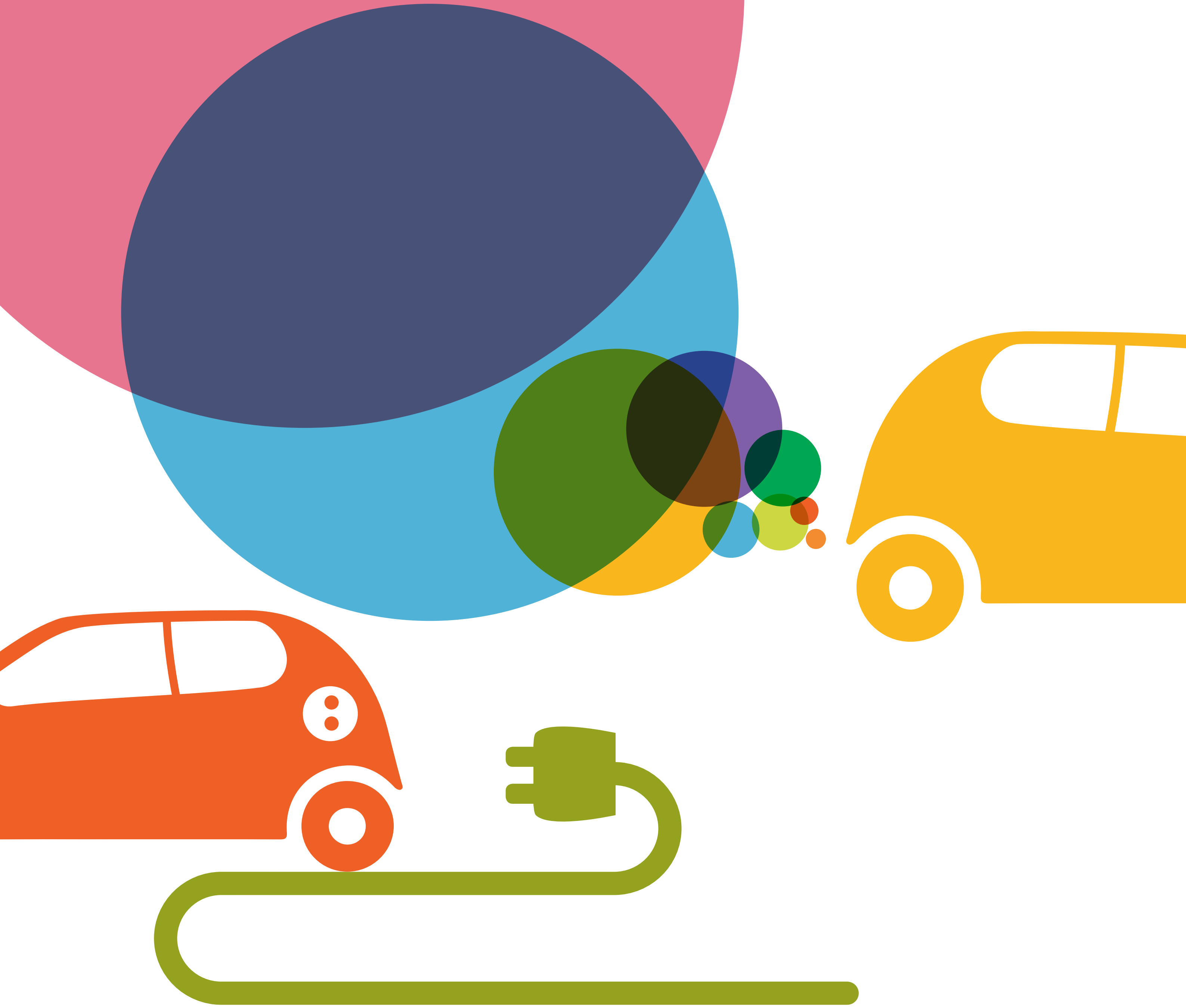

Low carbon cars in the 2020s

Consumer impacts and EU policy implications

Summary Report

BEUC
The European Consumer Organisation
The Consumer Voice in Europe

Table of contents

Summary of the study 'Low carbon cars in the 2020s: Consumer impacts and EU policy implications' that was produced by Element Energy

Acknowledgements

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The full report can be downloaded at: www.beuc.eu

Context

By 2050, the CO_2 emissions generated by the European transport sector will have to be 60% below 1990 levels. This means a 3% cut per year on average, sustained over 35 years[1]. In order to achieve these sorts of reductions it will require substantial technological improvements in passenger cars over the coming years. Such improvements will mean changes in the cost of owning and using a vehicle.

BEUC commissioned the consultancy Element Energy to explore what kind of consumer impacts can be expected from the roll out of lower carbon and fuel saving technologies in the period between 2020 and 2030, with a specific emphasis on the total cost of ownership (TCO) of a vehicle. An assessment was also made of the implications of delivering lower emissions vehicles into the 2020s with regard to the adoption of new EU passenger car CO_2 and fuel efficiency targets. It is expected that the European Commission will propose such targets in 2017.

This summary document outlines the main findings of the study that can be accessed on the BEUC website, and where all references of external studies can be found.

1 As required in the EU's 2050 Roadmap and 2011 Transport White paper.

Delivering lower carbon cars in the 2020s

key findings

How low carbon cars will benefit consumers

There will be numerous consumer benefits in having the most fuel and energy efficient cars available on the market by means of utilising the full potential of available and cost effective technologies:

- Between 2020 and 2030, driving more fuel and energy efficient cars will help reduce the cost of driving for motorists.
- Ultra-low carbon electric vehicles will drop in price substantially and be highly competitive if not cheaper to run than conventional cars. By 2024 the average 4-year cost of running an electric vehicle should match that of a petrol car.
- There is a strong potential to improve the fuel economy of petrol and diesel cars at a low cost – compared to a 2015 vehicle, consumers driving a new fuel efficient car in 2025 will save on average €500 in fuel costs in the 1st year and over the whole lifetime between €4,400 and €9,400.
- Lower income motorists will benefit the most from the reduced running costs of conventional and alternatively powered cars in second hand markets.

What policy makers must deliver

Having the most fuel and energy efficient cars available on the market will not happen by itself. Decision makers need to ensure that industry is incentivised and given certainty by way of setting clear rules and regulations:

- EU post 2020 policies to decarbonise and improve the fuel efficiency of cars should be ambitious and ensure that manufacturers invest in new technologies.
- Policy makers must push for an EU NEDC equivalent fleet wide CO_2 average emissions level of at least 70g CO_2/km for 2025 and 45g CO_2/km for 2030. This will benefit consumers through reduced fuel and energy consumption.
- Between 2020 and 2030, there will be less need for governments to offer high-cost purchase price incentives for ultra-low carbon vehicles. Modest benefits, such as lower circulation taxes, should be sufficient.
- Policy makers at every level need to recognise that passenger car decarbonisation strategies can also reduce air pollution and in turn protect human health.
- Further action is needed on the deployment of charging infrastructure and understanding of battery durability, and its impact on the used electric vehicle market.

