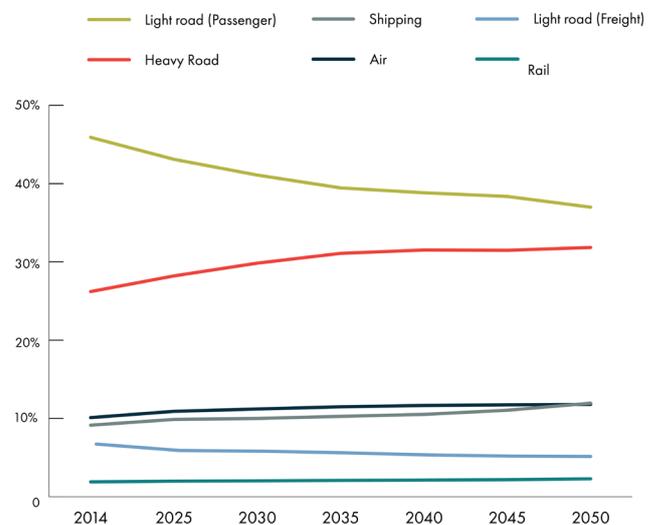
At present, transportation makes up over 50% of total oil demand. On current and planned policies and trends – the IEA’s Reference Technology Scenario (RTS) – this share is likely to increase slightly in the future – refer to Figure 2. While there is potential for much of the transportation sector to become electrified, it will be light-duty passenger vehicles that are electrified first. Figure 3 shows that light-duty passenger vehicles currently make up almost 50% of oil consumed in the transportation sector. Consequently, electric passenger vehicles pose considerable substitution risk to future oil demand. However, Figure 3 also shows that the heavy-duty road transport, aviation and shipping sectors will grow their share of the transport sector in the future, alluding to the need for decarbonisation efforts beyond light-duty passenger vehicles in the medium term.

Figure 2: Global oil demand in the IEA RTS by sector



Source: IEA Energy Technology Perspectives, 2017

Figure 3: Oil demand in transportation by sub-sector in the RTS

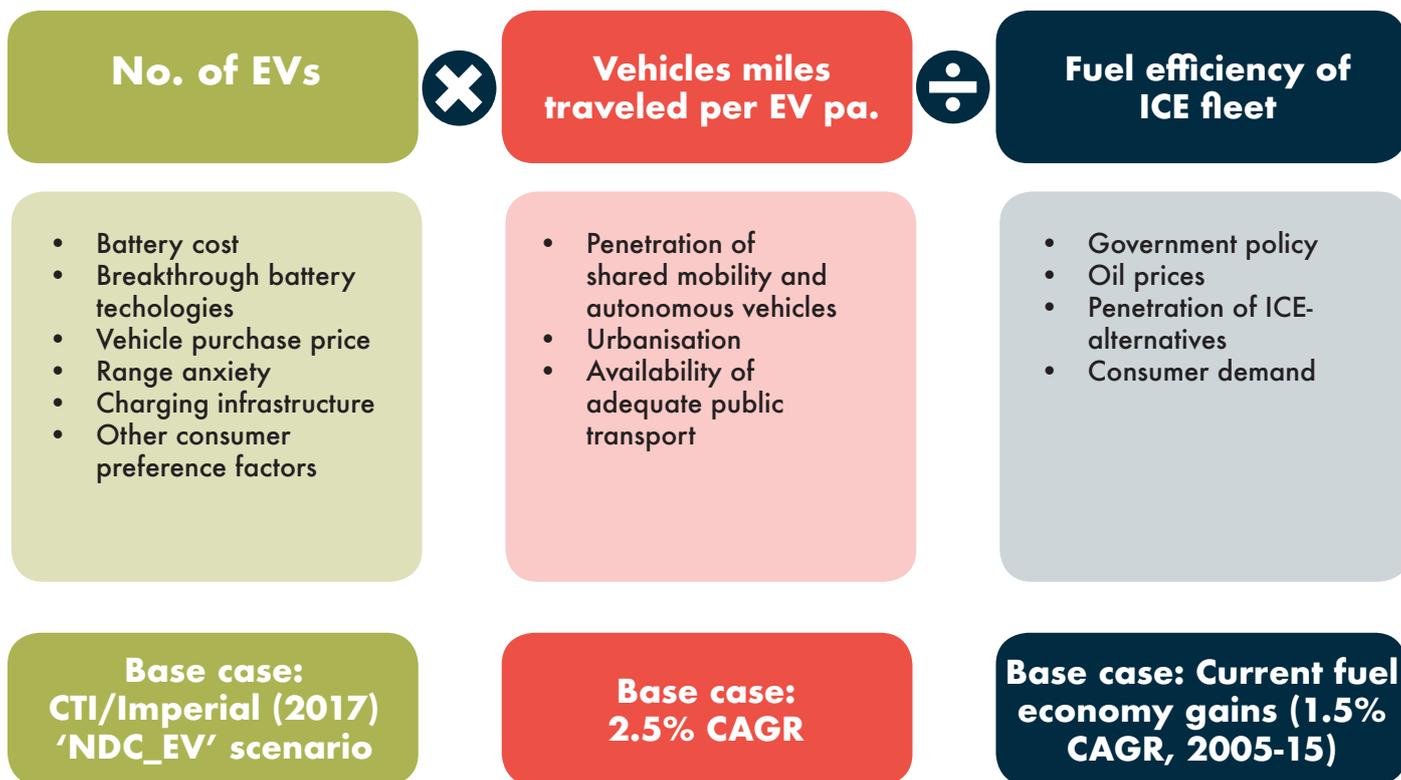


Source: IEA Energy Technology Perspectives, 2017

# Methodology

Calculating the amount of oil demand destroyed by EVs is determined by three core factors – refer to Figure 4. Many underlying variables determine these three factors, a few of which are highlighted below.

