Electric Cars in Lithuania: Calculating the Total Cost of Ownership for Consumers

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***Final Report*** *for LVOA (Vartotojų aljansas) & BEUC*

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# Executive Summary

*This Lithuania report has been developed in parallel with an overall EU level report (Electric Cars: Calculating the Total Cost of Ownership For Consumers) and eight additional European country specific reports on the total cost of ownership (TCO) of cars for consumers from 2020-30.*

Reducing passenger car CO2 emissions is a fundamental part of achieving the EU’s climate ambitions, including reaching net zero by 2050. Despite recent growth in zero emission vehicle sales, real-world reductions of car emissions have stalled since 2015, raising the question of whether stronger manufacturer CO2 targets for 2025 and 2030 are required to meet the EU’s climate goals[[1]](#footnote-2). The TCOs of different powertrains are an important part of this discussion and will determine how consumers can benefit from, and the ways policy should support, the decarbonisation transition.

This report forecasts the costs and efficiencies of petrol & diesel internal combustion engine (ICE) and full hybrid vehicles (HEVs), as well as low & zero emission powertrains, such as plug-in hybrids (PHEVs), battery electric vehicles (BEVs) and H2 fuel cell vehicles (FCEVs)[[2]](#footnote-3). The TCOs for different powertrains are calculated for first, second and third owners of vehicles bought new between 2020-30 in Lithuania.

This report explores how TCOs in Lithuania vary from the EU average case and what consequences this has for consumers. “Real world” examples, representing specific user groups in Lithuania, reflect how decarbonisation will affect various consumers differently, an essential consideration for policymakers.

#### Battery electric vehicles are just around the corner in Lithuania

In Lithuania, BEVs become the cheapest powertrain for small and medium cars in 2025 and 2024 respectively, which is illustrated in Figure 1 (for medium cars). This is one year later for small cars and four years later than medium cars compared to EU averages (excluding taxes and subsidies), which is driven primarily by cheaper ICEVs models. While lifetime TCO may not dictate the overall mix of vehicles bought in a market, it shows the cost optimal solution for consumers.

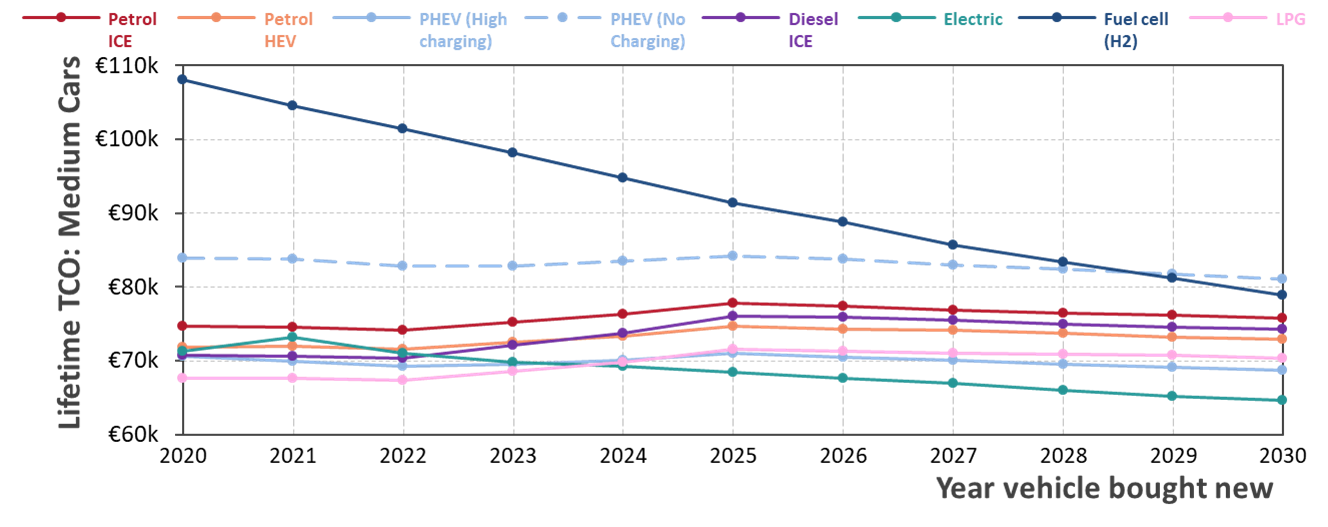


Figure 1: lifetime TCO comparison between different powertrains in Lithuania

It is important that policymakers in Lithuania consider the significant benefits that BEVs offer to less affluent consumers when compared to other powertrains. A medium BEV bought new today will save a total of almost €6,700 for its combined second and third owners over a Petrol ICE. It will also achieve reductions to CO2 emissions crucial for decarbonisation while reducing the adverse health impacts of air pollution in urban areas. Tightening EU manufacturer emission standards and encouraging OEMs to sell more BEVs will most benefit the least affluent consumers by increasing the available stock of used BEVs more quickly.

#### Policymakers in Lithuania should introduce short term BEV subsidies to boost uptake

A significant barrier to BEV market growth in Lithuania is higher upfront purchase prices than ICEVs, which drive greater depreciation costs for first owners. This is especially important as first owners determine the stock mix of the vehicle market and therefore the vehicles available for eventual used car buyers. Upfront purchase subsidies are currently not available for BEVs in Lithuania, however, Figure 2 illustrates the impact to first owner TCO savings for a BEV over a Petrol ICE with a €4,000 purchase subsidy. Without upfront subsidies, small and medium cars do not become cheaper than Petrol ICEs until 2027 and 2025 respectively. However, with a €4,000 grant, medium BEVs would already be cheaper than Petrol ICEs, with small BEVs following in 2023.



Figure 2: first owner TCO savings for a BEV over a Petrol ICE with and without a €4,000 upfront purchase grant

#### BEV growth in Lithuania limited due to prevalence of cheaper ICEV models

As shown in Figure 3, Lithuania has not achieved the high growth seen in some of the other European focus markets in this study, including France, Germany and Portugal. Growth has been restricted as small and medium BEVs are currently significantly more expensive that Petrol ICEs for first owners. Cost is the most important barrier for consumers, which 65% of consumers (EU average) in 2018 said that cost was the main reason for not buying an electric or fuel cell car[[3]](#footnote-4), and additional support is needed to stimulate BEV growth and unlock the significant savings available for eventual used car buyers. To fully eliminate barriers to growth, alongside reducing the costs of BEVs for consumers, it is essential for policymakers to also consider other factors such as building suitable charging infrastructure and securing OEM supply to meet the driving needs of all consumers in Lithuania.

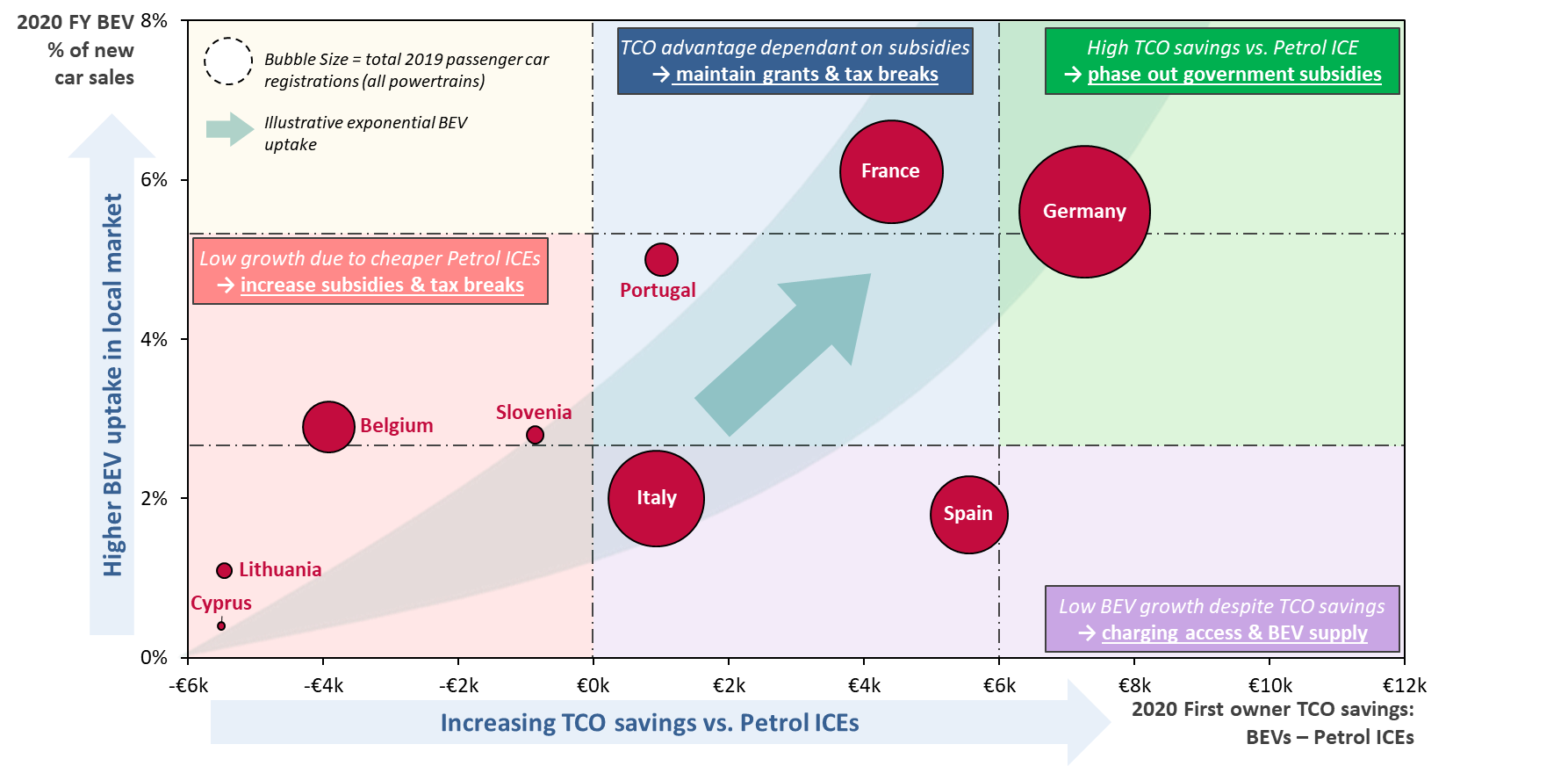


Figure 3: weighted average for small & medium cars showing BEV 2020 share of market sales vs BEV first owner TCO savings over Petrol ICEs

#### Specific User Groups analysed in Lithuania

TCO sensitivities for specific groups of Lithuanian consumers including: (1) company car drivers (2) consumers with access to cheaper off-peak tariffs (3) drivers that rely on more premium public charging tariffs. The 2020 first owner TCO results for a high annual mileage company car driver (39,000km) with 100% VAT deductibility are illustrated in Figure 4, where the BEV model is assumed to be a Nissan Leaf and is compared to the lower-medium sized segment averages of the other powertrains. The Nissan Leaf provides a consumer from this user group with savings of €8,300 and €5,000 compared to a Petrol and Diesel ICE respectively over the first ownership. This user group benefits the most on a TCO basis while also being the largest producer of CO2 tailpipe emissions. Thus, high mileage drivers should be considered a top priority group for educating about the benefits of switching to BEVs.

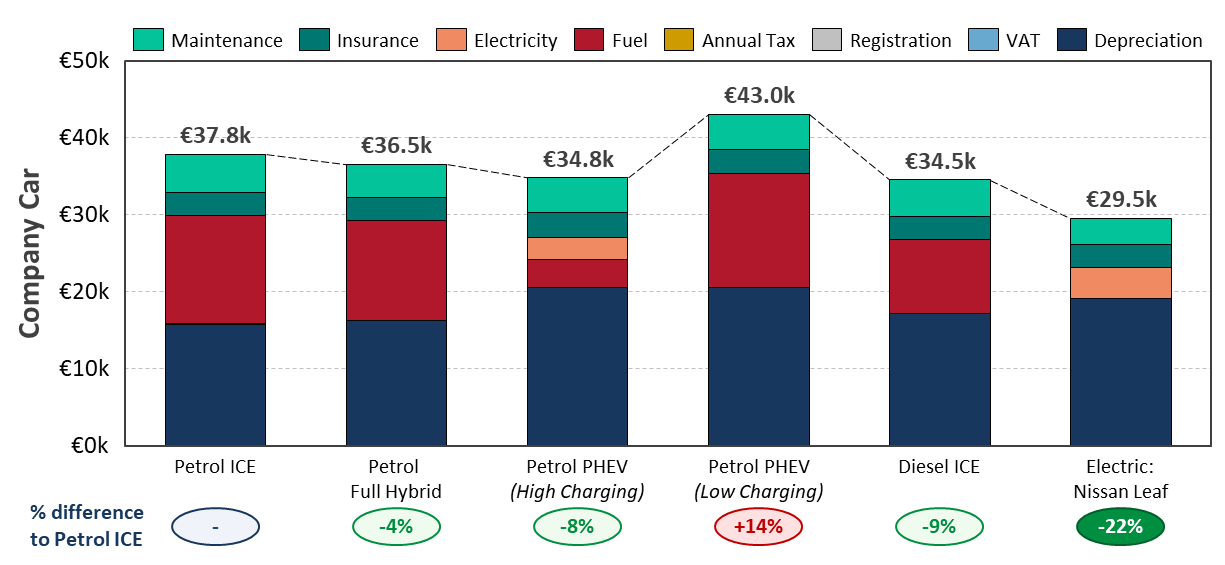


Figure 4: first owner TCOs for a new car bought in 2020 for a company car driver. A Nissan Leaf is compared against the lower-medium sized segment averages of the other powertrains.

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Acronyms

ACEA European Automobile Manufacturers' Association

BEUC The European Consumer Organisation

BEV Battery electric vehicle

EE Element Energy

EU European Union

EV Electric vehicle

FCV Fuel cell vehicle

HEV (Full) Hybrid electric vehicle, non-plug in

ICE Internal Combustion Engine

ICEV Internal Combustion Engine Vehicle

IEA International Energy Agency

LDV Light duty vehicle

LED Light emitting diode

NEDC New European Driving Cycle

OEM Original equipment manufacturer

PHEV Plug-in hybrid electric vehicle

TCO Total cost of ownership

ULEV Ultra-low emission vehicle

VAT Value added tax

WEO World Energy Outlook (IEA)

WLTP Worldwide harmonized Light vehicles Test Procedure

# Introduction

In order to achieve decarbonisation in the passenger car sector required by the EU, a rapid transition to electric vehicles will be required. There are several factors that will impact the rate at which decarbonisation occurs, including: the cost to consumers, provision of charging and the supply of EVs.

This study explores the cost aspect of the transition, by analysing the Total Cost of Ownership (TCO) of different car powertrains in Lithuania. It is important that electric vehicles are cost effective for consumers and, where required, government policy is put in place to make decarbonisation affordable. This is essential to deliver a just and equitable decarbonisation transition for all consumers.

## EU Level Report

*This Lithuania TCO report is part of a wider study that looked into TCOs at an EU level.*

The future European CO2 reduction targets are being reviewed and are expected to be made more stringent that the current target of a 37.5% reduction between 2021 and 2030 for new passenger cars[[4]](#footnote-5). As policy discussions continue within Europe about the level of ambition needed for new vehicle emissions in the 2020s and the mechanisms to be used to deliver them, it is timely to assess the future cost impacts of zero emissions vehicles on private and fleet vehicle users, and in particular whether the lower running costs will outweigh higher upfront costs.