The total cost of ownership

The focus of the study was to explore the likely financial impacts that motorists would face as a result of technologies applied to vehicles for the purpose of lowering CO_2 emissions for the period between 2020 and 2030. This involved making a calculation of the total cost of ownership (TCO) and in doing so an estimation was made of the impact of low carbon technologies on the purchase price of vehicles and the running costs associated with using a car (see Figures 1 and 2 for an overview of the different components).

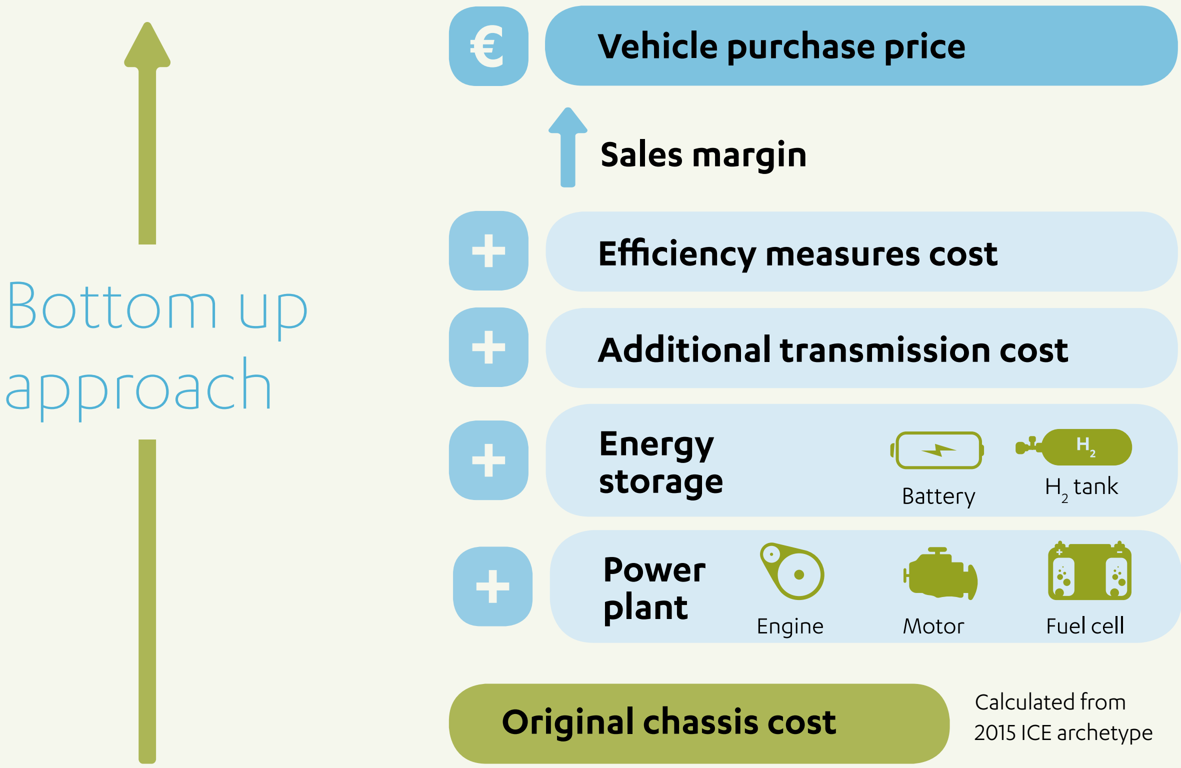


Figure 1: Representation of the bottom-up approach employed in the Cost and Performance Model – Technology costs were based on the latest and most detailed datasets and have been extensively reviewed by automotive experts and industry stakeholders such as component suppliers and manufacturers.

The study made use of the most robust and recent research available coupled with an intensive period of debate and discussion for over one year with experts on consumer issues, clean technology and automotive affairs from across Europe. In forecasting the costs of different cars, Element Energy used their own Cost and Performance model which factored in all the relevant attributes.

The study explored the TCO of different vehicle segments (including small, medium and large cars) and for different powertrains including internal combustion engines (ICE) run on petrol and diesel, but also alternatively powered cars such as hybrids, plug-in hybrids and battery electric vehicles.

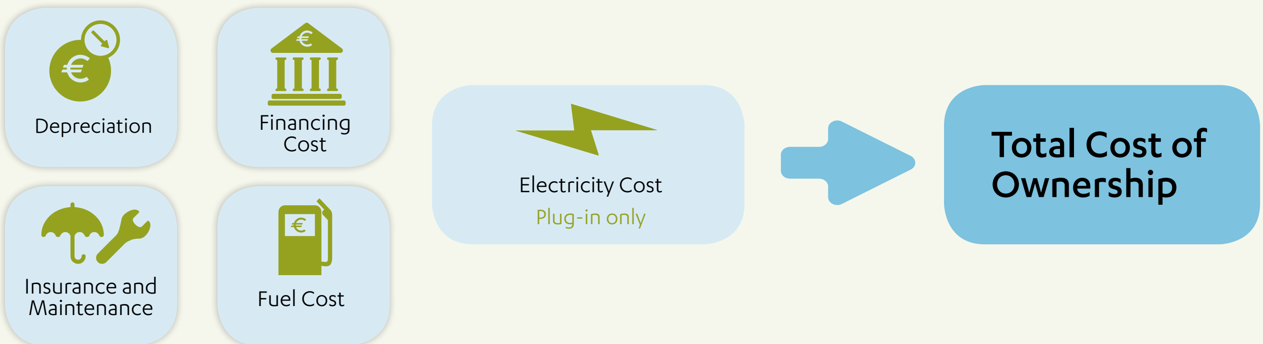


Figure 2. Components used in the total cost of ownership calculation

Impacts on new car owners & across lifetime

Reducing driving costs between 2020 & 2030

One of the standout results of the study indicates that between 2020 and 2030, the roll out of low carbon technologies will financially benefit European consumers. This is the case for a motorist, whether they are driving a conventional combustion powered car or an alternatively powered car such as an electric vehicle.