Figure 4: How to calculate oil demand displaced by EVs



Source: IEA Energy Technology Perspectives, 2017

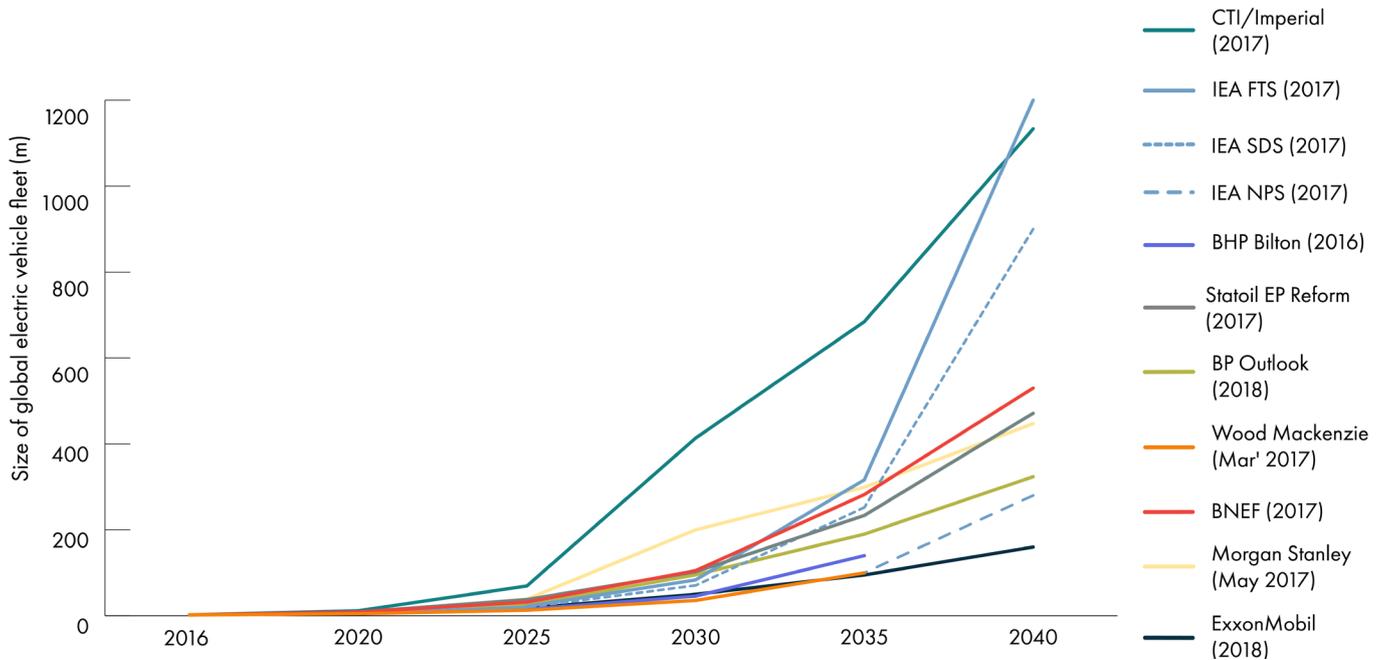
Carbon Tracker applies 'base case' assumptions for each of the three components (see above) to serve as a baseline from which comparisons can be made in this study.<sup>3</sup> We use model inputs from oil and gas company energy outlooks, where possible, to provide an industry perspective for comparison. No oil and gas company or research institution discloses its assumption for all three components of the equation, so the sensitivity analysis in this study tries to fill in the blanks where possible.

<sup>3</sup> The CTI/Imperial (2017) 'NDC\_EV' scenario is from our Expect the Unexpected report. Details of the scenario are on the following pages.

# Variable 1: Number of EVs

Most of the discourse around the future of EVs focuses on the sheer number on the road. This will be determined by many inter-relating economic, political and behavioural factors. Consequently, there is a wide range across energy industry projections for the growth of the EV fleet – see Figure 5 and Table 1.

Figure 5: Projections for the size of the global EV fleet<sup>4</sup>, <sup>ii</sup>



Source: IEA Energy Technology Perspectives, 2017

Table 1: EV fleet projections – (millions EVs)

	2016	2020	2025	2030	2035	2040		2016	2020	2025	2030	2035	2040
ExxonMobil (2018)	2.0	7.0	18.0	50.0	95.0	160.0	IEA NPS (2017)	2	4.6	12.8	35.7	100.0	280
BP Outlook (2018)	2.0	7.0	25.8	95.3	190.0	323.6	IEA SDS (2017)	2	5.5	19.8	70.6	252.1	900
Statoil EP Reform (2017)	2.0	7.5	38.6	200.0	299.1	447.2	IEA FTS (2017)	2	5.8	22.0	83.5	316.5	1200
BHP Billiton (2016)	2.0	4.9	15.0	45.8	140.0		Morgan Stanley (May 2017)	2	8.7	37.9	102.3	233.5	471.3
CTI/Imperial (2017)	2	11.6	69.3	413.5	684.6	1133.3	BNEF (2017)	2	8.8	31.9	105.0	282.1	530.0
							Wood Mackenzie (Mar' 2017)	2	4.6	12.8	35.7	100	

<sup>4</sup> Compound annual growth is assumed between given data points where necessary.

## The CTI/Imperial (2017) scenario

This study builds on the scenarios published in Carbon Tracker’s ‘Expect the Unexpected’ report<sup>5</sup> with the Grantham Institute at Imperial College London. As Figure 1 explained, the base case EV vehicle fleet projection applied in this study’s calculations is the ‘NDC\_EV’ scenario from that report.