Our EU-level report, which has been released in parallel with this report (and equivalent results for 8 additional European countries), is structured around 5 key messages that have emerged from our analysis:

* The inevitability of battery electric vehicles (BEVs)
* The importance of European emissions standards
* BEVs driving consumer market equity
* Opportunities to maximise the consumer value available through BEVs
* Mitigating the risks to BEV uptake and unlocking consumer benefits

While these themes are common across all European markets, it is important to consider how the decarbonisation transition will impact consumers differently across specific countries. This Lithuania-specific report provides policymakers with tailored TCO results and “real word” examples to support arguments for strengthening European CO2 reduction targets and inform consumers in Lithuania about the opportunities from decarbonisation and associated cost savings.

## Aims of this Study

This report by Element Energy was commissioned by LVOA (Vartotojų aljansas) and BEUC (The European Consumer Organisation), to explore the Total Costs of Ownership (TCO) of cars sold in the 2020s in Lithuania. Specifically, the study aims were as follows:

* Synthesise the latest evidence on future costs and performance of new cars, covering incremental improvements to petrol and diesel cars as well as low and zero emission powertrains.
* Develop a robust set of assumptions for the other components of vehicle ownership costs, such as fuel & electricity costs, taxes and subsidies, and how these are likely to evolve in the future for each powertrain.
* Calculate and compare the Lithuania-specific Total Costs of Ownership for different powertrains between 2020-30. This includes an assessment of how costs are likely to vary for first, second and third owners.
* Explore sensitivities for “real world” specific user groups to identify the impact of decarbonisation on different consumers.

### Report Structure

In Section 2, the methodology is detailed with an overview of vehicle scope and cost & performance modelling. The Lithuania-specific ongoing ownership assumptions, including differences to the EU average baseline, covering: fuel & electricity pricing, average annual mileages and taxes & subsidies, are also discussed. Lithuania specific TCO results for cars bought new between 2020-30 for different ownership periods are outlined in Section 3, which includes a comparison to the EU baseline and other European markets covered in the study. Section 4 shows TCO sensitivities that explore different “real world” specific user groups for BEV models currently available in the market today. Overall conclusions and implications are provided in Section 5.

# Project Methodology

This Section details the project methodology, providing an overview of vehicle scope and cost & performance modelling. The ongoing ownership assumptions are discussed, which include: fuel & electricity pricing, average annual mileages, depreciation rates, insurance and maintenance costs, as well as assumptions around PHEV charging scenarios.

## TCO Overview

Figure 5 shows the make-up of the Total Cost of Ownership (TCO) in terms of individual cost components. This includes both upfront purchase costs (including VAT) and vehicle running costs.

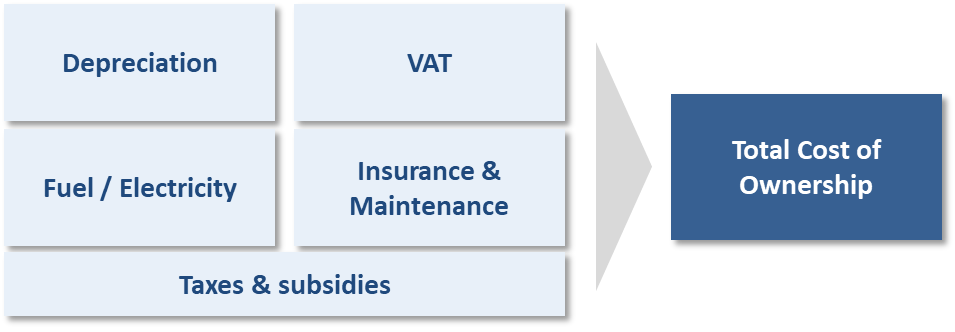


Figure 5: breakdown of the TCO cost components

## Vehicle Scope

The TCO work presented here focuses on generalised cars of specific size segment and powertrain types, rather than predicting future TCO for any individual car makes or models. This approach gives the TCO of an ‘average’ vehicle, which can be readily compared across different European markets.

In this report we consider 3 car size segments: small; medium; large, based broadly on ACEA segmentation[[5]](#footnote-6), and 6 powertrains: petrol and diesel internal combustion engines (ICE); petrol hybrid (HEV) electric vehicles; petrol plug-in hybrid (PHEV) vehicles; battery electric vehicles (BEV); and hydrogen fuel cell vehicles[[6]](#footnote-7). A brief description of each powertrain is included below. Figure 6 shows a graphic representation of the powertrain components included in each powertrain.

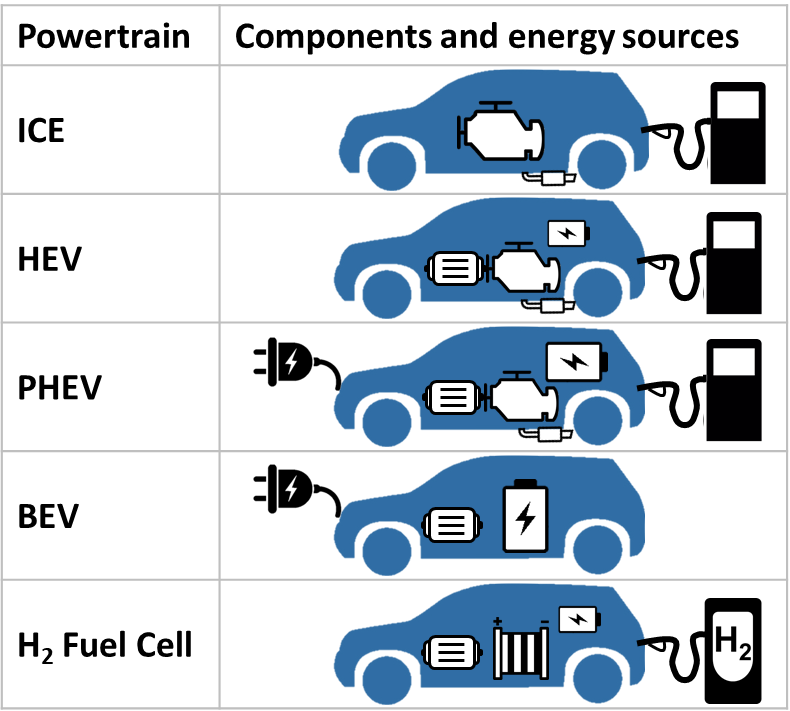


Figure 6: graphic representation of the powertrain components included in each powertrain.

***Internal Combustion Engine (ICE)***

Conventional vehicle comprising of an internal combustion engine and a fuel tank for fuel storage. Note that this powertrain can incorporate start-stop technology and micro-hybridisation, such as belt driven starter generators and 48V electrical systems.

***Full Hybrid Electric Vehicle (HEV)***

Similar to an ICE but supplemented with an electric motor and battery pack allowing it to drive short distances at low speed under electric-only power. The battery is charged by the engine, rather than an external power source. This configuration improves the fuel consumption relative to a conventional ICE, at the expense of additional capital cost.

***Plug-in Hybrid Electric Vehicle (PHEV)***

A hybrid electric vehicle with a larger battery which can be recharged by plugging into an external source of power, as well as by the engine. This enables a portion of overall energy consumption to be provided by electricity, rather than fuel. Recent analysis has shown that the real-world fuel consumption and emissions of PHEVs can be quite different from the WLTP values[[7]](#footnote-8), principally due to significant differences in the charging frequency assumed in official test cycles and how consumers appear to be behaving. In this report we present TCO findings for both PHEVs which are charged regularly (following the assumptions included in the WLTP specification[[8]](#footnote-9)) and for PHEVs which are never charged, and therefore drive under ICE power at all times. These two approaches are included to represent extreme values which bookend the range of values we expect consumers to fall within and can be viewed as a ‘worst-case’ and a ‘best-case’ scenario. Please note that an additional “low charging” scenario is included in the EU-level report based on destination charging, for example at a supermarket, a couple times each week.

***Battery Electric Vehicle (BEV)***

Uses electric motors for propulsion, which are powered entirely by electricity stored in a battery. The battery is charged by plugging into an external electricity source.

***H2 Fuel Cell (FCEV)***

Powered by a hydrogen fuel cell, which converts the chemical energy in hydrogen to electricity through an electrochemical reaction in order to charge a small battery and power an electric motor.

## Cost and Performance Modelling

The TCO forecasts presented in this report are derived from projections for future vehicle attributes from Element Energy’s Cost and Performance Model. This model takes a bottom-up approach to forecasting future vehicle attributes out to 2030, whereby powertrain components are added onto a blank chassis and their associated vehicle attributes (such as cost, weight, and efficiency) are aggregated to the vehicle level.

Figure 7 outlines the basic calculation structure of the Cost and Performance Model. Blank chassis are identified by removing components from known archetype vehicles, and future vehicles are constructed by adding back the required components for each powertrain. The cost, mass, and efficiency for each component is added together to create the overall vehicle characteristics, and individual projections for each component allow for highly granular insight into the effect on overall vehicle performance.

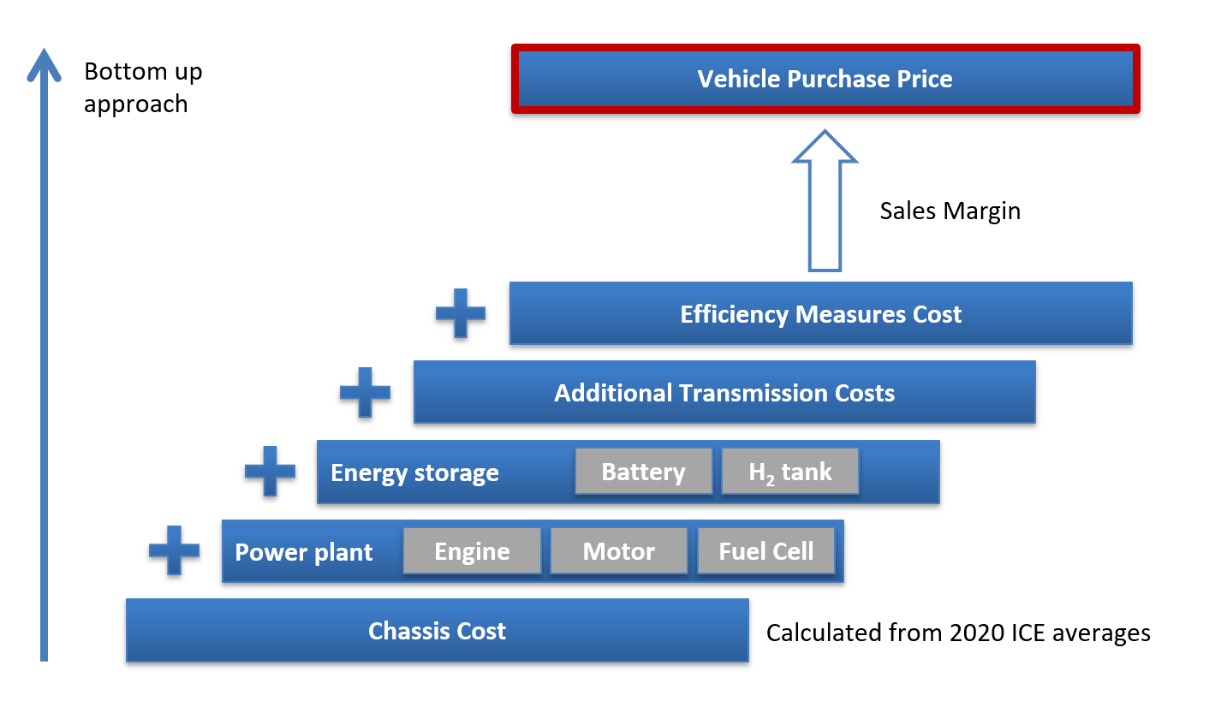


Figure 7: outline of the methodology applied in the Cost and Performance Model

In addition to the required powertrain components, each vehicle has a suite of efficiency measures deployed which change the overall vehicle characteristics, with an associated efficiency, weight and cost impact. 45 individual efficiency technologies are applied to vehicles, each with an individual cost curve and deployment projection which are taken from Ricardo-AEA’s 2016 cost curve study for the European Commission[[9]](#footnote-10).

Vehicles are constructed from the drivetrain components required to move the vehicle (engine, motor, battery, etc), and the chassis which forms the remainder of the vehicle (outer body of the vehicle, seats, windows, air-conditioning system etc). Drivetrain components define the powertrain and vary between vehicle types, whilst the chassis is common between powertrains. Detailed forecasts of component cost, mass, and efficiency are input into the model, so these can be defined accurately. The blank chassis however is treated as a black box: the model does not explicitly consider what materials go into the chassis or how these change over time; instead, the model considers how the chassis evolves as a whole. It is assumed that the chassis is common between related powertrains in the same size segment. Figure 8 shows a more detailed view of the modelling approach employed.

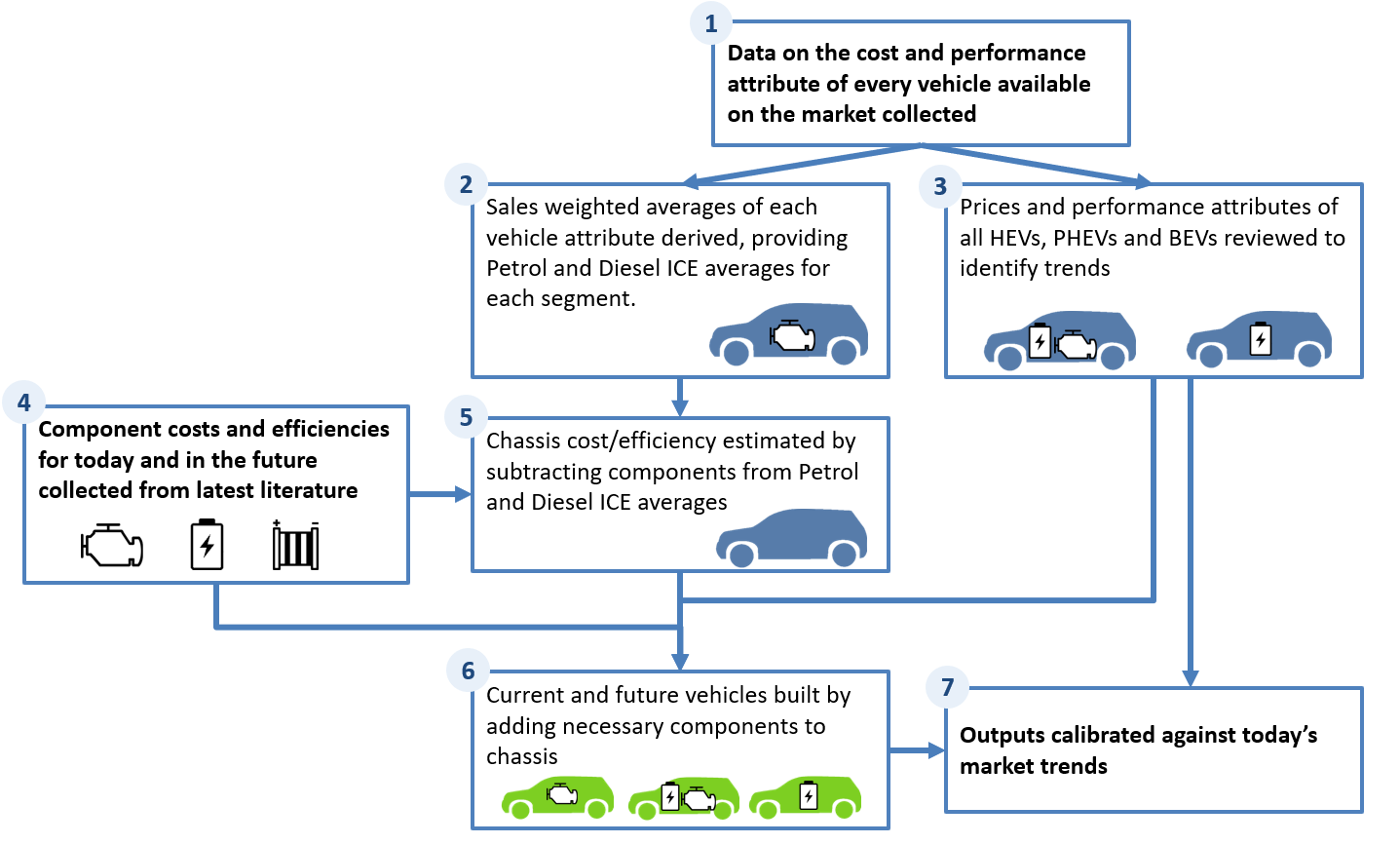


Figure 8: overview of steps taken to construct future vehicles. Numbers indicate modelling order.

