A TECHNICAL NOTE

Fuel duty decline

RAC Foundation

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Foreword

Could we get the price right?

For many years, if there has been one source of income that the UK Government could rely on consistently to raise huge sums of money at fantastically low cost of collection, it was fuel duty. Come rain or shine, the Treasury knew down to a few percentage points how many millions of pounds it could reliably expect to come rolling in.

Simple and surprisingly cost-effective to collect, almost impossible to evade, and levied on a product with barely any elasticity of demand, fuel duty has long been a banker for the Chancellor. In 2019 alone, it brought in £28 billion of which 58.6% was from car duty (£16.4 billion).

Yet this certainty is now under threat.

First, there has been the temporary impact of COVID-19 and associated restrictions on our travel. Hopefully that is now starting to be behind us but none of us can be sure what the lasting impacts might be if, as seems at least possible, those of us who can work at or near home choose to do so rather than returning to the five-days-a-week commute. On the other hand, some of us might actually drive more if we trade our daily rail commute for a weekly drive out or just drive more because we are at home. And then there is the growth in home deliveries, by vans and cars. The fact is we just do not know.

Second, more predictably, the number of miles we drive will increasingly not be in cars powered by fossil fuels; our cars, vans, trucks, and motorbikes are all ultimately going to have to change and the big push right now is on getting motorists to go for plug-in battery electric options.

So much does the Government want to get us away from fossil fuels that they are ending the sale of new petrol and diesel cars from 2030. We are setting aside here the outside chance that a wholly synthetic fuel can be developed at a volume and price that makes it a viable product for everyday travel, rather than niche, high-value markets such as motorsport or historic vehicles.

CO2 from motor vehicles is clearly a material part of our environmental problem and needs solving. But – whichever way one looks at it - at some point in the foreseeable future the Government's income from fossil fuel duty is going to evaporate – less fuel burnt, less fuel bought, less duty coming in. The only real uncertainty is: how fast?

One big factor is the enthusiasm of consumers. There are plenty of public opinion surveys that show there is considerable pent-up demand for electric vehicles. But translating best intentions ('would you buy an electric vehicle?') into showroom sales ('have you bought an electric vehicle?') is no foregone conclusion.

A multitude of factors are at play:

- the general state of the economy and people's perception of their own wealth;
- what subsidies and incentives the Government is offering;
- how close in price electric vehicles are to their fossil-fuelled counterparts;
- the convenience, cost, and reliability of recharging;
- the future relative cost of competing fuels;
- whether a stepping stone technology – cleaner petrol and diesel, plug-in hybrids – appears to offer a better short-term option; and
- the attraction of electric vehicles for business users – benefit-in-kind incentives for company cars might propel drivers into plug-in hybrids and full electric vehicles as might company policies driven by their environment, social and governance reporting obligations.

But the uncertainty is only one of timing, not outcome. This is what the technical report that follows focuses on, pulling together multiple permutations of the many variables to generate a range of plausible outcomes for fuel duty income from cars, all of which point to a substantial fall by the end of the decade. What's more, practically any changes arising from fresh policy initiatives to encourage EV take-up or constrain car use look set to accelerate the decline in fuel duty income.

So, what can the Chancellor do in the face of the fiscal dilemma he now faces?

First, there is the perfectly legitimate option of plugging the gap by tweaking other tax or duty rates (or spending less).

There is no hard and fast rule that decrees motoring should always be subject to its own special fiscal regime, it is just something we – as drivers – have grudgingly got used to, accepting that motoring imposes costs – environmental, safety, congestion – on society beyond those of maintaining, operating, improving, and building roads. Not that you will find any mathematical basis for the current rates of duty that relate back directly to those costs – a subject on which former RAC Foundation director Professor Stephen Glaister has recently written [1], arguing that getting the prices facing individuals closer to the social costs of their actions imposed on others is a necessary condition for making progress on carbon reduction, because as long as people see that the carbon implication of their choices is cheap to them it will be hard to encourage them to change.

But if we take it that the question the Chancellor is asking today is not 'given all the available options, how should I fill this gap?' but rather 'how can I maintain the income I receive from motoring?', then there are options before him which, to keep it simple, we believe could be boiled down to three variants.

1. Hike fuel duty and other motoring taxes such as vehicle excise duty (VED)

Raising fuel duty would hit poorest motorists hardest. They have the oldest, least economical vehicles and are not in the market for alternatively fuelled replacements. Then there are commercial vehicles that are still heavily dependent on diesel. Extra input costs for hauliers, delivery drivers, and tradespeople will either affect their ability to trade or result in higher prices for their customers.

Last year, the Government consulted on possible changes to the way VED is levied. There is sense in increasing the showroom tax on the most polluting vehicles and aligning ongoing payments to emission levels more precisely; however, with VED currently raising only around £6 billion per annum, there would have to be sweeping changes to the system if it was to be a long-term alternative to fuel duty in terms of yield. Not only that, VED is an ownership tax not a usage tax. Is it right for the level to rise regardless of how extensively vehicles get used?

2. Introduce road pricing

The very words are enough to send a thousand economists into a near-delirious state of excitement and tens of millions of drivers into a nervous sweat. If ever a phrase was Marmite, it is 'road pricing'. Charging by distance, time, and place is the perfect academic solution to the problems of road transport because it is a system that could capture the marginal damage being caused by drivers and charge them accordingly for each ill, be that for polluting the atmosphere or causing congestion.

For politicians, it is a nightmare: complicated to understand and collect, it has a history of generating lurid headlines when journalists pick up on the highest possible charge that someone might pay in the most congested of circumstances, rather than the more modest figure the rest of us would be likely to pay most of the time. It is 12 years since the then Labour Government decided to retrace its steps quietly back up this garden path, having tested the technology needed and then floated the idea only to run into a maelstrom of public opposition, at the heart of which was an online petition against the concept – a novelty at the time – which garnered more signatories than several smaller parties gain votes at a general election.

Of course, much has changed since 2009: our understanding of the climate crisis has heightened, as has our understanding of the health impacts of poor air quality. The demands to do something about both have grown and the technology needed to enable a workable road pricing system is not just closer at hand but has improved in functionality and fallen dramatically in price (not least in the take-up of connected vehicles and smartphones). Yet none of this is guaranteed to make traditional road pricing as economists would think of it an easier sell to a sceptical public.

Why?

Just on the practicalities, what we would be contemplating is a large-scale Government IT project – do-able, but the track record is not great. More challenging is whether we could really guarantee that we would get the pricing right to see an end to the jams. There would need to be endless charging permutations and a huge headache in ensuring the sum of all these individual journeys – costed by said distance, time, and place – added up to roughly the amount of lost income from the fuel duty you were trying to replace. Get that wrong and you are either out of pocket or risk being accused of creating a stealth tax. A surplus over and above historic fuel duty income levels might be desirable from an income perspective but would make the political pitch even more fraught.

Of course, you could ignore what has gone before and charge for the true economic cost of each journey taking into account the current price of carbon, the value put on lives lost in a road crashes, to air pollution, and to the economic impact of congestion. Probably a calculation worth revisiting, if only to see whether the numbers stack up, but still anomalous when every other activity that contributes a degree of harm – smoking, flying, heating your home, eating meat – bears no similar system of taxation.

And then there is the question: if it is such a good idea why has no one else done it? The nearest example of a car-based system is Singapore, a country that would fit geographically about three times over within the circumference of the M25 and has a modest system of gantries and cameras to keep track on the movement of vehicles – a system that is, frankly, little more than a click or two up from the simple London Congestion Charge. Schemes that apply charges to lorries are more common and could well be pathfinders for proving the performance of the charging architecture, but these only apply distance charges, not full road pricing as economists would recognise it.

So, on to number three.

3. Distance charging

The scheme some places around the world are starting to develop seriously is road pricing's less glamourous, less exciting, and consequently less contentious sibling – basic distance charging, which, in effect, is what fuel duty is: the more you drive, the more fuel you use and the more you pay in fuel duty. Except that there is some scope still to vary the per mile charge, for example, depending on how big and heavy your car is (remember the problems of non-tailpipe emissions are still with us in the EV world). Distance charging could be viewed as a de-risked version of road pricing. Dropping the time and place elements of charging makes for a radically simpler, and for that also read cheaper to run, system.

There is another element of de-risking that could be built into the deployment of a distance charge –only introduce it for vehicles that are not consuming fossil fuel. For those requiring petrol and diesel, keep the tried and tested fuel duty system in place.

Why not?

Migrating the entire world of motoring onto a new taxation system would be a mammoth task. But implementing a new charge only for new, zero tailpipe emission vehicles from a fixed date would still be a major project but a much more manageable one, more on a par with the scale of the various lorry road user charge schemes that are well established in many countries already. And love electric vehicles as we do, let us not forget the costs they will still be imposing on us in terms of road casualties, road congestion, and non-carbon-related particulate pollutants such as brake, tyre and road pavement wear.

Several US states have started to take steps in this direction, with electric vehicle charging projects live in Virginia, Utah, and Oregon and, potentially next year, Washington, and public pilots in Hawaii and California. Ironically, in the US where fuel tax is far lower than the UK (only about 10p per litre versus 58p per litre in the UK), 28 states already impose an additional fixed annual road tax charge for electric vehicles to contribute to their road budgets.

These projects show that obtaining robust mileage data can already be done in many ways: either by accessing the vehicle's on-board data directly from the vehicle maker, via an app or insurance 'dongle', or simpler still, by requiring an odometer reading. In the UK, this could easily be built into the annual service for the first three years and thereafter into the MOT check.

In some US schemes, an app is used to regularly upload a photo of the odometer as an alternative for users not wanting systems to connect to their vehicle. The creation of schemes offering different options has apparently helped US pilot programmes achieve public approval, along with good public communications about why the charges are made and engagement with the private sector to brand and run the charging systems at arms' length from Government.

Such a scheme could be developed for the UK so that drivers and fleet owners would have the option to pay upfront either in a single annual charge or monthly, as with household utilities based on projected mileage (derived from the historic average, or, as with many insurance policies, the driver's own estimate). The rate-per-mile could be set by reference to the estimated fall in fuel duty income but with the qualification that it would probably be politically wise to set it so that drivers opting to go green would, on average, not be out of pocket compared to what they would have paid had they stuck with fossil fuels. At the end of the year any overpayment could be refunded and any shortfall made good. It would even be possible to allow drivers a quota of 'free' miles, as suggested by another former RAC Foundation director, Edmund King of the AA (which might provide a further financial incentive to drive less)[2].

There would, of course, be much detail to be worked through. A solution would need to be found for plug-in hybrid vehicles. Models would need to be set running to estimate the outcome from different rates of charge. (As if such models aren't almost certainly already being run somewhere in the bowels of the Treasury.)

And there is another glitch to be overcome – the fact that electric cars still come at a price premium to their petrol and diesel competitors. Why on earth would the Government want to risk putting an additional price on the ownership of an electric vehicle when the lower running cost is part of the attraction? Very difficult, this one, but let us go back to the original questions we posed at the start of this musing. If, and it is a big 'if', the Government intends that motoring in the broadest sense should be a net contributor to the Exchequer, then there must come a time when it comes clean on its intentions with regard to electric vehicles and other zero tailpipe emission vehicles. Uncertainty over that – already reported to be an issue in electric vehicle-friendly Norway – could, of itself, put the brakes on electric vehicle take-up.

Of course, although we would hardly be advocates, the Chancellor might ponder on whether part of the package might be to unfreeze fuel duty on conventional fuels from the point when the new distance charge regime kicks in (after all, the level of duty has not risen since March 2011). One sure-fire way of making electric vehicles less expensive than internal combustion engine (ICE) vehicles would be to take steps to make ICEs more expensive to run. And while that brings yet more complexity into the forecasting, such a move could further accelerate the move to go electric, assuming the supply side can keep up (which, unfortunately, is not by any means guaranteed).

What follows in this report is our attempt to provide the Government and interested commentators with some possible scenarios on the fuel type breakdown of the UK car parc in the years ahead and what they might mean in terms of lost revenue for the Treasury. How the Government then influences these scenarios and responds to them is, of course, a matter for the Government of the day.

Ultimately the Chancellor – in discussion with the Prime Minister, Transport Secretary and colleagues – will decide which road to go down driven by environmental, social, and, inevitably, political priorities. The three things that we would observe are:

- the fact that the clock is ticking on fuel duty income declining, as recognised by several US states;
- that when it comes down to brass tacks there's a great, a very great, deal to be said for allowing the necessity to be bold in ambition to be tempered by minimising the practical delivery challenges through de-risking; and
- that in an uncertain and fluid environment Government can help set and stick to a clear path that enables us – be we individual motorists or fleet purchasers – to take informed decisions (and that does not just go for decisions about the cars we decide to drive).

Steve Gooding

Steve Gooding

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1. Executive Summary

As part of the national strategy to tackle carbon emissions, the Government is pushing through the transition from the internal combustion engine (ICE) to future drivetrains with zero tailpipe emissions, and, as of today, is putting huge effort and emphasis on encouraging the take-up of electric vehicles. But with this shift to electric power comes a challenge in another part of Government – an inevitable decrease in income from fuel duty and VAT on fuel.

The purpose of this report is to forecast how fuel duty income to the Exchequer from cars is likely to decline through to 2035, inform debate on what measures might be appropriate to plug the fiscal gap and, more specifically, suggest at what point decisions about those measures will need to be taken.

There are many uncertainties when creating forecasts, so this report explains the assumptions used in our modelling and sets out how we have sought to deal with the wide range of possible futures using 11 parameters. A plausible range has been set for each parameter and the model was then run with each permutation of these parameters, creating a total of 432 outputs. This allowed us to generate a range of trajectories for the likely rate of decrease in fuel duty income from cars.

Clearly how much fossil fuel continues to be consumed by motoring depends on which vehicles drivers choose, which trips they make, and how often they make them. Therefore, we have chosen as our starting point the pre-COVID-19 ownership, trip (mileage), and vehicle fuel economy patterns as representing a more realistic base than the reduced travel resulting from the COVID-19 lockdown and subsequent restrictions, although we recognise there are considerable uncertainties, for example, in the extent to which 'normal' five-days-per-week office working will return.

The analysis looks more closely at three scenarios illustrating total fuel duty income from cars in 2035. The 'high' output shows a scenario generating the highest amount of fuel duty (the 'high scenario'), the low output shows a scenario generating the lowest amount of fuel duty (the 'low scenario'), and the median output shows the average fuel duty amount by taking the middle value of fuel duty income in 2035, which we call the 'median scenario'.

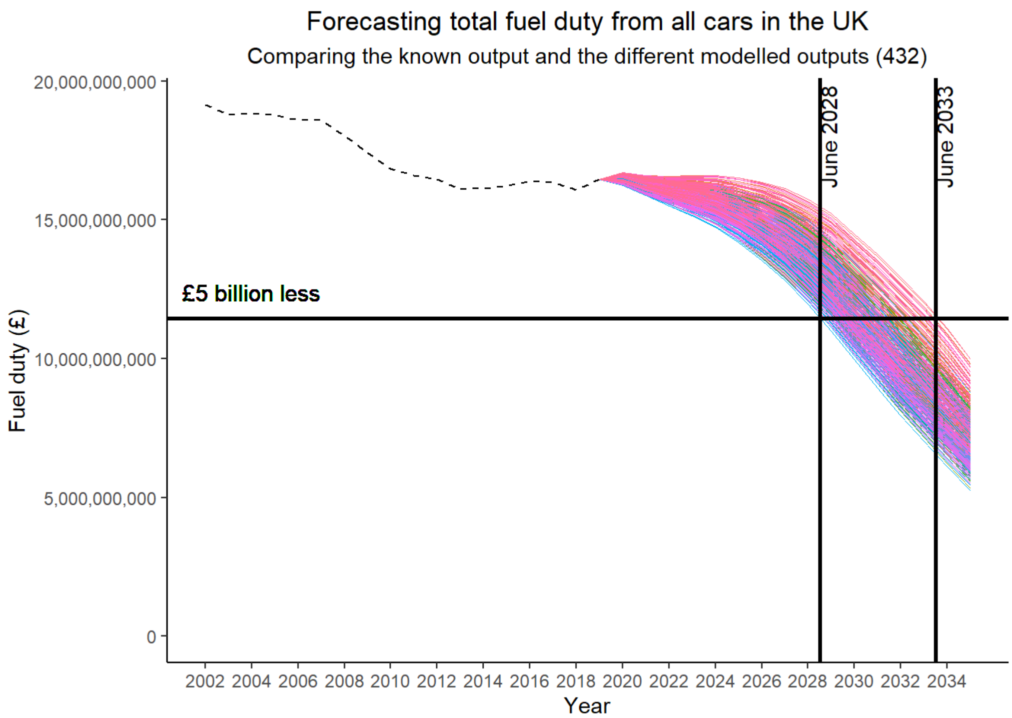
Fuel duty

The total fuel duty revenue from cars and taxis in 2019 was £16.4 billion representing 58.6% of the £28 billion of fuel duty income from all fuel sales (Office for Budget Responsibility, 2021).

By 2025, compared to the 2019 figure, we predict that fuel duty income from cars will have fallen by £1.1 billion to around £15.3 billion in our median scenario. In the low scenario, it could have fallen to around £14.2 billion while in the high scenario it could still be similar to the 2019 figure.

The results from the median scenario suggest that by 2035, fuel duty income from all cars could have declined by 57% to around £7.1 billion compared to the 2019 figure. In the high scenario, fuel duty would be around £10 billion and in the low scenario around £5.3 billion.

To identify the point at which the decline in fuel duty income from cars would become a serious issue for the Treasury we have specifically looked at when that income is likely to have fallen by 5 billion simply because that feels like a material sum. The graph below shows that there is a reasonably wide spread of dates by when this could happen, reflecting the wide range of scenarios run through our model. In the high income scenario it could be 2033 before income drops by £5 billion, in the median it is around 2031 and in the low scenario it could be as soon as 2028.



It is important to recognise that the modelling is based on existing policies and established trends. We have not speculated, for example, on the potential impact of the high fuel prices we are currently experiencing, were they to be sustained, save to observe that anything that either accelerates the move away from fossil-fuel consumption or reduces car travel will bring forward the date at which our notional 5 billion threshold will be reached (unless, of course, the duty rates are themselves increased – see chapter 7).

In 2019, fuel duty from diesel cars was £7.3 billion. By 2035, the median scenario suggests that fuel duty from diesel cars will fall by 84.3% to around £1.1 billion. The lowest expected fuel duty in the low scenario, by then, would be around £0.9 billion and in the high scenario it would be around £1.2 billion.

In 2019, fuel duty from petrol and Plug-in hybrid (PHEV) cars was £9.1 billion. This looks set to increase slightly until around 2024–2026 for the low and median scenarios, possibly as a result of drivers switching from diesel to petrol cars and from 'banking' improved fuel efficiency by trading up to larger, higher-performance vehicles, until peaking at around £9.3 billion in the low scenario (£10 billion in the median scenario). In the high scenario, this could increase at a higher rate until 2028 to around £11.7 billion, after which fuel duty from petrol declines in all scenarios.

By 2035, the median scenario shows that duty from petrol and PHEV cars could fall 35.2% to around £5.9 billion when compared to the 2019 figure. In the low scenario, this will be around £4.3 billion and in the high scenario it will be around £8.7 billion. In all scenarios, although in aggregate fossil fuel consumption, and consequently CO2 emissions, broadly flatline before reducing substantially into the 2030s.

Fuel consumption

In 2019, total fossil fuel consumption by car and taxi use was around 28.4 billion litres (DfT, 2021c). Compared to 2019, the median scenario in the model suggests that total fuel consumption will fall by 2.1 billion litres to 26.3 billion litres in 2025; by 2030, it could have fallen by 7.9 billion litres to 20.5 billion litres and by 2035 it could have fallen by 16.2 billion litres to 12.2 billion litres.

Diesel consumption was 12.6 billion litres in 2019. The median scenario suggests that diesel consumption will fall by 84.3% to around 2 billion litres by 2035.

The median scenario shows petrol consumption from petrol and PHEV cars will peak in 2026 at around 17.2 billion litres – around a 1.4 billion increase from the 2019 figure, 15.8 billion litres.

By 2035, compared to the 2019 figure, petrol consumption from petrol and PHEV cars could fall by 35.2% to around 10.2 billion litres in the median scenario. In the low scenario, it would fall even further to around 7.5 billion litres, although in the high scenario, petrol consumption would be (at most) 15.1 billion litres.

Car parc

The total UK licensed car parc in 2019 was 32.9 million. Future parc modelling is heavily dependent on the assumptions made about new car registrations and departure (for scrap or export) rates.

As a result, the model assumed that by 2035 there will be at least 29.3 million cars and at most 34.5 million cars in the UK licensed for use (i.e. excluding cars that are registered but off road).

The diesel car parc declines more rapidly in all modelled outputs. The median scenario in the report suggests it will fall from 12.9 million cars to around 2.9 million by 2035.

The petrol car parc follows a similar trend to the petrol duty and fuel consumption graphs, based on there being an increase (as buyers switch from diesel) before it starts to decline. The median scenario shows the petrol car parc will increase from

19.8 million in 2019 to 20.2 million in 2026. It then shows that the petrol parc will fall to around 12.6 million by 2035.

All modelled outputs show that the PHEV parc will increase exponentially. The median scenario shows the PHEV parc increasing from 156,000 cars to around 3.1 million by 2035.

All modelled outputs show that the battery electric vehicle (BEV) parc will increase exponentially. The median scenario shows the BEV parc increasing from 91,000 cars to around 15.4 million by 2035.

Annual total mileage

Various factors and policy initiatives could influence future annual mileage driven. Our analysis takes the pre-COVID-19 2018–2019 average as its starting point. This was found by using the Driver and Vehicle Standards Agency (DVSA)'s anonymised MOT data to obtain all car MOT results in 2018 and 2019 to find the total mileage driven between the two years. Using the MOT data allowed the model to use the average mileage by age of car and fuel type.

In 2020, total mileage in the median scenario was around 231.5 billion. By 2025, this increases by 1.3% to 234.5 billion miles. And by 2030, this increases to 240.4 billion miles. Finally, by 2035, this will increase to 254.6 billion miles.

Ultimately, the model generates a wide variation of possible future outcomes, that being a product of the wide range of assumptions and permutations we have run (see further detail in Chapter 3); however, the fuel duty graph generated suggests that all outputs follow a similarly shaped downward curve, the only difference being just how fast fuel duty income will decline.

2. Introduction

The purpose of this report is to forecast fuel duty income out to 2035 and explain how the model we have used captures assumptions for real-world fuel consumption, parc numbers, new market scenarios, driving, and parc turnover rates.

Fuel duty is a fixed duty that is added to the price of petrol and diesel fuel before the application of VAT. It is currently set at 57.95 pence per litre (December 2021). Since the Government encourages the increase of sales of zero tailpipe emission (predominantly electric) cars – by creating ultra-low emission zones, providing plug-in car grants, and banning the sales of new ICEs in 2030 and PHEVs in 2035 – the result will inevitably be a reduced yield from fuel duty (unless the duty rate is 'unfrozen' and increased, see Chapter 7). The question is then how much will fuel duty decrease by and at what rate, and, in particular, when is the decline likely to become significant in relation to overall Exchequer income?

To answer these questions, we created a model that uses various datasets from the Government, the SMMT (the trade association for the UK auto industry), and Spritmonitor.de (a collection of real-world fuel economy data). The model forecasts the future car parc by applying the established departure rates (explained in detail later) and new car sale predictions. Fuel economy (CO_2) figures and annual mileages are then applied to the model.

The level of fuel consumption needed to achieve the average mileage can then be calculated to predict the total fuel likely to be consumed and thus the duty yield for the Treasury.

The paper is divided into six further chapters. The next chapter explains the methodology of the model, describing the input data used, the assumptions made, and the calculations applied. The fourth chapter explains the parameters that can be adjusted in the model. The fifth chapter sets out the results of every output considered in the model. The sixth chapter sets out the results from three key outputs: the lowest, highest, and median total fuel duty likely to be collected in 2035. The seventh chapter shows how much fuel duty would have to increase by to maintain duty income at its 2019 level. And, finally, the last chapter explores alternative scenarios that avoid the increased consumption of petrol fuel (from petrol cars only) in the very near term.

3. Methods

This section describes the data sources, assumptions, and methodology used.

3.1 Input data

The following data sources were used in the creation of the model:

- Bespoke DfT tables of DVLA data:
    - Cars by fuel type and year of registration as of 31 December 2019 in the UK. The DVLA defines a car as a '4-wheel vehicle including people carriers and all passenger carrying vehicles that can carry no more than eight passengers (excluding the driver)'. This includes private hire taxis but not Hackney Carriages.
    - Average CO_2g km^{-1} emissions values from licensed cars at the end of the year by year of first registration and fuel type for the United Kingdom in 2019
- Published DfT tables (Table VEH0124; DfT, 2021a):
    - VEH0124: Licensed cars at the end of the year by make and model and year of first registration for the United Kingdom in 2016
    - VEH0124: Licensed cars at the end of the year by make and model and year of first registration for the United Kingdom in 2017
    - VEH0124: Licensed cars at the end of the year by make and model and year of first registration for the United Kingdom in 2018
    - VEH0124: Licensed cars at the end of the year by make and model and year of first registration for the United Kingdom in 2019
    - VEH0124: Licensed cars at the end of the year by make and model and year of first registration for the United Kingdom in 2020
- Divergence between Spritmonitor.de and type-approval CO_2g km^{-1} emission values by year of registration and fuel type (Tietge et al., 2019);
- Mileage values for all MOT tested cars in Great Britain via the DVSA anonymised data; and
- New car registrations outlook scenarios sourced from the SMMT (SMMT, 2021).

3.2 Assumptions

Before explaining how the model works, it is important that we explain the assumptions used to achieve a working and plausible model. Some aspects of forecasting fuel duty decline would have been incredibly complex to input into the model, so we have simplified these components.

The assumptions used included:

- The Government continues to tax cars and their use in the same way as it currently does.
- The model only forecasts the fuel duty from cars and we used the DVSA definition of a car, that is the makes and models that have done at least one Class 4 MOT test. Vans are not included because they have varied definitions in the source data and a wide range of use cases (different mileages, they span personal/leisure travel and commercial/freight, and so on).
- All cars that are younger than three years old perform a mileage that is the average of all three year old cars and any cars that are of that younger age but subject to an annual MOT from date of first registration (rather than from 3 years).
- All fuel economy and CO_2g km^{-1} figures are adjusted by Spritmonitor.de data to make lab test fuel economy figures more realistic.
- There will be no scrappage schemes and no sudden and large-scale shifts in public attitudes that might create a similar effect. (We know such policies could influence how people purchase and dispose of their cars but it is impossible for us to predict when, how, or whether this might happen).
- We dispose of cars in the same way as in the chosen parameter year in the model. This means the likelihood that a car of a given age in a given year will still be on the road in the next year; we call this the 'departure rate' throughout the report and it is based on past behaviour from specific years.
- Cars have the same average CO_2g km^{-1} fuel economy figures by age. We recognise that this is an extreme simplification since we know it differs not only by car but by the way that car is driven. However, trying to arrive at a more sophisticated measure would have added too much complexity to the modelling task. Plug-in hybrid (PHEV) fuel economies were further adjusted due to a lack of data on usage patterns (usage patterns for PHEVs having a much larger impact on their fuel economy than other fuel types) although our forecast for the proportion of PHEVs in the total parc is relatively small.
- All data used within the model (except Spritmonitor.de adjustments and SMMT's new car registrations outlook scenarios data) is taken from Government sources, which we have assumed to be the most reliable open source available.
- Cars continue to be driven in the same way as they were in 2018–2019, as per GB MOT records. We have not attempted to model any fundamental post-COVID-19 changes, for example, in commuting patterns resulting from increased home-working.

- Northern Ireland based cars are assumed to be driven similarly to their Great Britain based equivalents.

A researcher from Imperial College London carried out a detailed peer review to check that these assumptions were all correctly represented in the code within the model.

3.3 Methodology

As an overview, the model starts with the current state of the parc in a given year (2019) split by age and fuel type. Then, the departure rate is applied to the parc and new car registrations are then added to create the next year's car parc. This new car parc is then looped back to the start and the process is repeated until the model reaches the final year output. Mileages and CO_2g km^{-1} figures are applied according to age and fuel type, from which the amount of fuel consumed can be calculated. In total, four outputs are created: the total car parc; annual mileage; litres of fuel consumed; and total fuel duty income generated. Each component of the method is explained in greater detail below.

The first bespoke DVLA dataset 'Cars by fuel type and year of registration of 2019' is imported. This is the first car parc that starts off the model.

Departure rates are then calculated from the published DfT VEH0124 tables. The model takes two consecutive years of data from 2016 to 2020 and finds the proportion of cars per year of age that still exist in the following year. This creates four different versions of departure rates that can then be used in the model. The chosen departure rate is used across all fuel types in the model to find the next year's parc (excluding new sales). Rates of departure differed in each pair of years looked at. The more recent the departure rate, the more cars that were left in the parc. For example the 2016–2017 departure rate had the least cars in the parc and the 2019–2020 departure rate had the most.

The sale of new cars entering the parc is then introduced into the model. We used the SMMT's data, which provides a forecast of new cars sold from 2020 to 2035 for four different scenarios:

- A 'low' scenario where the uptake of BEVs is slowest, where the charging infrastructure is not supported, and there are no fiscal incentives for BEVs.
- A 'central' scenario showing a slow uptake of BEVs, where the charging infrastructure is supported and there are some fiscal incentives but only for the next few years.
- A 'high' scenario with the fastest uptake of BEVs, where the charging infrastructure is supported and there are sustained and improved fiscal incentives. It estimates that 75% of all BEV registrations (private and fleet/business) qualify for the incentive.
- Lastly, a 'high private' scenario that also shows a fast uptake of BEVs but assumes that VAT incentives are only for private BEV purchases. It is further assumed that 50% of BEV registrations that qualify for the incentive are private. Unlike the 'high' scenario, which benefits both private and fleet, the 'high private' scenario benefits private cars only.

From the SMMT projection tables, we divided the ICE column into separate diesel and petrol columns using the Government's new registration car data (Table VEH0253; DfT, 2021b). In 2020, the split between diesel and petrol new registrations was 77:23 (77 petrol, 23 diesel), so we applied that ratio to the SMMT projections for 2020 gradually progressing to a 90:10 ratio (90 petrol, 10 diesel) by 2029. The very small numbers of HEVs were then summed together with petrol cars, as advised by the SMMT. PHEV and BEVs had their own individual columns.

New car registrations were then added to the parc after the departure rate was applied to create the new total parc in the next year.

This new parc was then looped over to the beginning of the model to create the next year's parc up until the year to which we forecast, in this case we forecast up to 2035 (the end of PHEV sales).

The next step was finding the average fuel economies of cars (CO_2g km^{-1}). To do this, the second bespoke DfT table was imported into the model, the 'average CO_2 g km^{-1} emissions values from licensed cars at the end of the year by year of first registration and fuel type in 2019'.

It is important to note that the fuel economy estimates were among the least reliable input data used in modelling the fuel duty decline output; therefore, we took measures to correct issues caused by this parameter. We removed all fuel economy values before 2015 for PHEVs since these were outliers due to registration errors and the small number of PHEVs on the market at the time.

The Worldwide Harmonised Light Vehicle Test Procedure was introduced in 2018 and is based on real driving data to establish official fuel consumption and CO_2 emissions. This replaced the New European Driving Cycle (NEDC), which was solely based on laboratory testing of theoretical driving. Although fuel economy estimates have improved in accuracy as a result, the figures published by the DfT/DVLA (CO_2 data for tax purposes) do not wholly accurately reflect real-world performance since these are still conducted under controlled laboratory conditions.