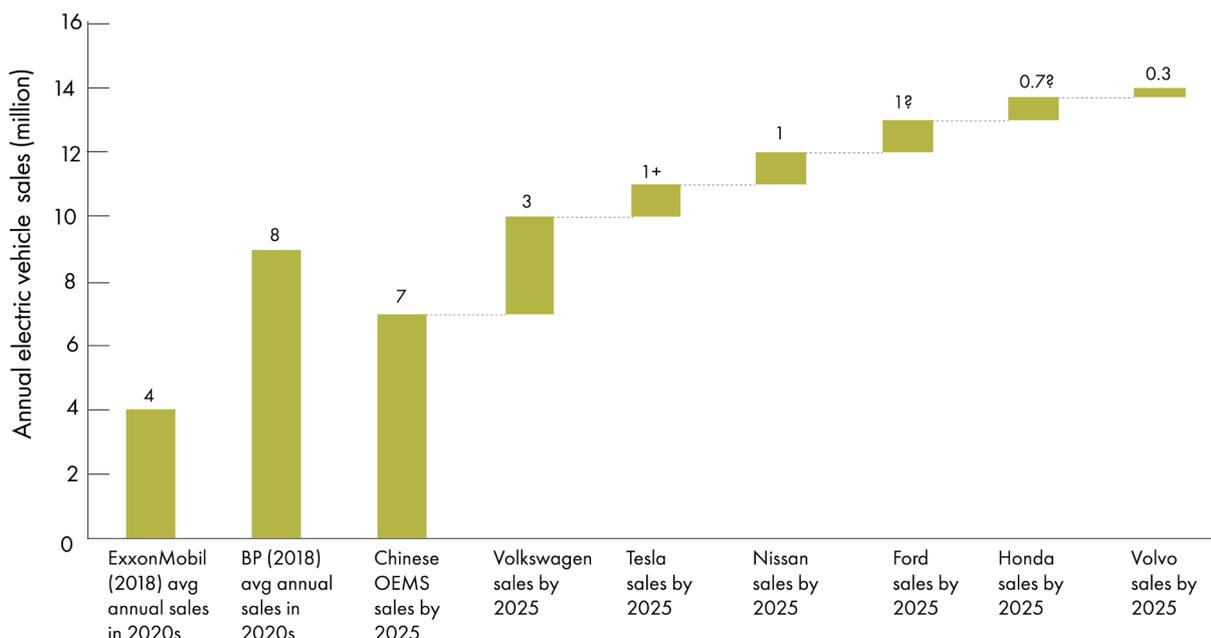
This pathway assumes that EVs reach cost parity with ICE vehicles by 2020 and governments meet their Nationally Determined Contributions (NDC). This means that by the late 2020s EVs begin to take off at scale as the global vehicle fleet turns over – as shown in Figure 5.<sup>6</sup>

## Bearish oil and gas industry is divergent with car manufacturers

Overall, projections made by energy companies tend to be more bearish on the prospect of EVs, and subsequent oil demand displacement, than projections from vehicle OEMs. For example, the latest outlooks from ExxonMobil and BP project an average increase in annual global EV sales of 4m and 9m, respectively, between 2020 and 2030.

This is highly conservative. For example, the Chinese OEMs target 7m annual sales<sup>iv</sup> and Volkswagen 3m annual sales<sup>v</sup>, both by 2025 – refer to Figure 6. If achieved, the sales of these manufacturers alone will surpass the average annual EV sales projections of BP and ExxonMobil. Figure 6 includes projections and estimated sales for other OEMs who have declared sales targets and/or intentions to profit from the switch to EVs. The addition of these OEMs emphasises the degree to which the expectations of the OEMs diverges from those of BP and ExxonMobil.

Figure 6: Comparing oil and gas industry EV projections against those of car manufacturers



5 See Carbon Tracker report ‘Expect the Unexpected. The Disruptive Power of Low-carbon Technology’, February 2017. <https://www.carbontracker.org/reports/expect-the-unexpected-the-disruptive-power-of-low-carbon-technology/>

6 The study assumed a lifetime per vehicle of 12 years.

## Translating EV growth projections into oil demand displacement

Figures 7 and 8 show the levels of oil demand that could be displaced by the number of EVs in scenarios across energy and finance institutions (as shown in Figure 5), with base case assumptions for the other two variables in the displacement formula (Fig 1.), namely that miles travelled per EV grows at 2.5% CAGR and that the rate of fuel efficiency gains in the global ICE fleet continue at recent growth rates (1.5% CAGR). Our demand displacement totals will differ from those companies who disclose their own conclusions, e.g. ExxonMobil and BP, because they will have different assumptions for future EV mileage and ICE fuel efficiency, which are not publicly disclosed.

Figure 7: Energy co. projections of oil displacement<sup>7</sup>

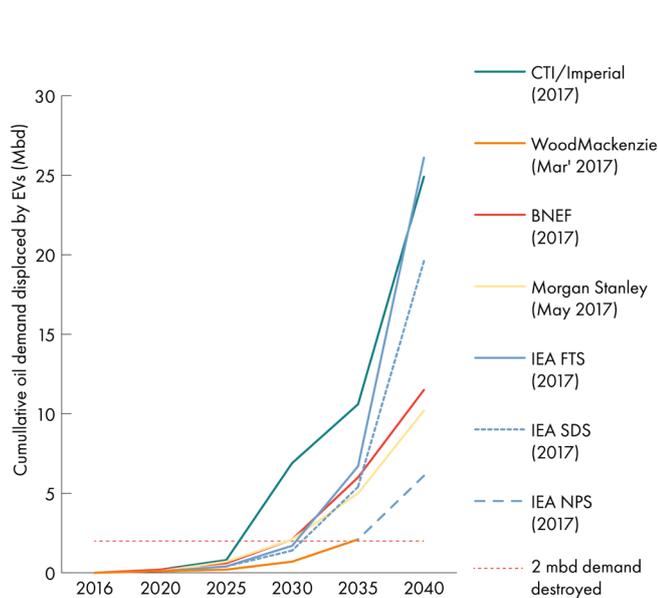
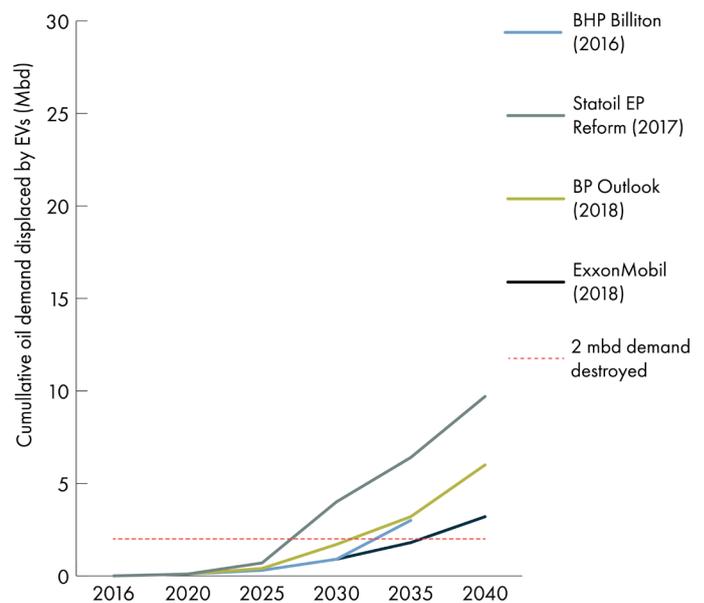