Once the overall manufacturing cost of each vehicle has been calculated, a margin is applied to calculate the purchase price a consumer would see in a showroom. The margins used are based on literature review[[10]](#footnote-11),[[11]](#footnote-12),[[12]](#footnote-13),[[13]](#footnote-14) and market research conducted by Element Energy.

In order to have a representative baseline on which to base future vehicles, 2020 archetype vehicles are identified for each segment and powertrain. These archetypes represent a sales-weighted average ICE vehicles and were determined by an analysis of the 9,000+ vehicle models on sale in October 2020, with adjustment factors to convert from EU averages to Lithuania-specific pricing using data sourced from a local market price comparison website[[14]](#footnote-15). The ICE archetypes generated are used to determine the basic properties of the vehicle chassis which are assumed to be common amongst vehicles of the same size segment. An analysis of all HEV, PHEV, and BEV vehicles on sale was also undertaken in order to identify representative 2020 archetypes which are used for the purpose of model calibration.

## Ongoing Ownership Assumptions

Please note that insurance, maintenance & PHEV charging assumptions have been set in line with the methodology set out in the EU level report.

There is significant uncertainty around forecasting the relative residual value of ICE versus BEV cars in the short term. While many more EVs will enter the used car market, demand will also considerably increase; at the same time there is a potential for a fall in ICEVs resale value due to local and national policies limiting their popularity. This uncertainty is particularly important when considering the impact of first owner purchase subsidies on the residual value of EVs. In this study we have assumed that purchase subsidies do not change EVs’ residual value at the end of the first ownership.

### Fuel and Electricity Projections

Historic Lithuania fuel prices (ex VAT and fuel duty) were sourced from the European Commission’s Weekly Oil Price Bulletin[[15]](#footnote-16) and correlated with historic oil prices. These were then projected forward using the same oil price scenario that has been used at an EU level (see EU Level Report for full details).

2020 domestic electricity prices for Lithuania were provided by a local market review by LVOA. The wholesale, network, CO2 and tax cost components were then projected forward using the same electricity price scenario uses at an EU level. Full fuel and electricity pricing assumptions are detailed in Appendix . Prices were adjusted for 2020 based on a review by LVOA of local market tariffs.

### Ownership Periods & Average Annual Mileage

LVOA local market review revealed that annual mileages and ownership periods in Lithuania are broadly in line with EU averages, we have assumed mileages of 15,000km, 12,000km & 10,000km for the first (4 years), second (5 years) and third ownerships (7 years) respectively.

### Taxes and Subsidies

CO2 based registration tax data was provided by LVOA; complete assumptions are detailed in Appendix 6.2. BEV subsidies have been completely excluded. A VAT rate of 21% is applied for new and used cars.

# Vehicle TCO Results: Consumer Cost Saving in the Decarbonisation Transition

## Lithuania TCO Results

This sub-section looks at: (A) the lifetime (16 years) TCOs of different vehicle powertrains purchased between 2020 and 2030 to show the total costs that will be faced by consumers for car ownerships in the decarbonisation transition and (B) the first ownership (4 years), which is especially important as it dictates the long-term market stock. Equivalent graphs detailing the second (5 years) and third ownerships (7 years) can be found in Appendix 6.3.

### Lifetime TCO

Figure 9 compares the TCOs between different powertrains on a total lifetime basis. Each data point illustrates the TCO over the 16-year lifetime of the car, starting from the year that the car was bought new, which is shown on the x axis. Separate trends are considered for small, medium and large cars. While lifetime TCO may not dictate the overall mix of vehicles bought in a market, it is useful for showing the long-term cost optimal solution for consumers.

BEVs become the cheapest powertrain for small and medium cars in 2025 and 2024 respectively, and only become the cheapest option (excluding LPG) for large cars in 2028. Compared to EU averages, this is one years later for small cars and four years later for medium cars (excluding taxes and subsidies), which is driven primarily by cheaper ICEVs available in Lithuania.

It should be noted that the introduction of Euro 7 requirements between 2022-24 has a significant impact on petrol and diesel lifetime TCOs, with additional cost passed onto ICEV consumers. The health consequences of delaying Euro 7, which is essential to reducing air pollution, especially in local urban areas, would be highly damaging for consumers. Furthermore, preventing delays to Euro 7 is essential to share transition costs evenly between governments and OEMs and to maximise the supply of BEVs in the market stock to unlock the substantial benefits to consumers in the used car market.

PHEVs are only slightly more expensive on a TCO basis than BEVs for large cars, however, this is only the case with high charging behaviour. If not charged at all, Petrol PHEVs become significantly more expensive, providing the worst financial value of any powertrain on a lifetime TCO basis. This is particularly important for second and third owners providing an additional risk to consumer equity because they are less likely to have access to off-street parking and therefore will be more impacted by significantly higher running costs,. Furthermore, policymakers have little control over PHEV charging after the vehicle is purchased. Please note that an additional low charging PHEV scenario has been considered in the EU-level report, based on destination charging, for example at a supermarket, a couple of times each week.

LPG offers a cost competitive option in the short term on a lifetime TCO basis, however, this is driven by significantly lower fuel duty compared to petrol and diesel. Current low market share of LPG converted vehicles and limited growth potential due to minimal OEM investment, especially as LPG achieves minimal emission reductions, means there is no long term future for LPG vehicles in the decarbonisation transition.

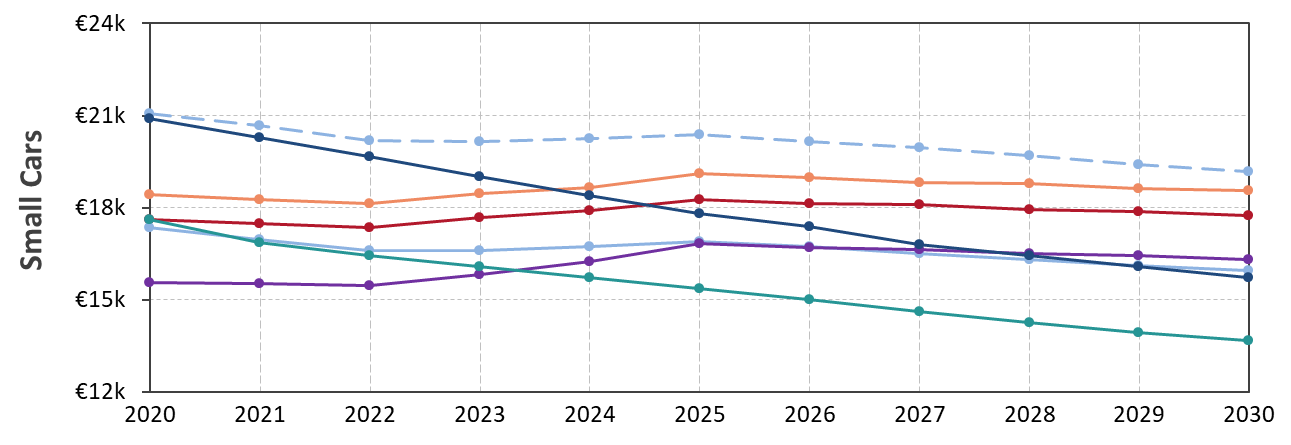
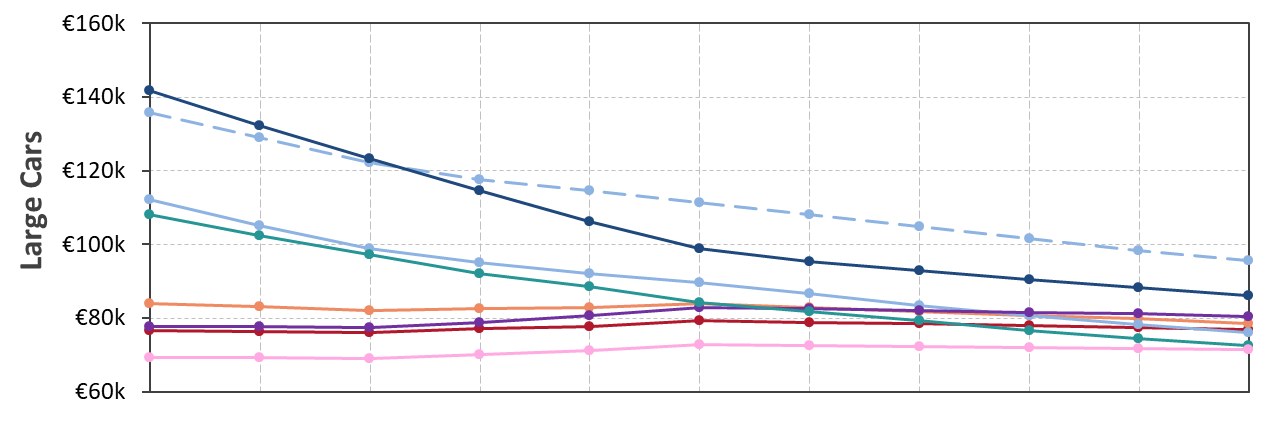
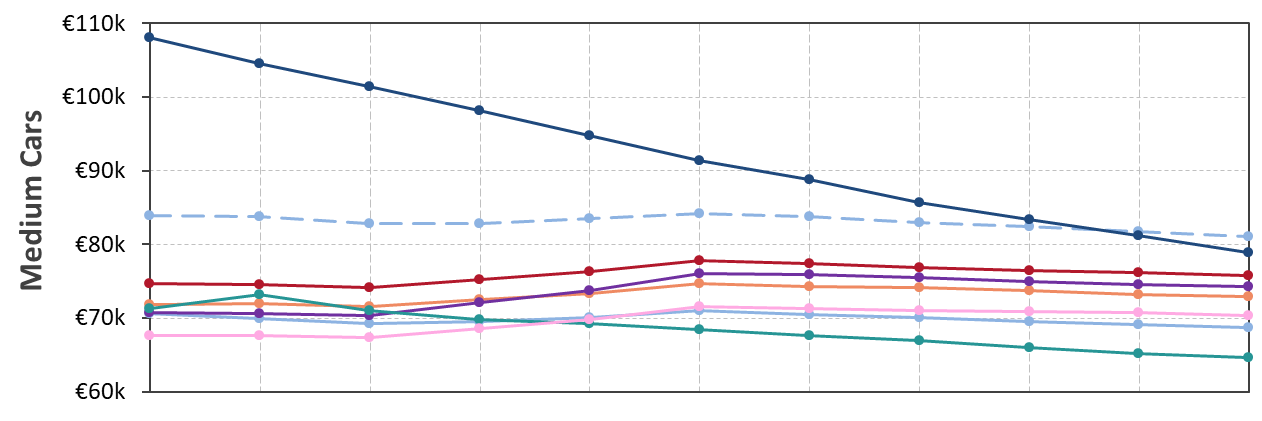
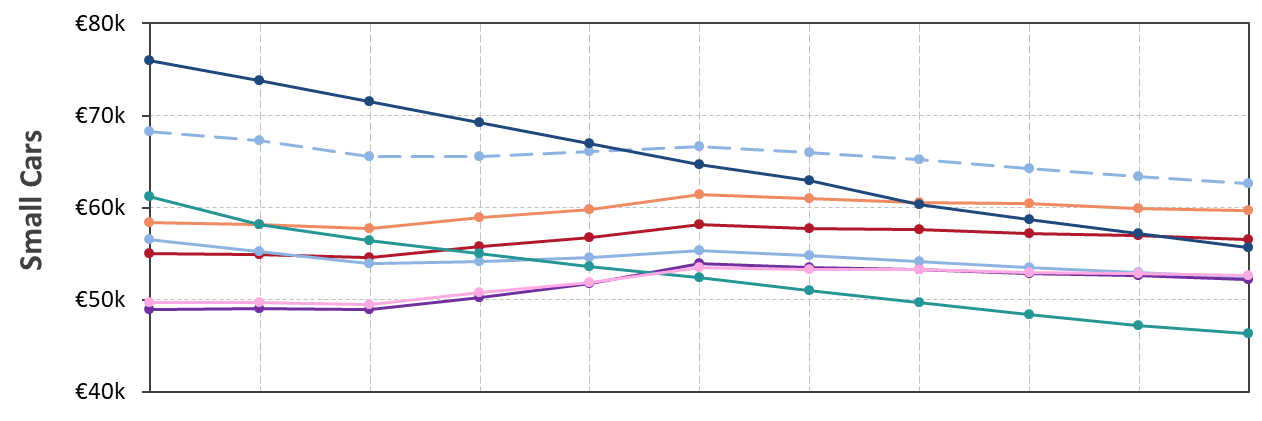


Figure 9: lifetime TCO comparison between different powertrains. Note that the year indicates when the car is first bought new.

### First Owner TCO

Although BEVs provide significantly better value for second and third owners, it is especially important to consider the first ownership period. This impacts new buyer purchasing decisions, which in turn determines the long-term market stock and thus used car availability. The relative first owner TCOs are forecast for the various powertrains in Figure 10. The TCOs for BEVs and FCEVs will drop significantly over the next decade, driven by falling battery and fuel cell costs. BEVs do not become the cheapest powertrain until 2030 for all powertrains, which is 4 years behind EU averages. Small Petrol ICEs in Lithuania cost on average 10% less than EU averages. It is crucial that small BEV models, which have historically been limited, are made available for consumers by OEMs to ensure early BEV adoption for a mass market that buys smaller and cheaper vehicles. Flexibility over battery size (which is discussed at length in the EU-level report) allows consumers to elect to purchase smaller battery model variants and unlock additional cost savings. This enables consumers to find an optimum balance between convenience and cost, with a vehicle to meet their driving needs and which is priced accordingly.