Therefore, we adjusted the figures using Spritmonitor's divergence percentages to arrive at a more realistic number. Spritmonitor.de is a German website that collects and delivers information about the fuel consumption of vehicles under real-life conditions. We decided to use their divergence figures because their fleet structure was mostly from private cars and provided divergence values for petrol, diesel, and plug-in hybrid vehicles separately whereas the published figures of other organisations did not (Tietge et al., 2019).

A further economy deflation percentage was used since we assumed that cars in the UK may be used slightly differently to where Spritmonitor's data comes from (Germany). Different deflators were used; for diesel cars a further deflation of 1.025% was applied while for petrol cars this was 1.18%. These figures were chosen because they matched up to the known 2019 fuel economy figure (after applying the Spritmonitor's adjustment). Petrol cars have a slightly larger deflator because the fuel economies of these types of cars are much more dependent on how they are driven compared to diesel cars. On longer trips, petrol cars achieve fuel economy numbers that are close to the published NEDC figures. However, on shorter journeys and in stop/start driving, fuel economy degrades very rapidly. This trend is similar for diesel cars but to a much lesser extent.

Future fuel economy/CO_2 figures for ICEs were predicted by choosing how much of the ICE parc sales-weighted average improves year on year. This is only an improvement to only the ICE fleet and BEVs do not contribute to this improvement. In the model, there are 3 options to choose from, that is, 0, 1, and 2%. We expected like-for-like car economy to improve at 1.5% per year. However, sales may not be like for like. Using 0% would cover a scenario where cars improved in economy but consumers bought less economic cars as a result (as per Jevons paradox); 2% would be a scenario where consumers instead moved down a class, as they have done with superminis, such as the Ford Focus, taking market share away from larger saloon models, such as the now discontinued Ford Mondeo. (Jevons paradox is when advancements in technology or Government policy improve the efficiency of a particular resource but consumption increases due to increasing demand brought about by that efficiency).

PHEVs are treated differently because of the lack of available data of usage patterns from a reliable source. Therefore, PHEVs were split into three driving styles as options to choose from in the model.

The first option is that all PHEVs achieve the best fuel economy - which is the lab test fuel economy values adjusted by Spritmonitor deflators. The second option is the worst case scenario where PHEVs perform worse than petrol cars by a chosen percentage.

Lastly, PHEVs achieve a 'mid fuel economy'; this is created by determining how many of the 0–3-year-old PHEV parc are fleet vehicles. We make the assumption that these cars are not recharged and run as they would need to minimise petrol consumption (because the incentive for their drivers may not be sufficiently sharp in contrast to the benefit-in-kind tax treatment, e.g. if they benefit from free petrol but not free electricity from their employers), so the higher the percentage, the worse the fuel economy while all other cars ≥4 years old have the best fuel economy value. (Here private buyers are assumed to recharge to benefit from the technology because they have chosen the plug-hybrid option for environmental or fuel economy reasons). The mid value will be a number in between the best and worst figures.

Cars registered before 2000 can have their fuel economies adjusted. However, there are not that many in the parc and by and large they are not driven that far per annum, so changes to them do not make a material difference to the total output.

Once CO_2g km^{-1} figures are found, average mileages also need to be found. The 2019 anonymised MOT data was filtered to only include class 4 tests (DVSA definition of what a car is). This dataset was filtered to only include DVSA fuel types that fall within the categories we need here: petrol, diesel, PHEV and BEV.

The 2018 MOT passes are then combined to the dataset by choosing the earliest test that the car did in 2018. Vehicles tested in 2019, but without a 2018 test were assumed to be taken off the road previously unless 2019 was the 3 year "first" test. Tests that had the first use date before the 1st January 1880 or after 31st December 2019 were removed.

The age of cars were calculated in a new column, by subtracting the first used date from date of 2019 test completion. The data was then categorised into 9 categories based on whether the test date in 2018 was missing and the age of the car.

Those without a missing 2018 test date and:

- are >= 4 years old were classed as 'normal pair' ;
- are <= 1 were classed as 'within first year, pair';
- are between ages 1 and 2 were classed as 'within second year, pair';
- are between ages 2 and 3 were classed as 'within third year, pair';
- are between ages 3 and 4 were classed as 'normal pair'.

Those with a missing 2018 test date and:

- are >= 4 years old were classed as '+4, no match';
- are <= 1 were classed as 'within first year, no match';
- are between ages 1 and 2 were classed as 'within second year, no match';
- are between ages 2 and 3 were classed as 'within third year, no match';
- are between ages 3 and 4 were classed as 'within fourth year, no match'.

All normal pairs were kept, all categories with cars older than 4 with no matches were discarded, as these vehicles would have had some unknown time off-road and would thereby produce inaccurate mileage rates. The missing 2018 test date results were then set to the first use date and unknown mileages were set to 0 (in other words, mileages were taken from the entire life of the car).

Miles per year were then found by calculating the difference between the mileages in the 2019 and 2018 MOT results, which was then divided by the days between the two tests and multiplied by 365 to get the yearly mileage.

The results that had less than 180 days between the two tests were removed, and those with less than 1 mile were removed. Further outliers were removed, by removing those that had a mileage that fell outside of the band between 0.1 and 99.9 percentiles of the distribution.

As new cars are not required to do an MOT test until the car is three years old, cars 0-2 years old were infilled. Cars aged between 2 and 3 were given the same mileage as a 3 year old from the normal pair. Cars in each age group between 0-2 were averaged with all the three year old cars. Missing data values were linearly interpolated up to 40 years old, after which all vehicles were set to drive an annual mileage of 1000 miles a year.

The model's mileage estimates do not match up to the Government's road traffic statistics. This is because the model uses vehicle registration statistics, estimates mileages for cars using the MOT data, and breaks down mileages by age and fuel type which road traffic statistics does not provide. The DfT supported MOT Project did not get vehicle and MOT data to match road traffic statistics exactly as they are two separate estimates of slightly separate things hence why the we do not include these in the results.

The average mileages of BEVs and PHEVs can be adjusted in three ways. This is because the initial 2018–2019 MOT mileages for BEVs/PHEVs showed that cars that were 3 years old and younger were doing fewer miles than older cars. (This possibly reflects the high proportion of Teslas benefitting from free recharging in the early BEV cohort but does not look set to continue in the future). This mileage is what we called the 'original'. The other two mileage profiles are either BEVs/PHEVs drives the average mileage of a pure petrol or pure diesel car. This makes the assumption that these will drive at the higher end of 'normal' since that would be the cheaper and more efficient behaviour.

The average mileages of cars over 40 years old can also be adjusted but as with the calculation of CO_2g km^{-1} values of older cars, their low numbers mean that such adjustment makes no material difference to the overall output.

Lastly, total mileages for subsequent years can changed by a percentage year-on-year; however, for this model we kept that to 0%, which assumes that average mileages will continue to be like they were in 2018–2019.

Forecasting future fuel duty income is a complex task. Uncertainty will always exist in any future forecast. This is why the model uses a range of assumptions and can use different parameters for certain variables as explained earlier in this section. A plausible range was set for each parameter and we can run the model on each permutation of these parameters.

To combat this level of uncertainty in the forecast, we compiled 432 outputs before illustrating the range of likely outcomes by choosing the outputs in 2035 with the highest, lowest, and median fuel duty total. In chapter 6, we explain in more detail the difference between the two extremes.

4. Parameters

The following list summarises the parameters that can be changed in the model and states what we kept constant in all model outputs:

- Departure rates:
  - 2016-17 - fastest departure rate;
  - 2017-18 - fast departure rate;
  - 2018-19 - slow departure rate; and
  - 2019-20 - slowest departure rate.
- new car registration (i.e. new cars sold):
  - SMMT central - mid level BEV uptake;
  - SMMT low - slow BEV uptake;
  - SMMT high - accelerated BEV uptake; and
  - SMMT high private - accelerated BEV uptake (incentive for only private cars).
- economy deflation percentage for petrol cars - kept at 1.18% for the model;
- economy deflation percentage for diesel cars - kept at 1.025% for the model;
- improvement percentage to fuel economy, the sales-weighted new car CO_2g km^{-1} figures for petrol/diesel/PHEV only, year on year:
  - 0%;
  - 1%; and
  - 2%.
- worst PHEV CO_2g km^{-1} figure (the percentage worse than petrol fuel economy) - kept at 1.1% which means that the worst PHEV fuel economy is 110% of petrol fuel economy;
- mid PHEV CO_2g km^{-1} figure (the percentage of cars 0-3 years old that are fleet) - kept to 50%;
- the average mileage of BEV/PHEVs:
  - original - BEVs younger than 3 years old do less average mileage a year than older BEVs;
  - like petrol cars - a more realistic average mileage; and
  - like diesel cars - assuming that these will drive at the higher end of normal due to it being cheaper and more efficient.
- average mileages of cars older than 40 years old - kept at 1000 miles in the model;
- CO_2g km^{-1} adjustment for cars registered before 2000 - kept at 20 miles per gallon; and
- total mileage adjustment year on year- kept at 0%.

5. Outputs

This section presents the results from the outputs.

5.1 Fuel duty from cars

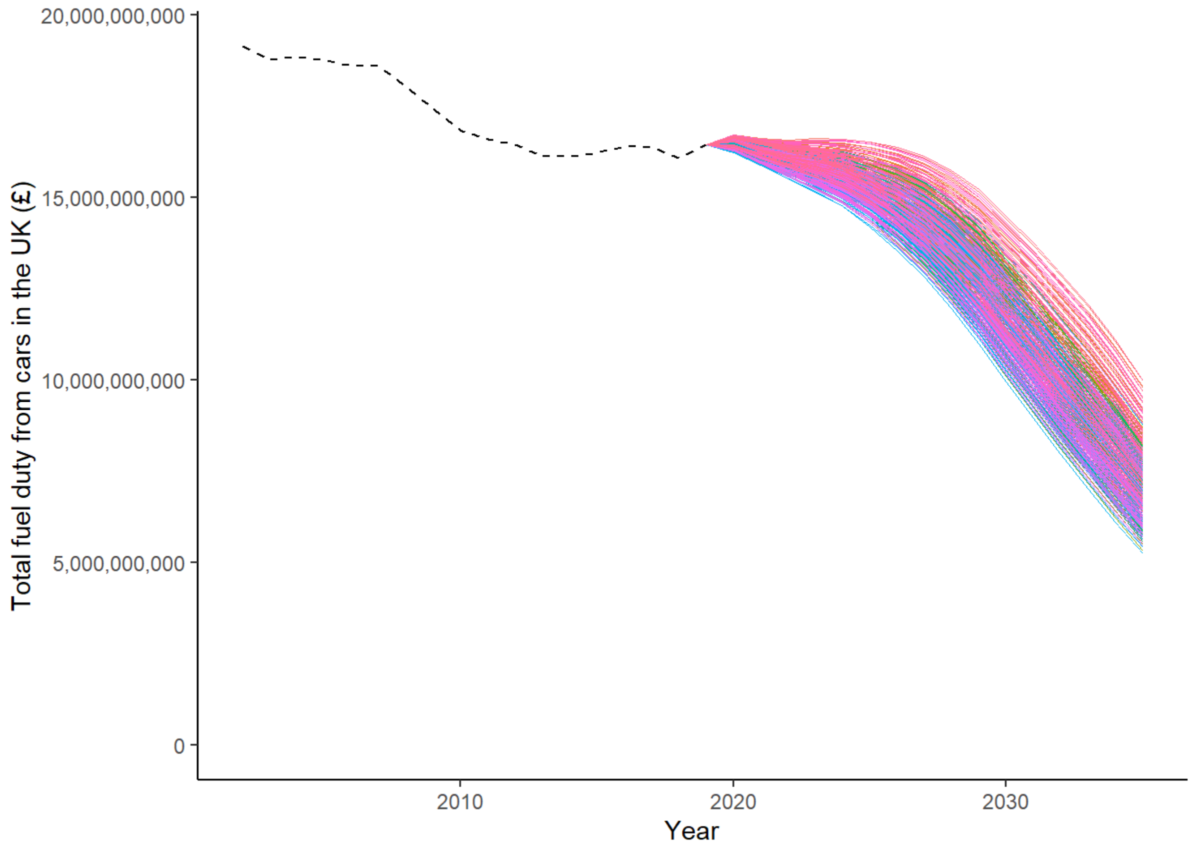


Figure 1: Forecasting the total fuel duty from cars in the UK by comparing the known and different modelled outputs (432)

Figure 1 shows that the total fuel duty starts to decline at various rates and times. The variation between outputs starts off small in the first few years from 2019 and gradually becomes larger. Figures 2 and 3 show how fuel duty is split between the two fuel types: diesel and petrol (from both petrol cars and PHEVs).

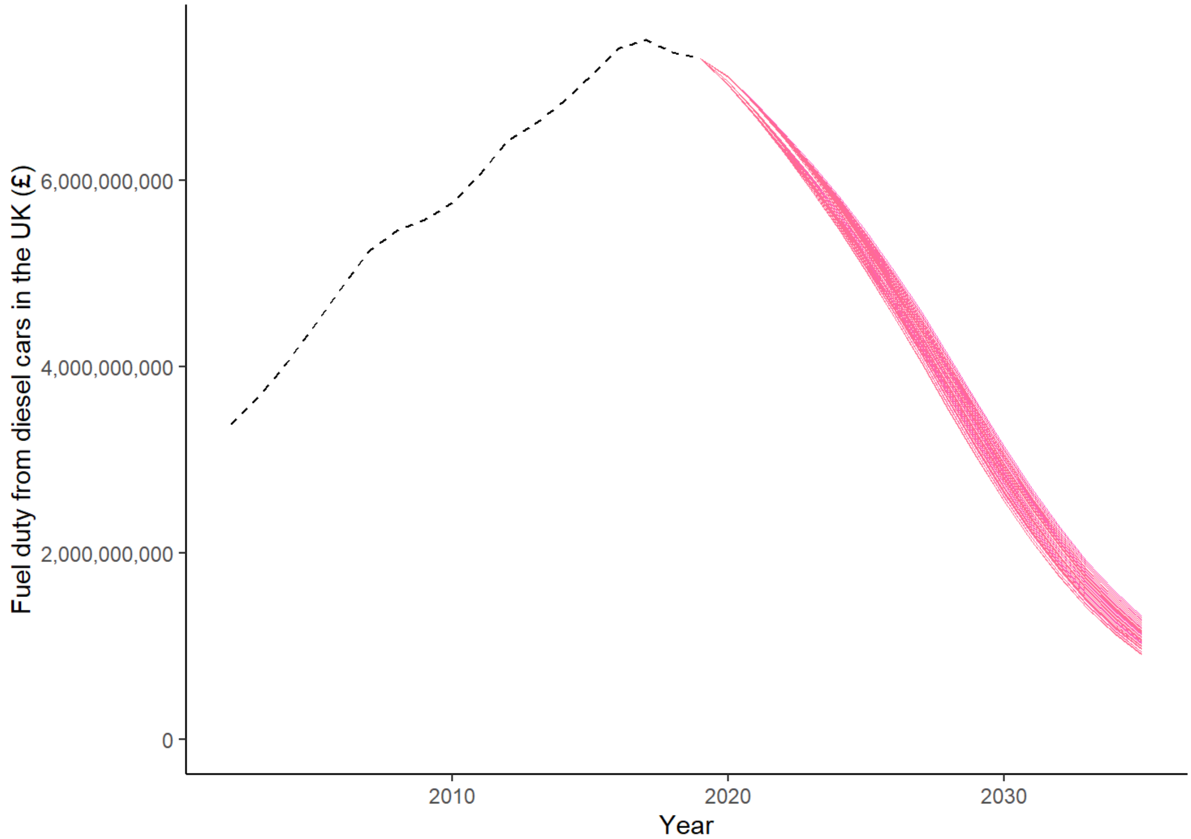


Figure 2: Forecasting the total fuel duty from diesel cars in the UK by comparing the known and different modelled outputs (432)

Figure 2 shows that fuel duty receipts form diesel will continue to decline from 2019 in all outputs to a level around £1 billion in 2035.

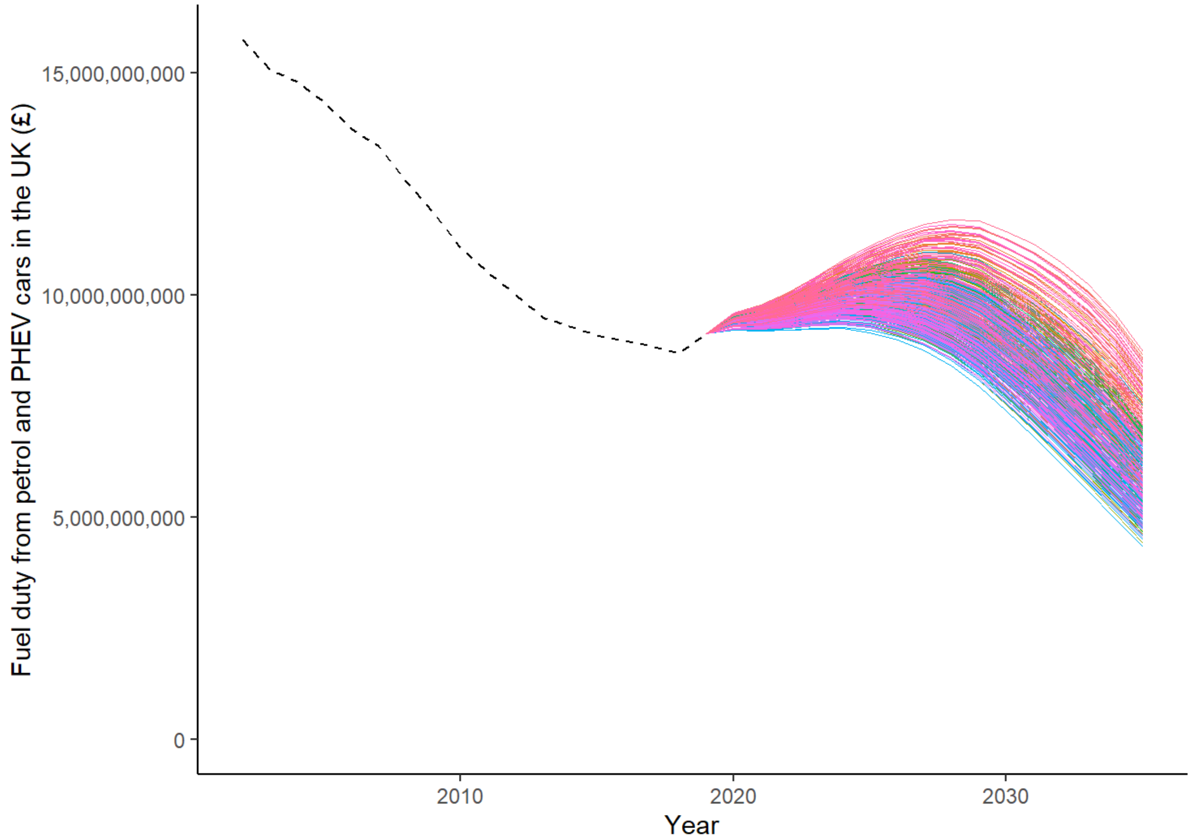


Figure 3: Forecasting the total fuel duty from petrol and PHEV cars in the UK by comparing the known and different modelled outputs (432)

Figure 3 shows a range of variation of outputs of fuel duty receipts from petrol of both petrol and PHEV cars. Some outputs show a decline in fuel duty from petrol from 2019, with a steeper fall in 2029. Some outputs continue at the same level before falling due to a later uptake of BEVs while some outputs suggest that fuel duty from petrol will increase after 2019 before starting to decline towards the end of the 2020s, reflecting the possibility of the continued switch from cars than run on diesel to cars that run on petrol (i.e. petrol, HEV, PHEV) and therefore generally use more fuel per mile.

5.2 Fuel consumption from cars

Fuel consumption shows the same shaped curve as the fuel duty graphs since they are multiples of each other.

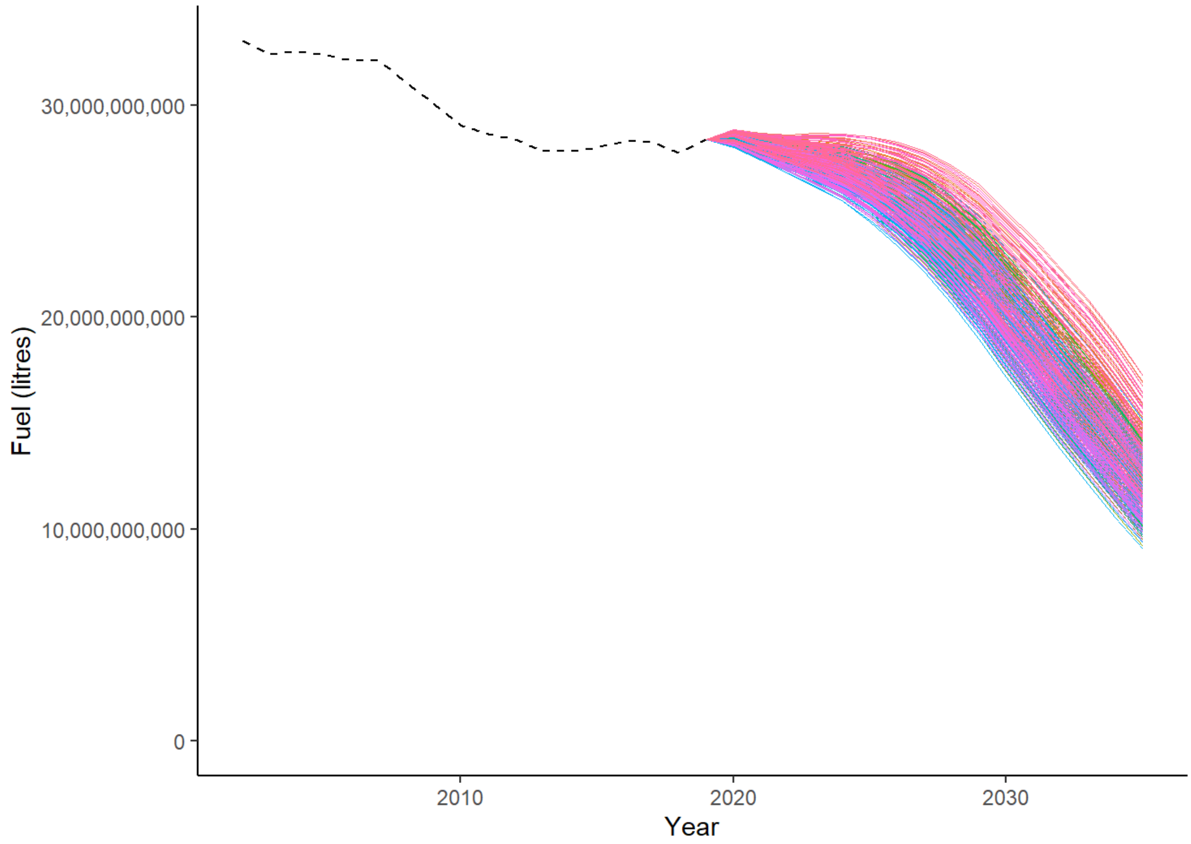


Figure 4: Forecasting the total fuel consumed by all cars in the UK, comparing the known and different modelled outputs (432)

As in the fuel duty graphs, figure 4 shows that total fuel consumption will start to decline at various rates and times.

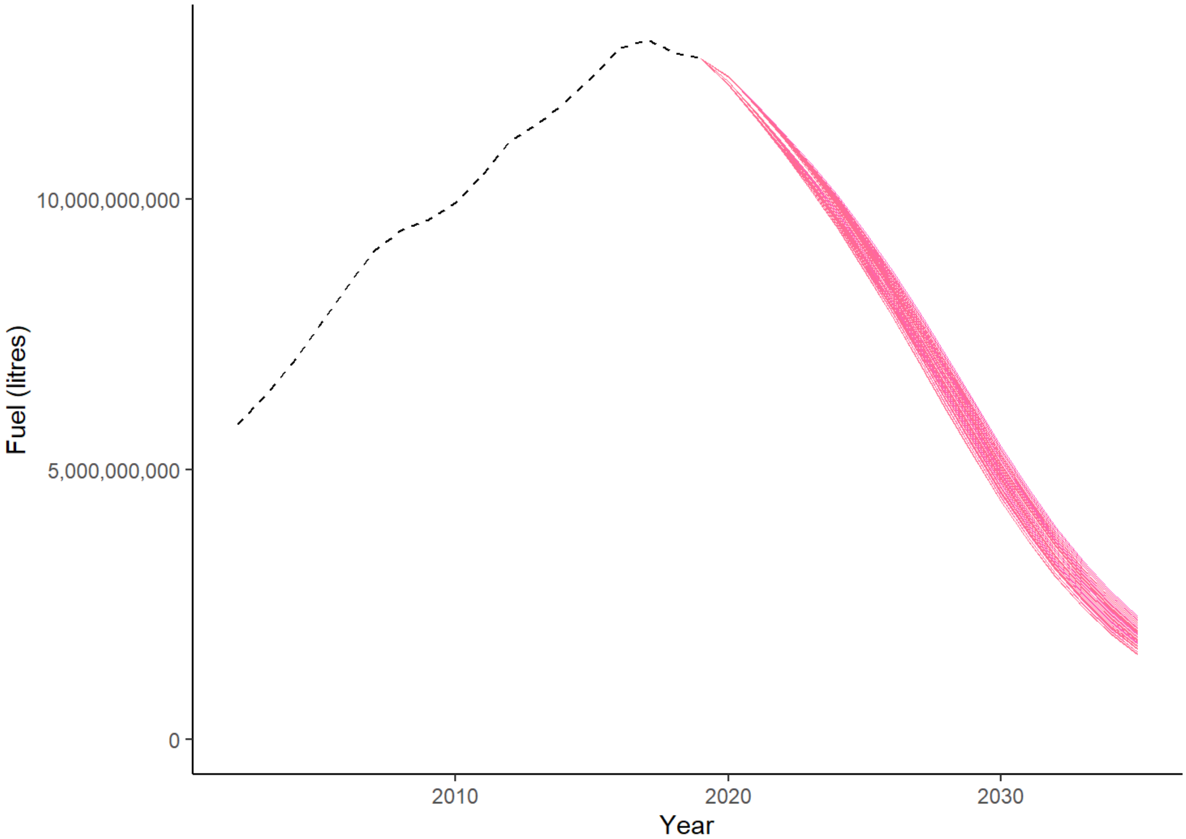


Figure 5: Forecasting the total fuel consumed by all diesel cars in the UK by comparing the known and different modelled outputs (432)

Figure 5 shows diesel consumption will fall.

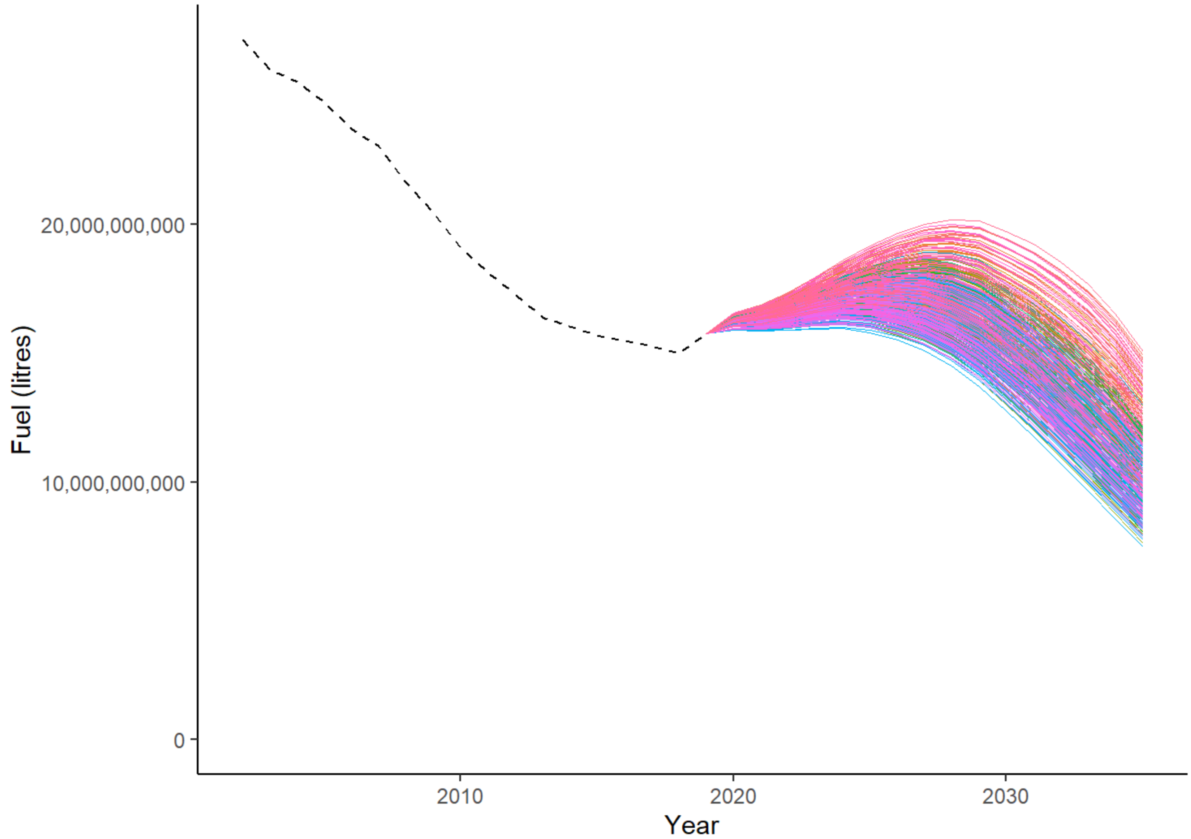


Figure 6: Forecasting the total fuel consumed by all petrol and PHEV cars in the UK by comparing the known and different modelled outputs (432)

Figure 6 shows that petrol consumption from both petrol and PHEV cars has different outputs. Some outputs see a rise in petrol consumption before it falls, and others are more stable in the near term before decreasing.

5.3 Average fuel economy

Figure 7 below shows the fleet average projected fuel economy of diesel, petrol and PHEV cars (these values have been adjusted).

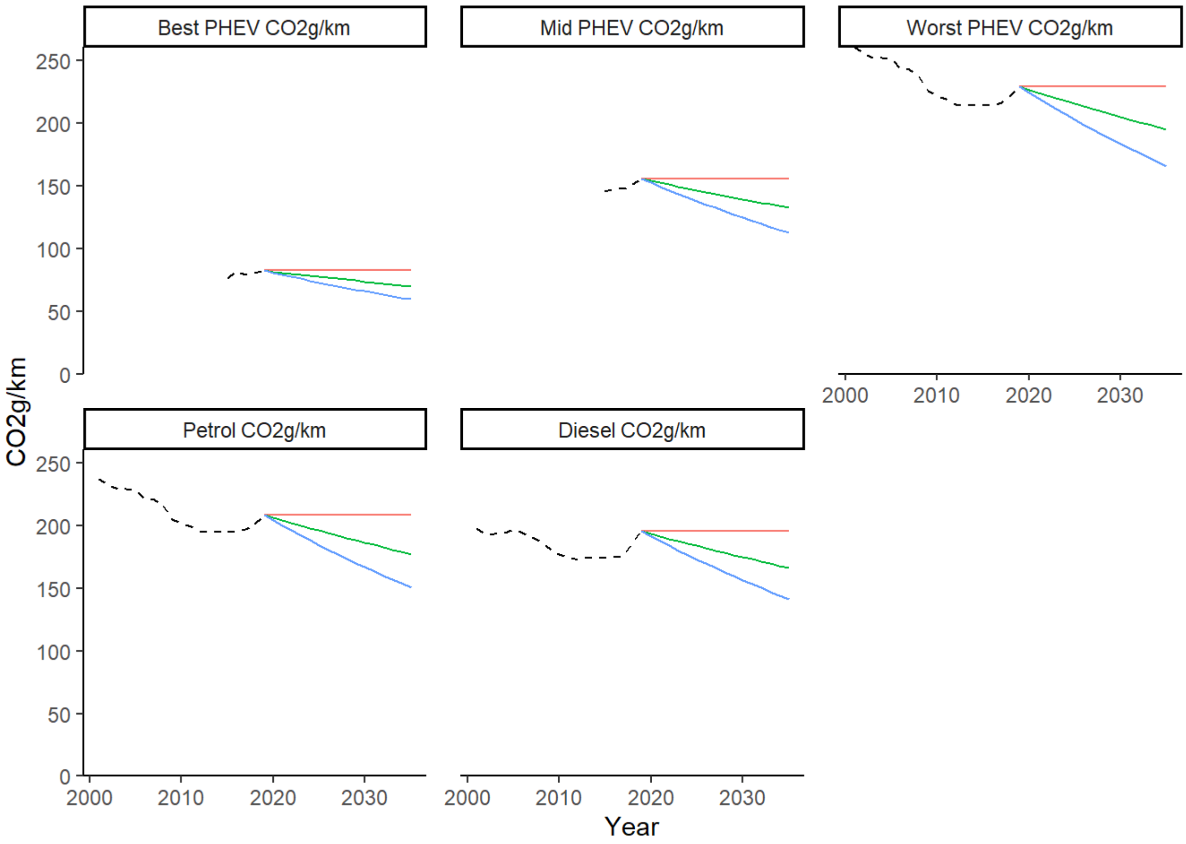


Figure 7: Forecasting average fuel economy used in different modelled outputs by comparing the known and different modelled outputs (432)

Figure 7 shows the three parameters of future sales-weighted average $CO_2 g\ km^{-1}$ figures used in each output permutation.