Figure 8: Energy market projections of oil displacement



Assumes base case assumptions; mileage per EV increases at 2.5% CAGR and ICE fuel efficiency improves at current rates (1.5% CAGR).

## Material demand destruction by mid-2020s

Our calculations show that EVs pose a material risk to oil demand. For every 60 million EVs on the road<sup>8</sup>, 1 mbd of oil demand is displaced, under our base case assumptions. To date, the oil and gas industry has dismissed the risk of EVs to its business model, claiming that the oil volumes at risk are too small.<sup>vi</sup> However, recent history has shown the oil market to be highly volatile.

Consequently, small imbalances in supply and demand can result in disproportionate levels of disruption and value destruction. Figures 7 and 8 highlight the 2 mbd demand displaced threshold given it was this amount of imbalance in supply and demand that contributed to the 2014 oil price

<sup>7</sup> The model applies the split between BEVs and PHEVs given by the modelling institution, where possible, i.e. ExxonMobil, BP and CTI/Imperial. For those institutions that do not specify the BEV:PHEV split within its 'electric vehicle' projection, this model applies a ratio of BEVs:PHEVs that goes from 50:50 today to 90:10 in 2040; a ratio in line with CTI's work with Imperial College London (2017) and market projections such as from Morgan Stanley (2017). This represents BEVs becoming increasingly favourable as costs fall, range increases and government policies continue their support. This is an important consideration to make because there is a significant difference in oil consumption between the types of EV.

<sup>8</sup> Taking our assumptions in 2030. This is also dependent on the assumed split between BEVs:PHEVs in the future. See footnote 5 for details of CTI's assumed ratio.

crash. These charts show that EVs threaten to destroy this amount of oil demand by as early as the mid-2020s. This displacement from EVs could result in similar levels of disruption to the industry if this substitution risk continues to be dismissed by the major oil and gas companies.

## Oil and gas companies underestimate demand displacement

Disclosure of the 'oil demand displaced by EVs' metric is sparse within the oil and gas industry – refer to Table 2. Further disclosures of this metric from Statoil, Shell, Total and Chevron, would help advance the EV substitution risk discourse.

Table 2: Oil demand displaced as disclosed by oil and gas companies

Company Outlook	Projected EV fleet (2040, unless stated)	No. of EVs to displace 1mbd (2040, unless stated)
BP (2016) <sup>vii</sup>	71m in 2035	101m in 2035
BP (2017)	100m in 2035	83m in 2035
ExxonMobil (2018)	160m	83m
BP (2018)	320m	71m
This paper's base case assumptions		45.6m

This reveals three key conclusions:

- Oil and gas companies are attempting to catch-up with the pace of progress in the EV industry by increasing their EV fleet projections year on year, as typified by BP's projections in Table 2.
- The falling ratio of number of EVs to displace each 1mbd of oil demand suggests the industry is increasing its assumption on the intensity with which EVs are used (see Variable 2 below).
- Nevertheless, BP and ExxonMobil's estimates of demand displacement in 2040 fall short of the ratio resulting from the base case assumptions made in this study.

## The ratio between pure battery EVs (BEVs) and plug-in hybrid EVs (PHEVs) is critical

Part of the variation between the institutions featured in Table 2 will be due to different assumptions on the future split of BEVs and PHEVs – both of which are included under the 'electric vehicle (EV)' classification used throughout this report and in industry. This ratio is significant because BEVs consume no oil, whereas driving behaviour data suggests that PHEVs complete roughly half of their distance on electricity and half on oil at present.

The CTI/Imperial scenario used as the base case in this study sees BEVs dominate the EV fleet. For those EV projections that do not distinguish between type of EV, this model applies a ratio of BEVs:PHEVs that goes from 50:50 today to 90:10 in 2040. This represents the belief that BEVs will become increasingly favourable as EV purchase prices continue to fall, range increases and the rollout of ancillary services builds. ExxonMobil's 2018 EV projection is broadly consistent with this narrative, foreseeing BEVs making up 50%-66% of the global EV market between 2016 and 2040.

BP on the other hand hold the opposite view. PHEVs make up the majority of the global EV fleet throughout the projection period in its 2018 Energy Outlook. This may reflect a belief that the charging infrastructure required for a majority BEV fleet will be lacking in the future, for example. This viewpoint will serve to significantly reduce the oil demand displaced due to EVs compared with equivalent calculations in scenarios that see a BEV-led EV fleet.

Another factor that can lead to variation is the intensity with which EVs are assumed to be utilised in the future, which will be addressed in the following section.