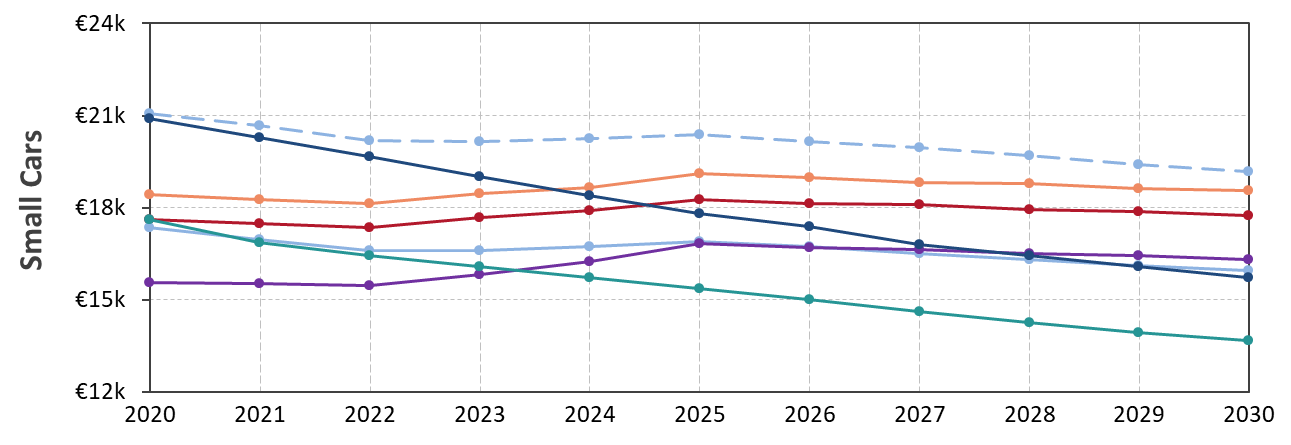
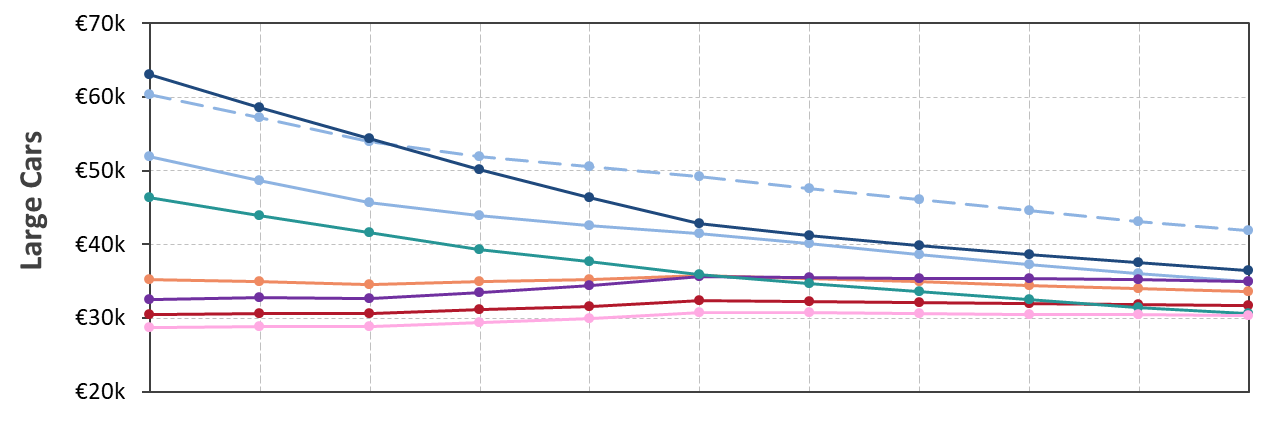
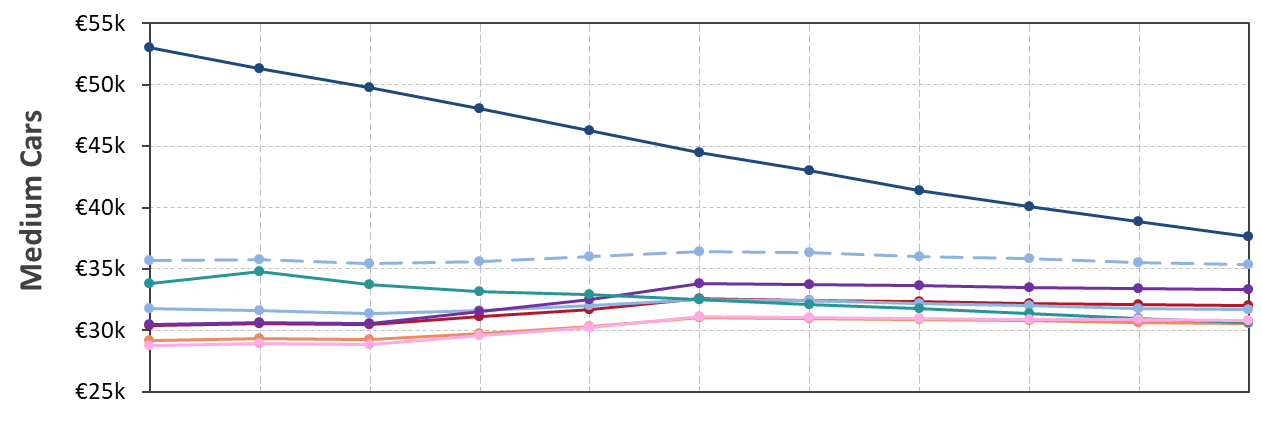
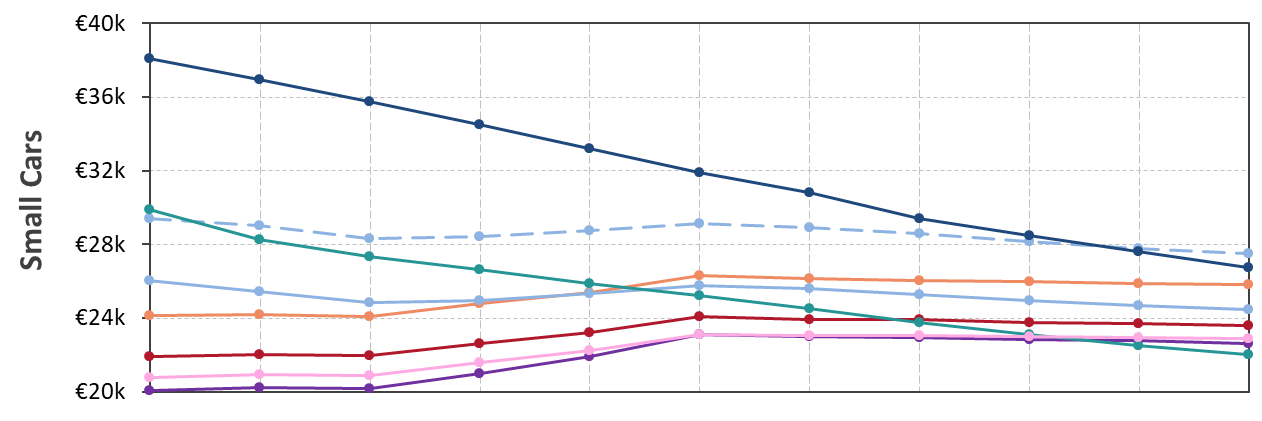


Figure 10: first owner TCO comparison between different powertrains. Note that the year indicates when the car is first bought new.

Figure 11 illustrates the first owner TCO saving for a BEV over a Petrol ICE with and without a €4,000 purchase subsidy. This represents the impact of subsidies that are currently available in several of the other European focus markets in this study but are not available to consumers in Lithuania. Without upfront subsidies, small and medium cars do not become cheaper than Petrol ICEs until 2027 and 2025 respectively. However, with a €4,000 grant, medium BEVs would already be cheaper than Petrol ICEs, with small cars following in 2023.

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Figure 11: first owner TCO savings for a BEV over a Petrol ICE with and without a €4,000 upfront purchase grant

### TCO component evolution between Ownerships

This section considers TCO on a cost component level for first, second and third ownerships. Purchase price differences between ICEVs and BEVs become smaller for used-car owners, which means that savings will be available to the eventual second and third owners of medium BEVs bought new today.

#### First Owners

Figure 12 shows the TCO cost component break out – depreciation, VAT, fuel/electricity, insurance & maintenance – for the first owners of different powertrains for a medium car bought new in 2020. For first owners, depreciation is the largest single TCO component. Depreciation costs are higher for BEVs, due to a more expensive upfront purchase price. A medium BEV currently costs €3,400 more than a Petrol ICE on a TCO basis. The 2020 first owner TCO for PHEVs varies by around €3,900 depending on charging behaviour. If a PHEV is not charged at all, for example by consumers that have access to and use a company fuel card, PHEVs will cost over €1,900 more than a fully electric car.

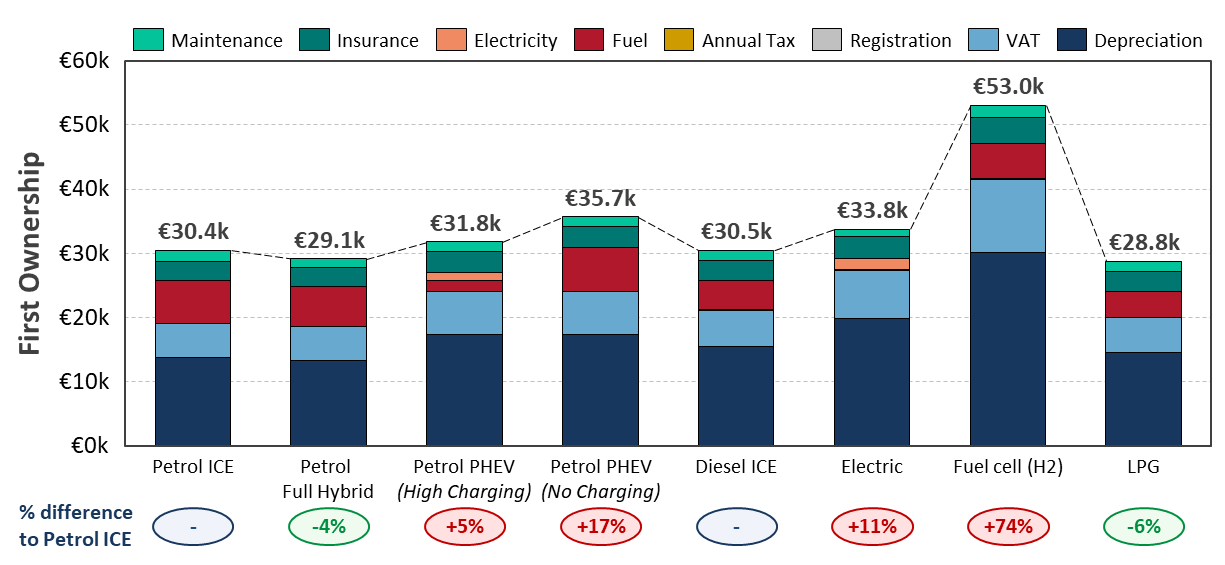


Figure 12: first owner TCOs for different powertrains for a medium car bought new in 2020

#### Second Owners

As shown in Figure 13, for a second-hand medium car that was originally bought new in 2020 and bought by the second owner in 2024, depreciation makes up a smaller proportion of the overall TCO and variation between vehicle powertrains is driven largely by differences in fuel/electricity costs. A medium BEV, originally bought new in 2020, will provide a €1,400 saving for its eventual secondowners over a Petrol ICE, which amounts to a 7% cost saving.

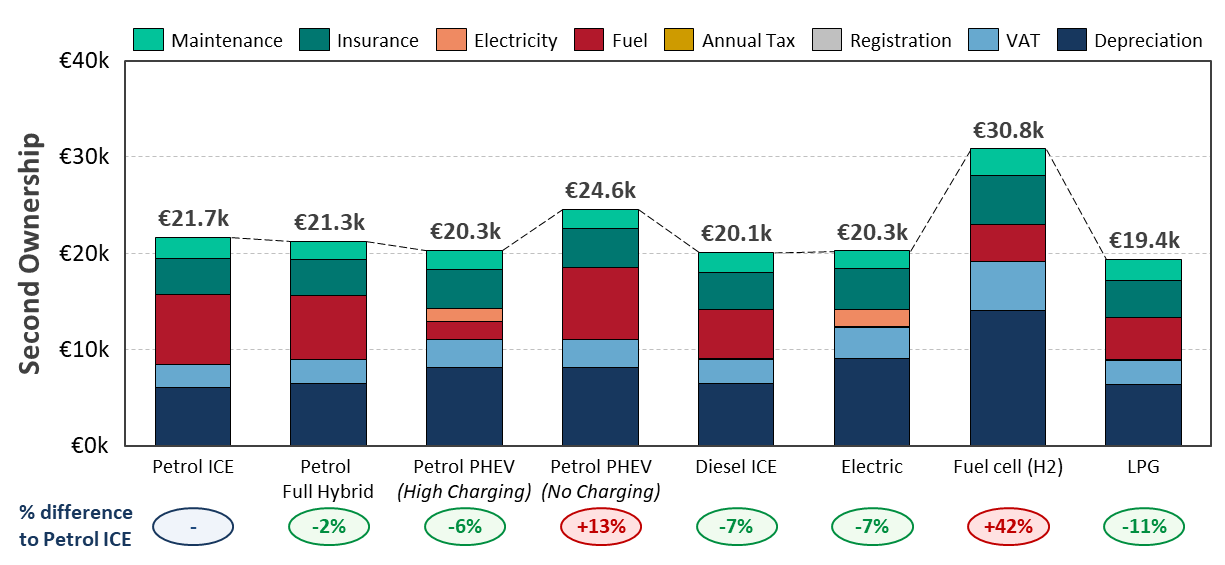


Figure 13: second owner TCOs for different powertrains for a medium car bought new in 2020

#### Third Owners

The TCO of a third-hand medium car that was originally bought new in 2020 (bought by third owner in 2029) is shown in Figure 14. Once different powertrains have significantly depreciated, running costs determine TCO savings compared to the Petrol ICE baseline. BEVs offer best value to consumers, with almost €5,300 and €3,000 savings over a Petrol and Diesel ICE respectively. BEVs drive market equity as they unlock savings for the used-car owners, who are typically less affluent. For every medium BEV that is bought in 2020 instead of a Petrol ICE, the second and third owners combined will save almost €6,700 over the lifetime of the car. This shows that tightening European emission standards, encouraging OEMs to promote earlier BEV adoption, will most benefit the least affluent consumers.

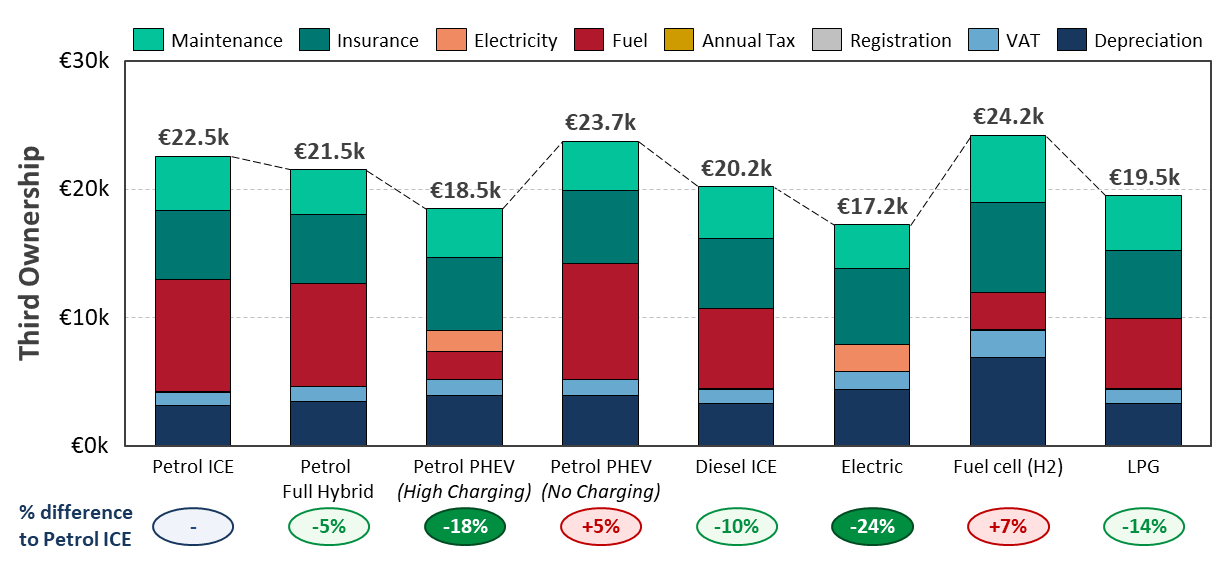


Figure 14: third owner TCOs for different powertrains for a medium car bought new in 2020

## Lithuania compared to EU baseline & European Focus Markets

Figure 15 shows a case study of the factors driving differences between the EU baseline and Lithuania for the relative TCO of a medium Petrol ICE & BEV for first owners. Medium BEVs, based on EU averages and excluding taxes & subsidies, are on average around €1,100 more expensive than Petrol ICE equivalents on a first owner TCO basis. In Lithuania, Petrol ICEs are ca. 10% cheaper than EU averages, increasing the relative TCO costs for first owners by around €2,200. Running cost savings are similar in Lithuania due to a cheaper electricity costs counterbalanced out by the impact of lower petrol prices. With limited additional tax breaks and no BEV purchase subsidies available for consumers in Lithuania, BEVs are ca. €3,350 more expensive for first owners than Petrol ICEs.