Zero per cent is represented by the red line. This covers a scenario where cars improved in economy but consumers traded the advantage away for a larger/higher-performance model; therefore, the sales-weighted new ICE economies are static.

The green line represents the 1% parameter where consumers bought a more economical car. This means that the sales-weighted new ICE economies improved somewhat.

Lastly, the blue line represents the 2% parameter involving a scenario where consumers moved down a class; this means that the sales-weighted new ICE economies improved to a greater degree.

5.4 Car parc

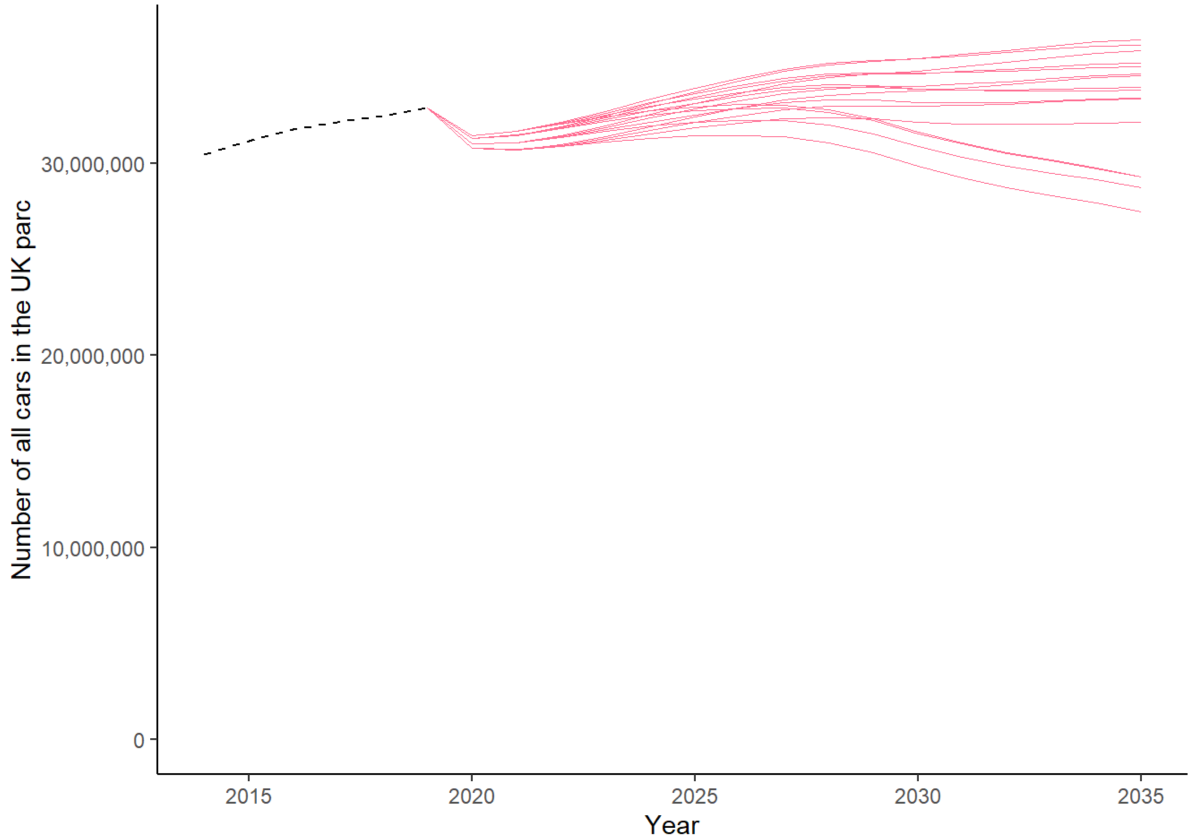


Figure 8: Forecasting the number of all cars in the UK parc by comparing the known and different modelled outputs (432)

Figure 8 shows a range of possible changes that could happen with the number of cars in the parc. These changes are the product of the new car registration scenarios inputs and departure rates, hence a more dramatic split from 2028. Figures 9-12 show the split between diesel cars, petrol cars, PHEVs, and BEVs.

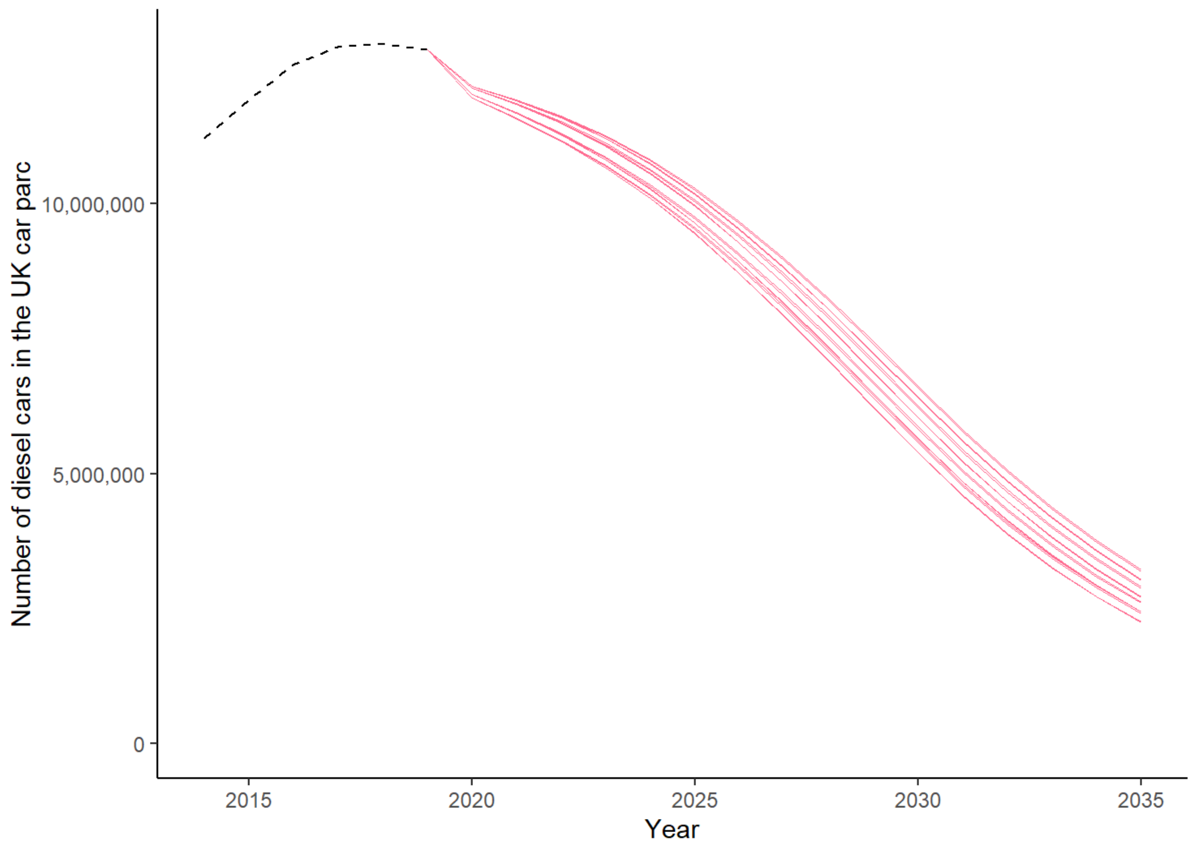


Figure 9: Forecasting the number of diesel cars in the UK parc by comparing the known and different modelled outputs (432)

The number of diesel cars in all scenarios falls.

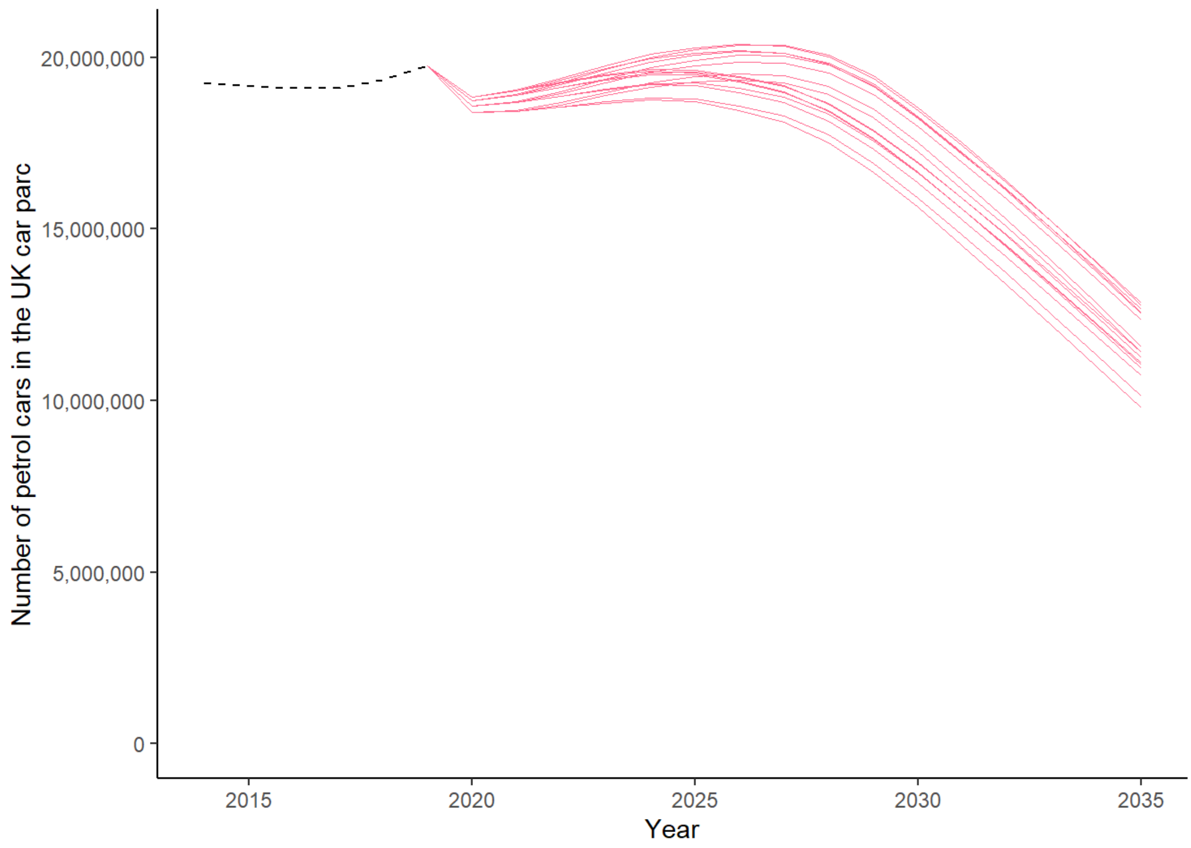


Figure 10: Forecasting the number of petrol cars in the UK parc by comparing the known and different modelled outputs (432)

As shown in figure 10, the number of petrol cars in the parc is either constant or increases before falling at different rates.

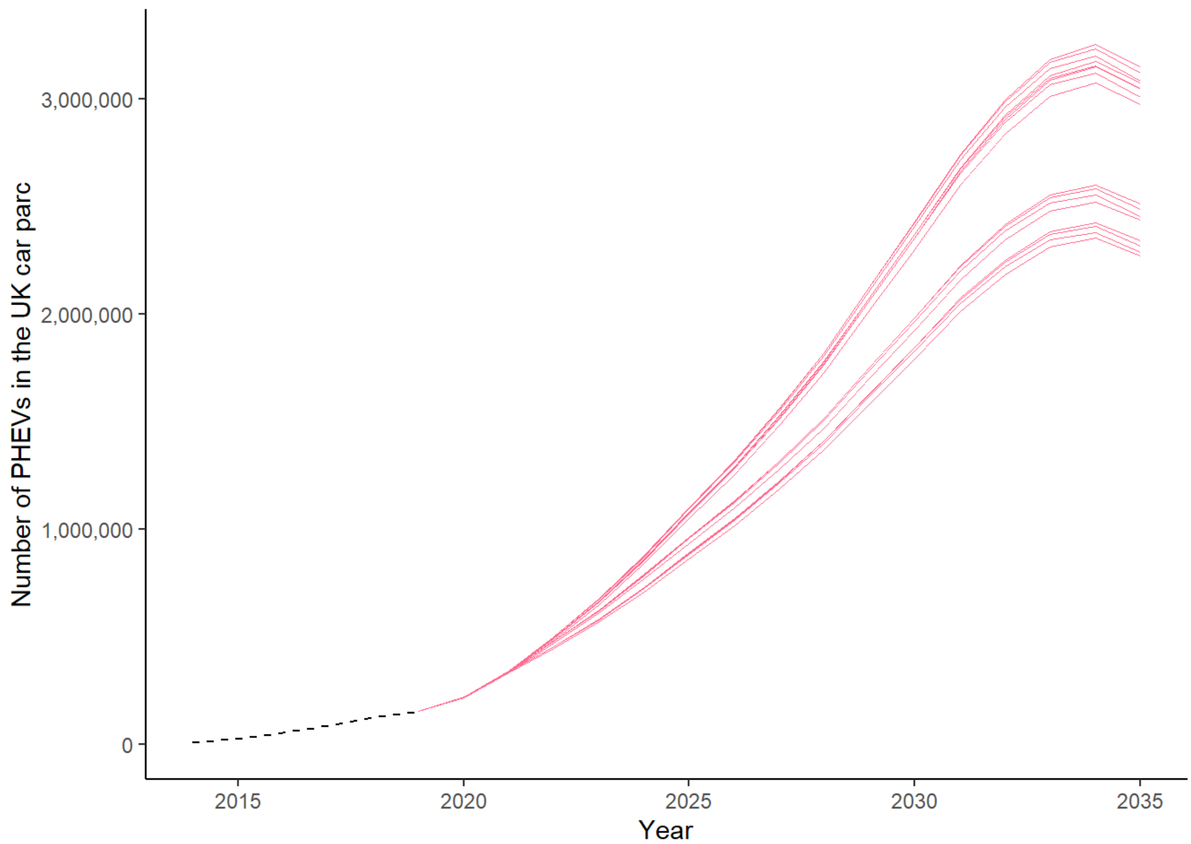


Figure 11: Forecasting the number of PHEVs in the UK parc by comparing the known and different modelled outputs (432)

Figure 11 shows how PHEV numbers increase in all outputs but start to plateau around 2033.

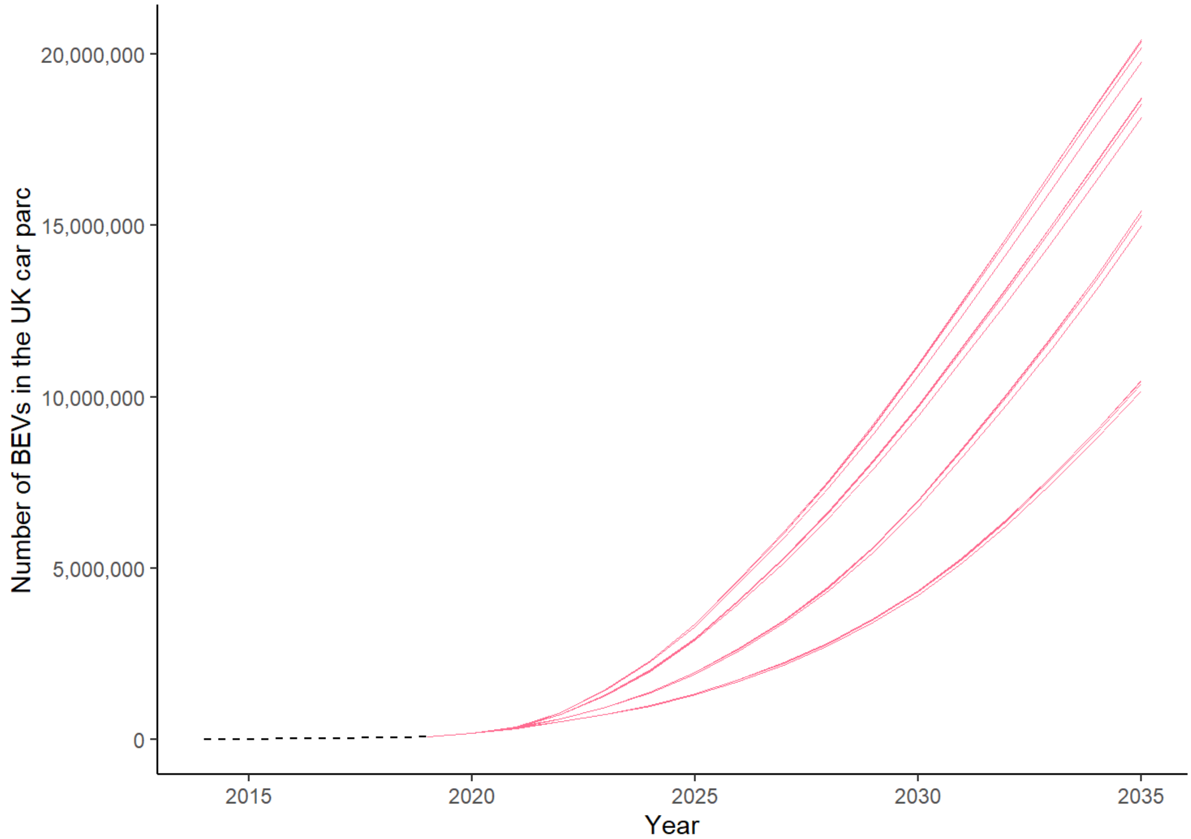


Figure 12: Forecasting the number of BEVs in the UK parc by comparing the known and different modelled outputs (432)

Figure 12 shows BEVs increasing exponentially in all outputs.

5.5 Mileages

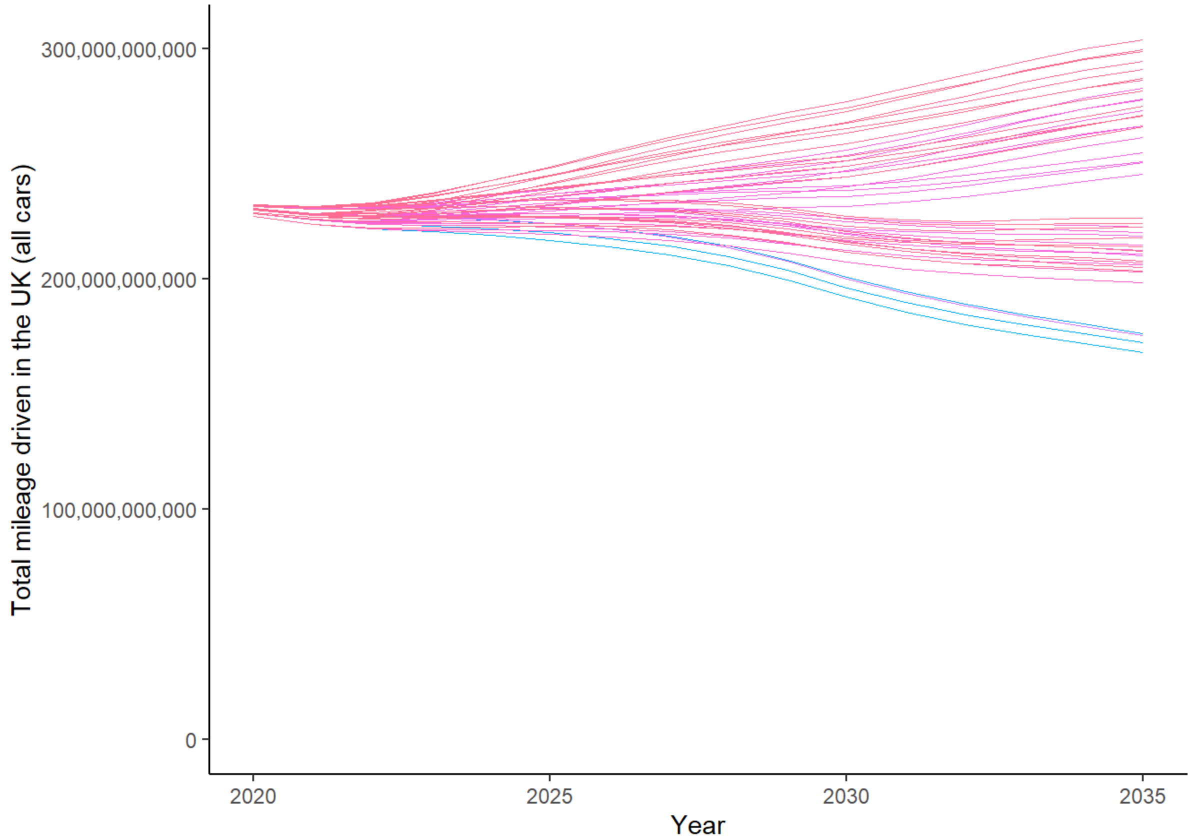


Figure 13: Forecasting the total mileage driven by all cars in the UK by comparing the known and different modelled outputs (432)

The total annual mileage shows similar trends to the car parc numbers; the totals in Figure 13 follow a similar trend in the early years and then split around 2026.

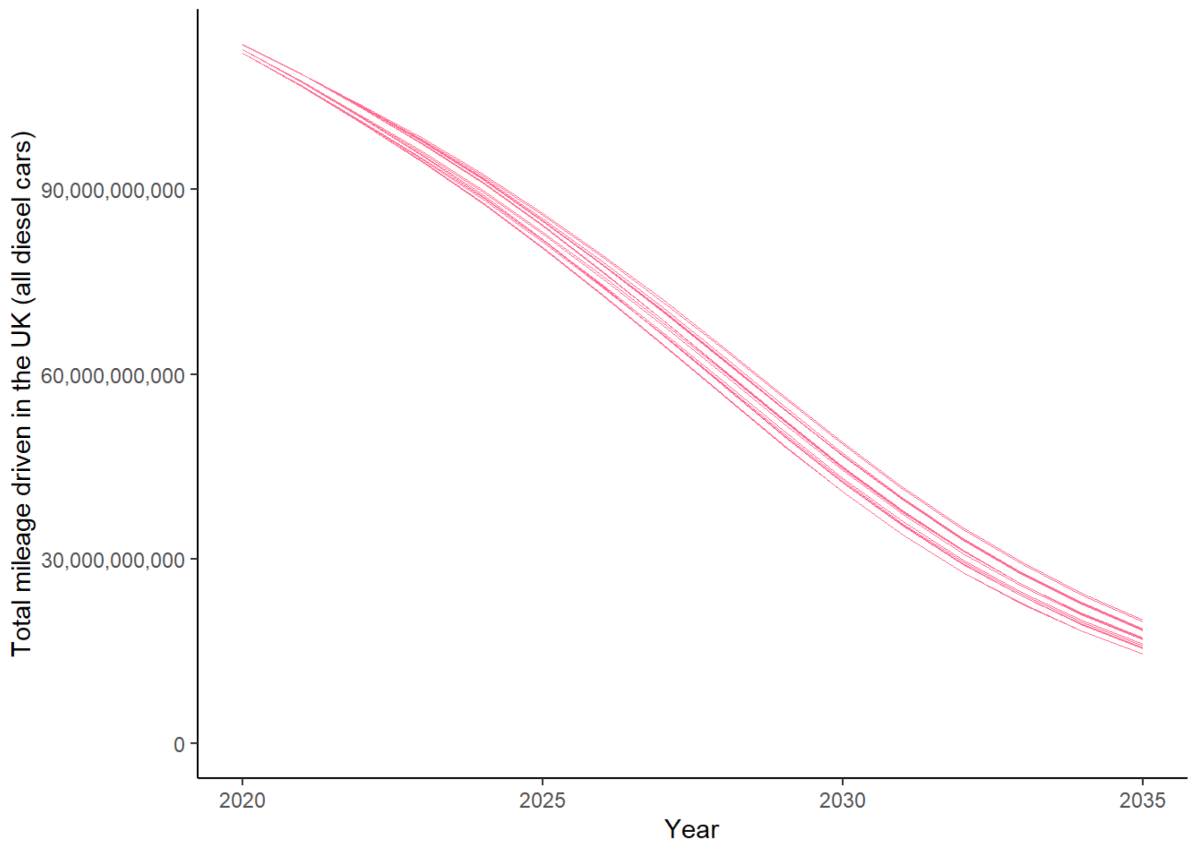


Figure 14: Forecasting the total mileage driven by diesel cars in the UK. Comparing the known output and different modelled outputs (432)

As shown in Figure 14, the total annual mileage of diesel cars declines from 2020.

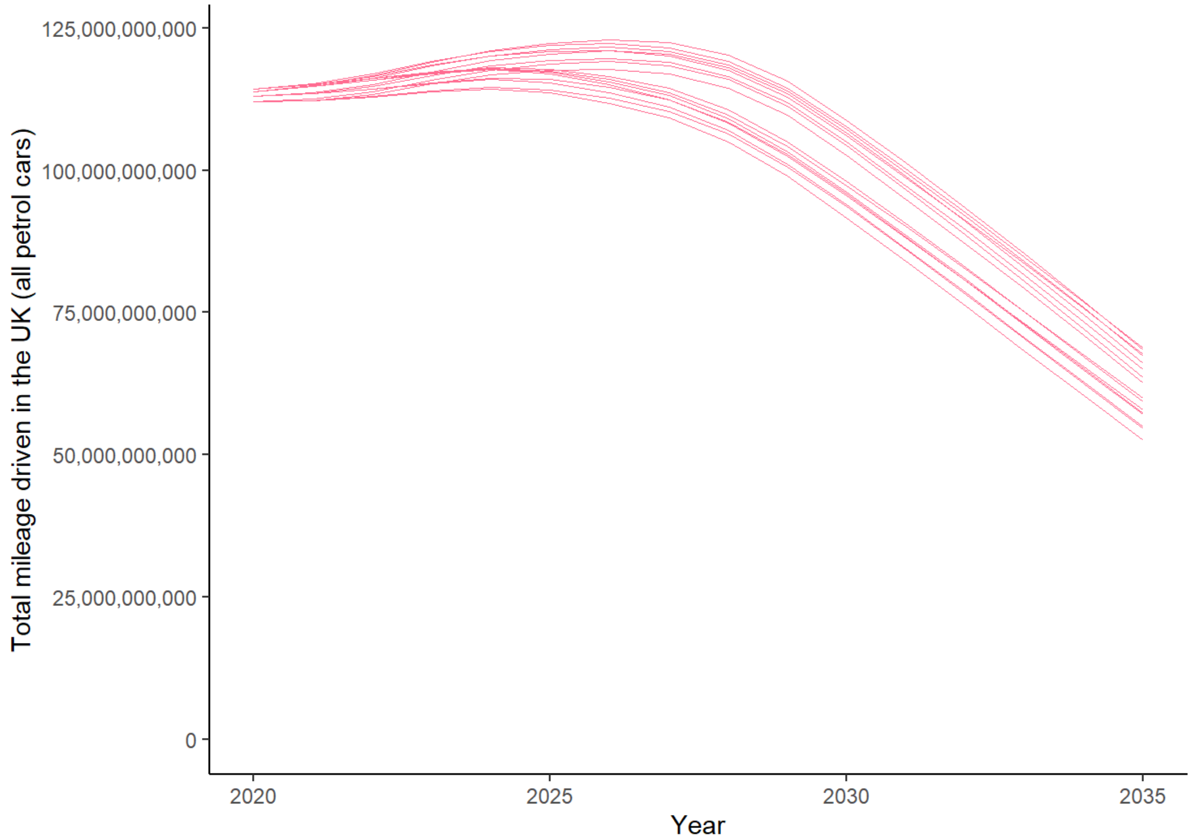


Figure 15: Forecasting the total mileage driven by petrol cars in the UK by comparing the known and different modelled outputs (432)

The total mileage of petrol cars increases at different rates, some outputs see an increase in mileage until 2025, whilst others see an increase until around 2026/2027 (Figure 15).

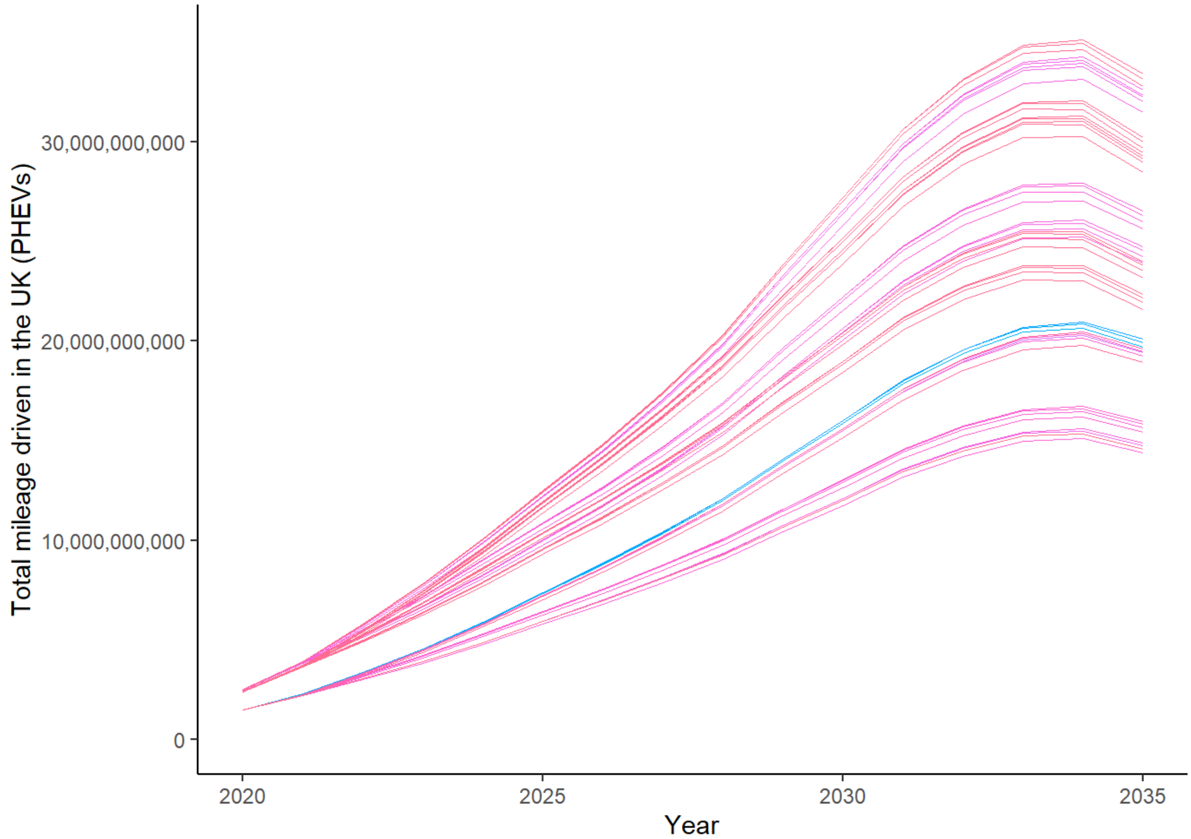


Figure 16: Forecasting the total mileage driven by PHEVs in the UK by comparing the known and different modelled outputs (432)

Figure 16 shows that the PHEV total annual mileage increases from 2020.