## Variable 2: The intensity of EV use

The impact on oil demand from the sheer number of EVs on the road is clear. Perhaps less obvious is the role that EV use could have on demand for oil. In theory, every mile powered by electricity is a mile that would have been powered by oil. As such, more miles travelled by the global EV fleet will result, theoretically, in more oil demand displacement, and vice versa.

### How will we use EVs in the future?

Studies on EV use remain in their infancy. Early efforts suggest that PHEVs travel more miles per year than BEVs.<sup>viii</sup> However, data on the average miles driven per Tesla Model S and the Nissan Leaf in Europe suggest BEVs could be travelling well over 10,000 miles per year – the average ICE vehicle clocks approx. 12,000 miles per year.<sup>ix</sup> As the purchase price of EVs falls, performance improves and charging points become more numerous, it is likely that the average annual mileage per EV will increase and a preference for BEVs over PHEVs (as explained earlier) will emerge. Consequently, in this study we test three different rates of growth in the intensity of EV use – refer to Table 3 and Figure 9.<sup>9</sup> The exact rate of growth in EV use is very much uncertain and will be determined by many factors, among which are:

- Improvements in communication technologies;
- Provision of public transport services; and
- The rate and nature of global urbanisation.

Table 3: Sensitivity of oil demand displacement to vehicle usage in 2030<sup>10</sup>

Growth in miles driven per EV from 2016	1% CAGR	2.5% CAGR	4% CAGR
Average miles pa. per BEV/PHEV	10345/12514	12717/15383	15585/18853

Assumes base case assumptions; the number of EVs grows as per the CTI/Imperial (2017) 'NDC\_EV' scenario and ICE fuel efficiency improves at current rates (1.5% CAGR).

No. of EVs to displace 1 mbd of oil demand (m)	73.7	60.0	48.9
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<sup>9</sup> We acknowledge that it is also feasible that EVs are used less in the future due to urbanisation and road congestion in urban areas. This is an area that will be explored in forthcoming Carbon Tracker reports on the road transport sector.

<sup>10</sup> This compound annual growth rate is applied to both BEVs and PHEVs.

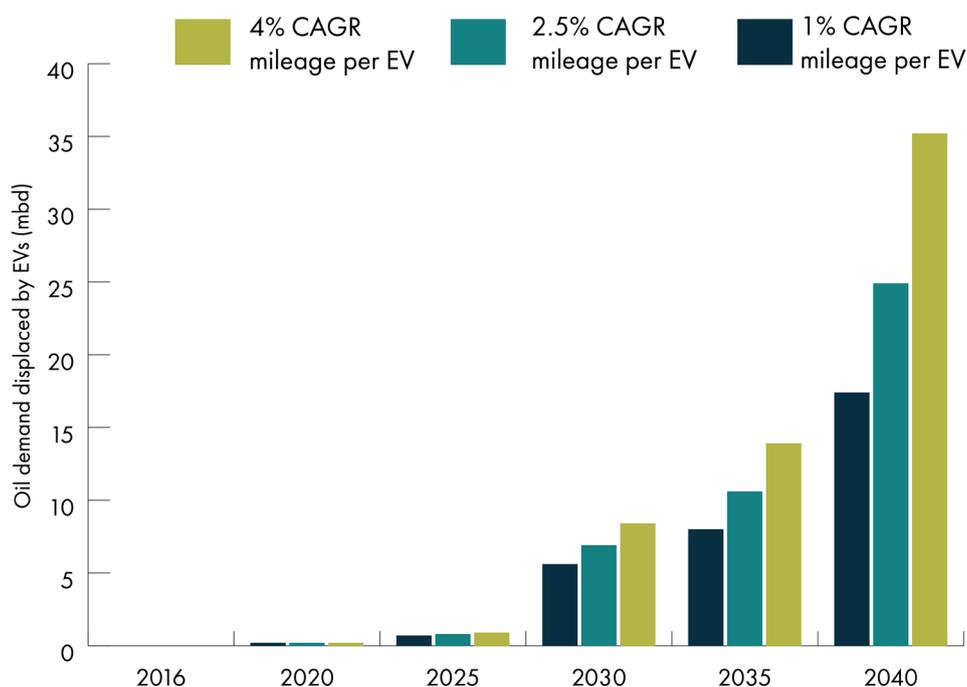
If miles per EV increases faster (4% CAGR) than our base case assumption (2.5% CAGR) then the number of EVs on the road displacing 1mbd falls by 11.1 million. This would make EVs an increasingly near-term risk. For context, BNEF assumes that each EV will travel 22,420 miles in 2040.<sup>x</sup> This equates to 3.9% CAGR over the projection period, so consistent with the high EV usage case, illustrating the potential for our base case to be conservative.

Alternatively, if use of EVs grows more slowly (1% CAGR) than in the base case the number of EVs to displace each 1mbd of oil increases by 13.7 million.

## Understanding total electric vehicles miles travelled is critical

Figure 9 illustrates this impact in terms of cumulative, absolute levels of oil demand displaced by EVs over time. The chart shows that by 2030 significant volumes of oil demand are being displaced by EVs across all three usage sensitivities. By 2040, the more intensive use of EVs scenario (4% CAGR) displaces over 10mbd more than our base case assumption (2.5% CAGR).

Figure 9: How vehicle usage changes the oil demand displaced by EVs in our base case



Assumes base case assumptions; CTI/Imperial (2017) 'NDC\_EV' scenario for EV fleet and ICE fuel efficiency improves at current rates (1.5% CAGR).

Oil demand displacement in Figure 9 is determined by the total electric vehicle miles travelled per year, i.e. the number of EVs multiplied by the annual mileage per EV. A number of complex inter-relationships and potential feedbacks determine the scale of future electric vehicle miles travelled including, but not limited to:

- **Positive rebound effects:** The cost per mile supplied by EVs will fall over time as performance and specifications improve. Users may drive EVs more in response, as evidenced by increased mileages during times of a lower oil price.
- **Negative rebound effects:** Falling purchase prices of EVs could lead to soaring sales, but result in crippling congestion particularly in urban areas, which limits annual electric mileage.