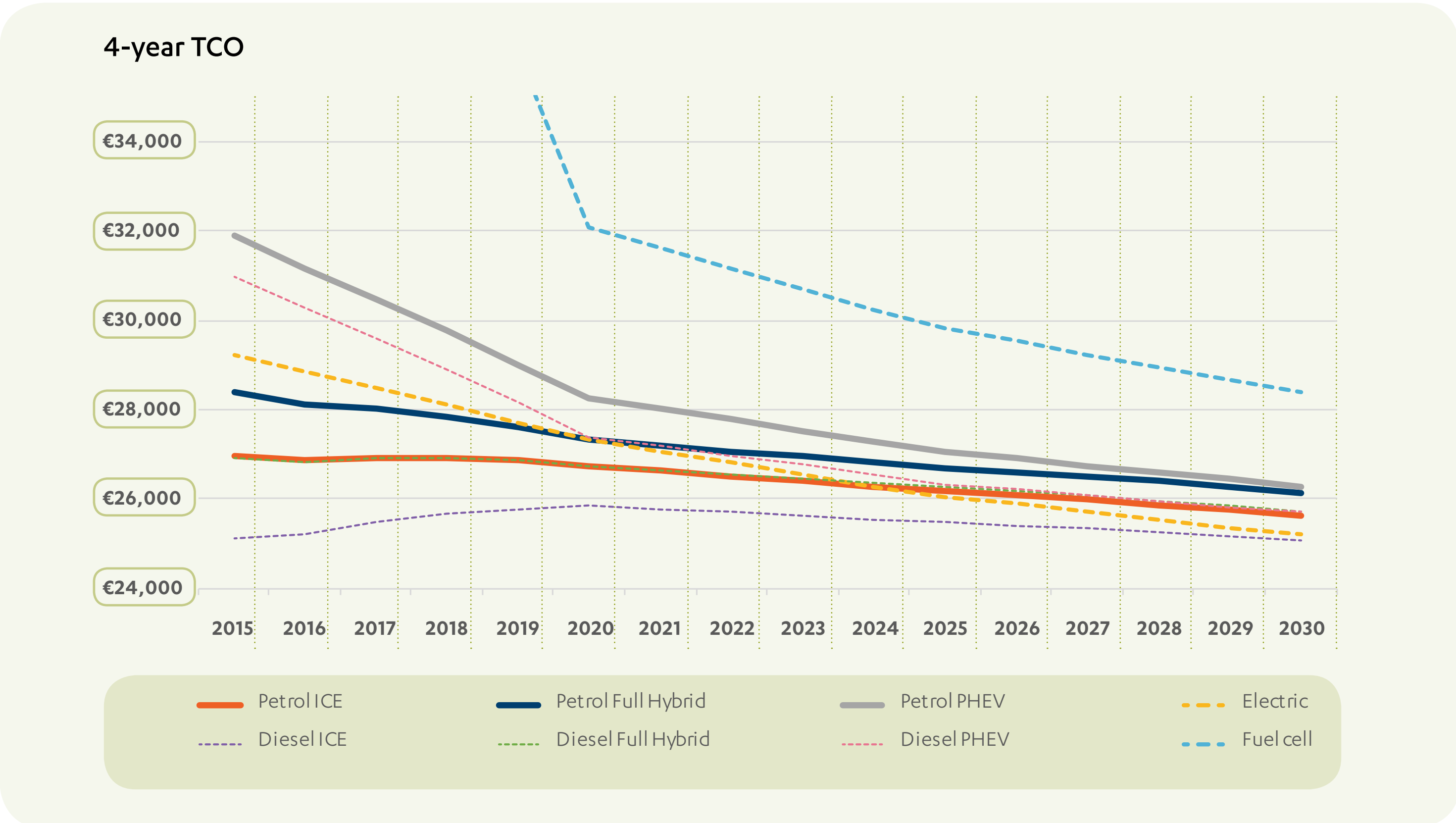


Figure 3: Change in the average 4-year TCO of all vehicle types between 2015 and 2030

Figure 3 shows how the TCO of all vehicles over their first four years should reduce between 2020 and 2030 for all powertrains. This in turn highlights the need of policies to drive further efficiency improvements in new cars beyond 2020, since any additional vehicle cost is offset by the fuel savings within the first ownership period.

The cost of conventional and alternatively powered cars will converge in the 2020s

Between 2020 and 2030 the costs associated with buying and running a conventional and alternatively powered car will converge. By 2024 the average 4-year TCO of an electric vehicle could match that of a petrol car. Furthermore, by 2030, all powertrains except those running on hydrogen fuel cells should have lower 4-year costs than a petrol car on the road in 2015, despite a backdrop of rising fuel and electricity prices. This will have been primarily driven by the reduction in costs of advanced power trains over this period.

In fact, the study suggests that even for a battery electric car purchased in 2020, over its entire lifetime it will be cheaper to run than both a petrol and diesel vehicle (see Figure 4).

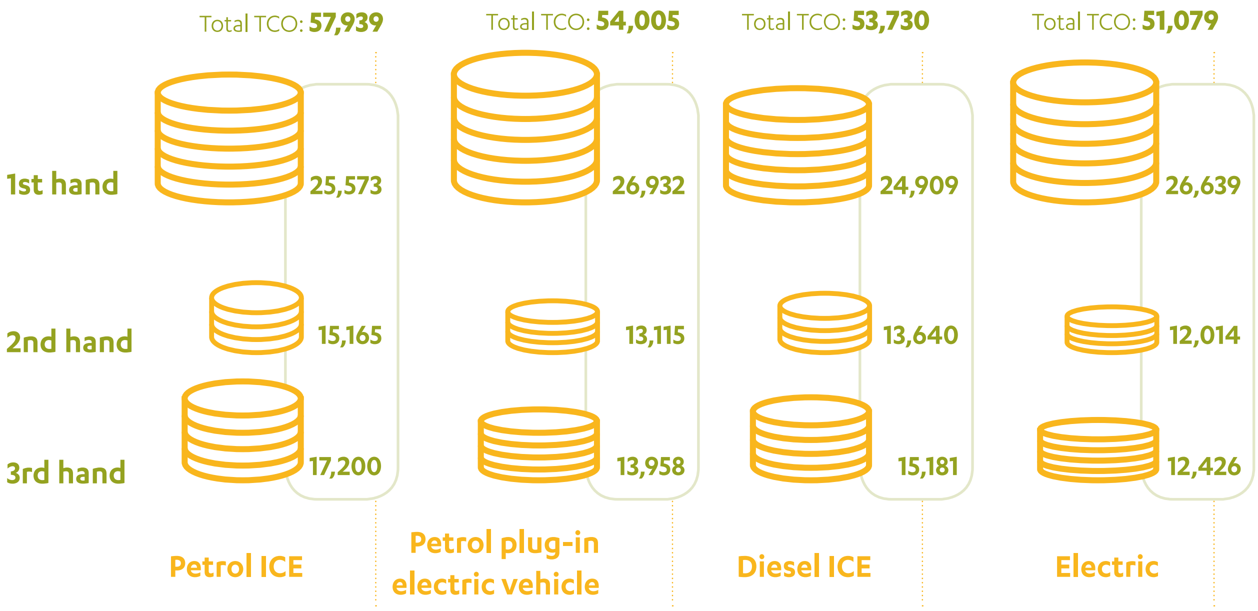


Figure 4: 16-year TCO (EUR) of a C segment vehicle, spread between 1st, 2nd and 3rd hand owners, initially purchased in 2020