Figure 15: drivers of 2020 Δ BEV – Petrol ICE first owner TCO between EU average & Lithuania. Note that fuel and electricity prices in the graph exclude VAT.

For each of the nine European countries assessed in this project, the 2020 first owner TCO difference between BEVs and Petrol ICEs is plotted against current BEV sales[[16]](#footnote-17) in Figure 16. There is a broad exponential correlation between first owner TCO savings and BEV uptake, with the strongest growth seen in Germany and France where BEVs provide best value to consumers. Each market’s position on this landscape should translate into a specific strategy in order to improve BEV uptake. In the red segment in the Figure, Lithuania has experienced limited growth due to Petrol ICEs currently being cheaper than BEVs, with upfront purchase prices of small and medium Petrol ICEs ca. 10% less than EU averages. As ICEV prices increase, due to the entry of Euro 7 requirements, BEV growth in Lithuania is forecast to significantly increase providing policymakers remove barriers to growth such as OEM supply and availability of suitable charging infrastructure.

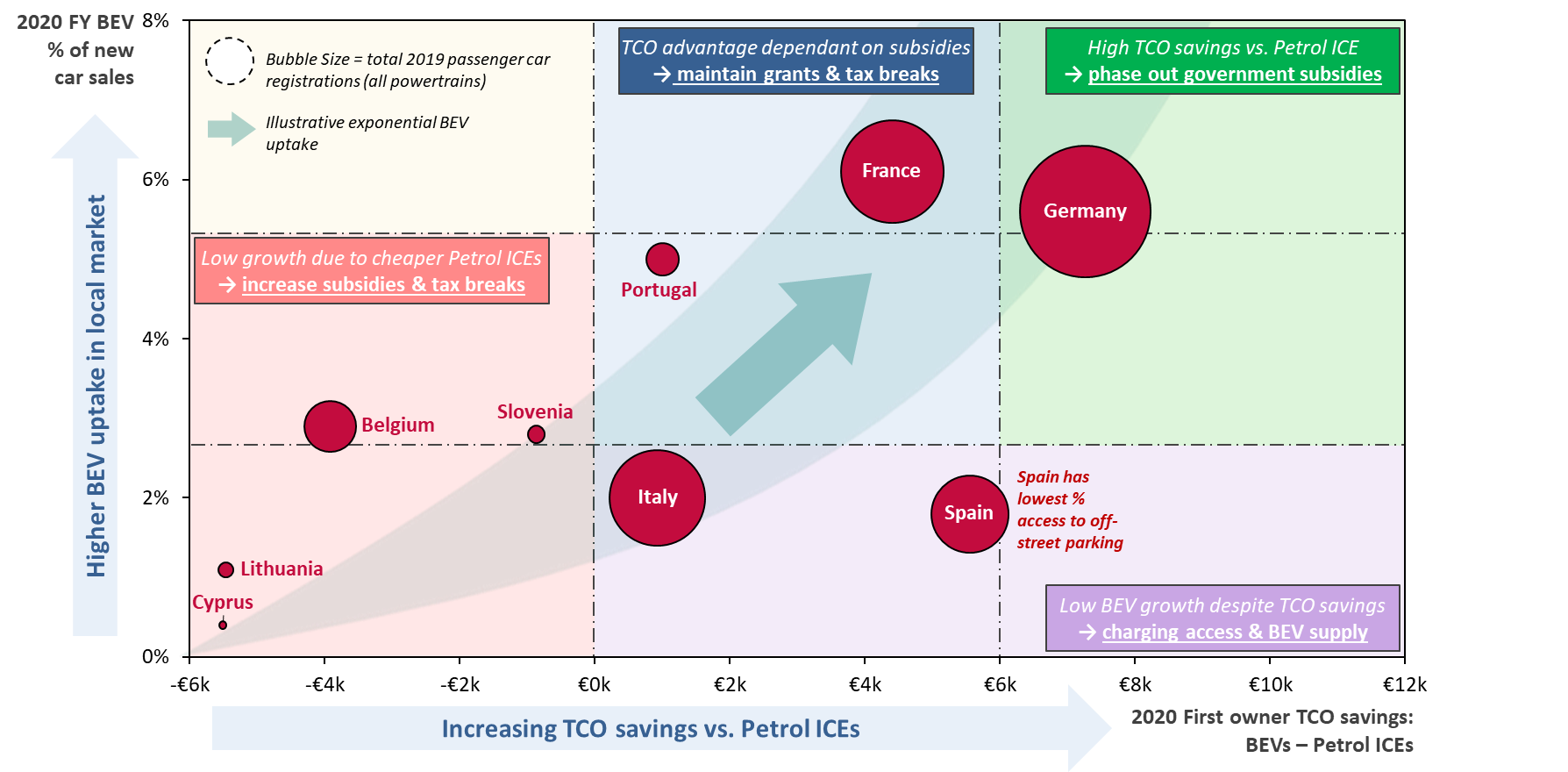


Figure 16: weighted average for small & medium cars showing BEV 2020 share of market sales vs BEV first owner Δ TCO to Petrol ICEs

# Lithuania Specific User Groups

There is high variation in the driving behaviour and needs of consumers, and the TCOs for different powertrains will change significantly due to factors including annual mileage and charging access. Specific user groups are detailed in this section in order to give “real world” examples of the relative first owner TCOs for different consumer groups for a new car bought in 2020. The BEV in each scenario is based on a real model available today and is compared to the segment averages of the other powertrains[[17]](#footnote-18).

## Specific User Group Scenarios

Figure 17 shows the inputs parameters that test specific user group sensitivities for (A) a company car driver who has a high annual mileage[[18]](#footnote-19) and access to a VAT rebate, (B) a consumer with access to cheaper off-peak charging tariffs and (C) a consumer who is 100% reliant on more premium, public charging tariffs[[19]](#footnote-20). Based on discussions with local market experts at LVOA, the Nissan Leaf was chosen as the representative BEV model for this analysis and is compared to the lower-medium car (ACEA segment C) segment averages for the other powertrains.

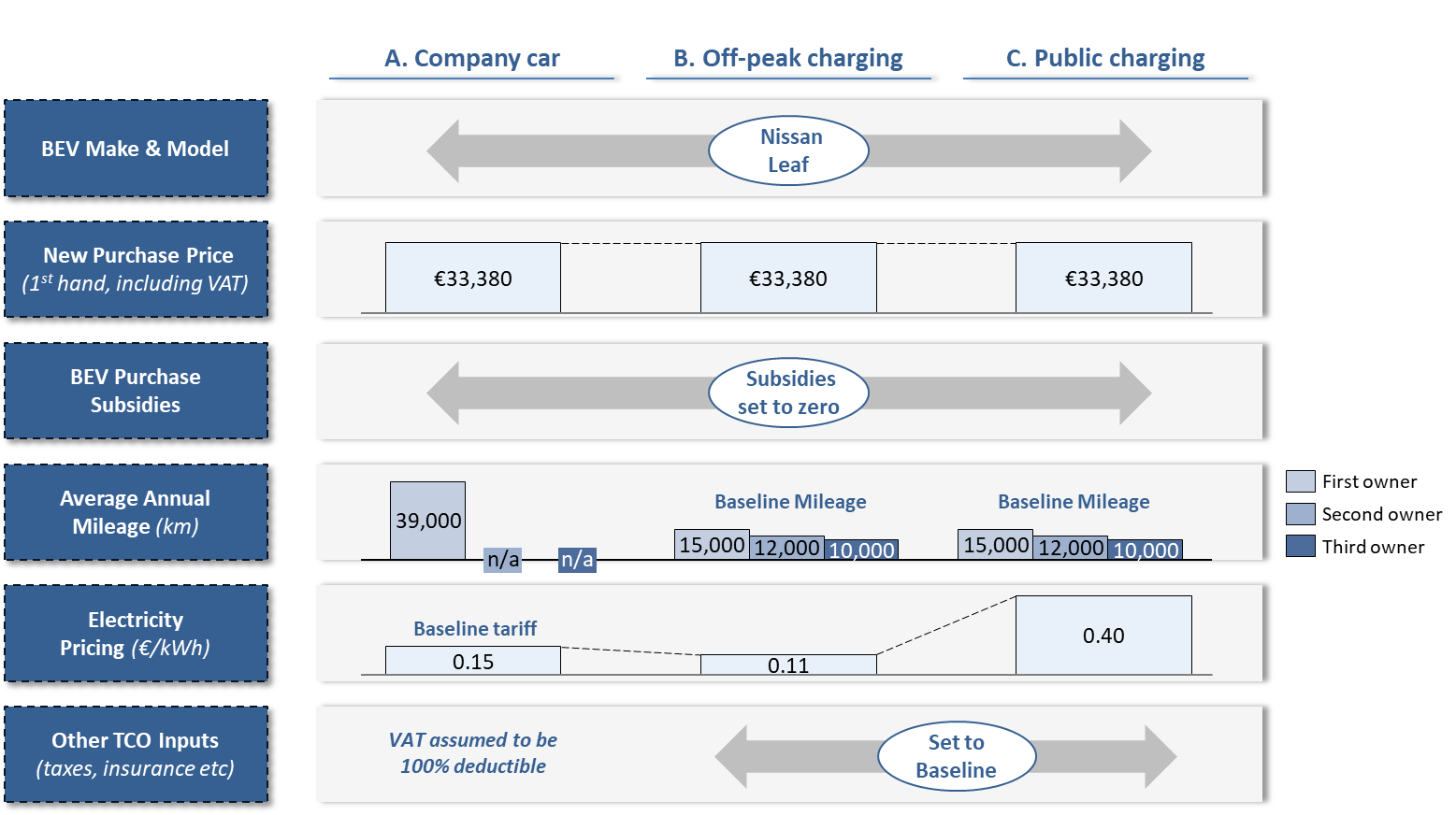


Figure 17: input parameters for Lithuania specific user groups sensitivities

## Company Car Sensitivity

Figure 18 illustrates the first owner TCO results for a new company car bought in 2020 that has a higher average annual mileage and where VAT is 100% deductible. The Nissan Leaf provides a company car driver with savings over a Petrol and Diesel ICE of €8,300 and €5,000 respectively. High mileage drivers should be considered a top priority group to incentivise to switch to BEVs. Financially, this user group benefits the most from switching, while also being the largest producer of tailpipe CO2 emissions. Particular focus on investment into en-route rapid charging infrastructure is an essential part of maximising the number of high mileage users that switch to BEVs.

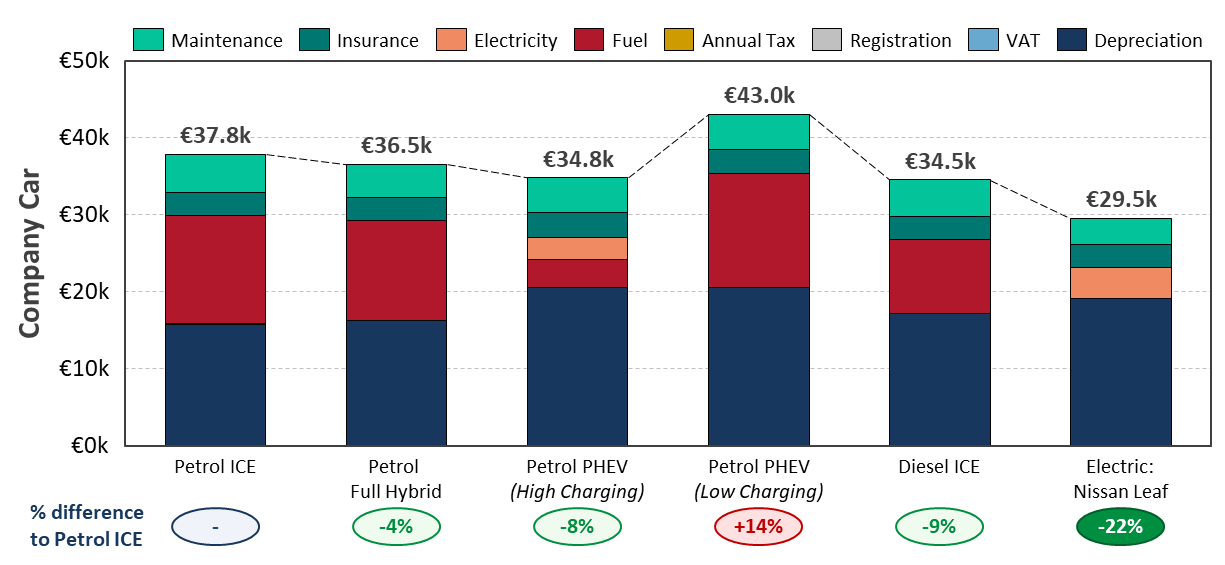


Figure 18: first owner TCOs for a new car bought in 2020 for a company car. The Nissan Leaf is compared against the lower-medium segment averages of the other powertrains.

## Charging Tariff Sensitivity

The first owner TCO results for a new car bought in 2020 for different charging tariffs are shown in Figure 19. Off-peak charging is typical of suburban or rural drivers with access to off-street parking, whereas city-based consumers may rely more on higher premium public charging tariffs.

The Nissan Leaf provides first owners with access to off-peak charging with savings of €1,700 and €1,200 over a Petrol and Diesel ICE respectively. This means that with appropriate financing options, a Nissan Leaf could provide these consumers with significant savings from day one. BEVs are ca. 6% more expensive than Petrol ICEs for first owners that rely 100% on public electricity tariffs if bought new today.

In these scenarios, the Nissan Leaf is close to parity with other powertrains for first owner, although medium BEVs do not become cheaper that ICEVs until 2025 on average, as discussed in Section 3.1.2. This is because the Nissan Leaf here is a more mainstream model that the average medium BEV, which are typically of higher specifications than those seen for equivalent ICEVs. This demonstrates that where OEMs provide more equivalent and cheaper models to consumers, TCO savings can already be achieved for BEVs over ICEVs.