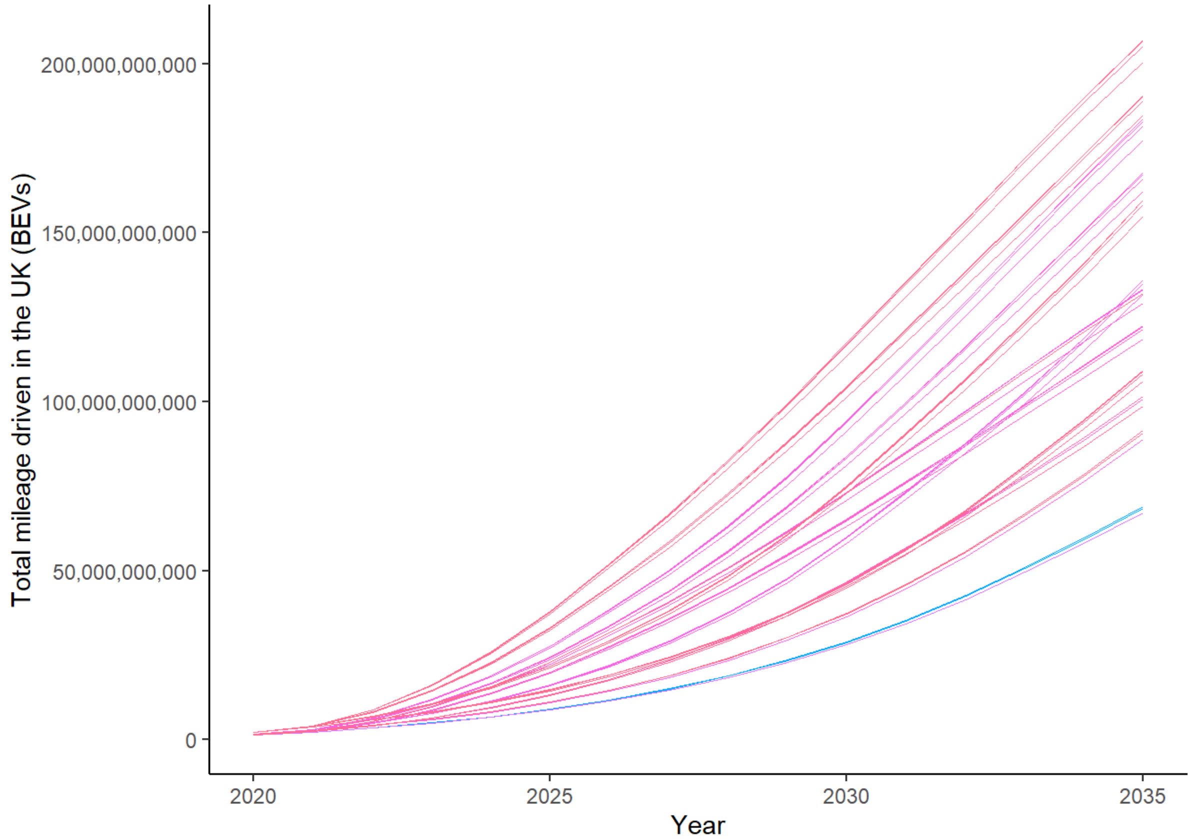


Figure 17: Forecasting the total mileage driven by BEVs in the UK by comparing the known and different modelled outputs (432)

Figure 17 shows that the total annual mileage of BEVs increases at a slower rate but grows exponentially from 2023.

6. Final Results

In this chapter, we discuss three outputs (scenarios): the highest, lowest and median in terms of duty collected in 2035.

6.1 Scenarios

This section explains each scenario case.

6.1.1 Scenario 1: low duty revenue ('low scenario')

In this scenario, the uptake of new electric cars is accelerated, more people decide to make the switch to BEVs in the early 2020s because of a range of reasons, such as a supported public charging infrastructure, an extended plug-in grant and possible new tax incentives (through to 2026), more choice in BEVs coming to market, and potentially a decrease in purchasing cost.

The output of this model uses the SMMT 'high' new car projection. It also uses the departure rate from 2016 to 2017 – the fastest turnover rate – which means it leaves the fewest cars in the parc.

The overall fuel economy shows an improvement of 2% year on year and PHEVs have the best fuel economy, assuming that all PHEVs are used efficiently.

The low scenario is based on BEVs and PHEVs driving distances matching those of petrol cars, the lower of the two most plausible options (lower than diesel).

6.1.2 Scenario 2: high duty revenue ('high scenario')

In this scenario, the uptake of new electric cars is the slowest and fewer people decide to make the switch to BEVs before the phaseout dates for ICEs; this could be due to a range of factors, such as the roll out of an unsupported public charging infrastructure, less choice in BEV models, no plug-in grants, and no reduction in purchase prices to match or beat ICE equivalents.

The high scenario uses the SMMT 'low' new car projection. It also uses the departure rate from 2018–2019, which shows a slow turnover rate of cars.

The overall fuel economy shows an improvement of 0% year on year, with PHEVs returning the worst fuel economy because they are not driven efficiently; this means that all PHEV fuel economy is 110% of petrol fuel economy.

The average mileage of BEVs and PHEVs is kept to the original mileage, resulting in younger BEVs driving a high mileages (very high relative to historic norms).

6.1.3 Scenario 3: median duty revenue ('median scenario')

This scenario uses the SMMT 'central' new car projection. It uses the departure rate from 2018-19, which shows the fastest turnover rate, leaving the fewest cars in the parc.

The overall fuel economy shows an improvement of 2% year on year and PHEVs have the best fuel economy, assuming that all PHEVs are used efficiently.

The average mileage of BEVs and PHEVs is kept to the original mileage, which results in younger BEVs driving a high mileage (very high relative to historic norms).

6.2 Fuel duty from cars

Table 1 shows the results of fuel duty income by scenario and fuel type. The petrol column in this table refers to fuel duty from both petrol and PHEV cars.

Table 1: Fuel duty totals (3 scenarios)

Year	Scenario	Diesel	Petrol	Total
2019	High	7,302,212,688	9,145,777,721	16,447,990,408
2020	High	7,115,064,803	9,559,744,259	16,674,809,062
2021	High	6,818,418,115	9,741,174,212	16,559,592,328
2022	High	6,496,426,079	10,039,021,067	16,535,447,145
2023	High	6,166,105,489	10,411,828,139	16,577,933,629
2024	High	5,802,361,456	10,783,222,361	16,585,583,817
2025	High	5,399,826,075	11,116,891,207	16,516,717,283
2026	High	4,969,606,101	11,394,416,214	16,364,022,315
2027	High	4,513,283,479	11,608,970,399	16,122,253,878
2028	High	4,033,902,505	11,710,116,548	15,744,019,053
2029	High	3,536,015,370	11,681,266,093	15,217,281,464
2030	High	3,044,577,400	11,445,932,458	14,490,509,857
2031	High	2,588,672,220	11,159,054,057	13,747,726,277
2032	High	2,177,448,069	10,749,569,578	12,927,017,647
2033	High	1,815,942,957	10,242,160,685	12,058,103,642
2034	High	1,502,437,455	9,593,124,286	11,095,561,741
2035	High	1,234,119,777	8,746,240,271	9,980,360,048
2019	Median	7,302,212,688	9,145,777,721	16,447,990,408
2020	Median	7,110,365,271	9,403,674,557	16,514,039,828
2021	Median	6,799,974,250	9,457,773,568	16,257,747,818
2022	Median	6,458,584,086	9,573,876,972	16,032,461,059
2023	Median	6,106,365,961	9,737,312,190	15,843,678,151
2024	Median	5,721,164,691	9,874,076,602	15,595,241,293
2025	Median	5,299,732,818	9,953,512,909	15,253,245,727
2026	Median	4,853,562,448	9,976,254,003	14,829,816,451
2027	Median	4,385,382,573	9,921,680,855	14,307,063,428
2028	Median	3,899,935,393	9,749,717,496	13,649,652,889
2029	Median	3,403,360,429	9,436,481,251	12,839,841,680
2030	Median	2,918,044,650	8,960,438,068	11,878,482,718
2031	Median	2,468,981,773	8,434,110,098	10,903,091,870
2032	Median	2,064,906,569	7,867,953,766	9,932,860,335
2033	Median	1,710,833,254	7,267,900,828	8,978,734,082
2034	Median	1,405,536,207	6,621,412,075	8,026,948,281
2035	Median	1,146,274,355	5,922,958,964	7,069,233,319
2019	Low	7,302,212,688	9,145,777,721	16,447,990,408
2020	Low	7,020,844,308	9,214,006,813	16,234,851,120
2021	Low	6,674,026,516	9,198,779,930	15,872,806,445
2022	Low	6,298,180,278	9,212,739,785	15,510,920,063
2023	Low	5,906,516,426	9,241,173,479	15,147,689,905
2024	Low	5,489,510,567	9,252,061,681	14,741,572,248
2025	Low	5,030,768,738	9,169,194,142	14,199,962,880

2026	Low	4,543,554,031	8,992,316,934	13,535,870,965
2027	Low	4,047,199,034	8,763,140,161	12,810,339,195
2028	Low	3,541,560,152	8,416,870,912	11,958,431,064
2029	Low	3,039,252,795	7,954,202,659	10,993,455,454
2030	Low	2,563,375,984	7,397,541,572	9,960,917,556
2031	Low	2,130,770,951	6,814,409,092	8,945,180,044
2032	Low	1,749,013,797	6,208,711,137	7,957,724,934
2033	Low	1,420,719,312	5,592,278,081	7,012,997,393
2034	Low	1,143,163,207	4,971,457,078	6,114,620,285
2035	Low	911,767,397	4,341,554,664	5,253,322,061

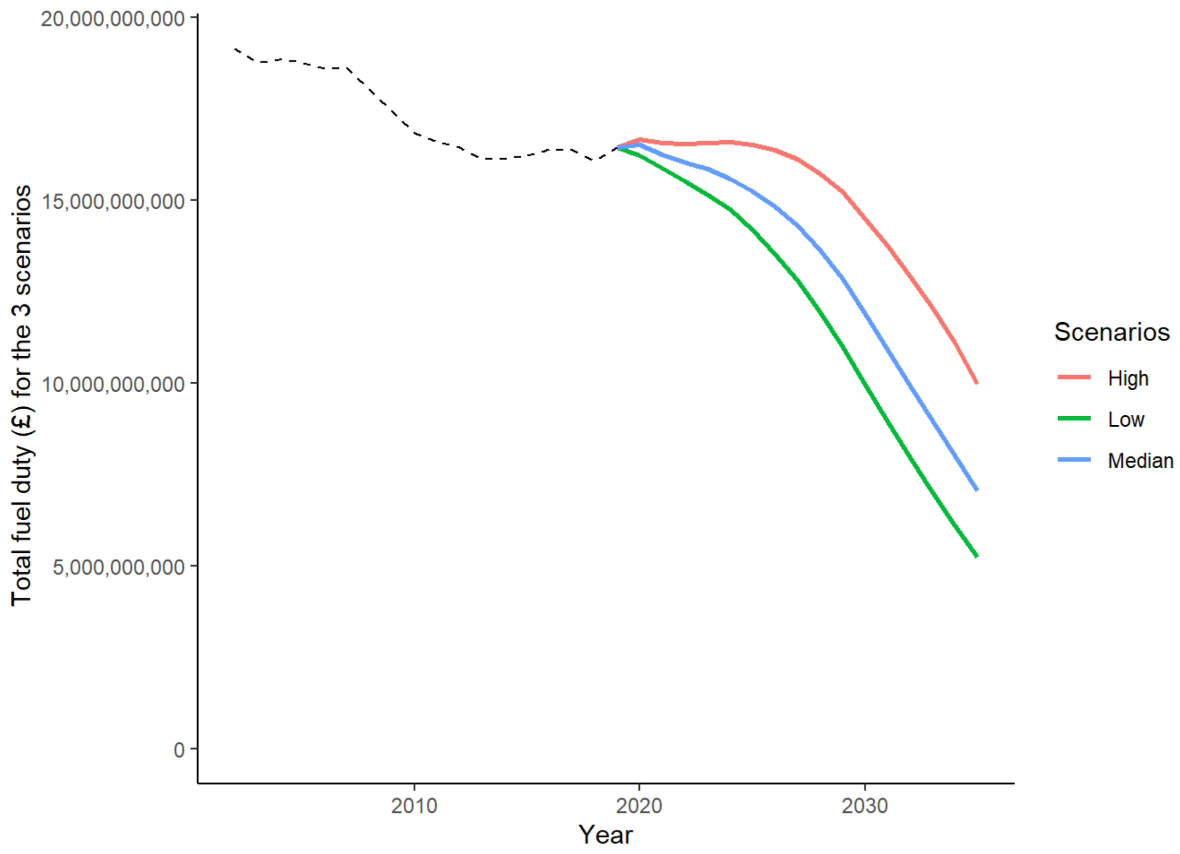


Figure 18: Forecasting the total fuel duty from cars in the UK (three scenarios) by comparing the known output and those of the three scenarios (modelled outputs)

Total fuel duty from cars (diesel, petrol and PHEV cars) was £16.4 billion in 2019. In 2028, in the high scenario, fuel duty is forecast to decrease by 4.3% to around £15.7 billion compared to 2019. In the median scenario, it decrease by 17% to around £13.6 billion. In the low scenario, it would decrease by 27.3% to around £12 billion. Thus, there is a difference of around £3.7 billion between the high and low scenarios in 2028.

In 2035, compared to the 2019 figure, fuel duty is forecast to decrease by 39.3% to around £10 billion in the high scenario. In the median scenario it would decrease by 57% to around £7.1 billion. In the low scenario, it would decrease by 68.1% to around £5.3 billion. Thus, there is a difference of around £4.7 billion between the high and low scenarios in 2035 (figure 18).

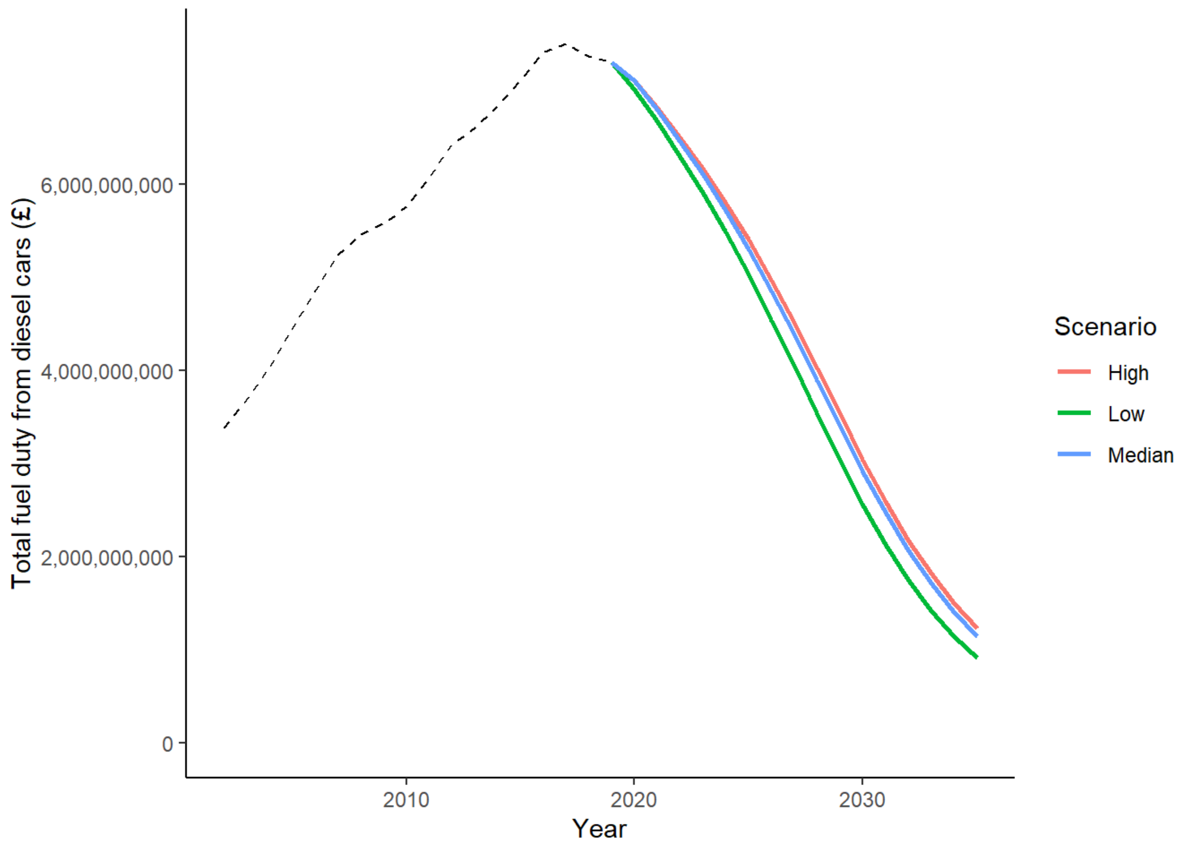


Figure 19: Forecasting the total fuel duty from diesel cars in the UK (three scenarios) by comparing the know output and those of the three scenarios

Total fuel duty from diesel was £7.3 billion in 2019 (figure 19).

In 2028, in the high scenario, fuel duty from diesel is forecast to decrease by 44.8% to around £4 billion compared to 2019. In the median scenario, it decreases by 46.6% to around £3.9 billion; in the low scenario, it decreases by 51.5% to around £3.5 billion. Thus, there is a difference of around £0.5 billion between the high and low scenarios in 2028.

In 2035, compared to the 2019 figure, fuel duty is forecast to decrease by 83.1% to around £1.2 billion in the high scenario. In the median scenario, it decreases by 84.3% to around £1.1 billion; in the low scenario, it decreases by 87.5% to around £0.9 billion. Thus, there is a difference of around £0.3 billion between the high and low scenarios in 2035.

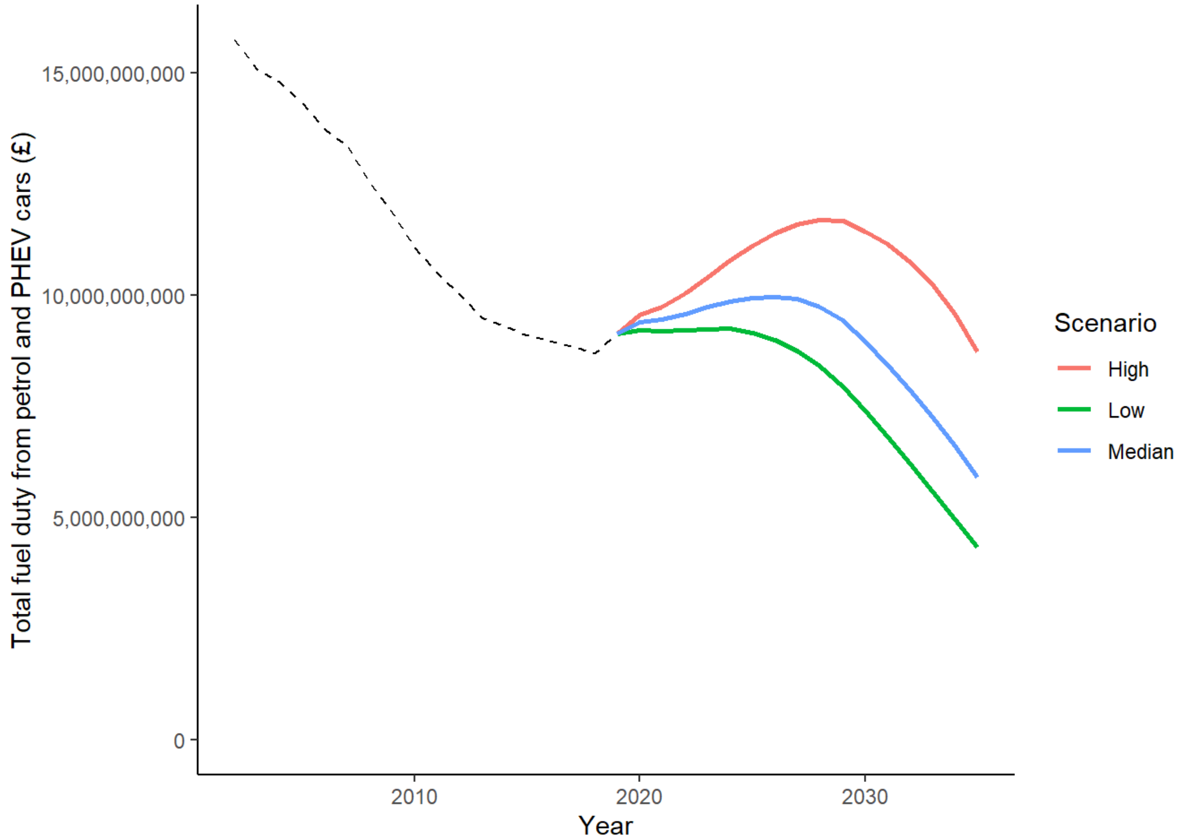


Figure 20: Forecasting the total fuel duty from petrol and PHEV cars in the UK (three scenarios) by comparing the known output and the three modelled outputs

Total fuel duty from petrol (from both petrol and PHEV cars) was £9.1 billion in 2019 (figure 20).

In 2028, in the high scenario, fuel duty from petrol (from both petrol and PHEV cars) is forecast to increase by 28% to around £11.7 billion compared to 2019. In the median scenario, it increases by 6.6% to around £9.7 billion; in the low scenario, it decreases by 8% to around £8.4 billion. Thus, there is a difference of around £3.3 billion between the high and low scenarios in 2028.

In 2035, compared to the 2019 figure, fuel duty from petrol (from both petrol and PHEV cars) is forecast to decrease by 4.4% to around £8.7 billion in the high scenario. In the median scenario it decreases by 35.2% to around £5.9 billion; in the low scenario it decreases by 52.5% to around £4.3 billion. Thus, there is a difference of around £4.4 billion between the high and low scenarios in 2035.

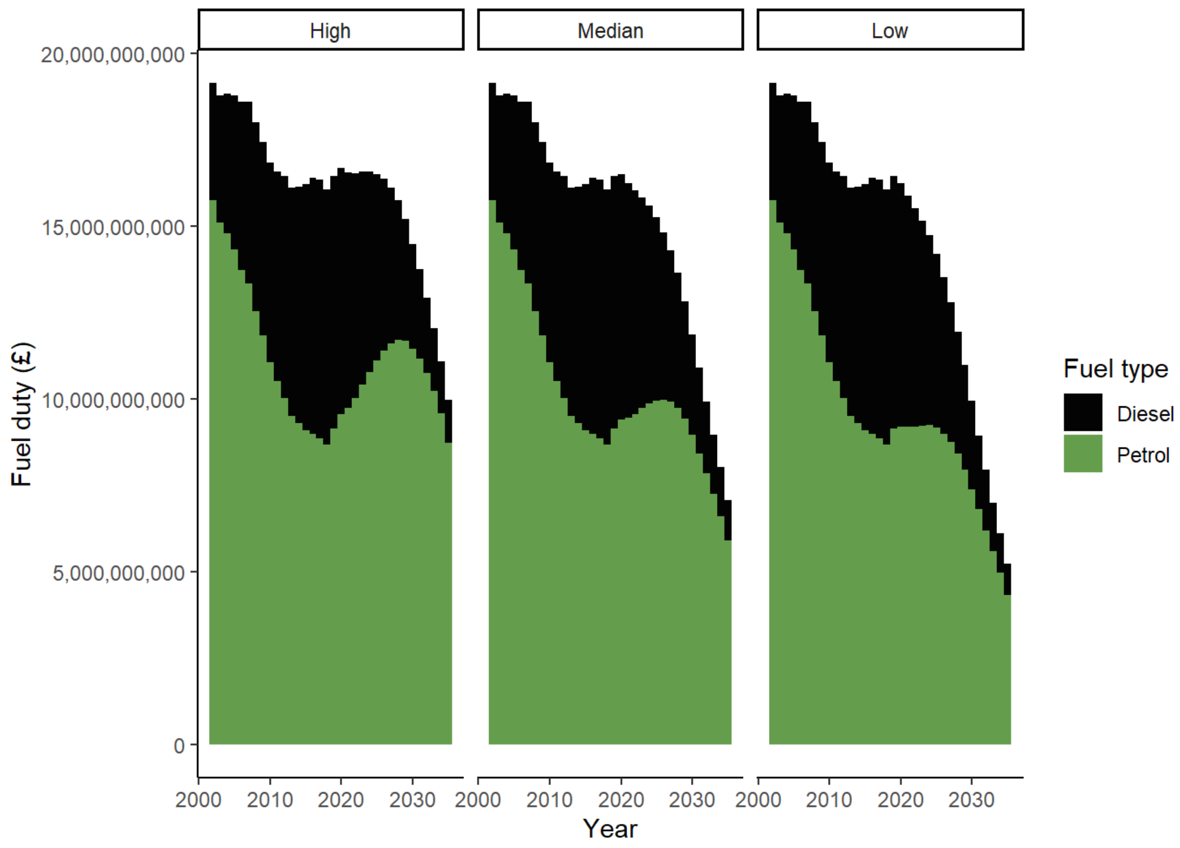


Figure 21: Fuel duty by year and fuel type (three scenarios)

The stacked bar graph in Figure 21 shows the difference in rates of decrease of fuel duty between the three scenarios. The known years are between 2002 and 2019. In the high scenario, where the fuel duty yield is the highest in 2035, the uptake in petrol consumption (from both petrol and PHEV cars) increases continuously from 2020 until it peaks at 2028 to around £11.7 billion. This uptake in petrol is due to people switching from diesel to petrol cars (i.e. petrol, HEV or PHEV) during the early years of the 2020s, with a relatively slow take-up of electric alternatives.

The median scenario shows a similar trend to the high scenario but fuel duty from cars that run on petrol (petrol and PHEV) does not increase as much or as quickly, peaking in 2026 at around £10 billion.

In the low scenario, there is a slight peak in 2024 (£9.3 billion) before a decline sets in, assuming an aggressive uptake of zero emission cars.

In all scenarios, income from diesel duty starts to decline, with the median and low scenarios having similar rates of decline.

6.3 Fuel consumption from cars

Table 2 shows the consumption of diesel, petrol and the total fuel consumption of cars. The petrol column in this table refers to petrol consumption from both petrol and PHEV cars.

Table 2: Fuel consumption (3 scenarios)

Year	Scenario	Diesel	Petrol	Total
2019	High	12,600,884,707	15,782,187,611	28,383,072,318
2020	High	12,277,937,538	16,496,538,842	28,774,476,380
2021	High	11,766,036,437	16,809,619,003	28,575,655,440
2022	High	11,210,398,756	17,323,591,142	28,533,989,897
2023	High	10,640,389,110	17,966,916,547	28,607,305,658
2024	High	10,012,703,117	18,607,803,901	28,620,507,018
2025	High	9,318,077,783	19,183,591,385	28,501,669,168
2026	High	8,575,679,208	19,662,495,624	28,238,174,832
2027	High	7,788,237,237	20,032,735,806	27,820,973,042
2028	High	6,961,005,186	20,207,276,183	27,168,281,369
2029	High	6,101,838,430	20,157,491,102	26,259,329,532
2030	High	5,253,800,517	19,751,393,370	25,005,193,887
2031	High	4,467,078,895	19,256,348,675	23,723,427,570
2032	High	3,757,459,998	18,549,731,799	22,307,191,798
2033	High	3,133,637,545	17,674,134,056	20,807,771,600
2034	High	2,592,644,444	16,554,140,270	19,146,784,713
2035	High	2,129,628,605	15,092,735,584	17,222,364,190
2019	Median	12,600,884,707	15,782,187,611	28,383,072,318
2020	Median	12,269,827,905	16,227,220,978	28,497,048,883
2021	Median	11,734,209,231	16,320,575,613	28,054,784,845
2022	Median	11,145,097,647	16,520,926,613	27,666,024,260
2023	Median	10,537,301,054	16,802,954,599	27,340,255,653
2024	Median	9,872,587,905	17,038,958,762	26,911,546,666
2025	Median	9,145,354,303	17,176,036,081	26,321,390,384
2026	Median	8,375,431,316	17,215,278,694	25,590,710,010
2027	Median	7,567,528,167	17,121,105,875	24,688,634,042
2028	Median	6,729,828,115	16,824,361,512	23,554,189,627
2029	Median	5,872,925,676	16,283,833,047	22,156,758,723
2030	Median	5,035,452,373	15,462,360,772	20,497,813,145
2031	Median	4,260,538,003	14,554,115,785	18,814,653,788
2032	Median	3,563,255,512	13,577,141,960	17,140,397,471
2033	Median	2,952,257,556	12,541,675,285	15,493,932,842
2034	Median	2,425,429,175	11,426,077,782	13,851,506,957
2035	Median	1,978,040,302	10,220,809,256	12,198,849,559
2019	Low	12,600,884,707	15,782,187,611	28,383,072,318
2020	Low	12,115,348,244	15,899,925,475	28,015,273,719
2021	Low	11,516,870,605	15,873,649,576	27,390,520,182
2022	Low	10,868,300,739	15,897,739,060	26,766,039,798
2023	Low	10,192,435,593	15,946,804,969	26,139,240,562
2024	Low	9,472,839,632	15,965,593,927	25,438,433,559

2025	Low	8,681,223,016	15,822,595,586	24,503,818,602
2026	Low	7,840,472,876	15,517,371,758	23,357,844,633
2027	Low	6,983,950,016	15,121,898,465	22,105,848,481
2028	Low	6,111,406,647	14,524,367,407	20,635,774,054
2029	Low	5,244,612,243	13,725,975,253	18,970,587,496
2030	Low	4,423,427,065	12,765,386,664	17,188,813,729
2031	Low	3,676,912,772	11,759,118,364	15,436,031,136
2032	Low	3,018,142,876	10,713,910,504	13,732,053,380
2033	Low	2,451,629,529	9,650,177,880	12,101,807,409
2034	Low	1,972,671,626	8,578,873,301	10,551,544,926
2035	Low	1,573,369,106	7,491,897,608	9,065,266,714

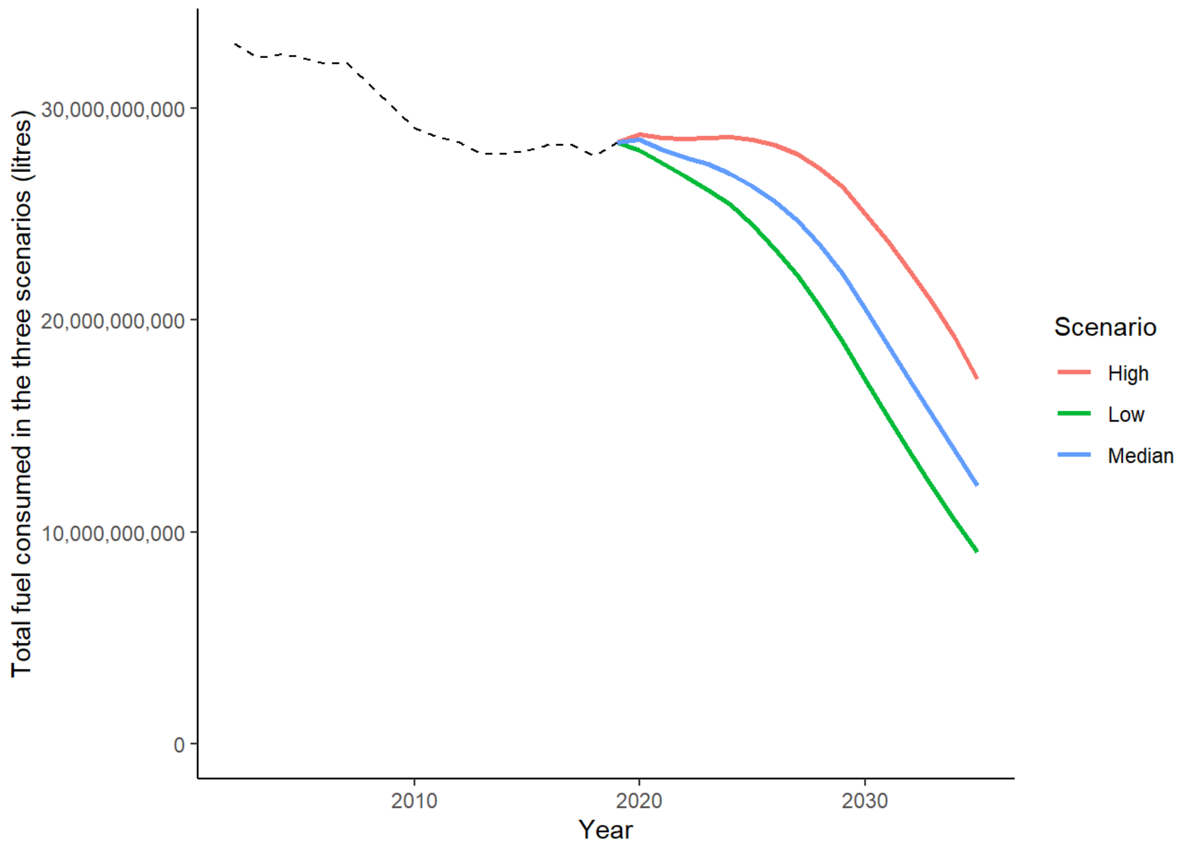


Figure 22: Forecasting the total fuel consumed by all cars in the UK (three scenarios) by comparing the known output and the three modelled outputs

Total fuel consumption in 2019 was 28.4 billion litres (figure 22).