At high or low energy prices, motorists will benefit from cars being more efficient

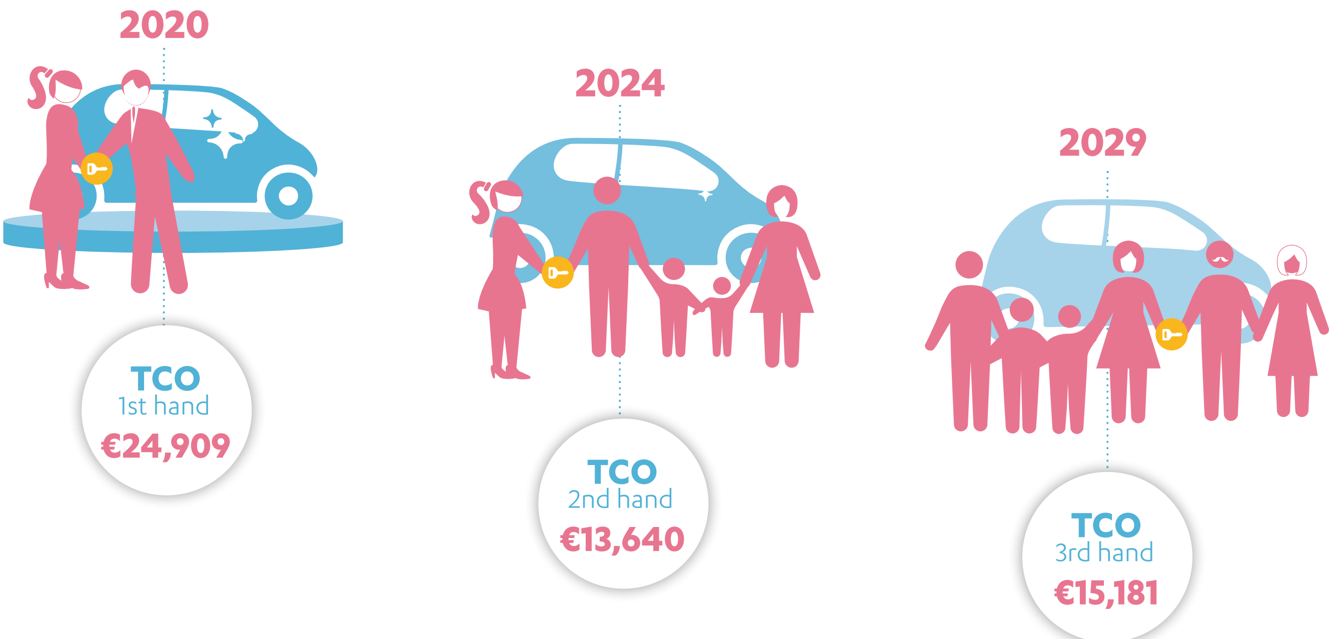
The study also indicates that even with projected low or high electricity/oil price scenarios in the 2020s, there will only be a relatively small change in the TCOs of all vehicles. This is because the energy cost component of the TCO becomes smaller as cars become more efficient. In this, the results indicated that a shift to lower carbon vehicles in the 2020s will pay dividends to motorists, whatever the vehicle they drive and whatever the energy price they pay. It is also worth bearing in mind that the 'high oil price' scenario was based on the central case used by the International Energy Agency: if prices rise more than projected - like they did in 2008 when crude oil hit record highs never seen before - the cost savings will be even greater to the motorist.

In addition, the study highlights recent research that shows how the deployment of fuel efficient and ultralow carbon vehicles can also have the knock on effect of lowering the cost of petrol and diesel (Cambridge Econometrics, 2016). In essence, if cars are using less petrol and diesel - and this is being achieved on a big enough scale - then demand for oil will drop and so too should prices at the pump, all things being equal. This additional TCO benefit was not explored in the analysis of this study, but the findings makes it clear that consumers stand to prosper in multiple ways as a result of policies and technologies that lower the CO_2 emissions of cars.

Impacts on second/third hand owners

Used car owners benefit at a fraction of the cost

Although there are clear financial benefits for consumers who purchase brand new fuel efficient vehicles, there are also big wins for used car owners. In essence, a second or third hand owner will benefit the most from lower fuel costs but only pay a fraction towards the manufacturing costs due to depreciation. This is important because used car owners are generally in lower income groups than owners of new cars and will therefore feel more acutely the benefits of lower costs. This means that improving the fuel and energy efficiency of cars can also be counted on as a socially equitable approach to reducing passenger car CO_2 emissions. Furthermore, the oil market effects in the previous section provide a further benefit to low-income groups.



The evolving cost of a fuel-efficient diesel car over its entire life

Looking again at Figure 4 and the image above, it is clear that used car owners get a huge bonus from purchasing a more fuel and energy efficient vehicle. In fact, it is more than likely that the second hand owner will benefit the most as a result of the severe depreciation in the value of a car in its first few years. It is also the case that a second or third hand electric car owner will benefit the most when compared to other second and third hand owners of conventional cars. This is because of the relatively small cost of using electricity instead of petroleum based fuels (see later in the report for further issues to be considered here).

It is worth bearing in mind that the proportion of used cars in several Member States is particularly high (see Figure 5). For example, in Poland, Greece, Hungary, Portugal, Estonia, Romania, Spain and Finland, over half of the vehicles in their fleets are used cars of 10 years or older (ACEA, 2016). In fact, almost 80% of all cars on the road in Poland are over a decade old. This just goes to show the scale of the second hand market in Europe and how millions of car owners will reap the rewards of investments into fuel efficiency.