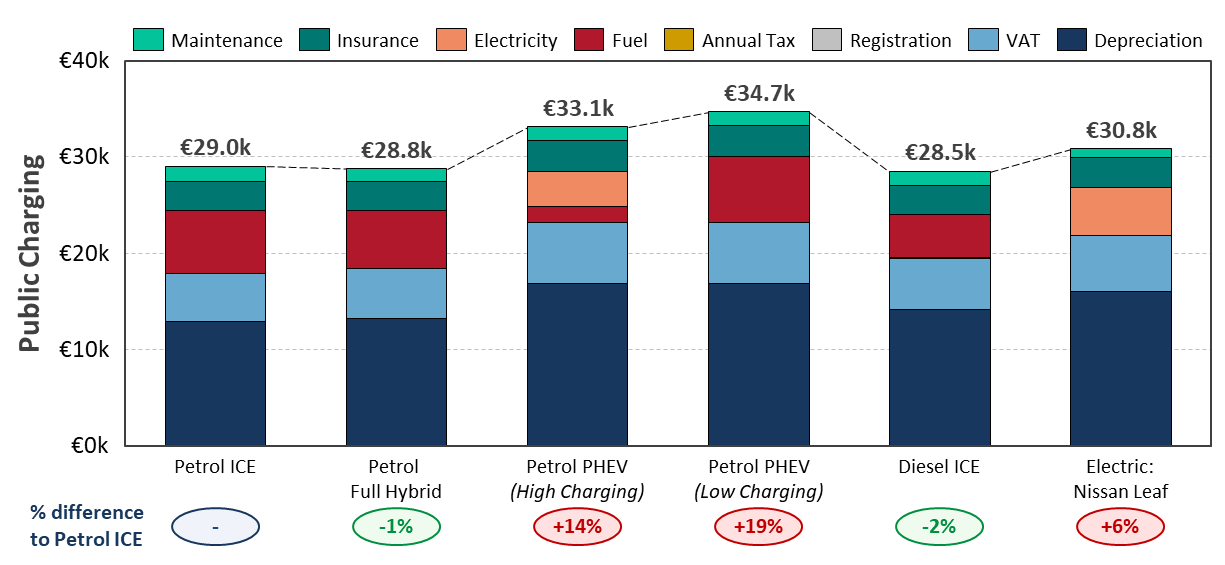
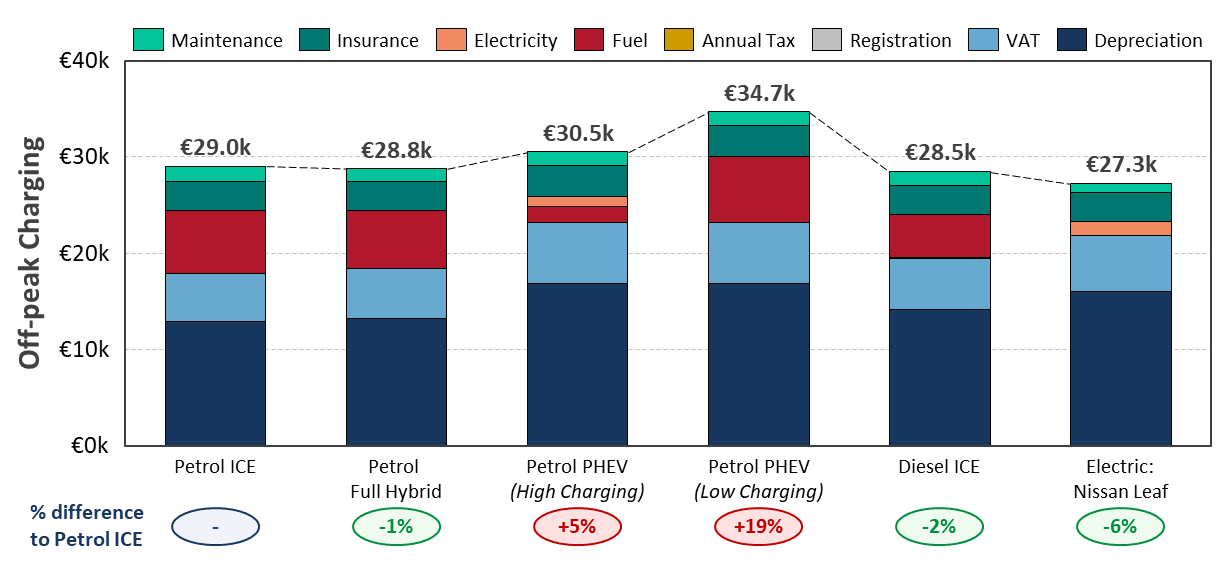


Figure 19: first owner TCOs for a new car bought in 2020 for different charging tariffs. The Nissan Leaf is compared against the lower-medium segment averages of the other powertrains

TCO savings for BEVs over ICEVs increase for both charging scenarios for their evenual second and third owners, as shown in Figure 20 for a car originally bought new in 2020. BEVs provide savings over Petrol ICEs of 24% and 36% for second and third owners respectively with access to off-peak charging tarriffs. Even when used owners rely on more premium public charging, BEVs still provide considerable cost savings over a Petrol ICE for its used owners, which reiterates the value that BEVs can provide for less affluent consumers.

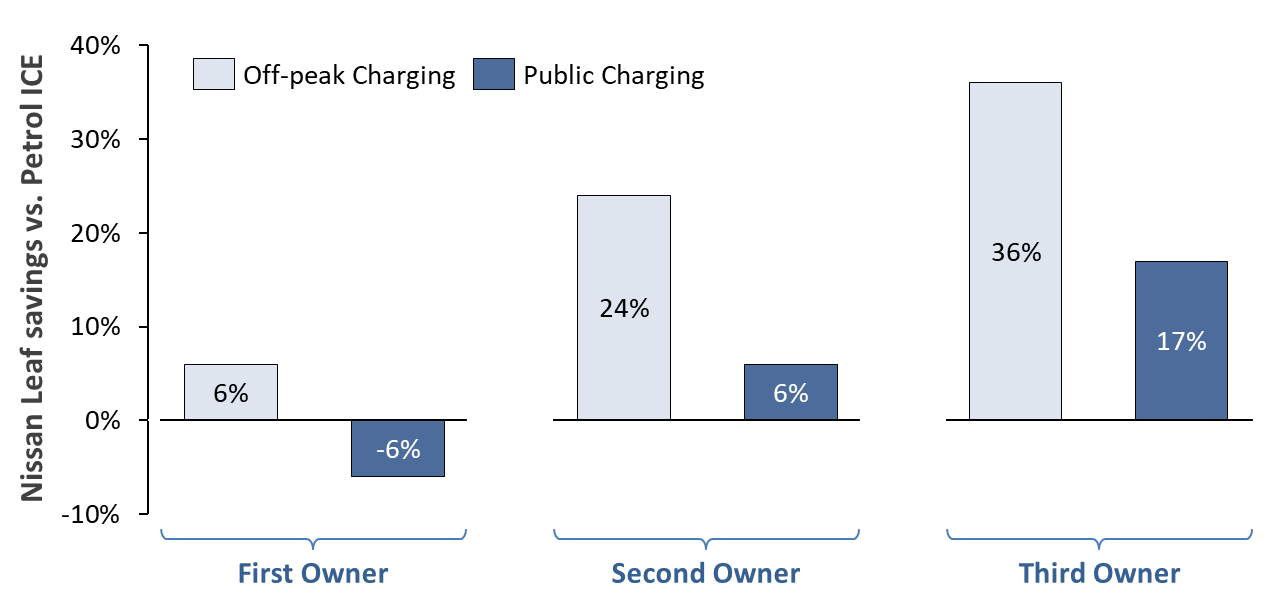


Figure 20: Nissan Leaf TCO savings over a lower-medium Petrol ICE for off-peak and public charging tariffs

# Conclusions

This study has assessed forecasted TCOs for different powertrain cars in Lithuania in the 2020s. We have used the latest evidence on trends in technology costs and efficiency improvements, and modelled different scenarios for a range of ownership costs to represent a variety of specific user groups. The results have wide-ranging implications for Lithuanian consumers as well as policymakers responsible for leading the decarbonisation transition.

BEVs become the cheapest powertrain for small and medium cars in 2025 and 2024 respectively on a lifetime TCO basis, and only become the cheapest option (excluding LPG) for large cars in 2028. This is one year later for small cars and four years later than medium cars compared to EU averages (excluding taxes and subsidies), which is driven primarily by cheaper ICEVs available in Lithuania.

BEVs offer most savings to less affluent consumers. A medium BEV bought new today will save almost a total of €6,700 for its second and third owners combined compared to a Petrol ICE. Switching to BEVs is essential for decarbonisation but also for reducing the adverse health impacts from air pollution in local urban areas. Tightening EU manufacturer emission targets will most benefit the least affluent consumers by increasing the available stock of used BEVs more quickly. This will also promote a higher variety of BEV models, such as increasing the range of small and large vehicles, which has historically been limited, in order to meet the driving needs of all consumers.

Petrol PHEVs that are not charged become the most expensive powertrain for consumers. Second and third owners, who are less likely to have access to off-street parking and therefore home charging, risk being impacted by higher running costs. Furthermore, Petrol PHEVs pose a potential competitive risk to uptake of BEVs rather than as a “stepping stone”, without necessarily bringing the expected emissions savings.

#### BEV subsidies are necessary in the short term to drive uptake in Lithuania

BEV growth in Lithuania has fallen behind other European focus markets, many of which have stimulated BEV growth through upfront purchase subsidies. In Lithuania, without upfront subsidies, small and medium cars will not become cheaper than Petrol ICEs for first owners until 2027 and 2025 respectively, however, with a €4,000 grant, BEVs would already be cheaper for medium cars with small cars following in 2023. There is evidence to suggest that to achieve the BEV growth required to meet Lithuania’s decarbonisation ambitions, purchase grants would be needed until at least 2025, which is the point when medium BEVs become cheaper for first owners without government support.

While providing a purchase subsidy for BEVs is advised in the short term, it is important that governments do not continue to subsidise BEVs for first owners once the market reaches the stage where the vast majority of consumers would already choose to buy a BEV regardless of incentives being available. This is expected to happen in Lithuania by the late 2020s. It is important that policymakers in Lithuania find a balance between encouraging earlier BEV adoption, while making sure that investment is targeted where it is most needed to maximise electromobility, and, in particular, where it does not compromise the immediate roll out of charging infrastructure.

#### Removing barriers to BEV uptake in Lithuania

It is essential that policymakers address the two most important barriers to BEV consumer uptake: (1) access to reliable and affordable charging, and (2) adequate OEM supply of BEV models. While strengthening manufacturer emissions targets is the most impactful way to support BEV supply, policymakers should adjust charging strategies to meet the specific needs of various socio-economic groups. They should acknowledge the differences in charging behaviour between first-hand and used-car buyers, with used-car owners less likely to have off-street parking. A comprehensive and strategically located charging network offering attractive tariffs (via preferential pricing for frequent users, smart charging, or EV charging included in electricity contracts and roaming agreements with charging operators) is crucial to ensure drivers have confidence in publicly available infrastructure, which will encourage consumers to switch to BEVs more quickly.

#### BEVs already provide cost savings for specific user groups in Lithuania

There are many Lithuanian consumers who have higher average annual mileages, which significantly increases the savings offered by BEVs due to their lower running costs. The 2020 first owner TCO was considered for a company car (annual mileage of 39,000km), where the BEV model is assumed to be a Nissan Leaf. The Leaf provides company car first owners savings of €8,300 over an equivalent Petrol ICE, and tailpipe CO2 savings over x2.5 that of an “average first owner” (annual mileage of 15,000km) that switches to a BEV. This user group benefits the most on a TCO basis while driving the highest savings of CO2 emissions. Therefore, it must be considered a top priority group for policymakers. Particular focus on investment, especially in urban areas, into en-route rapid charging infrastructure is an essential part of maximising the number of high mileage users that switch to BEVs over the next five years. This is especially relevant in Lithuania due to “working on wheels” salesmen, a key consumer group, having average annual mileages that may even exceed 50,000km.

A sensitivity analysis for consumers with access to cheaper off-peak tariffs showed that a Nissan Leaf provides first owner TCO savings of 6% over an equivalent lower-medium Petrol ICE. This means that with suitable financing schemes available to consumers, BEVs could provide savings from day one. Off-peak charging is especially important for used-car buyers, where running costs become the most important TCO cost component. Smart charging mechanisms (on both public and private charging points) to encourage consumers towards off-peak charging times will become increasingly important through the decarbonisation transition for managing peak loads, while allowing consumers to access additional savings. Some consumer groups may be able to even access cheaper electricity tariffs in Lithuania though schemes including co-ownership of small solar farms.

Even for consumers that completely rely on more premium public charging tariffs, such as city-based consumers without off-street parking, the Nissan Leaf saves around 6% and 17% for its second and third owners respectively over a lower-medium Petrol ICE. This demonstrates that on-street public charging, which will likely become typical in urban and suburban areas where consumers do not have access to off-street parking, provides a cost effective option for used car consumers in Lithuania. It is important to note that many public charging points in Lithuania are subsidised and currently offer tariffs more in line with domestic electricity prices, especially at destination charging locations, for example outside supermarkets, which may allow even greater savings for consumers.

# Appendix

## Fuel & Electricity Forecasting

In this Appendix Section, the full fuel and electricity inputs for the baseline scenario modelling are detailed based on the methodology laid out in Section 2.4.

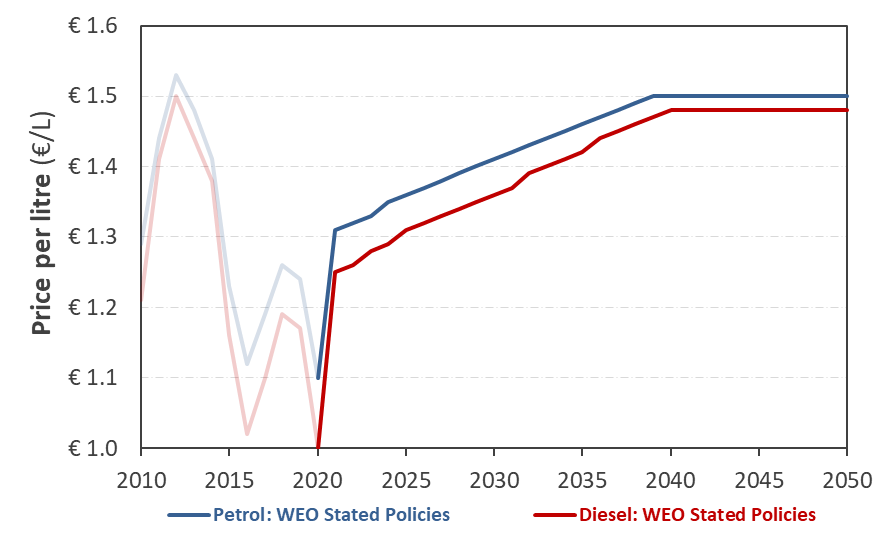


Figure 21: petrol & diesel price forecasting between 2020-50

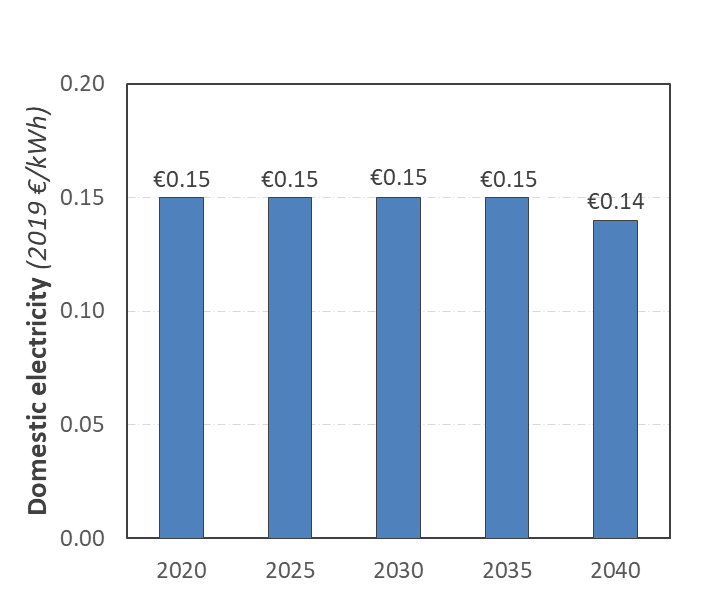


Figure 22: electricity price forecasting between 2020-40

## Taxes & Subsidies

Table 1: Registration Tax – CO2 based

|  |  |  |  |
| --- | --- | --- | --- |
|  | **€ per g CO2/km** | | |
| **CO2 Emissions** | **Diesel ICE** | **Petrol ICE** | **LPG** |
| 0-115 | 0 | 0 | 0 |
| 116-130 | 0 | 0 | 0 |
| 131-140 | 20 | 15 | 14 |
| 141-150 | 60 | 30 | 27 |
| 151-160 | 90 | 45 | 41 |
| 161-170 | 120 | 60 | 54 |
| 171-180 | 150 | 75 | 68 |
| 181-190 | 180 | 90 | 81 |
| 191-200 | 210 | 105 | 95 |
| 201-210 | 240 | 120 | 108 |
| 211-220 | 270 | 135 | 122 |
| 221-230 | 300 | 150 | 135 |
| 231-240 | 330 | 165 | 149 |
| 241-250 | 360 | 180 | 162 |
| 251-260 | 390 | 195 | 176 |
| 261-270 | 420 | 210 | 189 |
| 271-280 | 450 | 225 | 203 |
| 281-290 | 480 | 240 | 216 |
| 291-300 | 510 | 255 | 230 |
| >300 | 540 | 270 | 243 |