In 2028, in the high scenario, fuel consumption is forecast to decrease by 4.3% to around 27.2 billion litres compared to 2019. In the median scenario it decreases by 17% to around 23.6 billion litres; in the low scenario, it decreases by 27.3% to around 20.6 billion litres. Thus, there is a difference of around 6.6 billion litres between the high and low scenarios in 2028.

In 2035, compared to the 2019 figure, fuel consumption is forecast to decrease by 39.3% to around 17.2 billion litres in the high scenario. In the median scenario it decreases by 57% to around 12.2 billion litres and in the low scenario it decreases by 68.1% to around 9.1 billion litres. Thus, there is a difference of around 8.1 billion litres between the high and low scenarios in 2035.

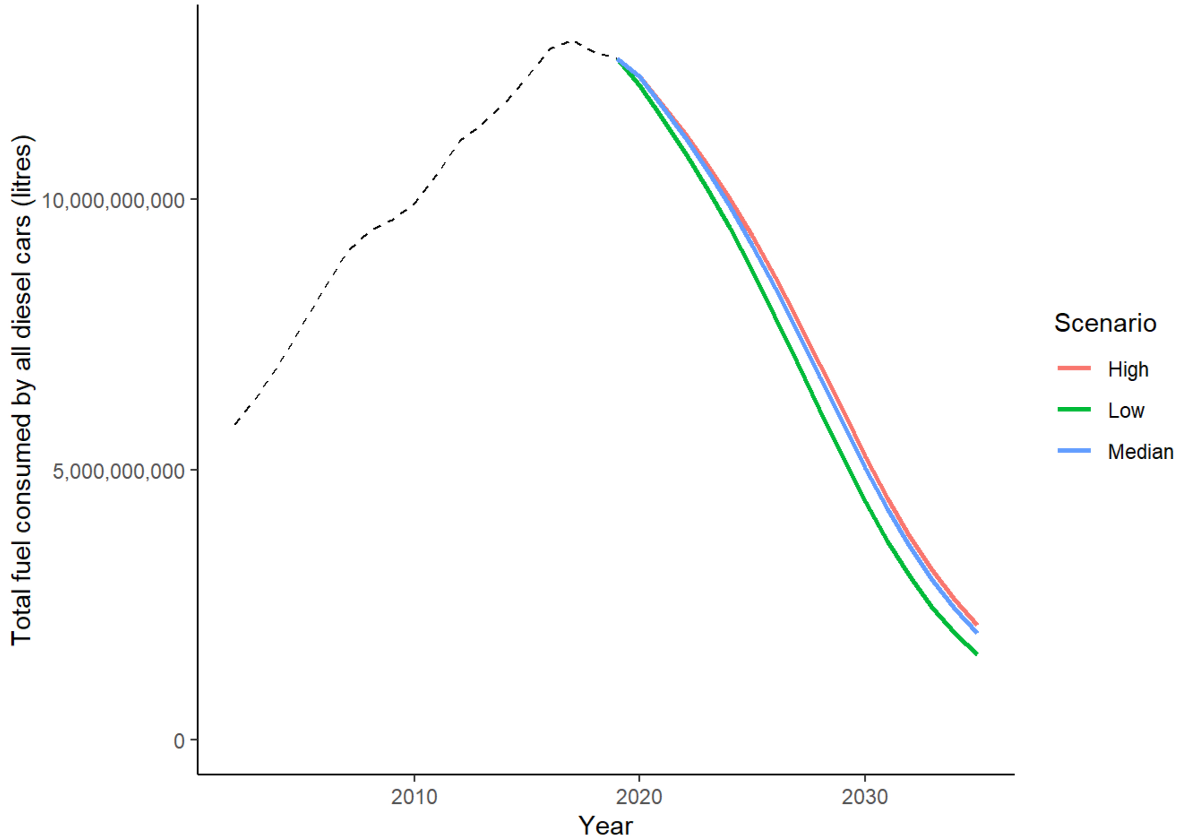


Figure 23: Forecasting the total fuel consumed by all diesel cars in the UK (three scenarios)

Total diesel consumption in 2019 was 12.6 billion litres (figure 23).

In 2028, in the high scenario, diesel fuel consumption is forecast to decrease by 44.8% to around 7 billion litres compared to 2019. In the median scenario it decreases by 46.6% to around 6.7 billion litres; in the low scenario, it decreases by 51.5% to around 6.1 billion litres. Thus, there is a difference of around 0.9 billion litres between the high and low scenarios in 2028.

In 2035, compared to the 2019 figure, diesel fuel consumption is forecast to decrease by 83.1% to around 2.1 billion litres in the high scenario. In the median scenario it decreases by 84.3% to around 2 billion litres; in the low scenario it decreases by 87.5% to around 1.6 billion litres. Thus, there is a difference of around 0.5 billion litres between the high and low scenarios in 2035.

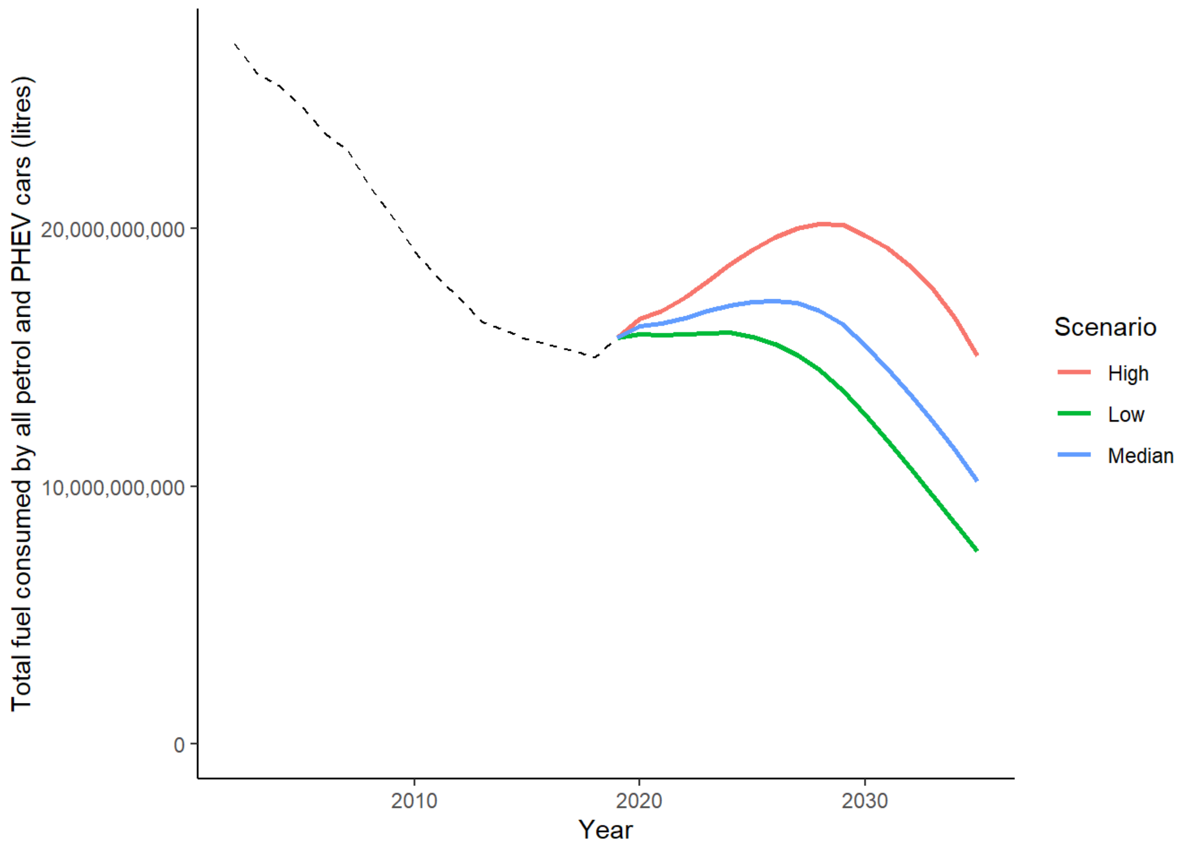


Figure 24: Forecasting the total fuel consumed by all petrol and PHEV cars in the UK (three scenarios) by comparing the known output and the three different modelled outputs

Total petrol consumption (from both petrol cars and PHEVs) in 2019 was 15.8 billion litres (figure 24).

In 2028, in the high scenario, petrol fuel consumption (from both petrol cars and PHEVs) is forecast to increase by 28% to around 20.2 billion litres compared to 2019. In the median scenario it increases by 6.6% to around 16.8 billion litres; in the low scenario, it decreases by 8% to around 14.5 billion litres. Thus, there is a difference of around 5.7 billion litres between the high and low scenarios in 2028.

In 2035, compared to the 2019 figure, petrol fuel consumption (from both petrol cars and PHEVs) is forecast to decrease by 4.4% to around 15.1 billion litres in the high scenario. In the median scenario it decreases by 35.2% to around 10.2 billion litres; in the low scenario it decreases by 52.5% to around 7.5 billion litres. Thus, there is a difference of around 7.6 billion litres between the high and low scenarios in 2035.

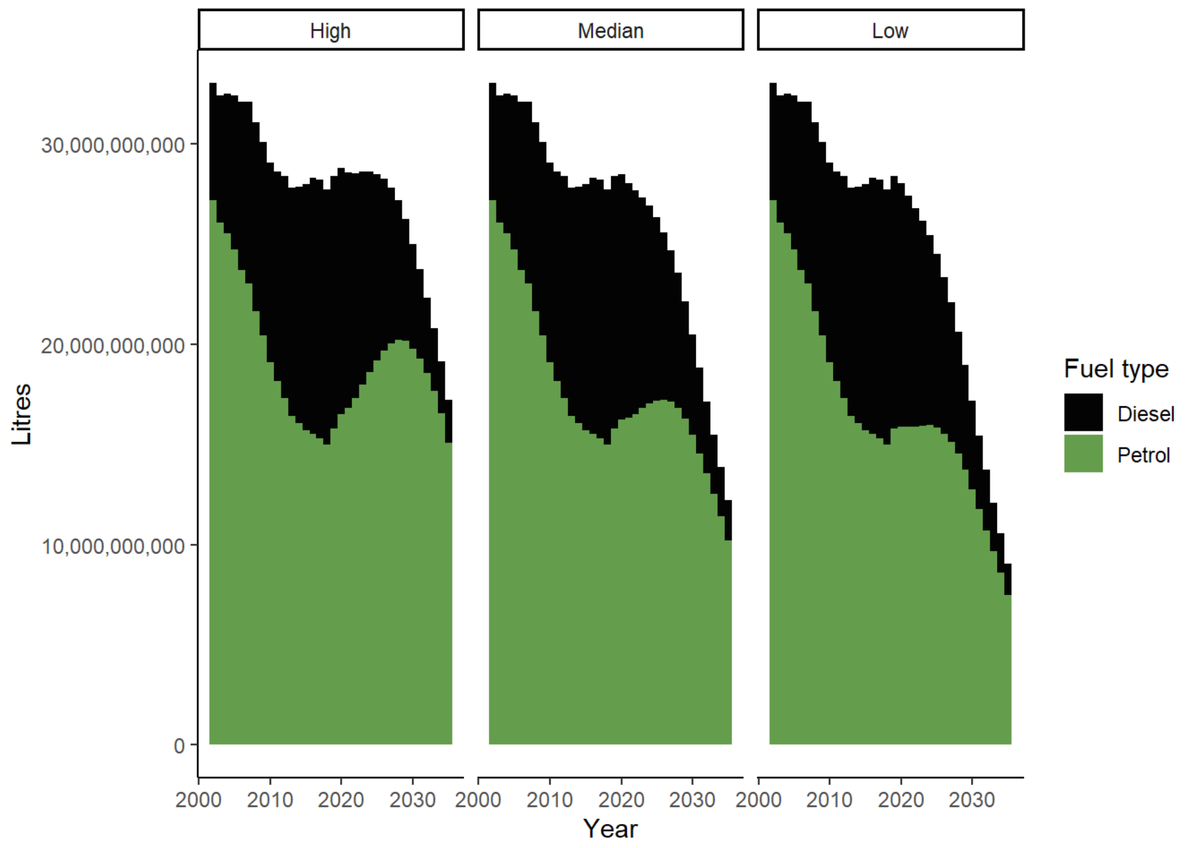


Figure 25: Fuel consumption by year and fuel type (three scenarios)

The stacked bar graph in Figure 25 shows the difference in rates of decrease of fuel consumption between the three scenarios. The graph has the same shape as the fuel duty graph because they are multiples of each other. The known years are between 2002 and 2019. In the high case scenario, where fuel duty is the highest in 2035, consumption of petrol (from both petrol and PHEV cars) increases continuously from 2020 until it peaks in 2028 to 20.2 billion litres. Again, this reflects a switch away from diesel but a sluggish take-up of zero emission cars.

The median case scenario shows a similar trend to the high scenario but petrol consumption, from petrol and PHEV cars, does not increase as much or as quickly, peaking in 2026 at 17.2 billion litres.

In the low case scenario, petrol consumption from petrol and PHEV cars declines earlier. This is to be expected since in this scenario there is an aggressive uptake of electric options.

Again, diesel fuel consumption falls in all scenarios.

6.3 Average fuel economy

Table 3 shows the fleet average fuel economy of diesel, petrol and PHEV cars (these values have been adjusted).

Table 3: Fuel economy

Year	Scenario	Diesel CO2g/km	Petrol CO2g/km	Best PHEV CO2g/km	Mid PHEV CO2g/km	Worst PHEV CO2g/km
2001	High	197.80	236.87	NA	NA	260.55
2002	High	192.46	232.64	NA	NA	255.91
2003	High	193.87	229.61	NA	NA	252.57
2004	High	193.92	229.34	NA	NA	252.27
2005	High	196.87	228.84	NA	NA	251.72
2006	High	194.21	221.65	NA	NA	243.81
2007	High	191.66	220.63	NA	NA	242.70
2008	High	186.82	215.91	NA	NA	237.50
2009	High	181.38	205.23	NA	NA	225.75
2010	High	176.77	202.35	NA	NA	222.58
2011	High	175.18	199.20	NA	NA	219.12
2012	High	173.02	195.59	NA	NA	215.15
2013	High	174.69	194.63	NA	NA	214.09
2014	High	174.21	195.10	NA	NA	214.61
2015	High	174.28	195.49	76.40	145.72	215.04
2016	High	174.78	194.76	81.85	148.04	214.24
2017	High	176.55	196.95	79.41	148.03	216.65
2018	High	186.66	201.73	80.24	151.07	221.91
2019	High	195.37	208.30	82.38	155.75	229.13
2020	High	195.37	208.30	82.38	155.75	229.13
2021	High	195.37	208.30	82.38	155.75	229.13
2022	High	195.37	208.30	82.38	155.75	229.13
2023	High	195.37	208.30	82.38	155.75	229.13
2024	High	195.37	208.30	82.38	155.75	229.13
2025	High	195.37	208.30	82.38	155.75	229.13
2026	High	195.37	208.30	82.38	155.75	229.13
2027	High	195.37	208.30	82.38	155.75	229.13
2028	High	195.37	208.30	82.38	155.75	229.13
2029	High	195.37	208.30	82.38	155.75	229.13
2030	High	195.37	208.30	82.38	155.75	229.13
2031	High	195.37	208.30	82.38	155.75	229.13
2032	High	195.37	208.30	82.38	155.75	229.13
2033	High	195.37	208.30	82.38	155.75	229.13
2034	High	195.37	208.30	82.38	155.75	229.13
2035	High	195.37	208.30	82.38	155.75	229.13
2001	Low	197.80	236.87	NA	NA	260.55
2002	Low	192.46	232.64	NA	NA	255.91
2003	Low	193.87	229.61	NA	NA	252.57
2004	Low	193.92	229.34	NA	NA	252.27
2005	Low	196.87	228.84	NA	NA	251.72
2006	Low	194.21	221.65	NA	NA	243.81

2007	Low	191.66	220.63	NA	NA	242.70
2008	Low	186.82	215.91	NA	NA	237.50
2009	Low	181.38	205.23	NA	NA	225.75
2010	Low	176.77	202.35	NA	NA	222.58
2011	Low	175.18	199.20	NA	NA	219.12
2012	Low	173.02	195.59	NA	NA	215.15
2013	Low	174.69	194.63	NA	NA	214.09
2014	Low	174.21	195.10	NA	NA	214.61
2015	Low	174.28	195.49	76.40	145.72	215.04
2016	Low	174.78	194.76	81.85	148.04	214.24
2017	Low	176.55	196.95	79.41	148.03	216.65
2018	Low	186.66	201.73	80.24	151.07	221.91
2019	Low	195.37	208.30	82.38	155.75	229.13
2020	Low	191.47	204.13	80.73	152.64	224.55
2021	Low	187.64	200.05	79.11	149.58	220.06
2022	Low	183.88	196.05	77.53	146.59	215.65
2023	Low	180.21	192.13	75.98	143.66	211.34
2024	Low	176.60	188.29	74.46	140.79	207.11
2025	Low	173.07	184.52	72.97	137.97	202.97
2026	Low	169.61	180.83	71.51	135.21	198.91
2027	Low	166.22	177.21	70.08	132.51	194.93
2028	Low	162.89	173.67	68.68	129.86	191.04
2029	Low	159.63	170.20	67.31	127.26	187.21
2030	Low	156.44	166.79	65.96	124.72	183.47
2031	Low	153.31	163.46	64.64	122.22	179.80
2032	Low	150.25	160.19	63.35	119.78	176.21
2033	Low	147.24	156.98	62.08	117.38	172.68
2034	Low	144.30	153.84	60.84	115.03	169.23
2035	Low	141.41	150.77	59.62	112.73	165.84
2001	Median	197.80	236.87	NA	NA	260.55
2002	Median	192.46	232.64	NA	NA	255.91
2003	Median	193.87	229.61	NA	NA	252.57
2004	Median	193.92	229.34	NA	NA	252.27
2005	Median	196.87	228.84	NA	NA	251.72
2006	Median	194.21	221.65	NA	NA	243.81
2007	Median	191.66	220.63	NA	NA	242.70
2008	Median	186.82	215.91	NA	NA	237.50
2009	Median	181.38	205.23	NA	NA	225.75
2010	Median	176.77	202.35	NA	NA	222.58
2011	Median	175.18	199.20	NA	NA	219.12
2012	Median	173.02	195.59	NA	NA	215.15
2013	Median	174.69	194.63	NA	NA	214.09
2014	Median	174.21	195.10	NA	NA	214.61
2015	Median	174.28	195.49	76.40	145.72	215.04
2016	Median	174.78	194.76	81.85	148.04	214.24
2017	Median	176.55	196.95	79.41	148.03	216.65
2018	Median	186.66	201.73	80.24	151.07	221.91
2019	Median	195.37	208.30	82.38	155.75	229.13
2020	Median	191.47	204.13	80.73	152.64	224.55
2021	Median	187.64	200.05	79.11	149.58	220.06
2022	Median	183.88	196.05	77.53	146.59	215.65

2023	Median	180.21	192.13	75.98	143.66	211.34
2024	Median	176.60	188.29	74.46	140.79	207.11
2025	Median	173.07	184.52	72.97	137.97	202.97
2026	Median	169.61	180.83	71.51	135.21	198.91
2027	Median	166.22	177.21	70.08	132.51	194.93
2028	Median	162.89	173.67	68.68	129.86	191.04
2029	Median	159.63	170.20	67.31	127.26	187.21
2030	Median	156.44	166.79	65.96	124.72	183.47
2031	Median	153.31	163.46	64.64	122.22	179.80
2032	Median	150.25	160.19	63.35	119.78	176.21
2033	Median	147.24	156.98	62.08	117.38	172.68
2034	Median	144.30	153.84	60.84	115.03	169.23
2035	Median	141.41	150.77	59.62	112.73	165.84

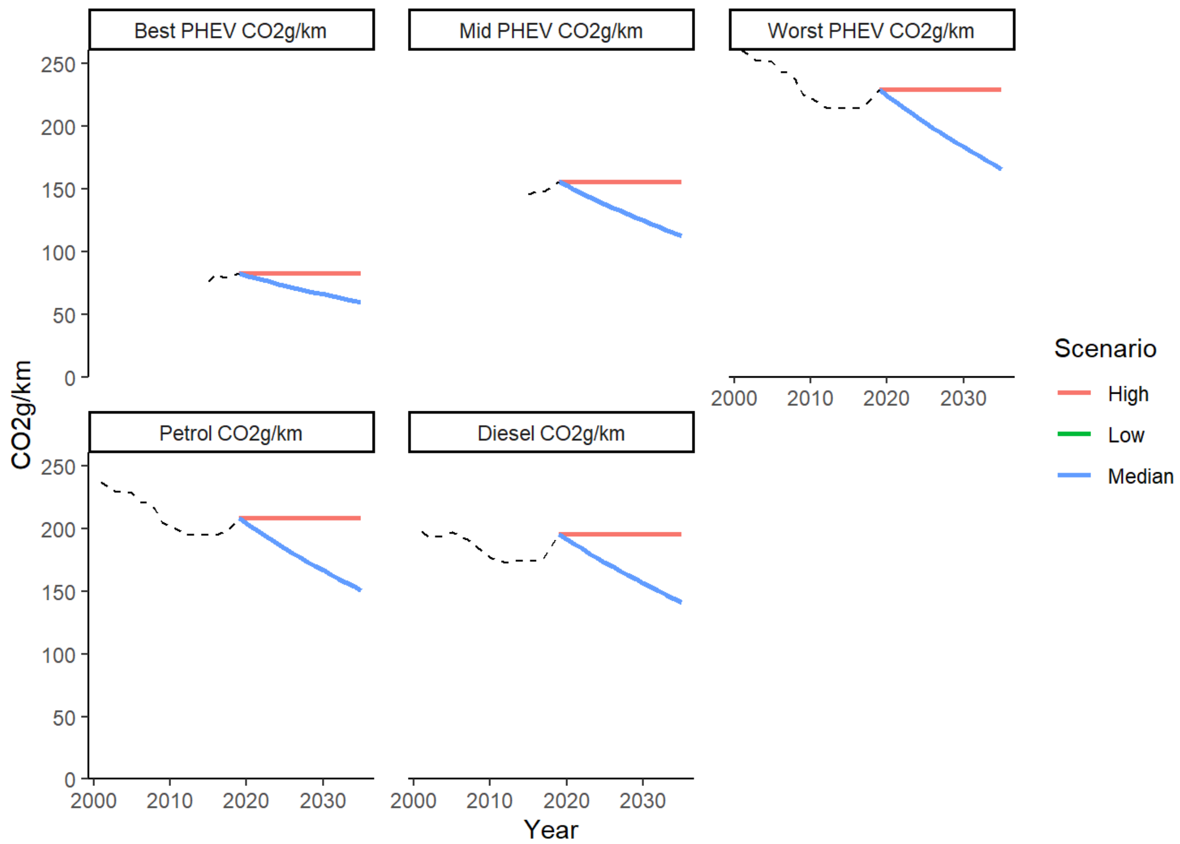


Figure 26: Forecasting the fuel economy used in the different modelled outputs (three scenarios)

The high scenario uses an improvement of 0%, the median and low scenario uses 2%.

6.4 Car parc

Table 4 shows the car parc split by diesel, petrol, PHEV and BEV by each scenario.

Table 4: Car parc

Year	Scenario	Diesel	Petrol	PHEV	BEV	Total
2019	High	12,852,314	19,758,612	156,390	91,041	32,858,357
2020	High	12,135,997	18,739,834	221,333.9	198,019.3	31,295,185
2021	High	11,855,671	18,923,344	340,740.3	337,141.2	31,456,897
2022	High	11,522,494	19,257,567	500,787.8	534,960.7	31,815,810
2023	High	11,122,994	19,641,994	675,871.6	740,528.1	32,181,387
2024	High	10,638,319	19,984,184	874,647.7	1,004,783	32,501,934
2025	High	10,066,458	20,218,787	1,097,283	1,341,327	32,723,855
2026	High	9,420,699	20,357,707	1,317,349	1,750,647	32,846,402
2027	High	8,705,270	20,345,890	1,558,321	2,244,849	32,854,330
2028	High	7,925,375	20,077,785	1,820,318	2,822,870	32,646,348
2029	High	7,094,660	19,470,177	2,127,539	3,513,182	32,205,557
2030	High	6,254,736	18,527,347	2,426,796	4,328,122	31,537,000
2031	High	5,453,169	17,496,456	2,742,507	5,298,238	30,990,369
2032	High	4,708,744	16,386,431	2,995,206	6,415,518	30,505,898
2033	High	4,033,647	15,213,127	3,182,782	7,687,578	30,117,134
2034	High	3,434,050	14,006,461	3,251,981	9,023,273	29,715,765
2035	High	2,910,386	12,752,647	3,150,657	10,473,069	29,286,759
2019	Median	12,852,314	19,758,612	156,390	91,041	32,858,357
2020	Median	12,135,997	18,739,834	221,333.9	198,019.3	31,295,185
2021	Median	11,849,636	18,897,379	337,740.3	362,141.2	31,446,897
2022	Median	11,509,013	19,197,031	493,786.3	609,973.4	31,809,803
2023	Median	11,102,645	19,545,531	664,889.3	955,388.8	32,268,453
2024	Median	10,612,156	19,852,682	858,773.4	1,398,680	32,722,291
2025	Median	10,035,607	20,055,159	1,075,520	1,963,150	33,129,435
2026	Median	9,386,191	20,165,088	1,289,719	2,647,704	33,488,702
2027	Median	8,668,059	20,126,677	1,524,896	3,475,962	33,795,594
2028	Median	7,886,660	19,838,220	1,780,171	4,445,410	33,950,461
2029	Median	7,055,767	19,219,582	2,079,739	5,603,710	33,958,798
2030	Median	6,216,391	18,273,850	2,371,460	6,971,864	33,833,564
2031	Median	5,415,528	17,231,882	2,678,816	8,469,929	33,796,156
2032	Median	4,672,069	16,149,079	2,924,397	10,065,086	33,810,630
2033	Median	3,998,323	15,006,050	3,107,162	11,749,701	33,861,237
2034	Median	3,400,552	13,808,276	3,173,969	13,516,490	33,899,288
2035	Median	2,879,232	12,566,202	3,074,691	15,429,675	33,949,800
2019	Low	12,852,314	19,758,612	156,390	91,041	32,858,357
2020	Low	11,952,495	18,386,424	221,127.4	197,925.8	30,757,972
2021	Low	11,584,436	18,415,261	337,324	362,089.3	30,699,110
2022	Low	11,165,077	18,548,186	454,223.4	795,957.9	30,963,444
2023	Low	10,672,907	18,667,217	580,924.6	1,455,549	31,376,597
2024	Low	10,108,661	18,770,917	724,268.8	2,302,864	31,906,711
2025	Low	9,451,697	18,698,777	885,288.7	3,367,242	32,403,005
2026	Low	8,715,021	18,442,885	1,043,159	4,660,811	32,861,877

2027	Low	7,931,468	18,102,780	1,215,788	6,022,031	33,272,067
2028	Low	7,098,736	17,518,262	1,401,462	7,516,069	33,534,528
2029	Low	6,239,601	16,661,134	1,619,474	9,139,198	33,659,408
2030	Low	5,400,998	15,621,315	1,829,749	10,889,684	33,741,746
2031	Low	4,616,790	14,519,291	2,050,096	12,704,417	33,890,594
2032	Low	3,904,586	13,368,788	2,221,541	14,572,474	34,067,388
2033	Low	3,274,263	12,184,373	2,344,383	16,479,197	34,282,216
2034	Low	2,727,722	10,995,389	2,378,494	18,357,399	34,459,003
2035	Low	2,260,764	9,795,973	2,286,854	20,185,838	34,529,429

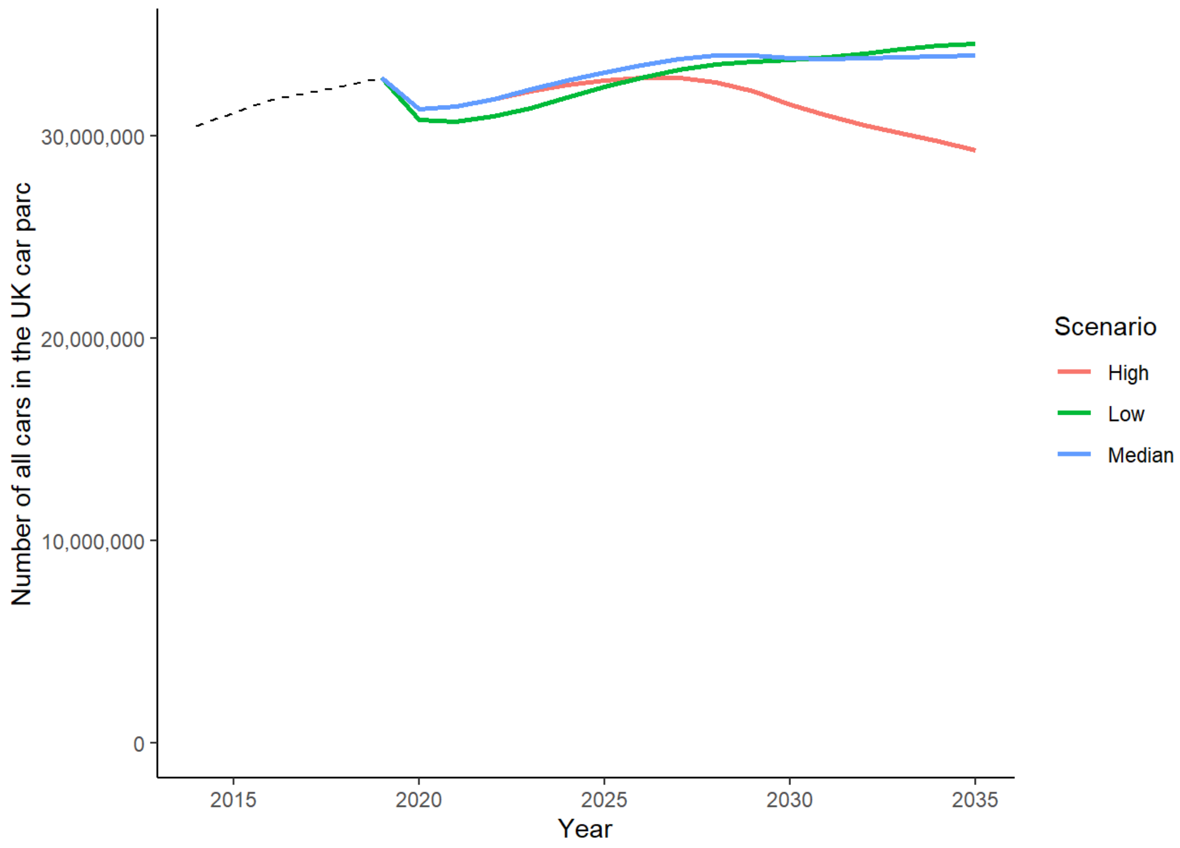


Figure 27: Forecasting the number of all cars in the UK parc (three scenarios)

The total number of cars in the parc in 2019 was 32.9 million (figure 27).