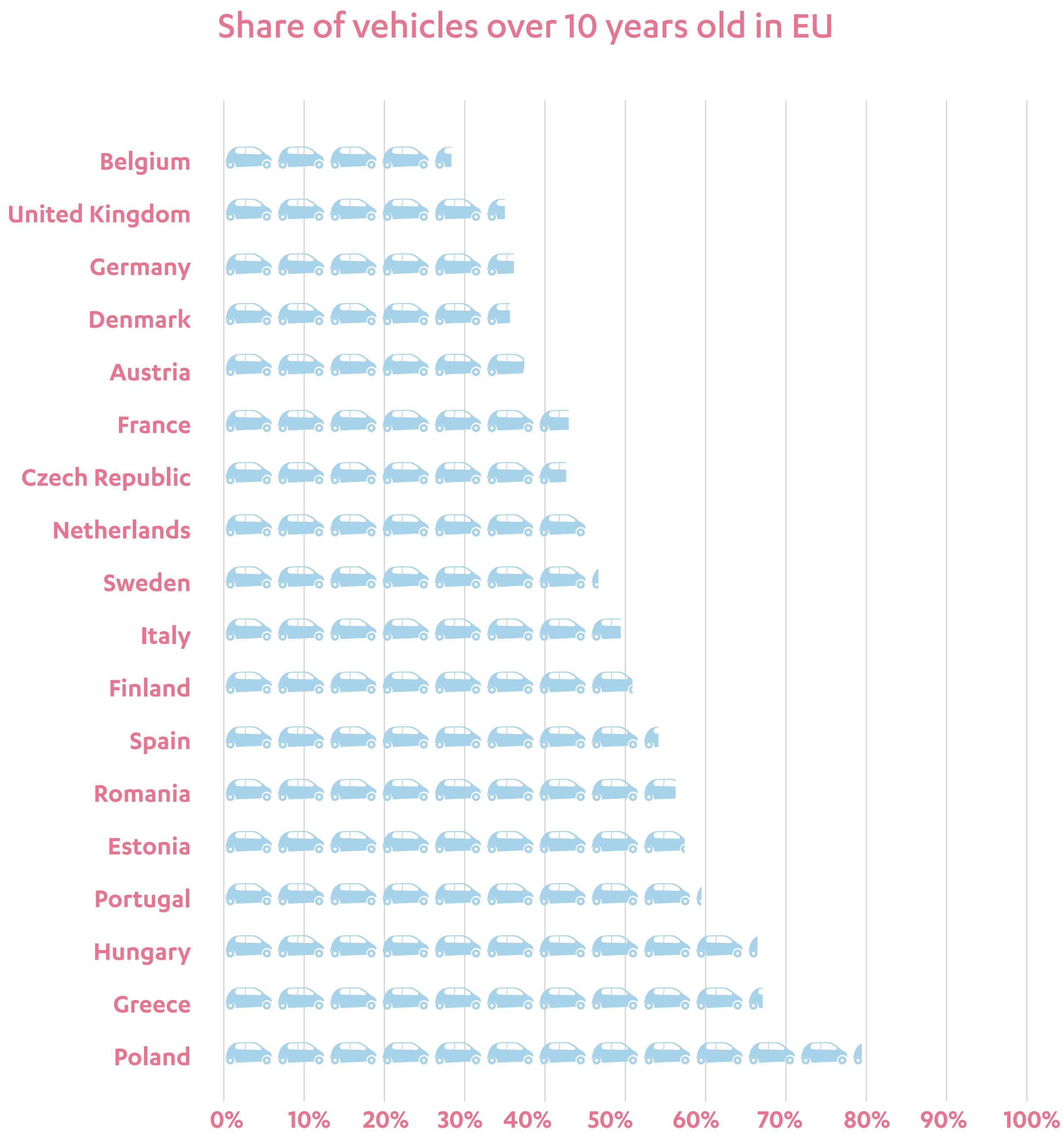
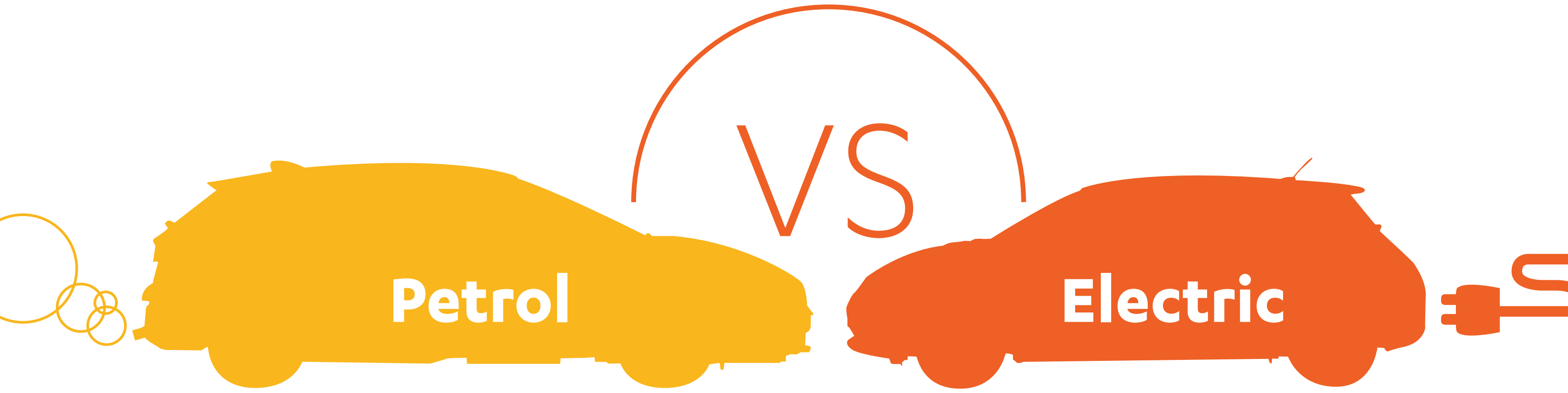


Figure 5: Share of vehicles over 10 years old in EU Member States, 2014, from ACEA Pocket Guide 2016/17. Sourced data unavailable for some Member States.

Case study
Petrol v Electric: Who wins?



Comparing a medium-sized C-segment petrol car with fully electric car
(e.g. Opel/Vauxhall Astra Vs Nissan Leaf)

Looking at the most popular vehicle segment, the C segment, in 2015 there was a difference of approximately 8% in the 4-year TCO between the petrol and electric variant. This difference can largely be accounted for due to the high cost of making the batteries for electric vehicles. In some European countries, attempts have been made to narrow this gap by offering incentives such as subsidies on the purchase price of electric cars or reduced vehicle taxes.