EVs & Fuel Cell (H2) excluded; paid by both first & subsequent owners

Table 2: Additional Registration Fees

|  |  |  |
| --- | --- | --- |
|  | **New Vehicles** | **Used Cars** |
| Registration Fee *(€)* | 14.48 | 12.00 |
| Vehicle Identity Check *(€)* | 15.35 | 15.35 |
| Number Plates *(€)* | 15.06 | 15.06 |

|  |  |
| --- | --- |
|  | **Roadworthiness Test Fee** *(€)* |
| Petrol ICE | 14.48 |
| Diesel ICE | 18.20 |
| LPG | 23.40 |

## Additional TCO Results

### Second Owner TCOs

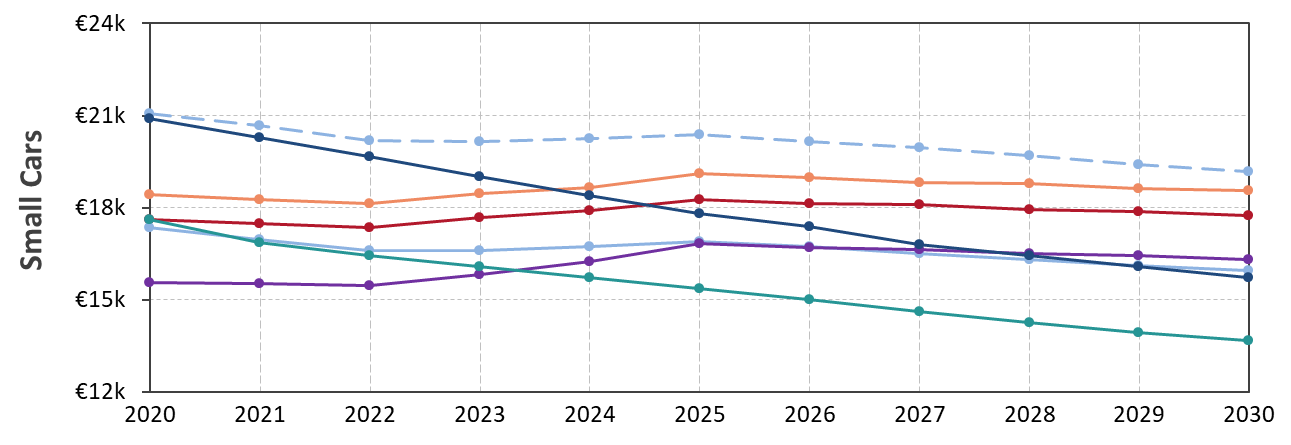
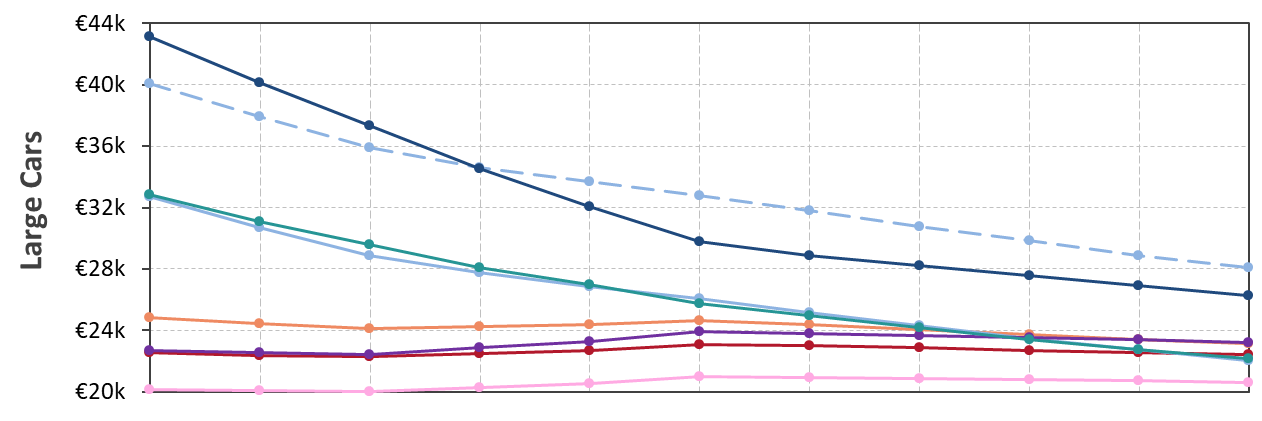
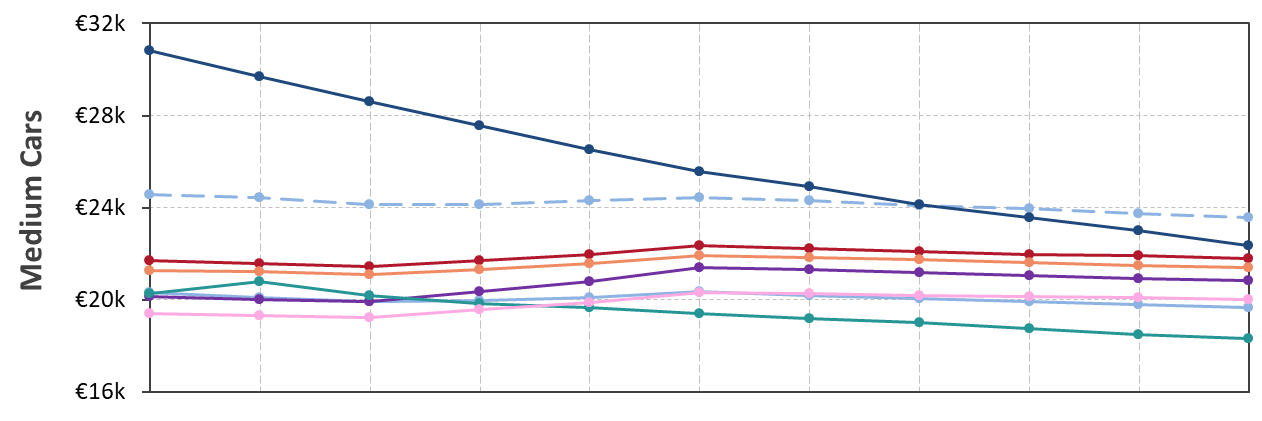
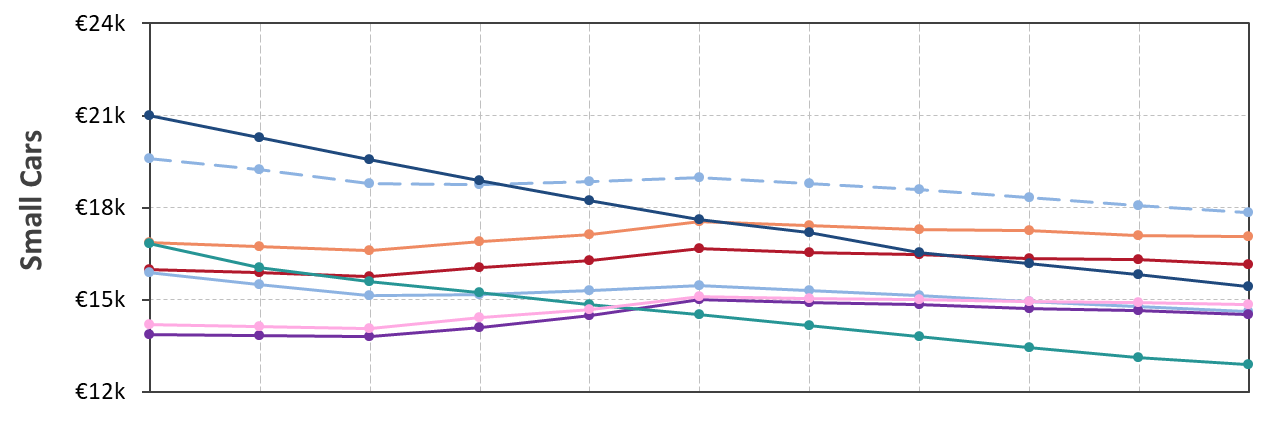
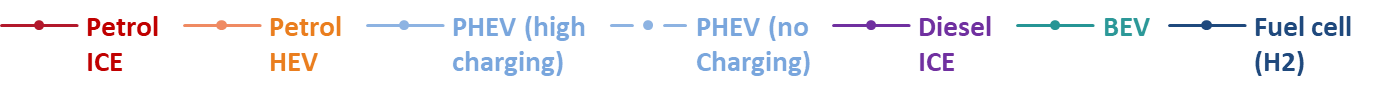


Figure 23: second owner TCO comparison between different powertrains. Note that the year indicates when the car is first bought new.



### Third Owner TCOs

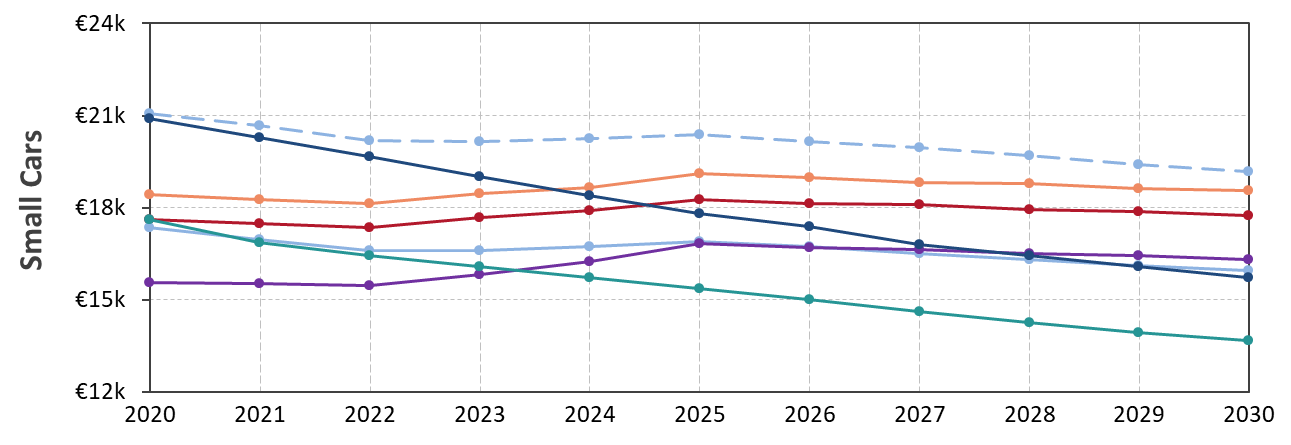
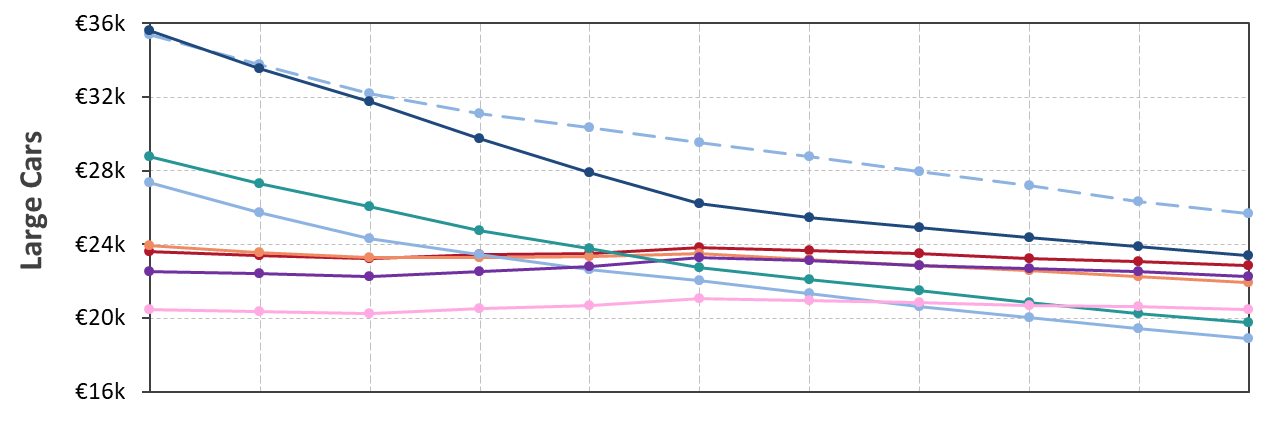
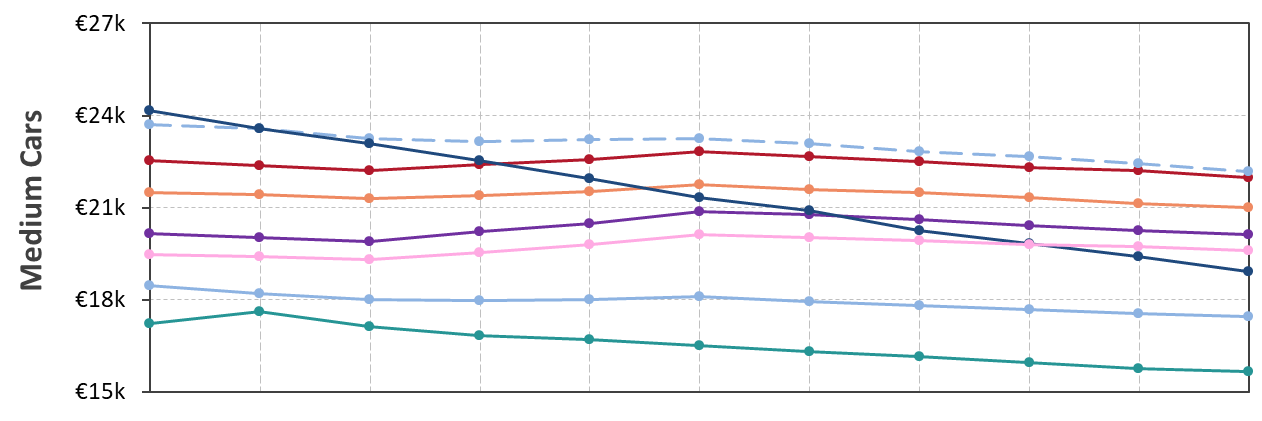
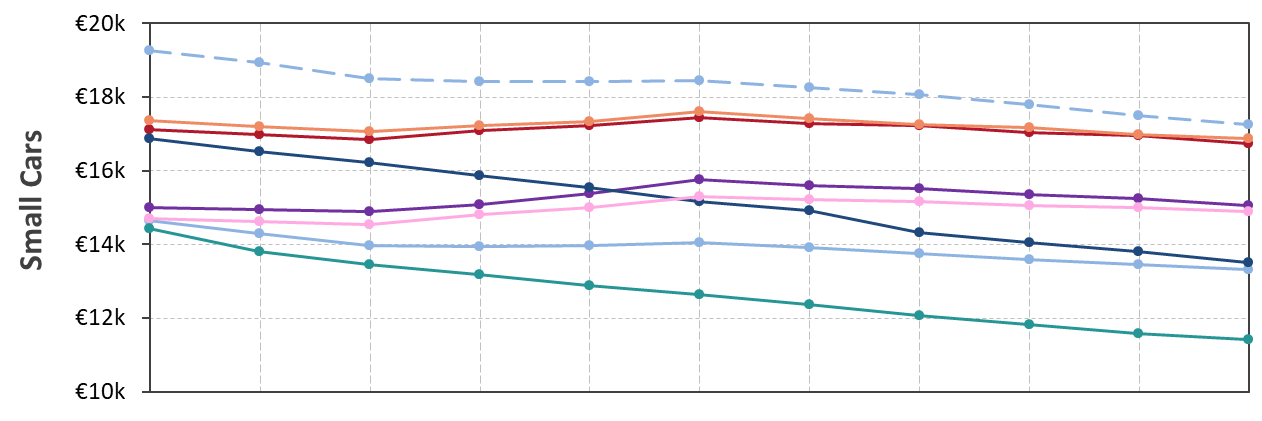


Figure 24: third owner TCO comparison between different powertrains. Note that the year indicates when the car is first bought new.