In 2028, in the high scenario, the parc is forecast to decrease by 0.6% to around 32.6 million compared to 2019. In the median scenario it increases by 3.3% to around 34 million; in the low scenario, it increases by 2.1% to around 33.5 million. Thus, there is a difference of around 0.9 million cars between the high and low scenarios in 2028.

In 2035, compared to the 2019 figure, the parc is forecast to decrease by 10.9% to around 29.3 million in the high scenario. In the median scenario increases by 3.3% to around 33.9 million; in the low scenario it increases by 5.1% to around 34.5 million. Thus, is a difference of around 5.2 million cars between the high and low scenarios in 2035.

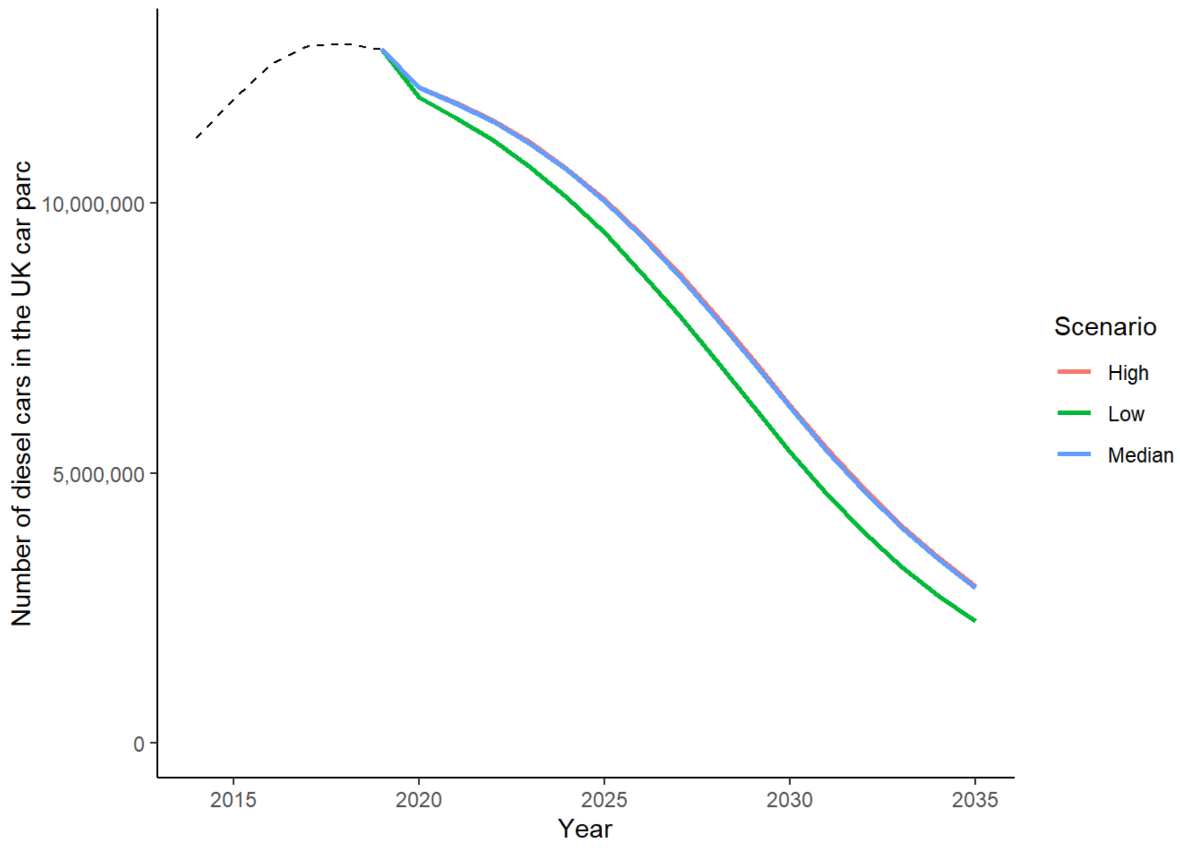


Figure 28: Forecasting the number of diesel cars in the UK parc (three scenarios)

The total number of diesel cars in the parc in 2019 was 12.9 million (figure 28).

In 2028, in the high scenario, the number of diesels in the parc is forecast to decrease by 38.3% to around 7.9 million compared to 2019. In the median scenario it decreases by 38.6% to around 7.9 million; in the low scenario, it decreases by 7.1% to around 7.1 million. Thus, there is a difference of around 0.8 million cars between the high and low scenarios in 2028.

In 2035, compared to the 2019 figure, the number of diesel cars is forecast to decrease by 77.4% to 2.9 million in the high scenario. In the median scenario it decreases by 77.6% to around 2.9 million; in the low scenario it decreases by 82.4% to around 2.3 million. Thus, there is a difference of around 0.6 million cars between the high and low scenarios in 2035.

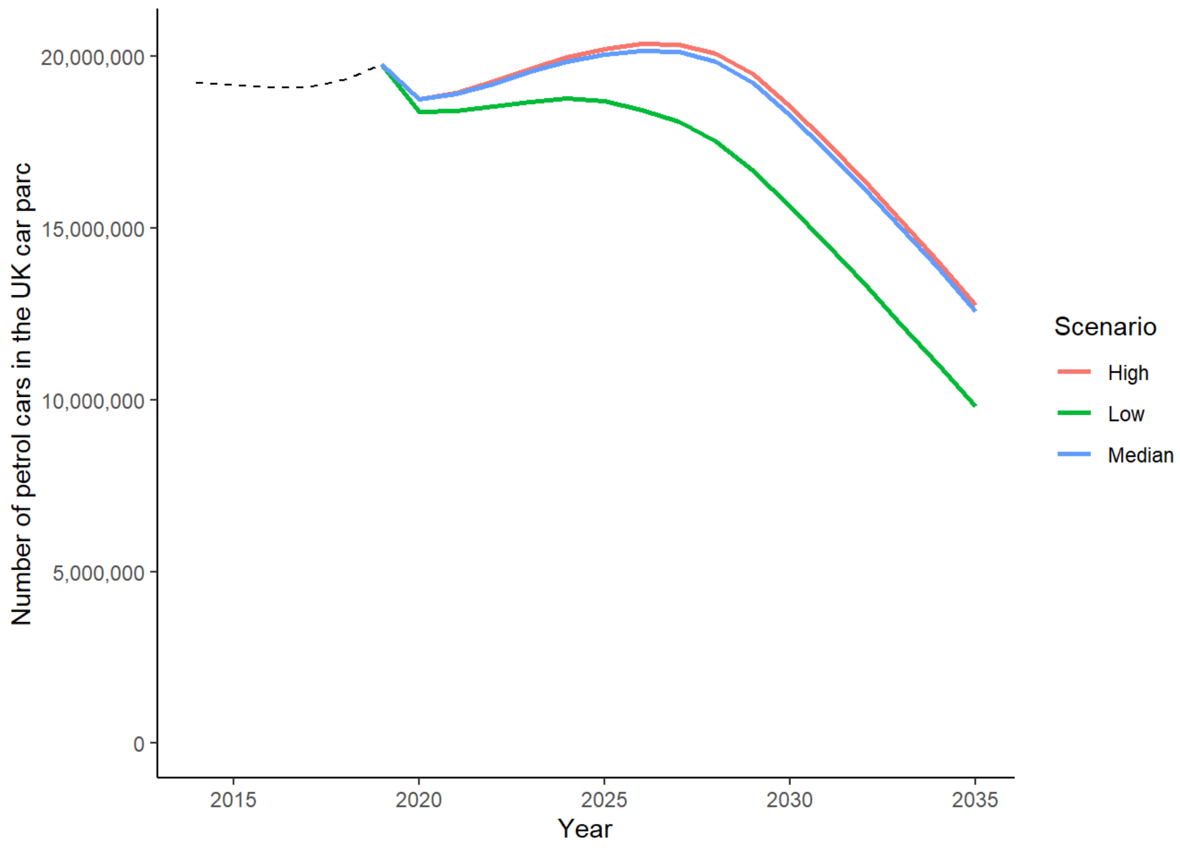


Figure 29: Forecasting the number of petrol cars in the UK parc (three scenarios)

The total number of petrol cars in the parc in 2019 was 19.8 million.

In 2028, in the high scenario, the number of petrol cars in the parc is forecast to increase by 1.6% to around 20.1 million compared to 2019. In the median scenario it increases by 0.4% to around 19.8 million; in the low scenario, it increases by decrease by 11.3% to around 17.5 million. Thus, there is a difference of around 2.6 million cars between the high and low scenarios in 2028.

In 2035, compared to the 2019 figure, the number of petrol cars is forecast to decrease by 35.5% to around 12.8 million in the high scenario. In the median scenario it decreases by 36.4% to around 12.6 million; in the low scenario it decreases by 50.4% to around 9.8 million. Thus, there is a difference of around 3 million cars between the high and low scenarios in 2035.

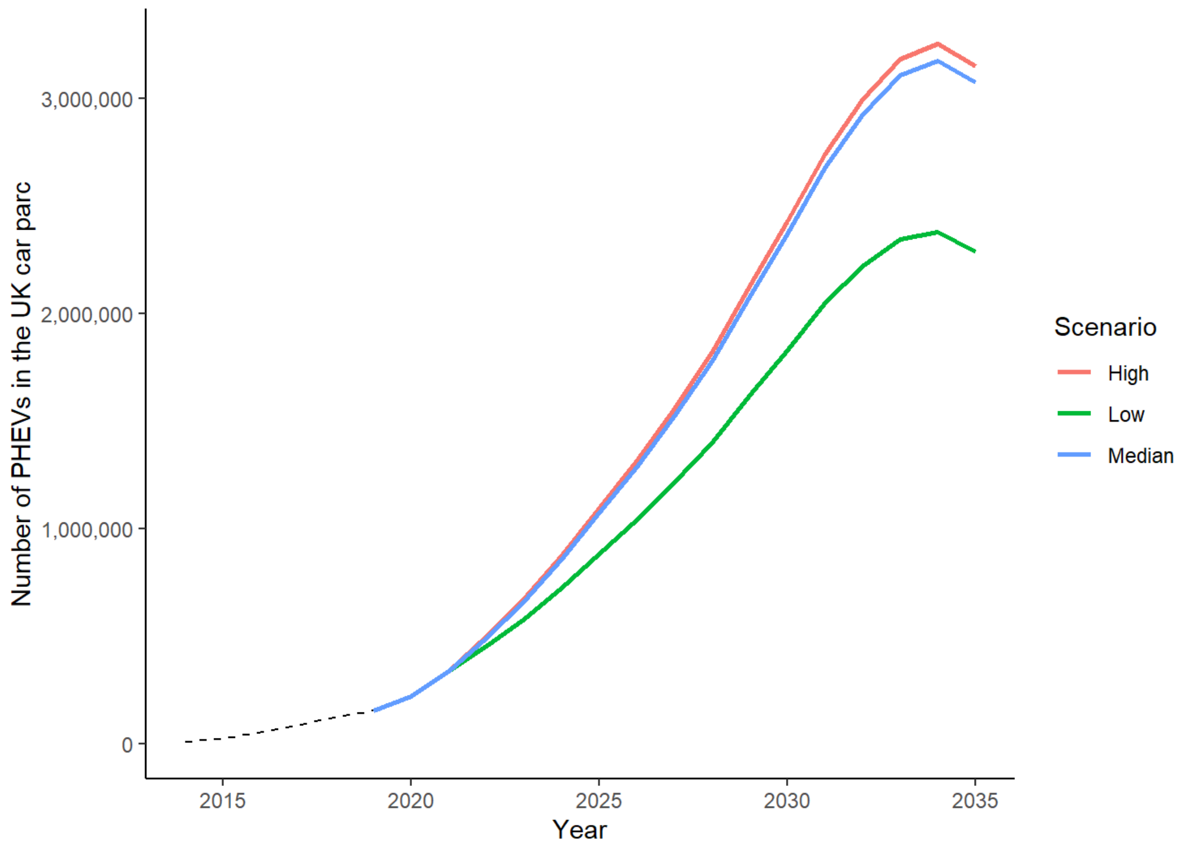


Figure 30: Forecasting the number of PHEVs in the UK parc (three scenarios)

The total number of PHEV cars in the parc in 2019 was 0.2 million.

In 2028, in the high scenario, the number of PHEVs in the parc is forecast to increase by 1064% to around 1.8 million compared to 2019. In the median scenario it increases by 1038.3% to around 1.8 million; in the low scenario, it increases by 796.1% to around 1.4 million. Thus, is a difference of around 0.4 million cars between the high and low scenarios in 2028.

In 2035, compared to the 2019 figure, the number of PHEVs is forecast to increase by 1914.6% to around 3.2 million in the high scenario. In the median scenario it increases by 1866% to around 3.1 million; in the low scenario it increases by 1362.3% to around 2.3 million. Thus, there is a difference of around 0.9 million cars between the high and low scenarios in 2035.

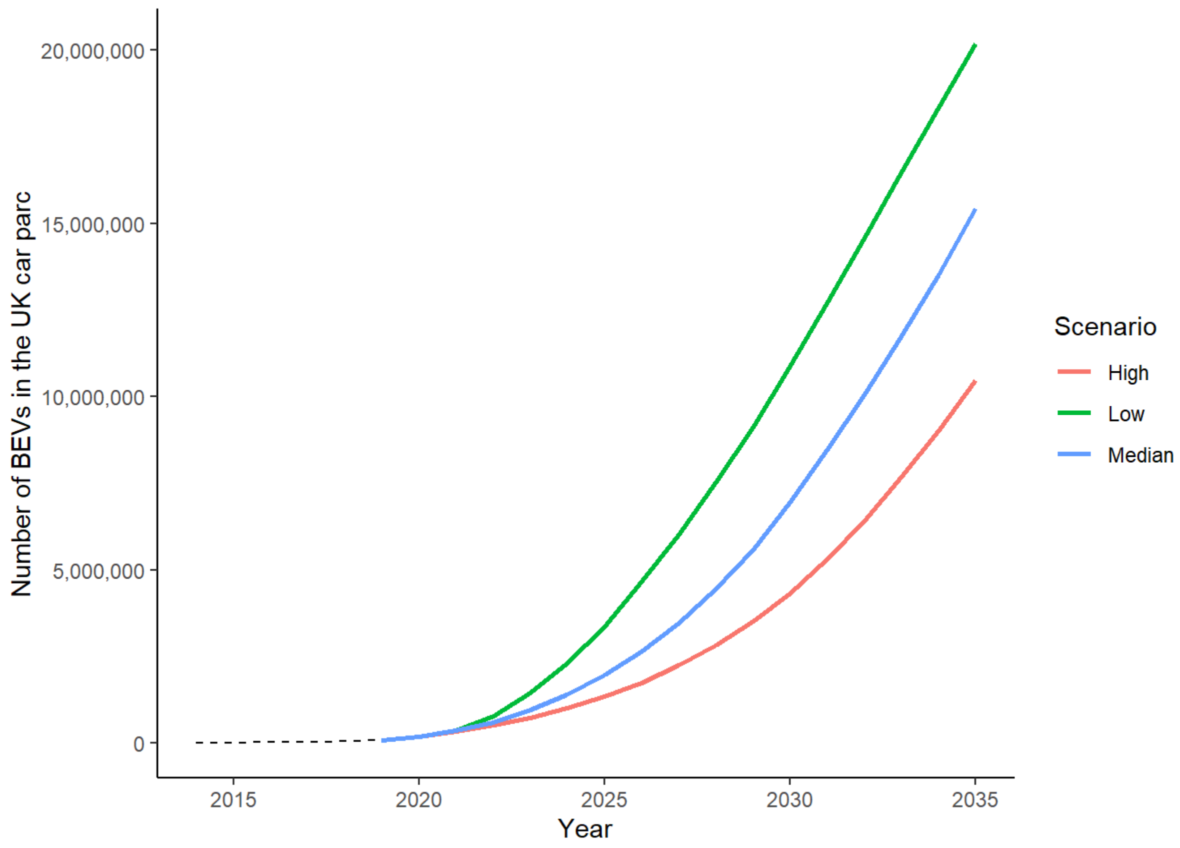


Figure 31: Forecasting the number of BEVs in the UK parc (three scenarios)

The total number of BEV cars in the parc in 2019 was 0.1 million.

In 2028, in the high scenario, the number of BEVs in the parc is forecast to increase by 3,000.7% to around 2.8 million compared to 2019. In the median scenario it increases by 4,782.9% to around 4.4 million; in the low scenario, it increases by 8,155.7% to around 7.5 million. Thus, there is a difference of around 4.7 million cars between the high and low scenarios in 2028.

In 2035, compared to the 2019 figure, the number of BEVs is forecast to increase by 11,403.7% to around 10.5 million in the high scenario. In the median scenario it increases by 16,848.1% to around 15.4 million; in the low scenario it increases by 22,072.3% to around 20.2 million. Thus, there is a difference of around 9.7 million cars between the high and low scenarios in 2035.

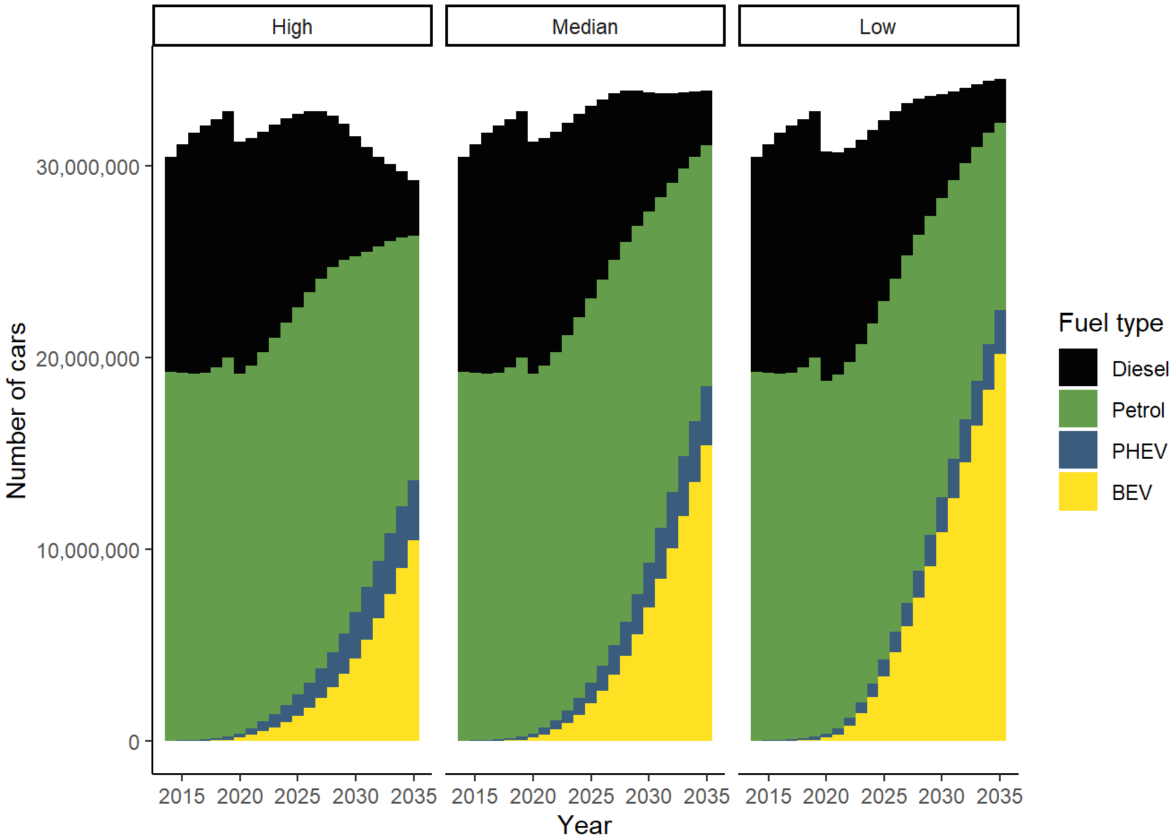


Figure 32: Number of cars in the parc split by fuel type in each scenario

Figure 32 shows the split of the car parc in each of the scenarios. The known values are from 2015-2019. The median and low scenarios have more cars in the parc than in the high scenario.

As expected the low scenario has the most BEVs in the parc by 2035 and the high scenario has the least.

6.5 Mileages

Table 5 shows the total mileages split by fuel type.

Table 5: Mileages from the three scenarios

Year	Scenario	Diesel	Petrol	PHEV	BEV	Total
2020	High	113,562,003,532	113,840,574,934	2,517,979,165	1,628,170,785	231,548,728,416
2021	High	108,668,504,864	114,823,629,249	3,914,465,566	2,778,778,034	230,185,377,713
2022	High	103,380,839,476	116,578,526,250	5,797,166,656	4,421,556,245	230,178,088,627
2023	High	97,920,087,079	118,955,811,245	7,823,113,724	6,107,723,458	230,806,735,506
2024	High	91,917,994,358	120,995,747,366	10,044,138,026	8,329,281,565	231,287,161,315
2025	High	85,301,149,095	122,264,726,815	12,468,379,972	11,138,625,517	231,172,881,399
2026	High	78,249,936,614	122,860,721,244	14,818,736,221	14,649,244,491	230,578,638,570
2027	High	70,805,608,125	122,364,974,002	17,417,654,225	18,971,058,645	229,559,294,998
2028	High	63,029,833,575	120,140,851,300	20,311,560,568	24,109,330,706	227,591,576,149
2029	High	55,011,451,545	115,631,951,767	23,840,074,589	30,310,684,710	224,794,162,611
2030	High	47,144,233,485	108,791,978,566	27,225,036,459	37,492,087,344	220,653,335,854
2031	High	39,882,395,284	101,318,453,877	30,638,235,584	45,979,850,780	217,818,935,524
2032	High	33,374,817,664	93,377,436,128	33,165,650,652	55,706,432,700	215,624,337,145
2033	High	27,695,908,966	85,230,086,471	34,846,665,019	66,859,455,395	214,632,115,851
2034	High	22,810,401,996	76,972,380,216	35,116,848,751	78,672,511,023	213,572,141,986
2035	High	18,664,668,395	68,533,710,648	33,421,974,406	91,542,041,988	212,162,395,438
2020	Median	113,562,003,532	113,840,574,934	2,517,979,165	1,628,170,785	231,548,728,416
2021	Median	108,601,005,116	114,649,965,667	3,878,063,581	2,981,038,907	230,110,073,270
2022	Median	103,230,057,690	116,173,627,002	5,712,210,241	5,028,441,380	230,144,336,313
2023	Median	97,687,780,567	118,297,589,076	7,691,981,831	7,854,971,545	231,532,323,019
2024	Median	91,620,903,140	120,099,171,247	9,858,816,288	11,524,335,997	233,103,226,672
2025	Median	84,956,748,049	121,151,567,985	12,219,410,257	16,211,025,462	234,538,751,753
2026	Median	77,872,700,537	121,554,599,478	14,506,850,839	21,956,298,610	235,890,449,464
2027	Median	70,408,373,356	120,887,416,907	17,043,251,906	29,060,533,655	237,399,575,824
2028	Median	62,627,001,764	118,537,332,746	19,861,690,171	37,522,616,120	238,548,640,802
2029	Median	54,618,799,278	113,968,832,421	23,300,629,216	47,773,241,253	239,661,502,168
2030	Median	46,770,731,633	107,130,635,919	26,596,334,928	59,893,609,706	240,391,312,185
2031	Median	39,529,779,642	99,607,340,674	29,918,381,544	73,267,028,243	242,322,530,103
2032	Median	33,044,048,356	91,872,494,858	32,373,201,097	87,591,409,172	244,881,153,483
2033	Median	27,388,378,856	83,944,186,040	34,009,840,903	102,754,097,898	248,096,503,696
2034	Median	22,528,937,009	75,785,733,205	34,266,392,711	118,787,701,334	251,368,764,258
2035	Median	18,412,302,747	67,444,650,995	32,609,923,296	136,144,675,261	254,611,552,299
2020	Low	112,181,741,670	112,055,418,518	1,497,326,809	1,328,032,131	227,062,519,127
2021	Low	106,645,446,508	112,260,101,391	2,266,646,787	2,435,083,576	223,607,278,262
2022	Low	100,719,683,747	112,900,175,460	3,058,406,885	5,368,860,836	222,047,126,928
2023	Low	94,530,460,291	113,697,816,775	3,919,206,883	9,804,134,911	221,951,618,859
2024	Low	87,929,161,764	114,289,091,991	4,863,470,548	15,602,437,768	222,684,162,071
2025	Low	80,631,101,378	113,623,637,590	5,929,029,176	22,820,689,021	223,004,457,165
2026	Low	72,841,179,797	111,726,401,576	6,965,956,406	31,547,276,194	223,080,813,972
2027	Low	64,886,540,355	109,132,063,042	8,090,749,097	40,713,685,987	222,823,038,481
2028	Low	56,750,455,033	104,904,012,753	9,284,050,786	50,707,602,849	221,646,121,422
2029	Low	48,637,363,224	98,939,902,460	10,689,227,907	61,404,355,434	219,670,849,025

2030	Low	40,952,104,290	91,663,988,406	12,028,663,681	72,889,911,190	217,534,667,567
2031	Low	33,994,100,570	84,001,978,300	13,440,295,478	84,667,416,465	216,103,790,813
2032	Low	27,887,919,599	76,142,691,273	14,498,849,328	96,680,399,104	215,209,859,304
2033	Low	22,663,648,993	68,213,045,992	15,233,620,227	108,816,364,369	214,926,679,581
2034	Low	18,264,287,429	60,386,855,557	15,335,330,476	120,644,199,482	214,630,672,944
2035	Low	14,604,737,319	52,613,855,116	14,590,890,796	132,028,559,776	213,838,043,007

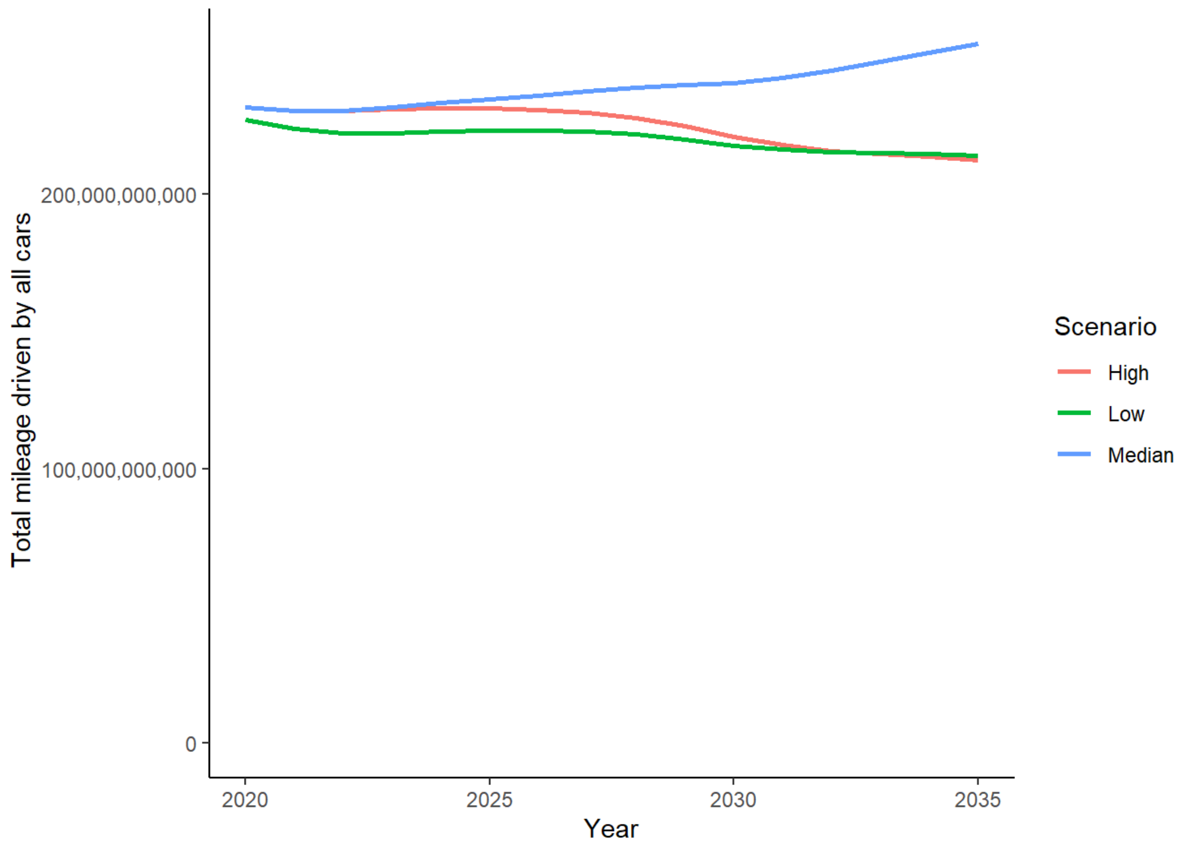


Figure 33: Forecasting the total mileage driven by all cars in the UK (three scenarios)

The median scenario shows an unusual trend here. This is due to the BEVs and PHEVs in this scenario driving high miles relative to historic norms.

The total annual mileage of all cars in 2020 was 231.5 billion miles (figure 33).

In 2028, in the high scenario, the total average mileage for all cars is forecast to decrease by 1.7% to around 227.6 billion miles compared to 2020. In the median scenario increases by 3% to around 238.5 billion miles; in the low scenario, it would decrease by 4.3% to around 221.6 billion miles. Thus, there is a difference of around 6 billion miles between the high and low scenarios in 2028.

In 2035, compared to the 2020 figure, the total average mileage is forecast to decrease by 8.4% to around 212.2 billion miles in the high scenario. In the median scenario it increases by 10% to around 254.6 billion miles; in the low scenario it would decrease by 7.6% to around 213.8 billion miles. Thus, there is a difference of around 1.6 billion miles cars between the high and low scenarios in 2035.