- **Shared mobility:** Studies suggest that the emergence of transport as a service business models will increase the average mileage per EV.<sup>xi</sup> However, the falling cost of these services could apply downward pressure on EV sales and ownership.
- **Autonomous vehicles:** Expected to gain market share from the mid-2020s onwards by the largest vehicle OEMs, autonomous vehicles could undercut the costs of private and shared EV use, particularly once the technology supersedes the need for a driver. This could have complex implications for EV sales, ownership and use prospects as vehicles are used for much more than simply transportation.

Accurately projecting these variables will be critical to understanding the risk EVs pose to future demand for oil. As a point of reference, BP’s central ‘Evolving Transition’ scenario sees the size of the EV fleet growing moderately to 2040 and that the average intensity of use for each EV grows substantially due to the emergence of shared and autonomous mobility – refer to Table 4.

Table 4: BP’s assumed mileage per EV per year<sup>11</sup>

2016	2020	2025	2030	2035	2040
11518	18052	23536	19658	19244	19066

Source: BP 2018 Energy Outlook, CTI analysis

This scenario has EVs making up just 15% of the global car fleet in 2040, but accounting for 30% of the total global miles travelled.<sup>xii</sup> To 2020, the intensity of EV use increases at a rate that far exceeds any tested in our sensitivity analysis. Over the longer-term to 2040, BP’s assumption equates to a CAGR of 2.1%, so more consistent with our base case assumption.

## Future vehicle ownership and use must mitigate CO<sub>2</sub> emissions

Evidently, many pathways of future EV use and its implication for vehicle ownership could transpire in the future. If the future of road mobility is going to mitigate CO<sub>2</sub> emissions, however:

- Private vehicles must increasingly be electric and driven by clean power;
- Ride hailing vehicles must be electric, shared and substitute for privately driven vehicle miles, not passenger miles on public transport; and
- Autonomous vehicles must be electric and displace private vehicle ownership rather than exacerbate congestion.

Policymakers, investors and civil society each have a role in ensuring future road mobility meets these characteristics rather than driving more CO<sub>2</sub>-intense feedbacks and rebound effects.

<sup>11</sup> Calculation based on EVs figures from p36 of BP’s data pack, and electric vehicle kilometres (vkms) for cars from p38. Analysis assumes 1km = 0.621371 miles.

## Variable 3: The efficiency of the ICE fleet

The final component that affects the scale of oil demand displaced by EVs is the assumed efficiency of the ICE vehicle being replaced by an EV. The less efficient the outgoing ICE vehicle the greater the volume of oil that vehicle would have consumed but has been displaced instead, and vice versa. In Figure 10 and Table 5 we test the ICE fleet efficiency assumptions of oil and gas companies against the current rate of improvement and targets set out in the Global Fuel Economy Initiative (GFEI), which is a 2 °C-compliant pathway for global fuel economy to 2030.<sup>xiii</sup>

Figure 10: How the efficiency of the ICE fleet affects oil demand displaced in 2030<sup>12</sup>

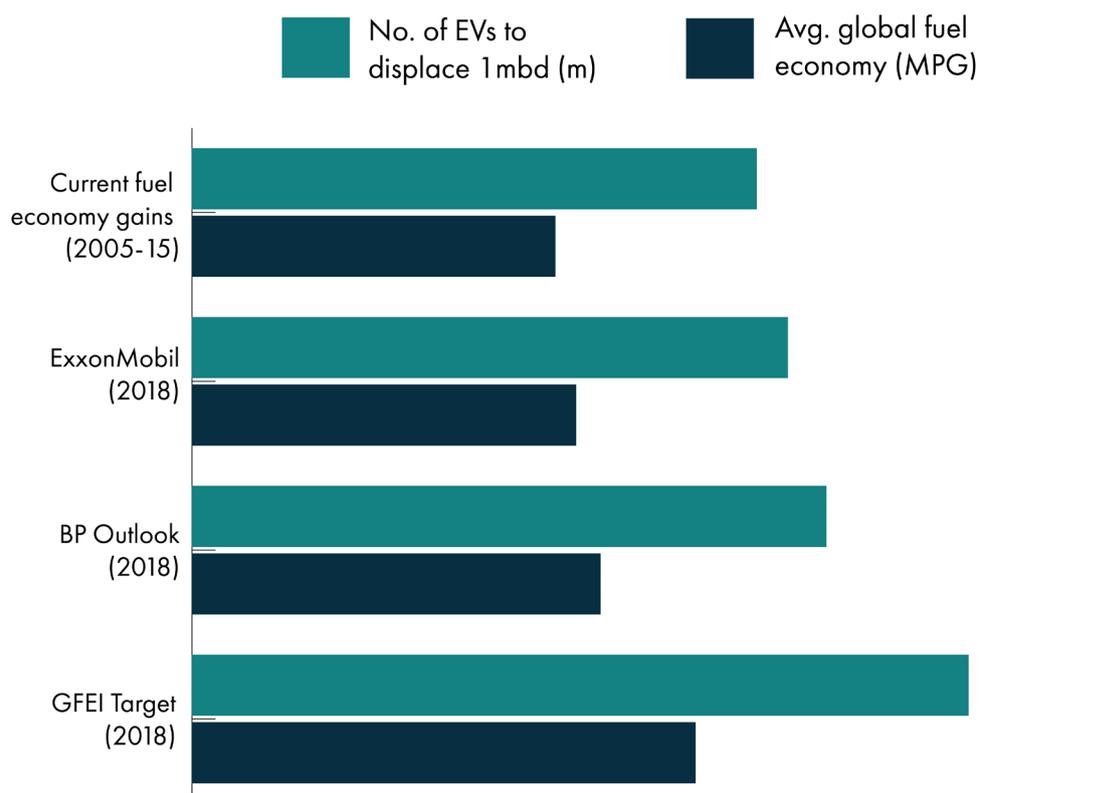


Table 5: Oil demand displacement at different levels of fuel economy

	in 2030		in 2040	
	Avg. global fuel economy (MPG)	No. of EVs to displace 1mbd	Avg. global fuel economy (MPG)	No. of EVs to displace 1mbd
Current fuel economy gains (2005-15)	38.6	60.0	44.8	45.6
ExxonMobil (2018)	40.8	63.3	50.0	50.1
BP Outlook (2018)	43.4	67.4	55.6	55.0
GFEI Target (2018)	53.5	82.5		