### Medium Car Cost Components 2025

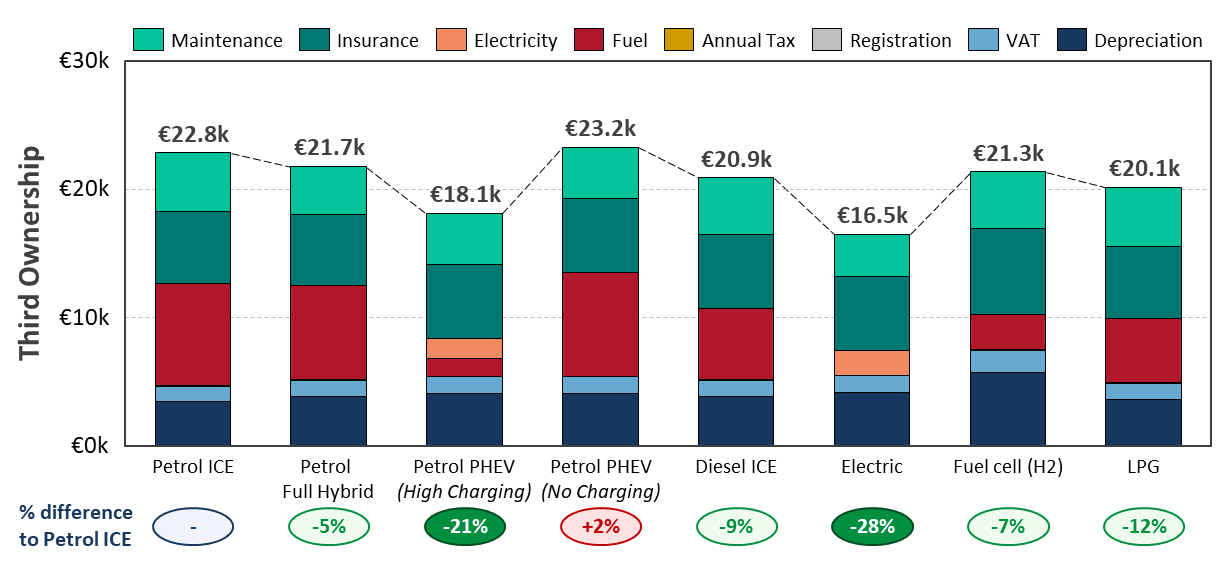
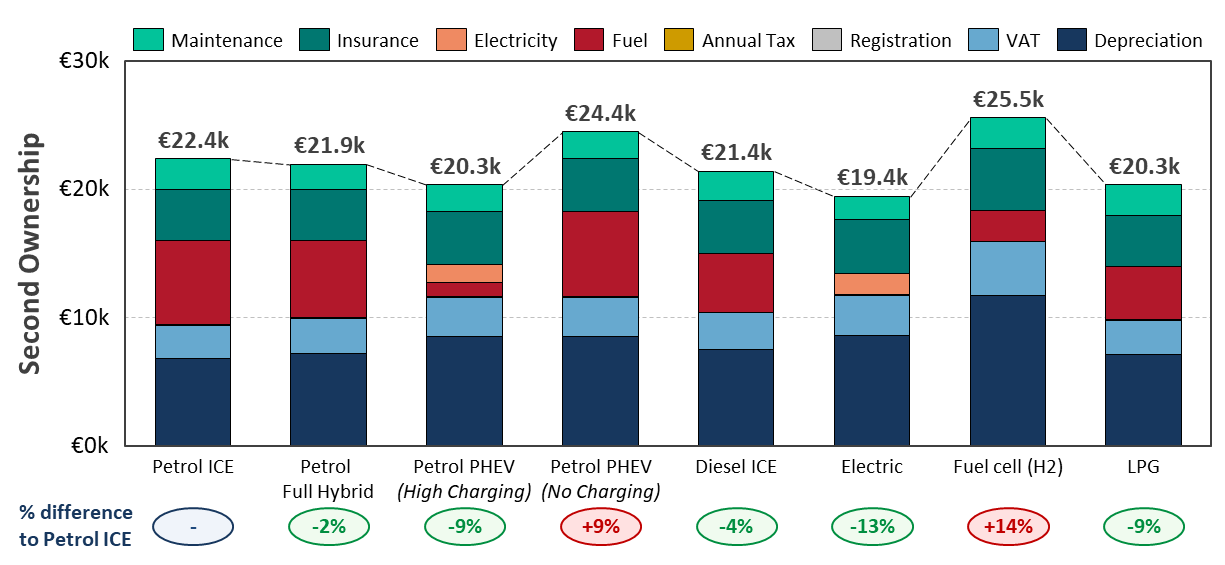
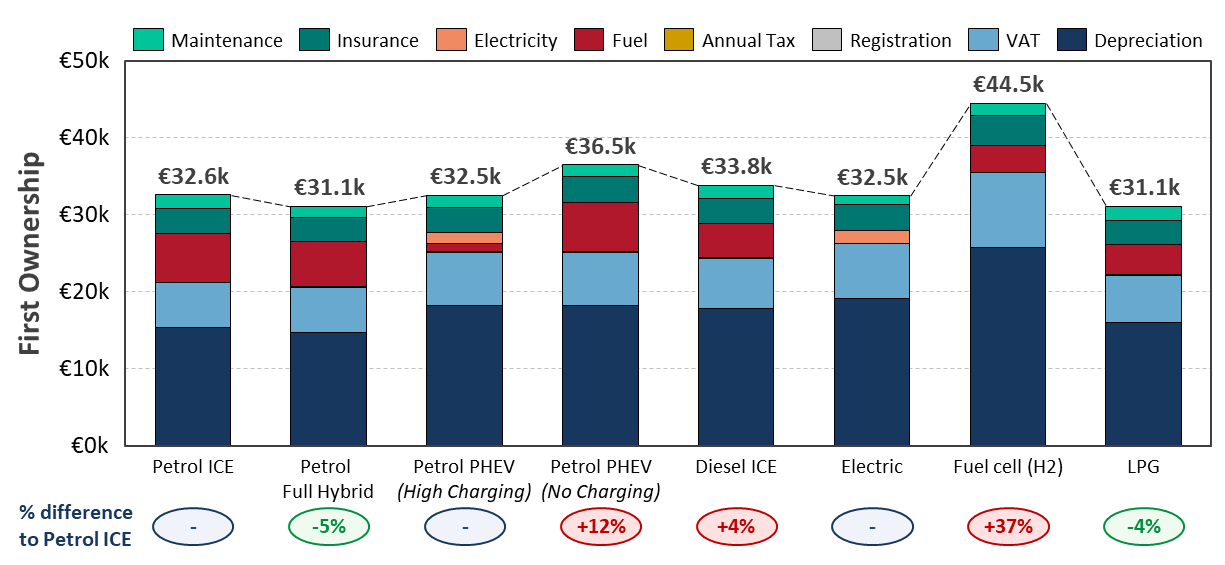


Figure 25: TCOs on a cost component level for different powertrains bought new in 2025

### Medium Car Cost Components 2030

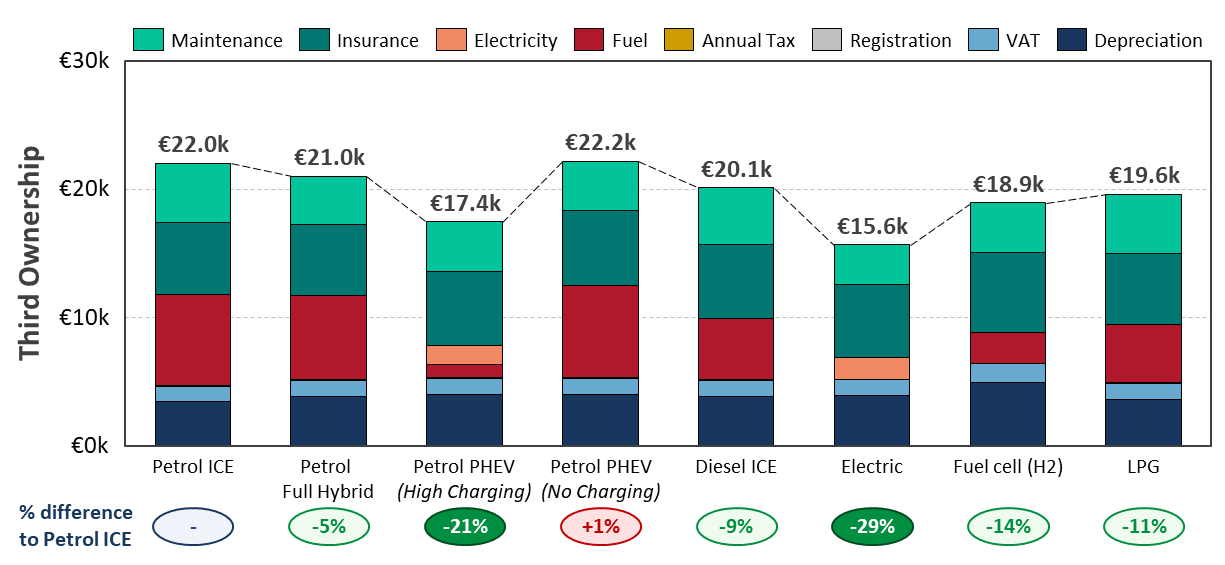
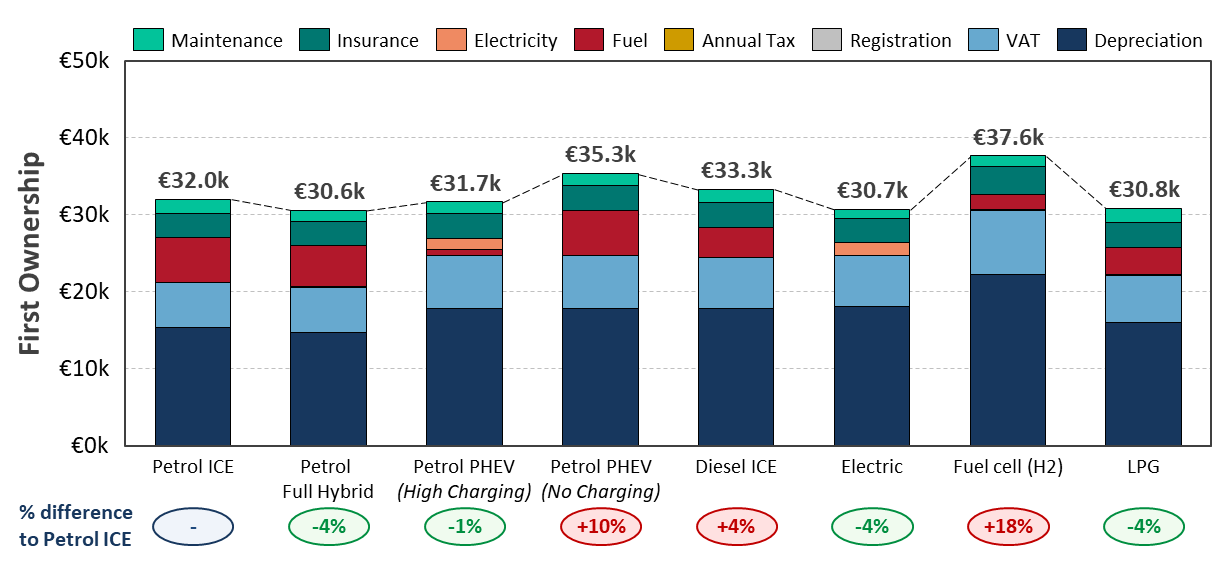


Figure 26: TCOs on a cost component level for different powertrains bought new in 2030

1. ICCT 2021 pocketbook <http://eupocketbook.org/> [↑](#footnote-ref-2)
2. CNG has been excluded due to low market share, very limited growth potential & OEM investment and because it achieves minimal emission reductions. [↑](#footnote-ref-3)
3. Transport & Environment (2018): Consumer attitudes to low and zero-emission cars [↑](#footnote-ref-4)
4. <https://ec.europa.eu/clima/policies/transport/vehicles/regulation_en> [↑](#footnote-ref-5)
5. Specialist Sport and Luxury Car are excluded from the large segment, to best reflect the choice for an average consumer. [↑](#footnote-ref-6)
6. CNG has been excluded due to low market share, very limited growth potential & OEM investment and because it achieves minimal emission reductions. [↑](#footnote-ref-7)
7. Transport & Environment (2020) Plug-in hybrids: Is Europe heading for a new Dieselgate? [↑](#footnote-ref-8)
8. UN/ECE Regulation 101, Annex 8, pg. 74 https://www.unece.org/fileadmin/DAM/trans/main/wp29/wp29regs/r101r2e.pdf [Accessed 12/03/2021] [↑](#footnote-ref-9)
9. Ricardo-AEA. Improving understanding of technology and costs for CO2 reductions from cars and LCVs in the period to 2030 and development of cost curves. 2016. [↑](#footnote-ref-10)
10. Roland Berger (2014) Global Automotive Supplier Study [↑](#footnote-ref-11)
11. KPMG (2013) Automotive Now, Trade in crisis [↑](#footnote-ref-12)
12. Holweg, Matthias, and Pil (2004) The Second Century: Reconnecting Customer and Value Chain through Build-to-Order – Moving Beyond Mass and Lean Production in the Auto Industry [↑](#footnote-ref-13)
13. Cuenca, Gaines, Vyas (1999) Evaluation of Electric Vehicle Production and Operating Costs [↑](#footnote-ref-14)
14. <https://en.autoplius.lt/> [↑](#footnote-ref-15)
15. https://ec.europa.eu/energy/data-analysis/weekly-oil-bulletin\_en?redir=1 [↑](#footnote-ref-16)
16. European Alternative Fuels Observatory (EAFO): EV Market Share of New Registrations (M1) [↑](#footnote-ref-17)
17. Fuel Cell (H2) and LPG excluded from specific user group analysis due to low market share [↑](#footnote-ref-18)
18. Company car mileage from methodology for a high mileage driver set out in the EU level report [↑](#footnote-ref-19)
19. Off-peak and public charging tariffs provided by a local market review by LVOA [↑](#footnote-ref-20)