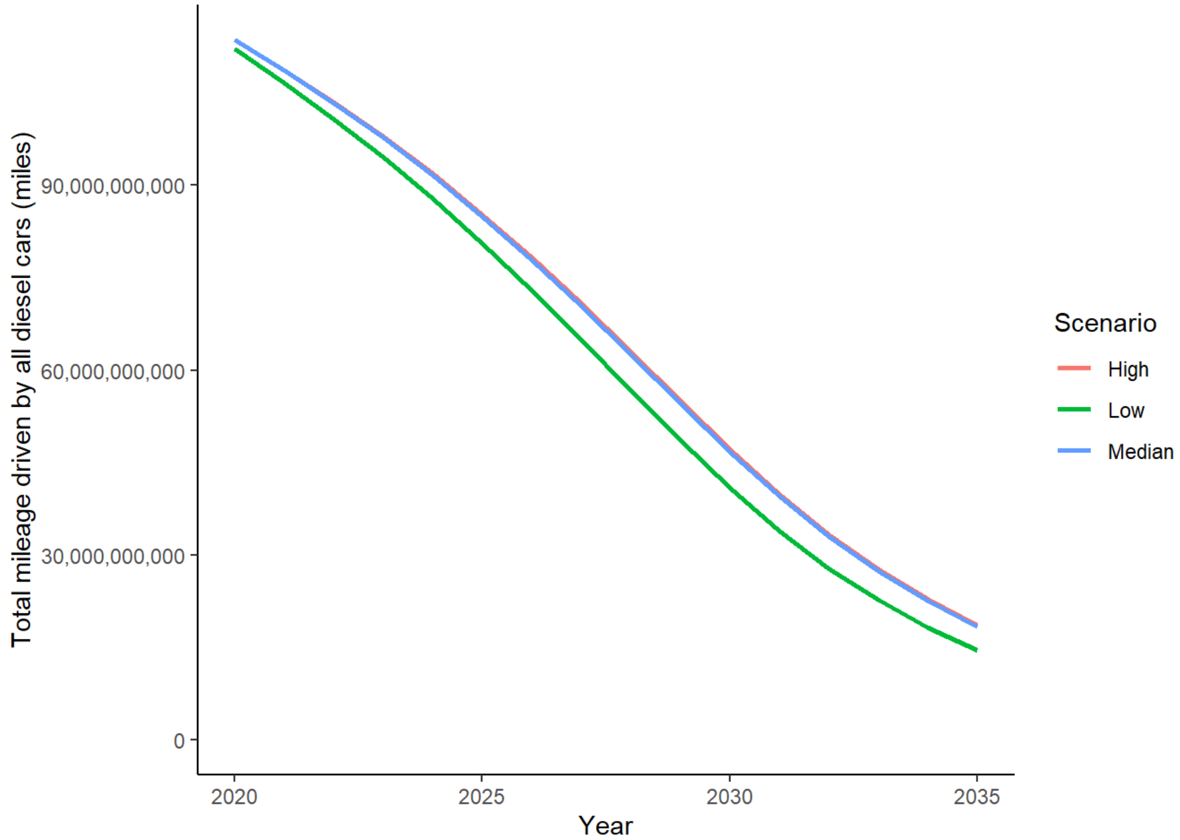


Figure 34: Forecasting the total mileage driven by all diesel cars in the UK (three scenarios)

The total annual mileage of all diesel cars in 2020 was around 113.6 billion miles (figure 34).

In 2028, in the high scenario, the total average mileage for all diesel cars is forecast to decrease by 44.5% to around 63 billion miles compared to 2020. In the median scenario it decreases by 44.9% to around 62.6 billion miles; in the low scenario, it decreases by 50% to around 56.8 billion miles. Thus, there is a difference of around 6.2 billion miles between the high and low scenarios in 2028.

Then in 2035, compared to the 2020 figure, the total average mileage is forecast to decrease by decrease by 83.6% to around 18.7 billion miles in the high scenario. In the median scenario it would decrease by 83.8% to around 18.4 billion miles and in the low scenario it would decrease by 87.1% to around 14.6 billion miles. Thus, there is a difference of around 4.1 billion miles cars between the high and low scenarios in 2035.

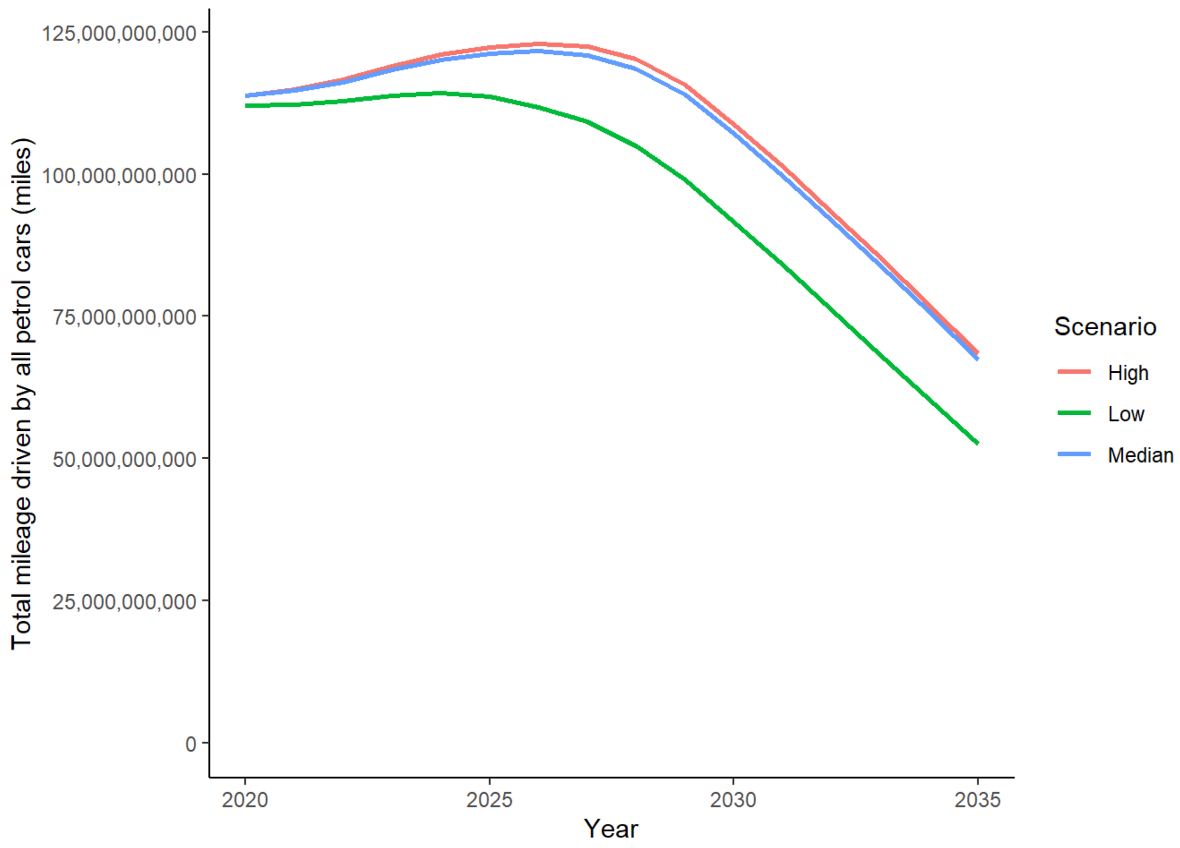


Figure 35: Forecasting the total mileage driven by all petrol cars in the UK (three scenarios)

The total annual mileage of all petrol cars in 2020 was around 113.8 billion miles (figure 35).

In 2028, in the high scenario, the total average mileage for all petrol cars is forecast to increase by 5.5% to around 120.1 billion miles compared to 2020. In the median scenario it increases by 4.1% to around 118.5 billion miles; in the low scenario, it would decrease by 7.9% to around 104.9 billion miles. Thus, there is a difference of around 15.2 billion miles between the high and low scenarios in 2028.

In 2035, compared to the 2020 figure, the total average mileage is forecast to decrease by 39.8% to around 68.5 billion miles in the high scenario. In the median scenario it decreases by 40.8% to around 67.4 billion miles; in the low scenario it decreases by 53.8% to around 52.6 billion miles. Thus, there is a difference of around 15.9 billion miles cars between the high and low scenarios in 2035.

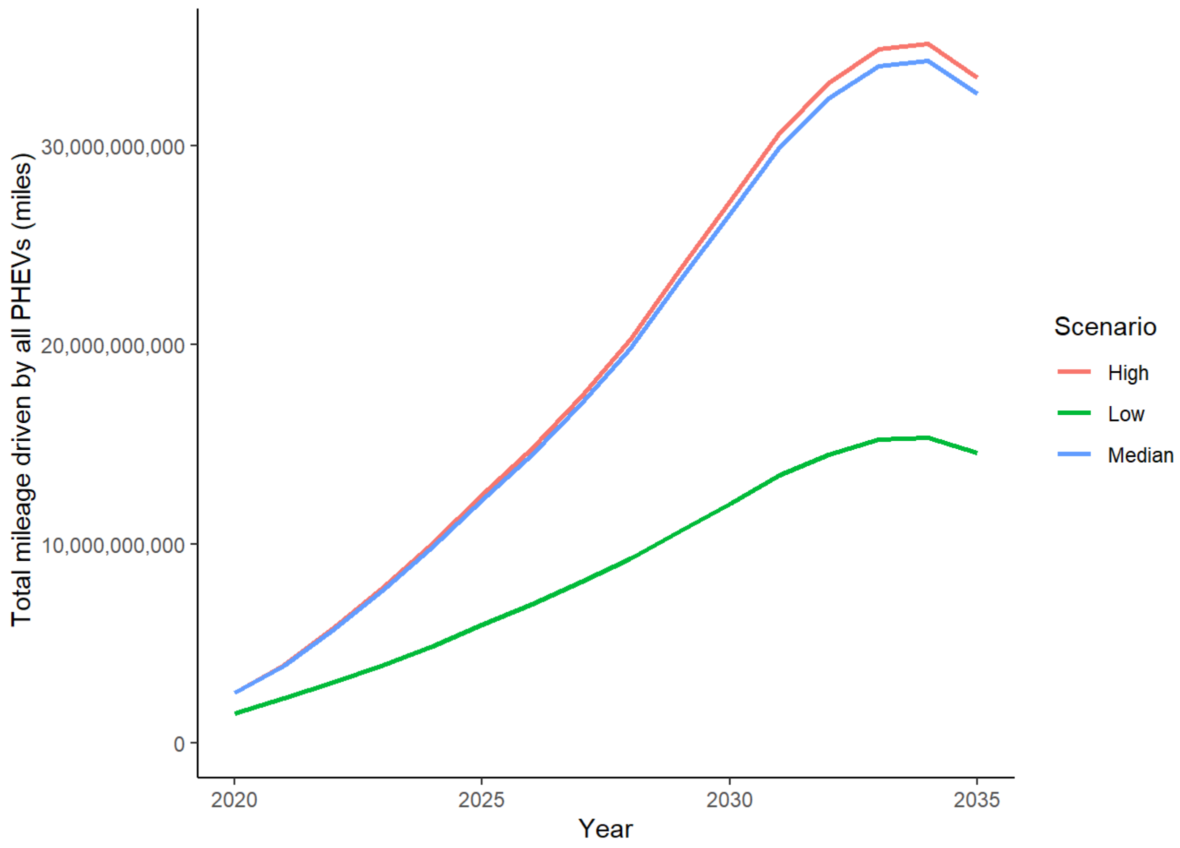


Figure 36: Forecasting the total mileage driven by all PHEVs in the UK (three scenarios)

Here, the high and median output scenarios are close to each other, this is partly due to the similar new PHEV registration inputs.

The total annual mileage of all PHEV cars in 2020 was around 2.5 billion miles.

In 2028, in the high scenario, the total average mileage for all PHEVs is forecast to increase by 706.7% to around 20.3 billion miles compared to 2020. In the median scenario it increases by 688.8% to around 19.9 billion miles; in the low scenario, it increases by 268.7% to around 9.3 billion miles. Thus, there is a difference of around 11 billion miles between the high and low scenarios in 2028.

In 2035, compared to the 2020 figure, the total average mileage is forecast to increase by 1227.3% to around 33.4 billion miles in the high scenario. In the median scenario it increases by 1195.1% to around 32.6 billion miles and in the low scenario it increases by 479.5% to around 14.6 billion miles. Thus, there is a difference of around 18.8 billion miles cars between the high and low scenarios in 2035.

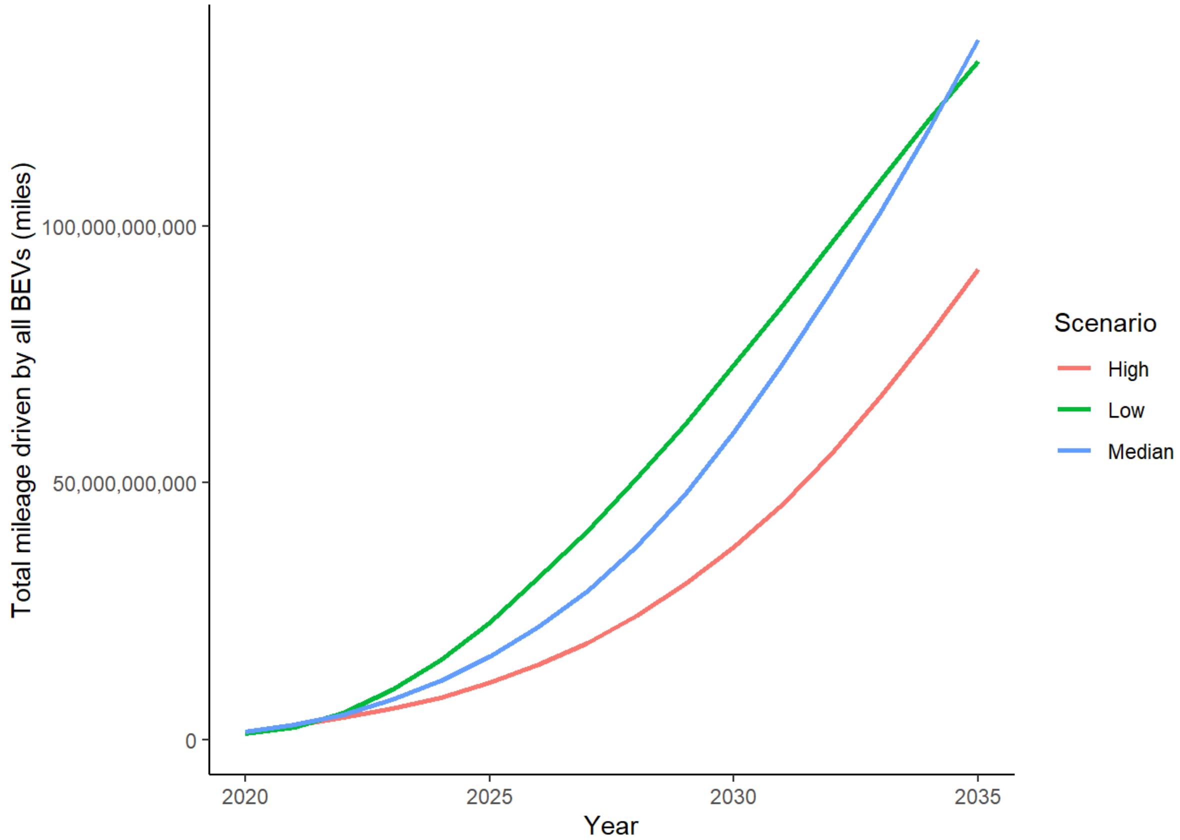


Figure 37: Forecasting the total mileage driven by all BEVs in the UK (three scenarios)

The total annual mileage of all battery electric cars in 2020 was around 1.6 billion miles.

In 2028, in the high scenario, the total average mileage for all BEVs is forecast to increase by 1,380.8% to around 24.1 billion miles compared to 2020. In the median scenario it increases by 2,204.6% to around 37.5 billion miles; in the low scenario, it increases by 3,014.4% to around 50.7 billion miles.

In 2035, compared to the 2020 figure, the total average mileage is forecast to increase by 5,522.4% to around 91.5 billion miles in the high scenario. In the median scenario it increases by 8,261.8% to around 136.1 billion miles; in the low scenario it increases by 8,009% to around 132 billion miles.

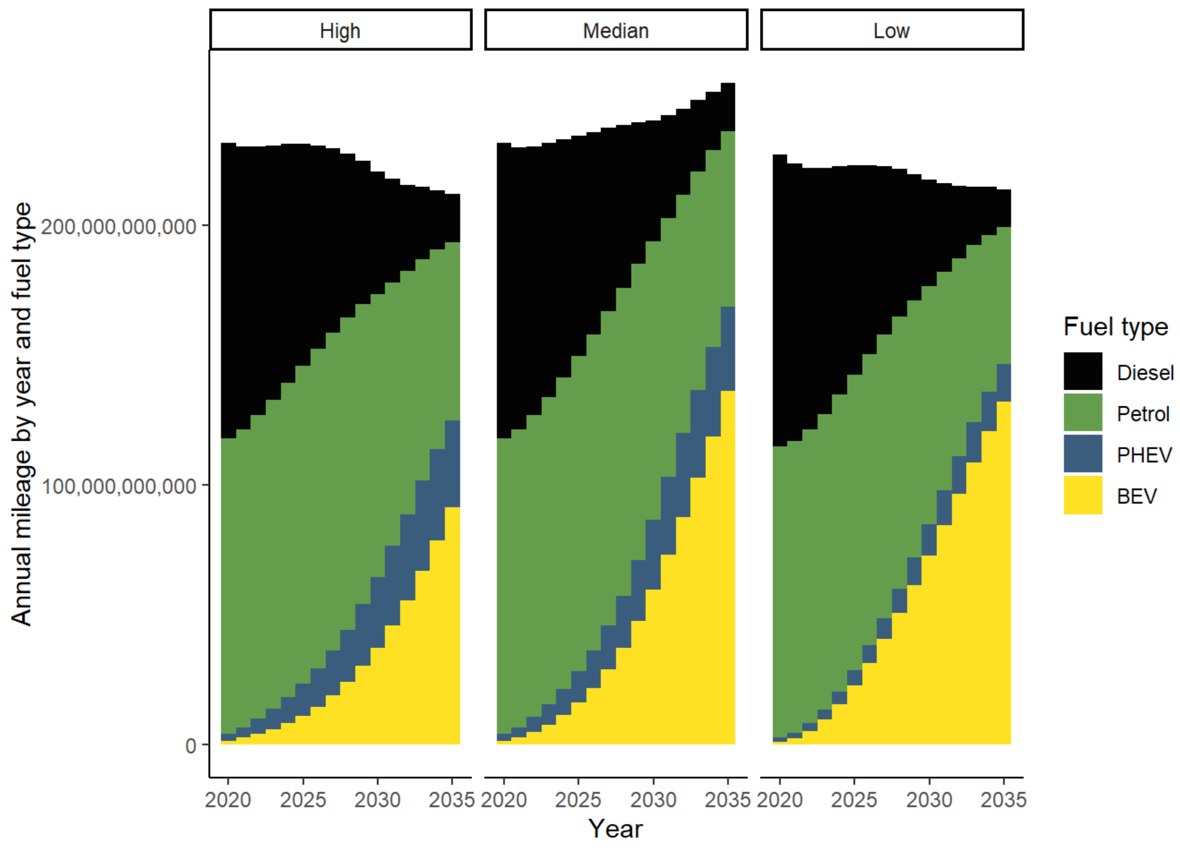


Figure 38: Annual mileage by year and fuel type (three scenarios)

Figure 38 shows as expected the mileages of BEVs are lowest in the high scenario.

The median and the low scenario shows a similar level of BEV mileages, but PHEV mileages are higher in the median scenario more due to the how their mileages were handled.

7. Escalator

Previous chapters have shown how fuel duty income from cars could fluctuate and ultimately decrease out to 2035, with associated explanations of the assumptions and parameters used to create the model. One key assumption is that the Government continues to tax cars and their use in the same way as it currently does. In other words, fuel duty would be frozen.

As an extension to this technical note, a fuel duty escalator (Tables 6 and 7) was calculated to provide an insight into how much fuel duty would have to increase by to continue to generate income at the 2019 level. It is important to note that this is a relatively crude calculation that does *not* attempt to take into account fuel price elasticity (as the rate of duty, and the per litre price of fuel rises, consumers will buy less); therefore, it is almost certainly an underestimate of the increases that would be needed in the event that higher prices resulted in fewer miles being driven by ICEs.

Table 6: Fuel duty escalator with no inflation

Year	Scenario	Litres of fuel	Fuel duty in 2019	New duty (£)	Annual fuel duty escalator (percentage increase)	Percentage change from £0.5795
2019	High	28,383,072,318	16,447,990,408	0.5795	0.00	0.00
2020	High	28,774,476,380	16,447,990,408	0.5716	-1.36	-1.36
2021	High	28,575,655,440	16,447,990,408	0.5756	0.70	-0.67
2022	High	28,533,989,897	16,447,990,408	0.5764	0.15	-0.53
2023	High	28,607,305,658	16,447,990,408	0.5750	-0.26	-0.78
2024	High	28,620,507,018	16,447,990,408	0.5747	-0.05	-0.83
2025	High	28,501,669,168	16,447,990,408	0.5771	0.42	-0.41
2026	High	28,238,174,832	16,447,990,408	0.5825	0.93	0.52
2027	High	27,820,973,042	16,447,990,408	0.5912	1.50	2.02
2028	High	27,168,281,369	16,447,990,408	0.6054	2.40	4.47
2029	High	26,259,329,532	16,447,990,408	0.6264	3.46	8.09
2030	High	25,005,193,887	16,447,990,408	0.6578	5.02	13.51
2031	High	23,723,427,570	16,447,990,408	0.6933	5.40	19.64
2032	High	22,307,191,798	16,447,990,408	0.7373	6.35	27.23
2033	High	20,807,771,600	16,447,990,408	0.7905	7.21	36.41
2034	High	19,146,784,713	16,447,990,408	0.8590	8.67	48.23
2035	High	17,222,364,190	16,447,990,408	0.9550	11.17	64.80
2019	Median	28,383,072,318	16,447,990,408	0.5795	0.00	0.00
2020	Median	28,497,048,883	16,447,990,408	0.5772	-0.40	-0.40
2021	Median	28,054,784,845	16,447,990,408	0.5863	1.58	1.17
2022	Median	27,666,024,260	16,447,990,408	0.5945	1.40	2.59
2023	Median	27,340,255,653	16,447,990,408	0.6016	1.19	3.81
2024	Median	26,911,546,666	16,447,990,408	0.6112	1.59	5.47
2025	Median	26,321,390,384	16,447,990,408	0.6249	2.24	7.83
2026	Median	25,590,710,010	16,447,990,408	0.6427	2.85	10.91
2027	Median	24,688,634,042	16,447,990,408	0.6662	3.65	14.96
2028	Median	23,554,189,627	16,447,990,408	0.6983	4.82	20.50
2029	Median	22,156,758,723	16,447,990,408	0.7423	6.31	28.09
2030	Median	20,497,813,145	16,447,990,408	0.8024	8.09	38.46
2031	Median	18,814,653,788	16,447,990,408	0.8742	8.95	50.85

2032	Median	17,140,397,471	16,447,990,408	0.9596	9.77	65.59
2033	Median	15,493,932,842	16,447,990,408	1.0616	10.63	83.19
2034	Median	13,851,506,957	16,447,990,408	1.1875	11.86	104.92
2035	Median	12,198,849,559	16,447,990,408	1.3483	13.55	132.67
2019	Low	28,383,072,318	16,447,990,408	0.5795	0.00	0.00
2020	Low	28,015,273,719	16,447,990,408	0.5871	1.31	1.31
2021	Low	27,390,520,182	16,447,990,408	0.6005	2.28	3.62
2022	Low	26,766,039,798	16,447,990,408	0.6145	2.33	6.04
2023	Low	26,139,240,562	16,447,990,408	0.6292	2.40	8.58
2024	Low	25,438,433,559	16,447,990,408	0.6466	2.76	11.58
2025	Low	24,503,818,602	16,447,990,408	0.6712	3.81	15.82
2026	Low	23,357,844,633	16,447,990,408	0.7042	4.91	21.52
2027	Low	22,105,848,481	16,447,990,408	0.7441	5.66	28.40
2028	Low	20,635,774,054	16,447,990,408	0.7971	7.12	37.55
2029	Low	18,970,587,496	16,447,990,408	0.8670	8.78	49.61
2030	Low	17,188,813,729	16,447,990,408	0.9569	10.37	65.13
2031	Low	15,436,031,136	16,447,990,408	1.0656	11.35	83.88
2032	Low	13,732,053,380	16,447,990,408	1.1978	12.41	106.70
2033	Low	12,101,807,409	16,447,990,408	1.3591	13.47	134.53
2034	Low	10,551,544,926	16,447,990,408	1.5588	14.69	168.99
2035	Low	9,065,266,714	16,447,990,408	1.8144	16.40	213.10

Table 7: Fuel duty escalator with 2.5% inflation

Year	Scenario	Litres of fuel	Fuel duty in 2019	New duty (£)	Annual fuel duty escalator (percentage increase)	Percentage change from £0.5795
2019	High	28,383,072,318	16,447,990,408	0.5795	0.00	0.00
2020	High	28,774,476,380	16,859,190,169	0.5859	1.11	1.10
2021	High	28,575,655,440	17,280,669,923	0.6047	3.21	4.35
2022	High	28,533,989,897	17,712,686,671	0.6208	2.65	7.13
2023	High	28,607,305,658	18,155,503,838	0.6346	2.24	9.51
2024	High	28,620,507,018	18,609,391,434	0.6502	2.45	12.20
2025	High	28,501,669,168	19,074,626,219	0.6692	2.93	15.48
2026	High	28,238,174,832	19,551,491,875	0.6924	3.46	19.48
2027	High	27,820,973,042	20,040,279,172	0.7203	4.04	24.30
2028	High	27,168,281,369	20,541,286,151	0.7561	4.96	30.47
2029	High	26,259,329,532	21,054,818,305	0.8018	6.05	38.36
2030	High	25,005,193,887	21,581,188,762	0.8631	7.64	48.94
2031	High	23,723,427,570	22,120,718,481	0.9324	8.04	60.90
2032	High	22,307,191,798	22,673,736,443	1.0164	9.01	75.39
2033	High	20,807,771,600	23,240,579,855	1.1169	9.89	92.74
2034	High	19,146,784,713	23,821,594,351	1.2442	11.39	114.70
2035	High	17,222,364,190	24,417,134,210	1.4178	13.95	144.66
2019	Median	28,383,072,318	16,447,990,408	0.5795	0.00	0.00
2020	Median	28,497,048,883	16,859,190,169	0.5916	2.09	2.09
2021	Median	28,054,784,845	17,280,669,923	0.6160	4.12	6.30
2022	Median	27,666,024,260	17,712,686,671	0.6402	3.94	10.47
2023	Median	27,340,255,653	18,155,503,838	0.6641	3.72	14.60
2024	Median	26,911,546,666	18,609,391,434	0.6915	4.13	19.33
2025	Median	26,321,390,384	19,074,626,219	0.7247	4.80	25.06
2026	Median	25,590,710,010	19,551,491,875	0.7640	5.43	31.84
2027	Median	24,688,634,042	20,040,279,172	0.8117	6.24	40.07
2028	Median	23,554,189,627	20,541,286,151	0.8721	7.44	50.49
2029	Median	22,156,758,723	21,054,818,305	0.9503	8.96	63.99
2030	Median	20,497,813,145	21,581,188,762	1.0529	10.80	81.69
2031	Median	18,814,653,788	22,120,718,481	1.1757	11.67	102.88
2032	Median	17,140,397,471	22,673,736,443	1.3228	12.51	128.27
2033	Median	15,493,932,842	23,240,579,855	1.5000	13.39	158.84
2034	Median	13,851,506,957	23,821,594,351	1.7198	14.65	196.77
2035	Median	12,198,849,559	24,417,134,210	2.0016	16.39	245.40
2019	Low	28,383,072,318	16,447,990,408	0.5795	0.00	0.00
2020	Low	28,015,273,719	16,859,190,169	0.6018	3.85	3.85
2021	Low	27,390,520,182	17,280,669,923	0.6309	4.84	8.87
2022	Low	26,766,039,798	17,712,686,671	0.6618	4.89	14.20
2023	Low	26,139,240,562	18,155,503,838	0.6946	4.96	19.86
2024	Low	25,438,433,559	18,609,391,434	0.7316	5.32	26.25
2025	Low	24,503,818,602	19,074,626,219	0.7784	6.41	34.32
2026	Low	23,357,844,633	19,551,491,875	0.8370	7.53	44.43
2027	Low	22,105,848,481	20,040,279,172	0.9066	8.30	56.45
2028	Low	20,635,774,054	20,541,286,151	0.9954	9.80	71.77
2029	Low	18,970,587,496	21,054,818,305	1.1099	11.50	91.53
2030	Low	17,188,813,729	21,581,188,762	1.2555	13.12	116.65
2031	Low	15,436,031,136	22,120,718,481	1.4331	14.14	147.30
2032	Low	13,732,053,380	22,673,736,443	1.6511	15.22	184.92
2033	Low	12,101,807,409	23,240,579,855	1.9204	16.31	231.39
2034	Low	10,551,544,926	23,821,594,351	2.2576	17.56	289.58
2035	Low	9,065,266,714	24,417,134,210	2.6935	19.30	364.80

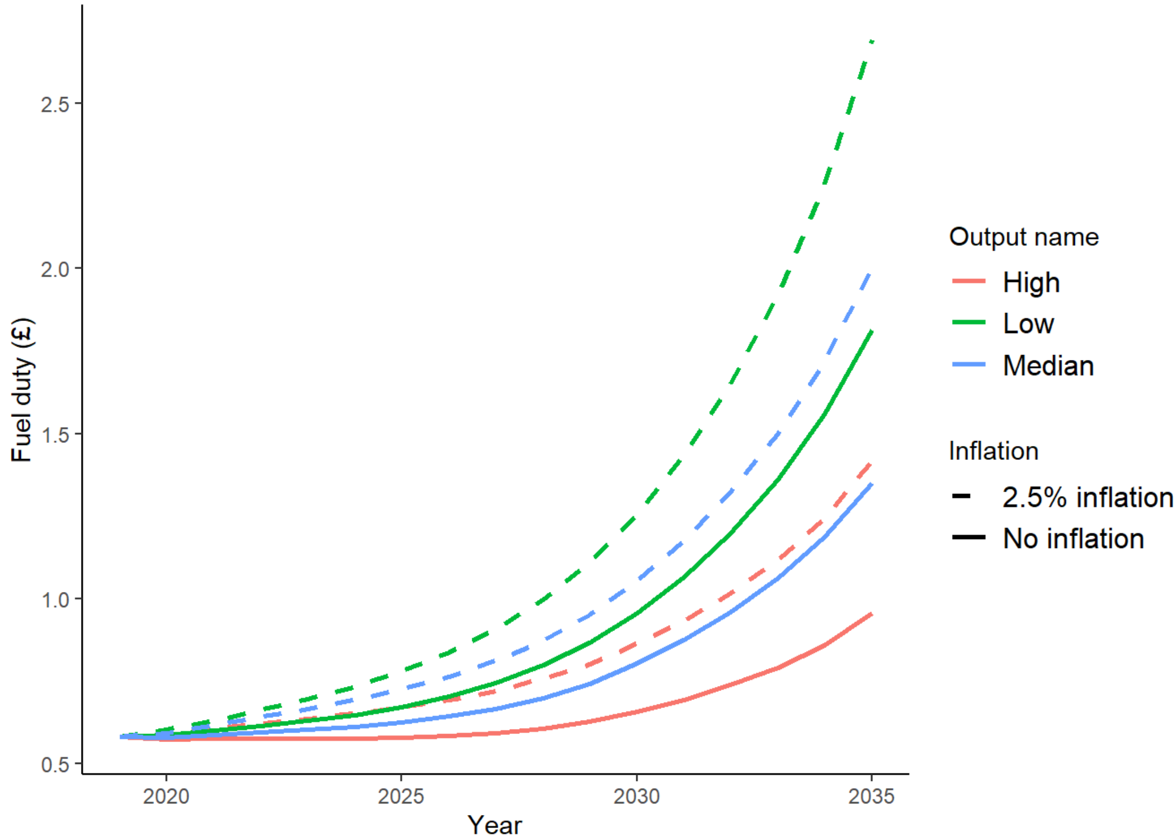


Figure 39: Fuel duty escalator

Figure 39 shows how much fuel duty would have to increase to in the three scenarios for total fuel duty income to remain at the same level as in 2019 (currently set at 57.95p).