Assumes base case assumptions; the number of EVs grows as per the CTI/Imperial (2017) 'NDC\_EV' scenario and 2.5% CAGR in mileage per EV.

<sup>12</sup> Our model acknowledges the potential role for 'oil hybrid' vehicles, i.e. non-plug-in vehicles that have an onboard recharging battery. These vehicles are much more efficient in terms of MPG than conventional ICEs. Our model assumptions compound annual growth of oil hybrids to a 10% share of the global vehicle fleet by 2040. Our model, therefore, applies a weighted average MPG across ICEs and oil hybrids that is slightly higher than the efficiencies in Figure 7.

Our base case models a scenario in which fuel economy of the global ICE fleet continues to improve at the rate seen over the period 2005-2015 (1.5% CAGR). Both ExxonMobil and BP assume an acceleration of the rate the average global fuel economy improves in the future, hereby reducing the oil demand displaced by EVs.

Recent data, however, shows no signs of such an acceleration in efficiency gains. In 2015, the average fuel economy of cars worldwide improved by 1.1%, a considerable slowdown on the 1.8% pa gains observed between 2005 and 2008. A number of countries and regions have more stringent fuel-economy standards planned that would constitute an acceleration of efficiency gains, if met. However, sports utility vehicles (SUVs), which are 30% less efficient than smaller passenger vehicles, are becoming increasingly popular globally, hereby offsetting some fuel economy gains.<sup>xiv</sup>

In this context, the 2°C-compliant GFEI target looks exceptionally ambitious - global fuel economy must improve by 3.8% CAGR to 2030.

## **Oil and gas industry pushing for more efficient ICE vehicles? Not quite**

On the surface, Figure 10 and Table 5 might suggest that the oil and gas industry could reduce the risk of oil demand displacement from EVs by supporting the acceleration of efficiency gains in the ICE fleet. However, this does not tell the whole story. If the efficiency of the ICE fleet improves strongly, for example in line with the GFEI:

- Less oil demand will be displaced by the growing EV fleet; but
- Less oil will be consumed by the ICE fleet due to these accelerated efficiency gains, so this is less desirable for the oil industry than a business-as-usual scenario; but
- The oil and gas industry would prefer ICE vehicles become more efficient than be entirely displaced by BEVs, which consume no oil whatsoever.

Clearly, there is an order of preference for the oil and gas industry across a business-as-usual scenario, ICE efficiency gains and the emergence of EVs. While this report focuses solely on the impact of EVs on oil demand, the inter-relationship between improving fuel efficiency of the ICE fleet and the emergence of EVs is critical to fully understanding the future evolution of oil demand in the road transport sector (see below).

## **ICE efficiency gains and growth of EVs are not mutually exclusive**

BP refer to this inter-relationship in its 2018 Energy Outlook in which it suggested that there is negative correlation between ICE efficiency gains and EV growth, i.e. if EVs grow strongly, car manufacturers will invest less in efficiency gains of ICEs which will slow, and vice versa. This argument essentially means that there is a maximum (ceiling) amount of oil demand that can be displaced due to advances in the road transport sector (efficiency gains plus EV growth).

BP's argument implies that the only driver of EV sales and fuel efficiency gains is from the car manufacturers to meet fuel economy regulations. However, we argue that this sole focus on the supply-side overlooks many other demand-side factors, most important of which is consumer preference, which means that the growth of EVs and ICE efficiency gains are not mutually exclusive.