Electric cars will fall in price rapidly between 2020 and 2030

By 2020, the difference in cost is expected to fall to 4% before narrowing further to around 1.5% by 2025 and ending up at less than a 0.5% gap by the end of the 2020s. This gap equates to a difference of around €100 by 2030, representing a remarkable fall from just under €2,000 in 2015. To put this €100 cost difference into context, it should be recognised that the range of electric vehicles should also increase from 200km to 320km. Furthermore, motorists often spend hundreds if not thousands of euros on optional extras such as built in satnav, metallic paint, electrical seats etc. In terms of the affordability of electric cars, it can be assumed that the €100 difference in the TCO would have little to no effect on consumer buying preferences. It is worth noting that electric drive trains also provide improvements to the motoring experience, such as reduced noise and improved acceleration, which have a value in themselves.

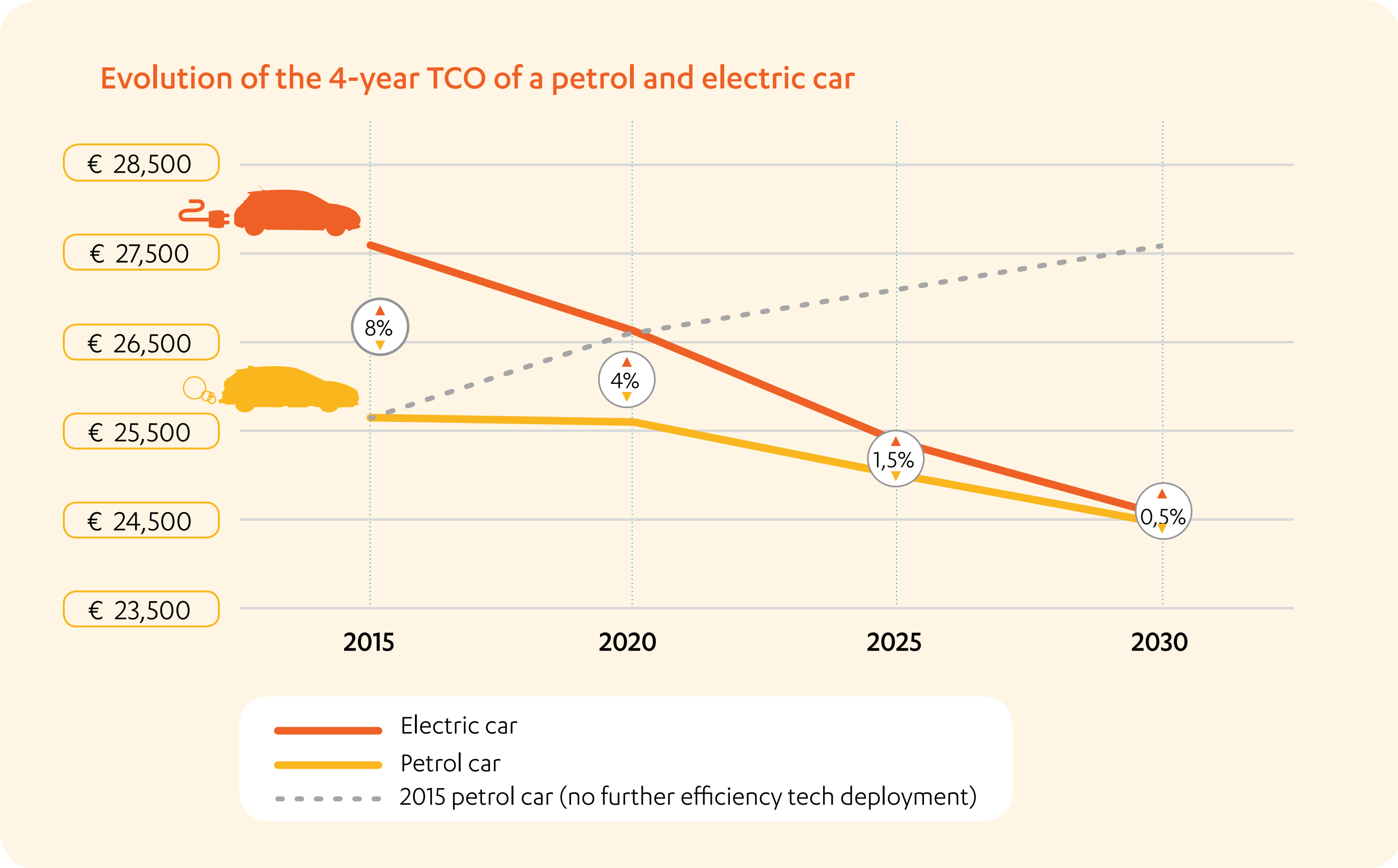


Figure 6: 4-year TCO difference between a C segment petrol and electric car

Electric cars should become affordable to the mass market

What these results also imply is that because of the expected and significant fall in the cost of electric cars, there is a good chance that they will become affordable to the mass market between 2020 and 2030. The current cost difference makes it challenging for low and medium income groups to afford an electric car and it is therefore largely higher income groups who can purchase or lease them. The C segment car is the most popular vehicle segment in Europe and so seeing that prices will also fall for this segment will be good news for wider uptake beyond the luxury ends of the market.

Finally, it is also important to recognise that the price difference assumed in this study does not include the cost of installing a home charging unit, which today stands at approximately €1,000. This additional cost is quite substantial today but is expected to fall to €600 with higher volume production or even become redundant for users in the future.

Impact on conventional car owners

Conventional cars have huge room for improvement

Conventional vehicles that run solely on either petrol or diesel still have great potential to become more fuel efficient and in turn lower running costs for consumers. The study finds that because of numerous ways to improve fuel efficiency such as improving the internal combustion engine, lowering vehicle weight or making cars more aerodynamic there will be substantial efficiency gains.

More fuel efficient cars will save motorists substantial fuel costs

In the first year of ownership of a new petrol or diesel vehicle in 2025, the study finds that owners should save between €330 and €710, and on average €500 compared to a 2015 model (see Table 1). The increase in purchase price that would result from advanced technologies will be on average €510 and would mean a payback period of within half a year and 2 years depending on the vehicle type. Over the lifetime of a vehicle bought in 2025 compared to one in 2015, owners would save on average between €4,400 and €9,400.