Setting aside inflation, figure 39 shows that fuel duty would have to increase by 213.1% to £1.8144 in 2035 to maintain the current level of fuel duty income in the low. The median output suggests a slightly lower increase than the low output, at 132.67% to £1.3483, whereas in the high output, the least fuel duty would have to be increased by is 64.8% to £0.955 per litre.

However, if we factor in a 2.5% annual inflation assumption, this would increase the percentage change needed so that the low output would mean an increase of 364.8% to £2.6935, the median output shows an increase of 245.4% to £2.0016, and the high output an increase of 144.66% to £1.4178.

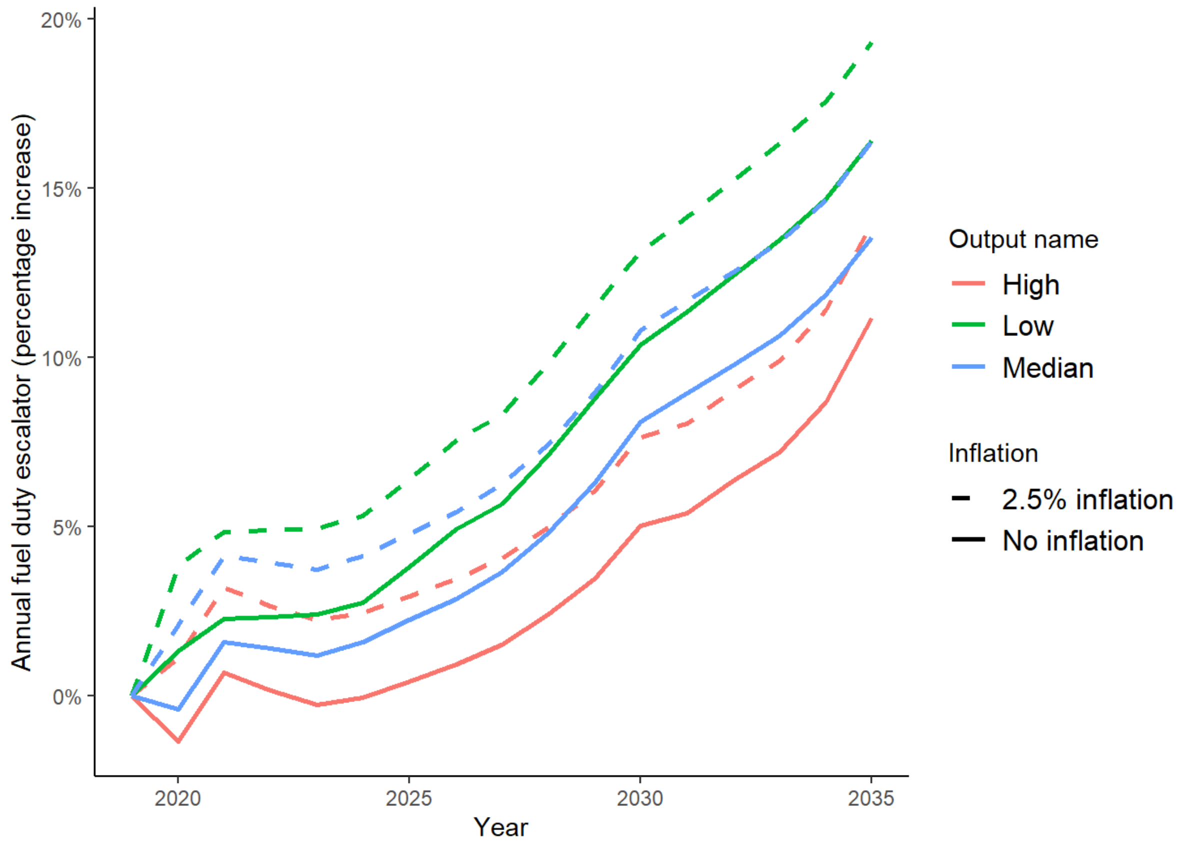


Figure 40: Fuel duty escalator year-on-year

Figure 40 shows how much fuel duty would have to increase by, as a percentage year on year, in the three scenarios for total fuel duty income to remain at the same level as in 2019 (currently set at 57.95p).

Setting aside inflation, the largest annual percentage increase is from 2034 to 2035, ranging from 11-16%.

However, when we factor in a 2.5% inflation, this percentage increases to 14-19%.

8. Alternative scenarios

In the previous chapters (5 and 6), some results from the model showed that petrol consumption (from petrol and PHEV cars) would rise in the future up until 2028 and therefore showing an increase in fuel duty from petrol. This is due to the new vehicle registration data from the SMMT which is thus far the best publicly available projection that is consistent with the inputs used by the Road Transport Transition Council.

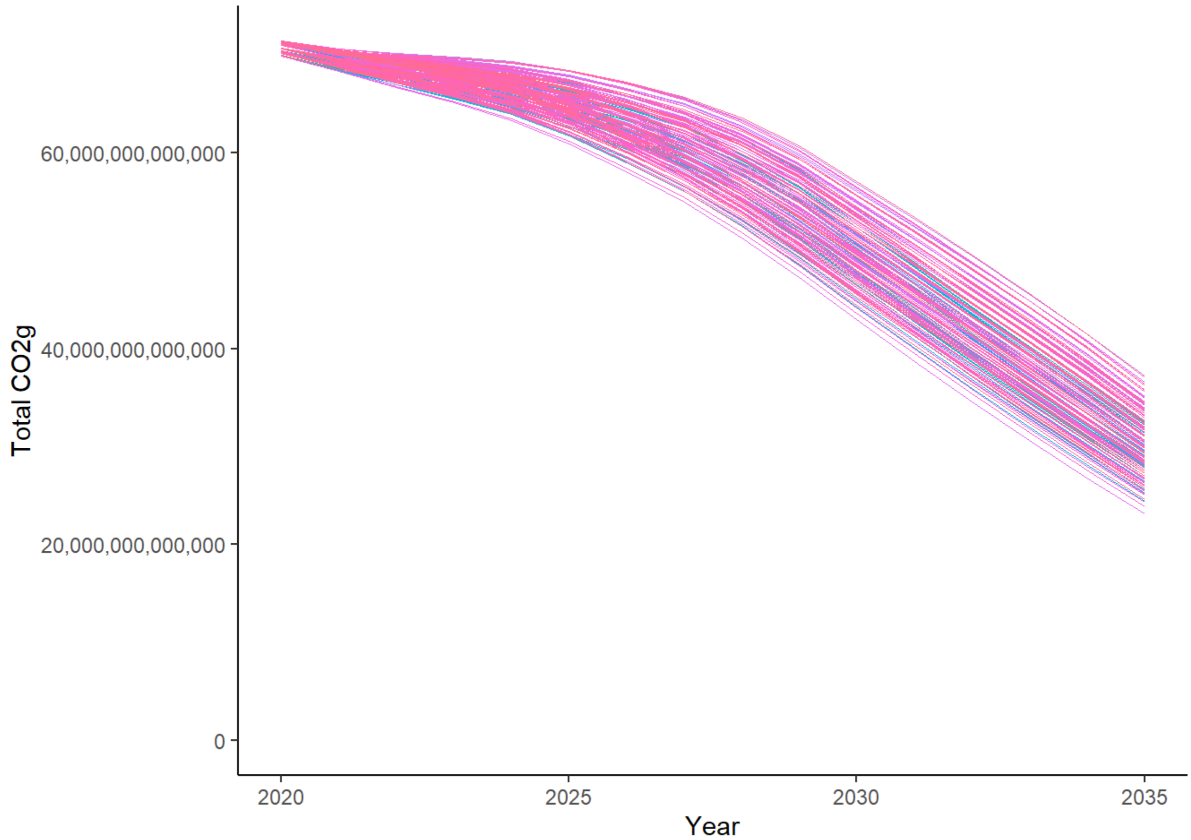


Figure 41: Total tailpipe CO2g emitted from all cars (432 outputs)

Figure 41 shows the total CO_2g produced in 2020 was around on average, 70,732 billion. By 2025, the total CO_2g produced by all cars (excluding BEV) is around 64,870 billion.

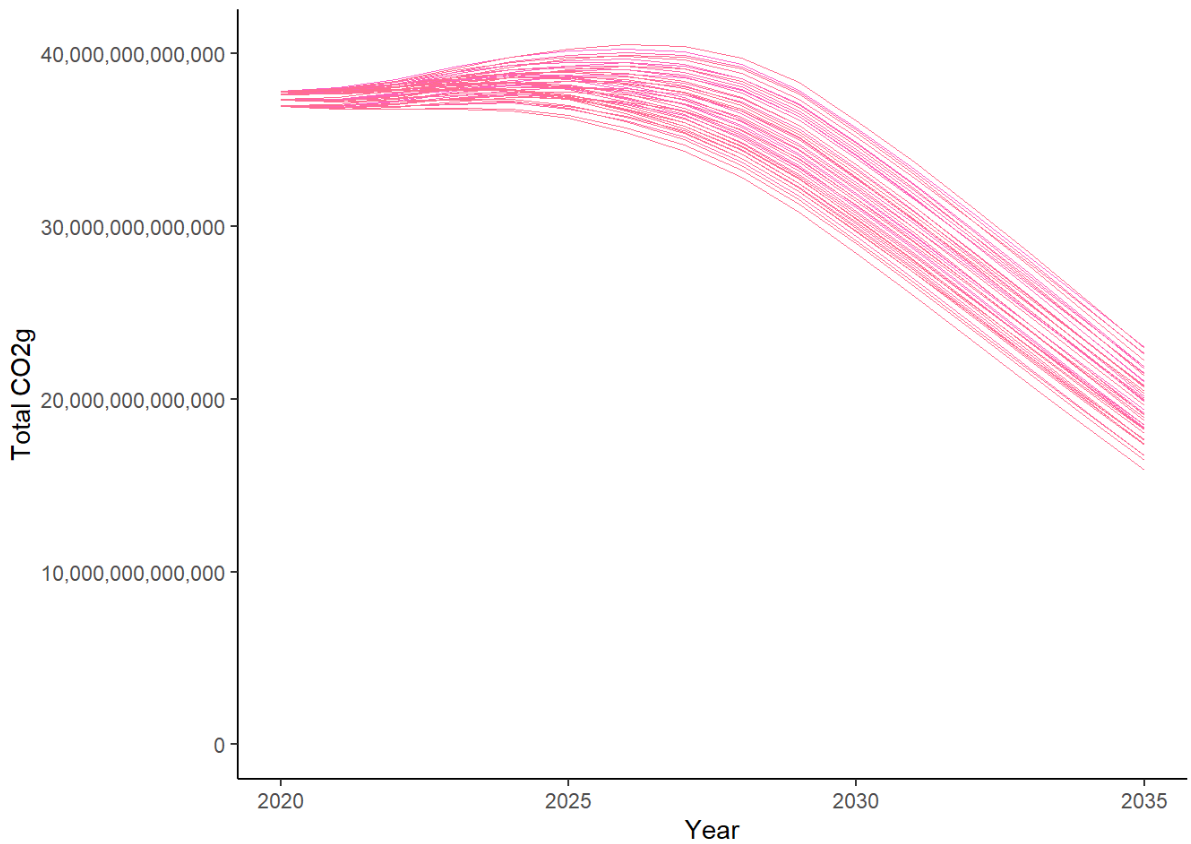


Figure 42: Total tailpipe CO2g emitted from all petrol cars in the 432 outputs

Figure 42 shows that CO_2g from petrol cars only (not including PHEV) is around 37,428 billion which is about 53% of the total in 2020.

In 2025, CO_2g from strictly petrol cars is around 38,288 billion which is about 59% of the total.

The two figures together show that petrol consumption from only petrol cars is increasing in the short term, hence CO_2g will also increase. Total CO_2g from petrol cars increases 2% from 2020 to 2025.

This chapter explores what would be needed to avoid the growth in petrol consumption in the near term by adjusting the proportion of BEV and petrol cars in the new car registration data. In other words, these alternative scenarios have a much more aggressive BEV car uptake and lower petrol car uptake than all SMMT scenarios that were used earlier in the report – whilst keeping the total number of new registrations the same.

The new car registration parameter was altered in three ways by increasing the proportion of BEVs faster and by specific year points:

- A fast uptake of BEVs: BEVs account for all new car sales by 2030
- A faster uptake of BEVs: BEVs account for all new car sales by 2028
- fastest uptake of BEVs: BEVs account for all new car sales by 2025

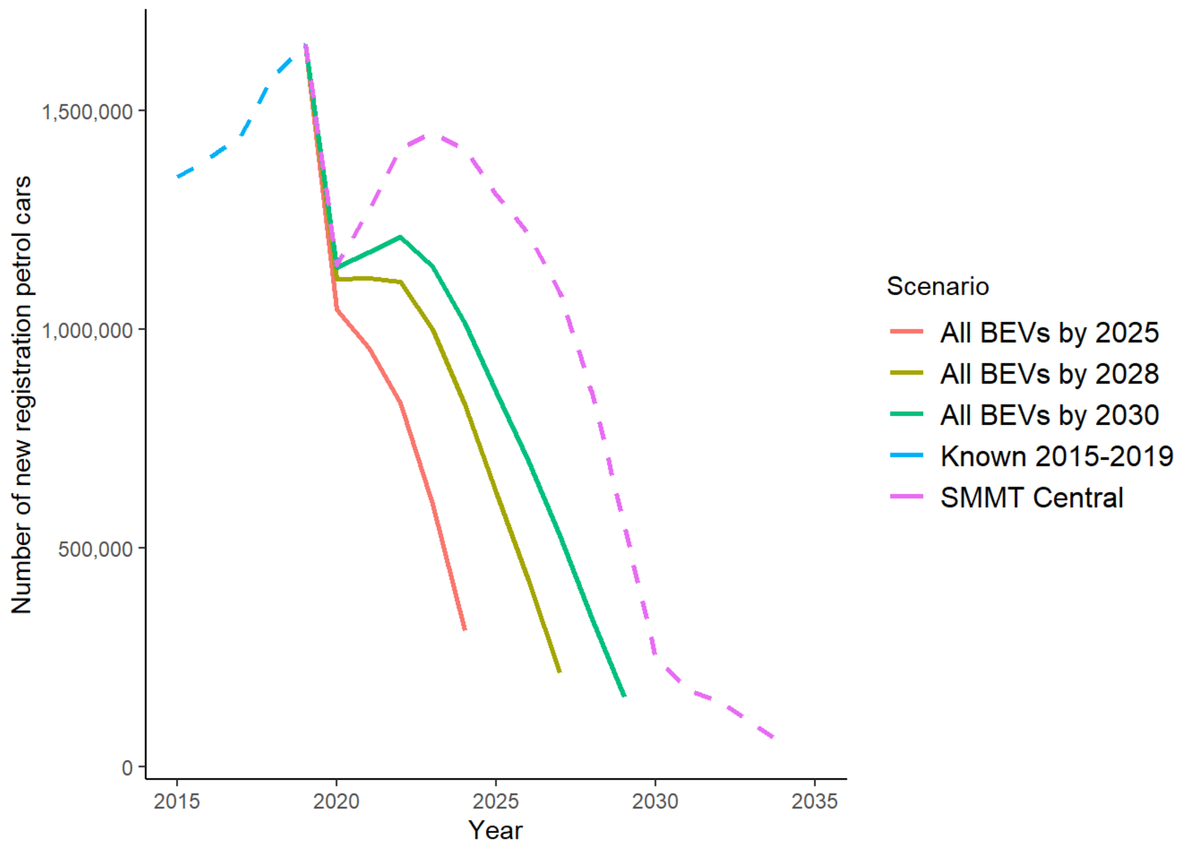


Figure 43: New petrol car registration numbers with alternative scenarios

Figure 43 compares the new petrol car registrations with the alternative scenarios. Overall, new petrol car registrations are predicted to fall below the known values. The SMMT's central scenario shows an increase of new petrol car registrations until 2023 to around 1.4 million petrol cars. There are new petrol registrations after 2030 due to adding petrol and hybrid cars (HEVs) together in the original data - so these are HEVs being sold.

The alternative scenarios predicts the number of petrol cars to be around 600 thousand-1.3million in 2023.

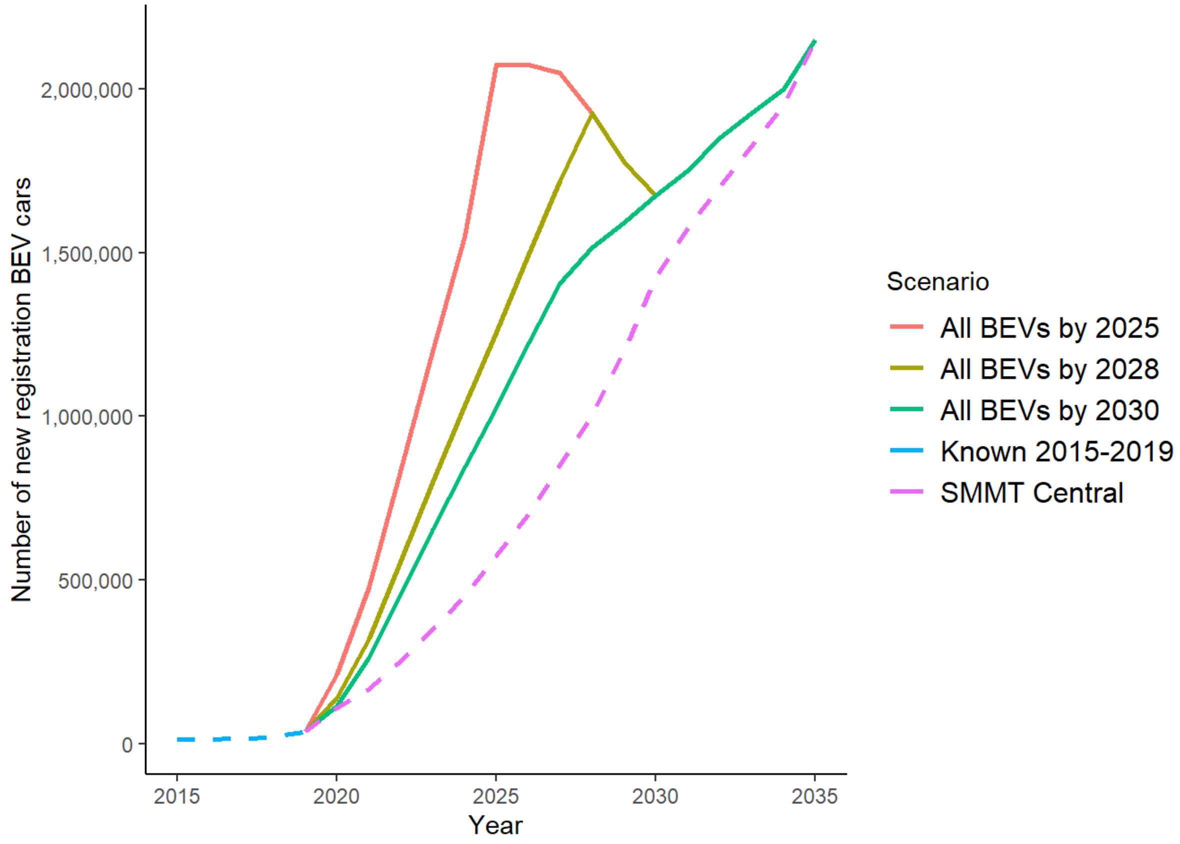


Figure 44: New BEV car registration numbers with alternative scenarios

Figure 44 shows how the number of BEVs will increase over time comparing SMMT's prediction to the alternative scenarios.

The alternative scenarios show a much faster uptake of BEVs than the SMMT's central scenario.

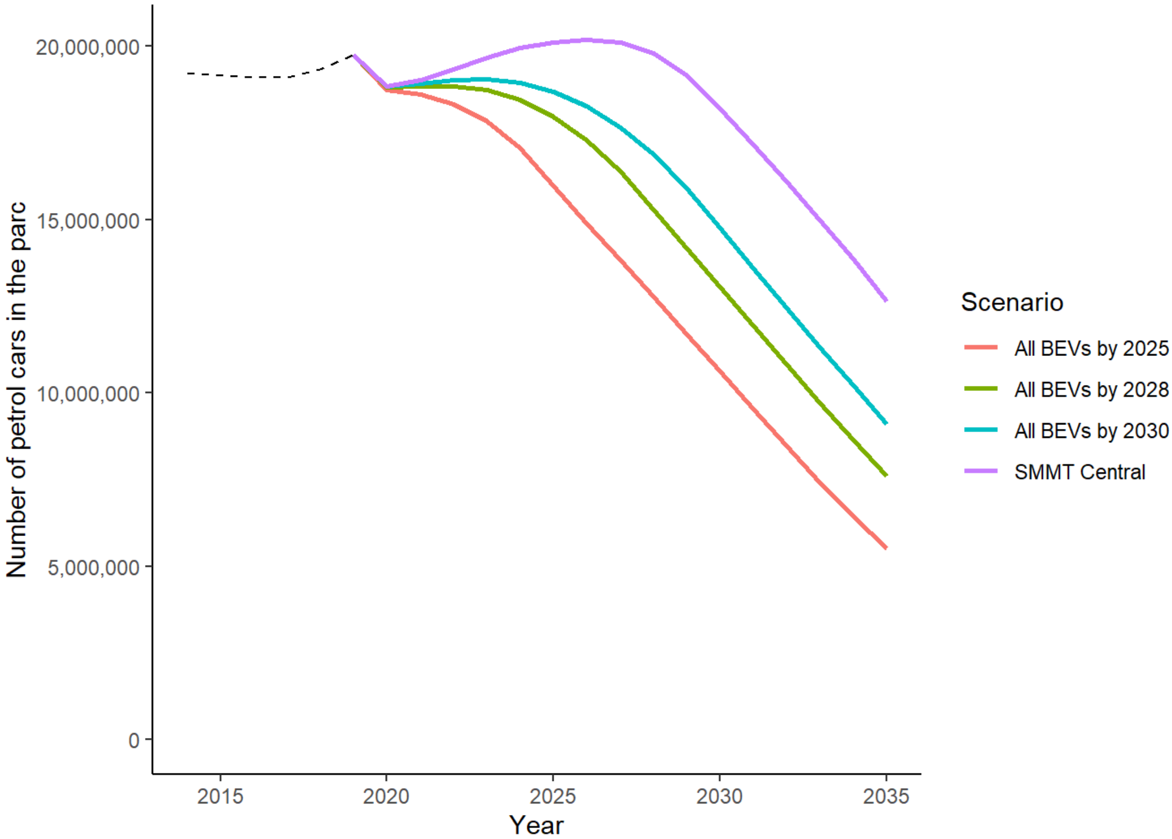


Figure 45: Total petrol cars in the parc with alternative scenarios

Figure 45 shows how the new registration numbers affect the total petrol car parc in the future.

The central scenario shows an increase in the total number of petrol cars in the parc. And the alternative scenario where all new car registrations are BEV by 2030, shows the number of petrol cars increases slightly.

The other alternative scenario where all new registrations are BEVs by 2028 shows a stable trend before declining in 2024, and the last alternative scenario where all new registrations are BEVs by 2025, shows a decrease in the number of petrol cars in the parc from 2019.

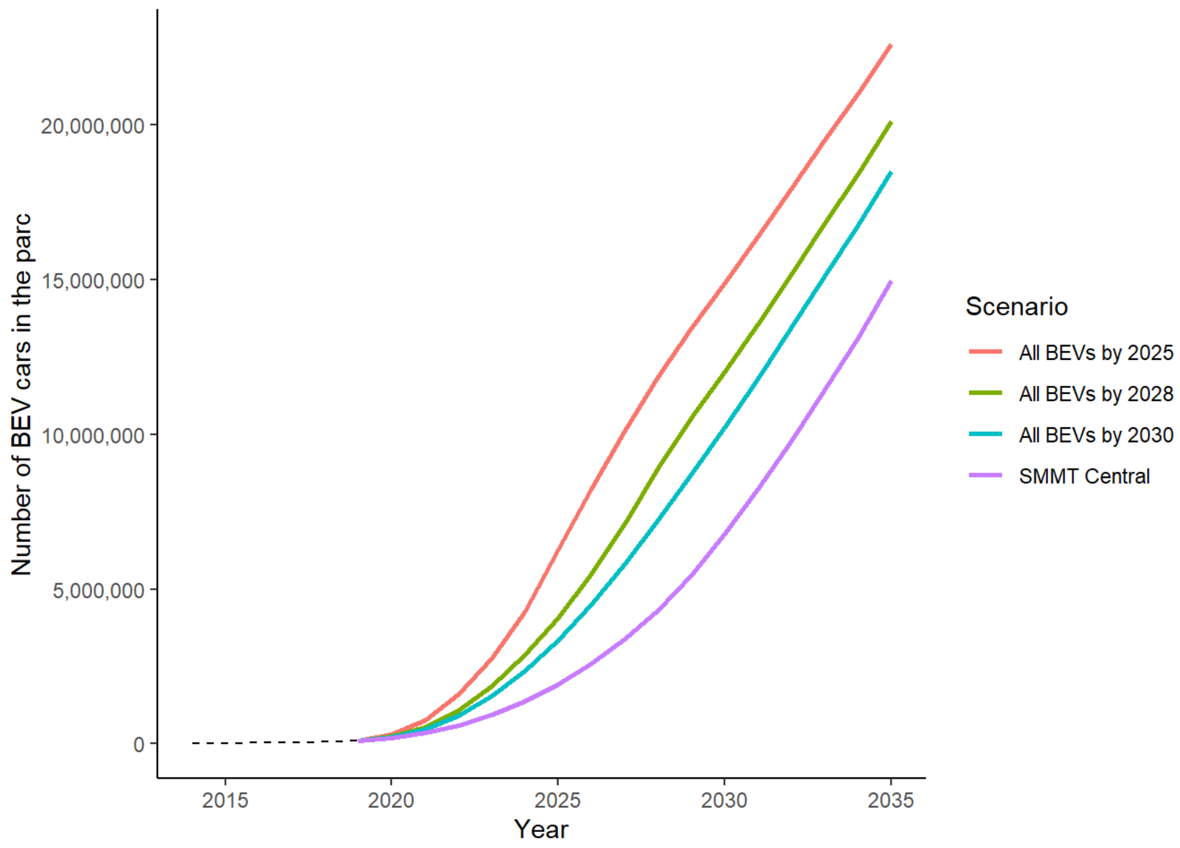


Figure 46: Total BEV cars in the parc with alternative scenarios

Figure 46 shows the different rates of BEV growth in the car parc. The sooner that all new registrations are BEV, the faster the rate of increase.

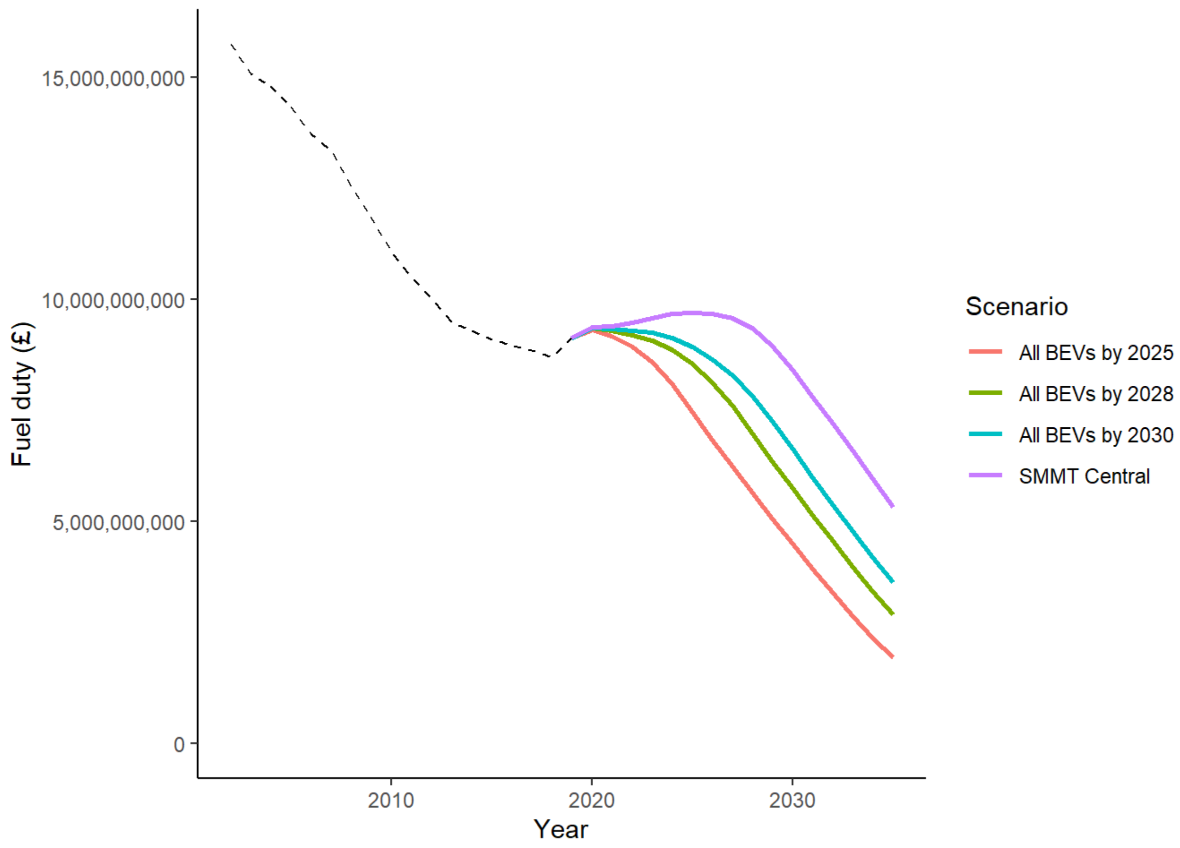


Figure 47: Fuel duty from petrol cars with alternative scenarios

Figure 47 shows the fuel duty from petrol cars only. The central scenario shows that there is a slight increase of fuel duty. The scenario where all new registrations are BEVs by 2030 sees fuel duty being quite stable until it falls in 2024.

The scenario where all new registrations are BEVs by 2028 shows fuel duty decreases from 2020 and all BEVs by 2025 scenario shows duty decreasing at a faster rate.

Overall the graph shows that only a massive move out of petrol and into BEV cars would eliminate the near term increase in petrol consumption.

This begs the question of how realistic it would be for the global automotive industry to generate a sufficient - significantly increased - volume of new BEVs across the car market segments and in particular in those segments accounting for most sales and most mileage driven. There is clearly growing customer appetite, including from the important fleet market (which is crucial in feeding cars at volume into the used market), but that appetite is anecdotally still leading to long delivery waiting times. Whilst it is clear that ever more models are being developed and promised, concerns remain in particular about the global supply of battery components and batteries, and that, in turn, means there is a stubborn price differential between BEV and ICE models that is particularly acute in developing commercially viable small models.

A scientific/engineering breakthrough in battery design and performance that boosted production while substantially reducing cost would be a game-changer, but probably one, based on today's evidence, that we can hope for but not bank on.

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