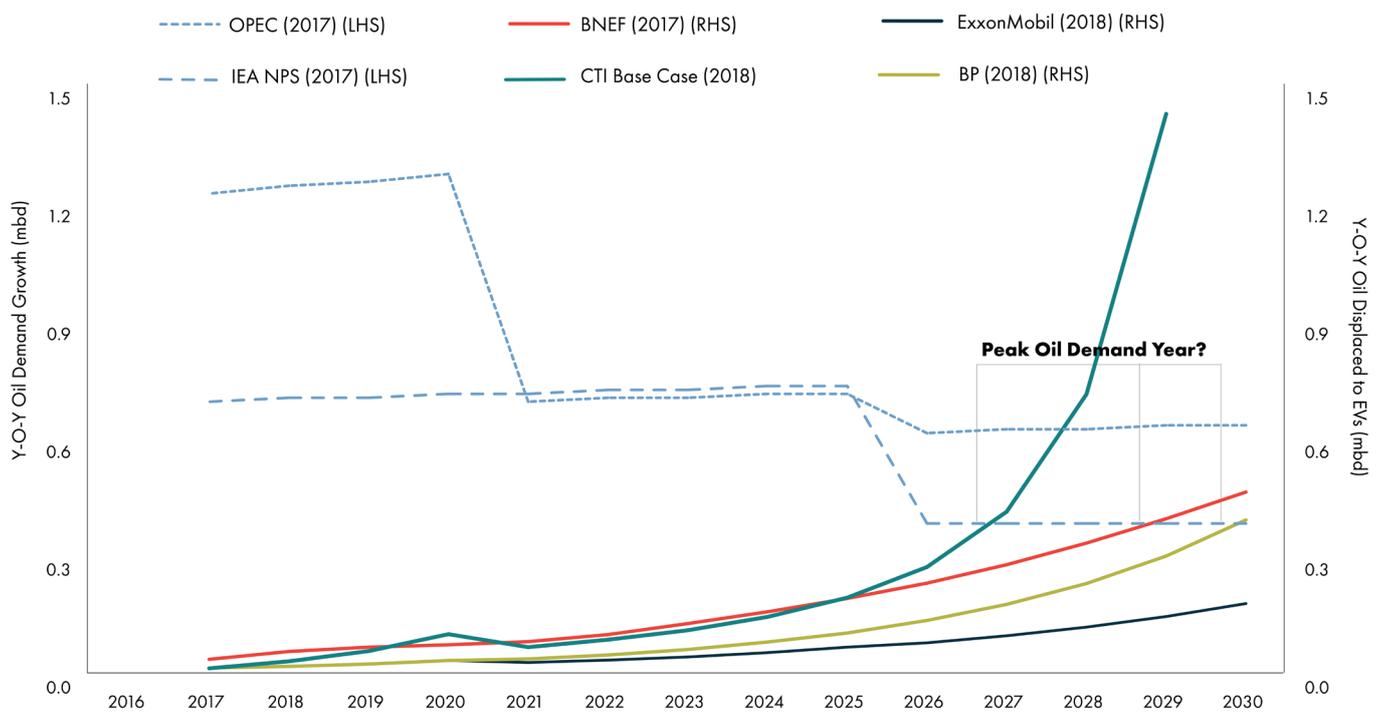
# When might global oil demand peak due to EVs?

The light duty passenger vehicle market is huge, approximately 25% (25mbd) of global oil demand. As such, the market share that the electrification of the passenger road transport sector will take in the future will be more than enough to peak oil demand by itself. The question is when will this occur and will this be soon enough to align global oil demand with international climate change agreements?

Global oil demand is currently growing above trend at 1.5mbd per year. Most scenarios expect this to slow. Figure 11 shows that both the IEA's 2017 NPS and OPEC's World Oil Outlook 2017 expect annual oil demand growth to be 0.7mbd from 2020, slowing further from 2025.

Figure 11 takes these oil demand scenarios and overlays year-on-year change in oil demand displaced by EVs in a range of scenarios, under our base case assumptions where necessary. This shows that EVs alone could displace all marginal growth in oil demand projected in the IEA NPS from 2027 onwards, meaning peak global oil demand.

Figure 11: When might EVs peak global oil demand?<sup>13</sup>



Source: IEA WEO 2017, OPEC WOO 2017, BNEF 2017, BP 2018 Energy Outlook, ExxonMobil 2018 Energy Outlook, CTI analysis 2018  
 NB: This chart is illustrative because the IEA NPS and OPEC oil demand scenarios include a modest number of EVs which will marginally serve to constrain oil demand growth. This can not be isolated and removed, so there is some double counting of EVs in the chart.

There are a range of sensitivities to the potential peaking of global oil demand in Figure 11. If oil demand is more robust than the IEA NPS, as projected in the OPEC scenario for example, the year of peak oil demand will be later than 2027. Similarly, this study has explored a number of variables that could result in upsides to future oil demand in the road transport sector and push back the year of peak oil demand, as per oil and gas industry scenarios in Figure 11.

## Achieving 2°C needs more than EVs

Clearly, EVs pose a material risk to future oil demand. The oil and gas industry should not dismiss the fact that EVs alone could peak oil demand in 10 years. However, most scenarios that keep global warming to +2°C require oil demand to peak sooner than the late 2020s. The IEA's SDS sees oil demand peak in 2020, for example. Consequently, it is clear that decarbonisation of other oil consuming sectors must compliment electrification of the passenger road transport sector if the oil sector is to be aligned with a 2°C outcome.

## Conclusion

- Oil and gas industry projections of future EV fleet growth in the 2020s are 75%-250% smaller than the sales expected by those global car manufacturers that have announced targets.
- The oil and gas industry are largely dismissing the threat of EV substitution in the global car parc. This is risky in light of the volatility of the oil market and the fact that up to 8mbd of oil demand could be displaced due to EVs before 2030.
- EVs could peak global oil demand by 2027.
- To have the best chance of meeting the +2°C climate target, oil demand must peak as soon as possible. Consequently, decarbonisation will be required in oil consuming sectors other than just the road transport sector.

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<sup>vii</sup> <https://www.bp.com/en/global/corporate/media/speeches/back-to-the-future-electric-vehicles-and-oil-demand.html>

<sup>viii</sup> [https://energy.gov/sites/prod/files/2015/07/f24/vss171\\_carlson\\_2015\\_p.pdf](https://energy.gov/sites/prod/files/2015/07/f24/vss171_carlson_2015_p.pdf)

<sup>ix</sup> <https://newsroom.nissan-europe.com/uk/en-gb/media/pressreleases/128282>

<sup>x</sup> <http://blogs.platts.com/2016/04/21/electric-vehicles-impact-oil-electricity/>

*the intensity of EV use and the assumed efficiency of ICE vehicles, which are not disclosed by the companies. BNEF publish its own oil demand displacement figures.*

<sup>xi</sup> [https://www.energy.gov/sites/prod/files/2015/07/f24/vss171\\_carlson\\_2015\\_p.pdf](https://www.energy.gov/sites/prod/files/2015/07/f24/vss171_carlson_2015_p.pdf)

<sup>xii</sup> BP Outlook 2018

<sup>xiii</sup> <https://www.globalfueleconomy.org/>

<sup>xiv</sup> <https://www.nytimes.com/2018/03/03/climate/suv-sales-global-climate.html>

**Author:** Luke Sussams, Senior Researcher at Carbon Tracker (until May 2018)

### **About Carbon Tracker**

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