Baseline 2025 vehicle relative to:	Powertrain	Additional Purchase Price	First Year Fuel Cost Saving	Payback Period, years	Lifetime (16yr) Fuel Cost Savings
Technology deployment kept at 2015 level	Petrol ICE	€710	€450 - €712	1.1 - 1.7	€5,914 - €9,362
	Diesel ICE	€310	€332 - €504	0.7 - 1.0	€4,409 - €6,700
	Average	€510	€499	1.1	€6,596

Table 1: Summary of the average costs and benefits of additional efficiency technology applied across all vehicle segments for vehicles in 2025 compared to vehicles from 2015

Low cost of technologies means quick payback for owners

One of the main reasons for the payback period being so short is that the cost of including technologies to reduce carbon emissions for petrol and diesel cars into the 2020s will be relatively low. The efficiency improvements have the effect of lowering their TCOs as the change in purchase price is outweighed by reductions in fuel use.

The study also highlights that even the purchase price of petrol and diesel cars could remain constant or decrease slightly in the 2020s, in turn making their TCOs look even better. To achieve this, high volume deployment of technologies would be necessary in order to realise economies of scale.

Such an outcome is very much possible: despite cars increasing in efficiency over recent years, average retail prices of new cars have not increased since the introduction of existing EU CO_2 limits for 2015 and 2020 (FTI, 2015). This has meant that a car owner has not had to pay a premium for a more fuel efficient new or second hand car but has benefited from lower fuel costs.

Policy implications

Ambitious CO_2 reduction goals are essential

The study explains how rolling out low carbon technologies into the 2020s will reduce the carbon footprint of cars and in turn help cut running costs for consumers. **However, nothing is certain about whether these fuel efficient, cost cutting technologies will be brought to the market**. The only way of ensuring that such a development takes place is to set achievable EU wide targets that lock in the deployment of technologies to lower CO_2 emissions and improve vehicle efficiency.

Policy makers must recognise the consumer benefits of improving vehicle efficiency

What is also suggested by the study's results, on a cost basis alone, is that there will be more reason for a consumer to choose a low or ultra-low carbon vehicle over a conventional car between 2020 and 2030. This is largely because of the expected fall in costs of batteries within this period and hence the converging TCOs of conventional and ultra-low carbon cars. This potential scenario means that **policy makers should not be overly concerned about the cost to consumers of adopting ambitious passenger car CO_2 and fuel consumption reduction targets.**

At the European level, the EU's 2030 Climate and Energy Package has already set a target to reduce emissions in the non-Emissions Trading Scheme sectors by 30% from 2005 levels. Transport is included in these sectors. For passenger cars to play an equal role with other sectors therefore it would need to cut its emissions by at least 30% from 2005 levels. To achieve this sort of reduction, a significant cut in carbon emissions from passenger cars will be required.

Fleet wide average CO_2 emissions can fall by 2025 and 2030

The study in fact highlights that the average fleet wide **CO_2 emissions for 2025 could realistically hit 65-70g CO_2/km and by 2030, 40-45g CO_2/km on an NEDC basis**. Being that a new test protocol, the Worldwide harmonized Light vehicles Test Procedure (WLTP) will replace the NEDC in the coming years and therefore likely to be the new monitoring protocol for measuring future emissions, these fleet wider averages would equate to approximately **75g CO_2/km and a 50g CO_2/km on a WLTP** basis respectively.

In order to reach these levels, the mix of different vehicle types required on the market by 2025 and 2030 can be quite varied (see Figure 7 for a snap shot of a 75g CO_2 /km WLTP fleet average for 2025). Rather than intending to show how exactly the market will look like in the future, the study makes it clear that a much larger proportion of vehicles on the road will need to be ultra-low carbon cars than what is on the market today. The study points at approximately 15% of vehicles needing to be ultra-low carbon in order to hit a 75g CO_2 /km fleet wide average target.

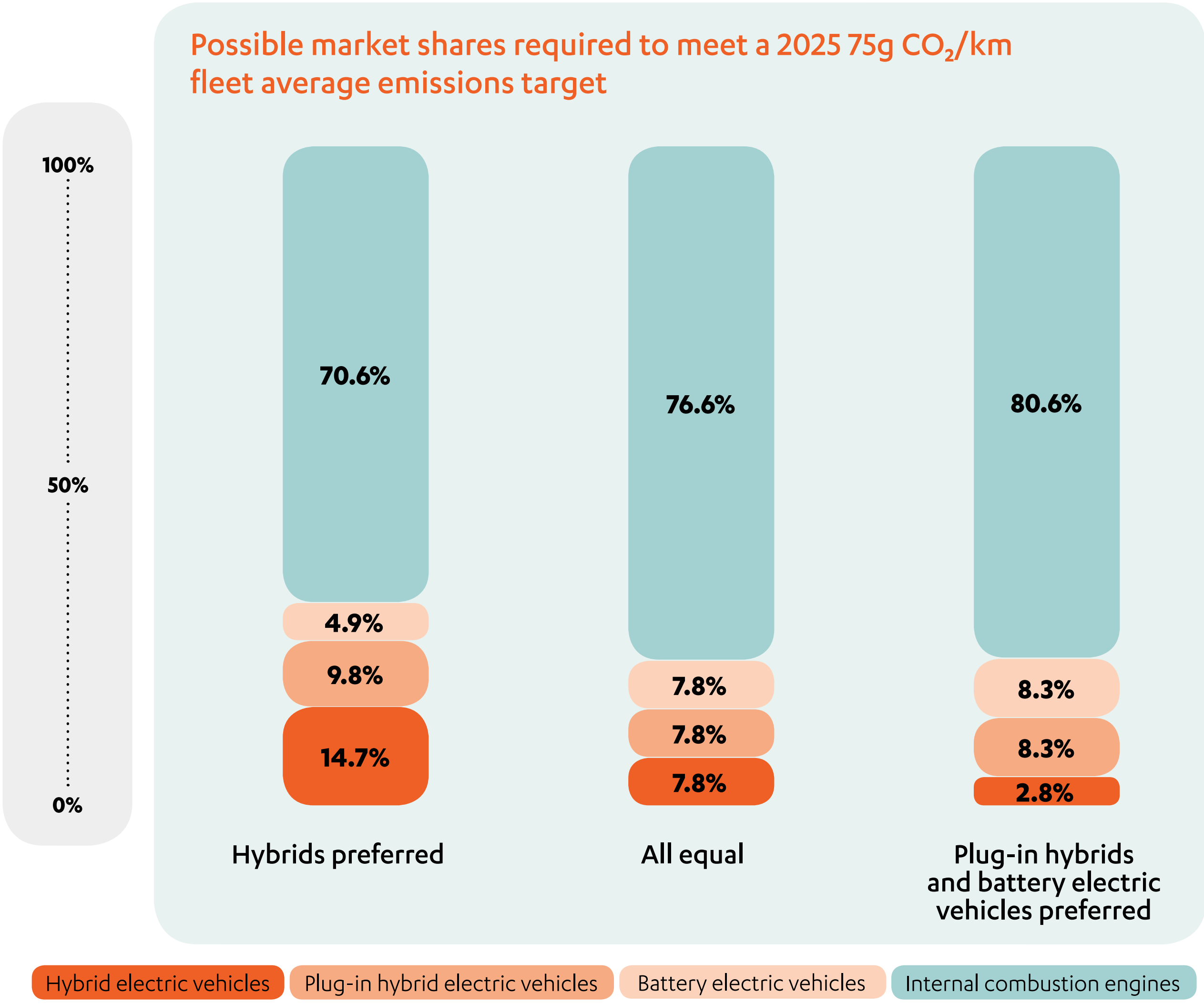


Figure 7: Possible market shares for combustion (ICE), hybrid (HEV), plug in hybrid (PHEV) and battery electric vehicles (BEV) required to meet a 2025 75gCO_2 /km WLTP fleet average emissions under different uptake scenarios

Higher uptake of ultra-low carbon cars in the 2020s is likely

The study signals that higher deployment levels of advanced powertrains in the 2020s is feasible based on the relatively small differences in ownership costs, and sales would be more likely to be determined by other factors such as the availability of models in all vehicle segments and the availability of charging infrastructure to provide convenient mobility to ultra-low emissions vehicle users. If these potential barriers can be addressed, then seeking deep reductions in new car CO_2 emissions is feasible while bringing net financial benefits to car users.

Ultra-low carbon cars can help reduce air pollution, reduce oil demand and provide wider consumer benefits

The study also points out that policy makers at every level should recognise the relationship between decarbonisation, local level efforts to improve air quality (e.g. urban area ‘low emissions zones’), and reducing European dependence on imported oil which results in more value from consumer spending being retained within the European economy. A strong decarbonisation strategy, which necessitates the deployment of ultra-low carbon technology, therefore offers a mutual benefit to both car owners and wider European society.

Ultra-low carbon cars need further support

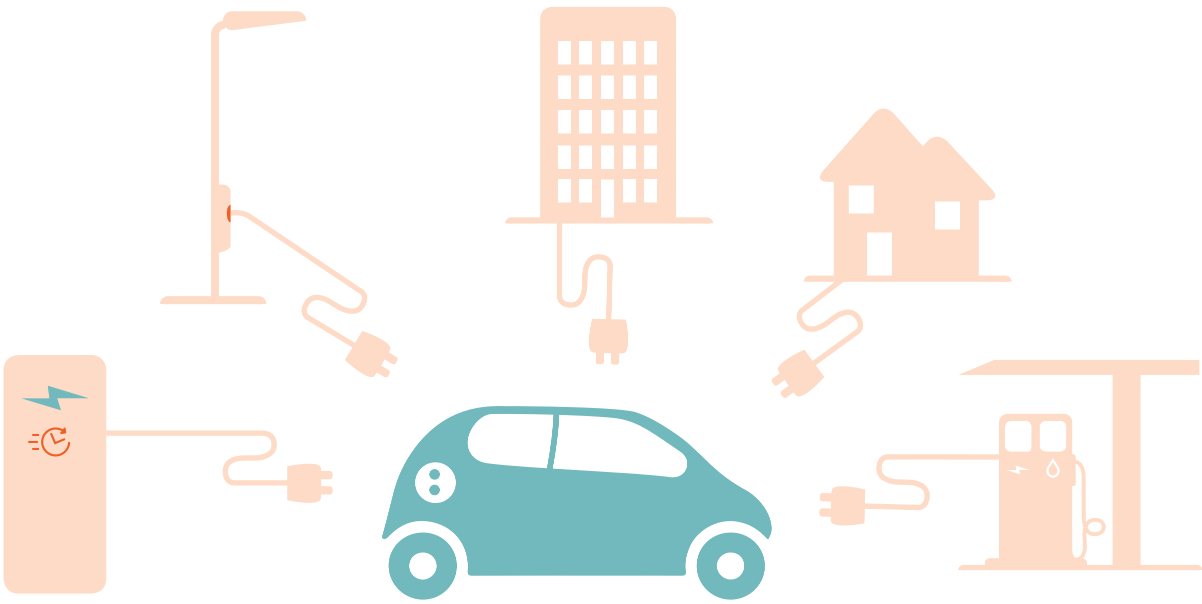
Since ownership costs are only one aspect in the decision making process for car buyers, the study also highlights other barriers to electric mobility that need addressing. Although this was not the main focus of the research, the authors note several key areas, including the need to:

- Increase the coverage of rapid charging stations on major roads;
- Tackle the problem of home charging where off-street parking is not available;
- Ensuring convenient access and payment options for charging between cities and countries.

Consumers need certainty about battery durability

Furthermore, one of the key areas of uncertainty with electric cars lies in the durability of their batteries. The oldest electric vehicles on the road today are only 5-6 years old and thus real world battery lifetimes are not yet fully known. A replacement battery for a 2020 C Segment electric car is predicted to cost upward of €5,000, which would significantly affect the lifetime TCO. Having said this, current battery warranties from Nissan, BMW and Volkswagen already cover 160,000km - the average lifetime mileage of a petrol car in Europe. It is also important to recognise that the probability of costly mechanical failures to petrol and diesel cars also increases over their lifetime. The relative weakness therefore of replacing a battery compared to mechanical failure in a conventional car is not clear.

What is certain is that industry must work to maximise the durability of batteries through more sophisticated battery management systems, designs allowing replacement of modules rather than whole packs, and developing second life applications for used batteries which furthermore would help reduce costs.



Final comments

In calculating the TCO of the different vehicle types, a number of assumptions were made about the costs associated with the purchase price of cars and their resale values (the difference being the depreciation) and the fuel, financing, maintenance and insurance costs. Concerning fuel and electricity costs specifically, the study considered both low and high price scenarios.

It is important to recognise that cost assumptions made in the study for ultra-low carbon vehicles did not factor in any incentives that would affect consumer choice (e.g. purchase price incentives, circulation tax incentives, free parking etc.). If national governments would offer such incentives, ultra-low carbon vehicles would appear even better on a TCO basis.

It is also important to note the study's objective was to explore the cost of low emissions technologies and so has not factored in other associated costs such as optional extras that could apply to all vehicles in the present day or the future. Therefore, the costs presented by the study must be considered as being indicative of the potential of low emissions technologies rather than being taken as a prediction of the cost of passenger cars in the future.

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The Consumer Voice in Europe