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

***Final report** for CCA & BEUC*

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elementenergy

Element Energy Limited, Suite 1, Bishop Bateman Court, Thompson's Lane, Cambridge, CB5 8AQ UK

Tel: +44 (0)1223 852499

Executive Summary

This Cyprus report has been developed in parallel with a far-reaching EU level and eight additional European country specific reports on the total cost of ownership (TCO) for consumers from 2020-30.

Reducing passenger car CO_2 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 CO_2 targets for 2025 and 2030 are required to meet the EU's climate goals[1]. 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, as well as low & zero emission powertrains, such as plug-in hybrids (PHEVs), battery electric vehicles (BEVs) and H_2 fuel cells (FCEVs)[2]. The TCOs for different powertrains are calculated for first, second and third owners for vehicles bought new between 2020-30 in Cyprus.

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

Battery electric vehicles are just around the corner in Cyprus

In Cyprus (including purchase subsidies and tax breaks), BEVs are already the cheapest powertrain for medium cars bought today, which is illustrated in Figure 1. Small and large cars become the cheapest powertrain on a lifetime TCO basis from 2024 and 2028 respectively. Compared with EU averages (which excludes purchase subsidies and tax breaks), this is the same for small cars and two years later for large cars. While lifetime TCO may not dictate the overall mix of vehicles bought in a market, it shows the long-term cost optimal solution for consumers.

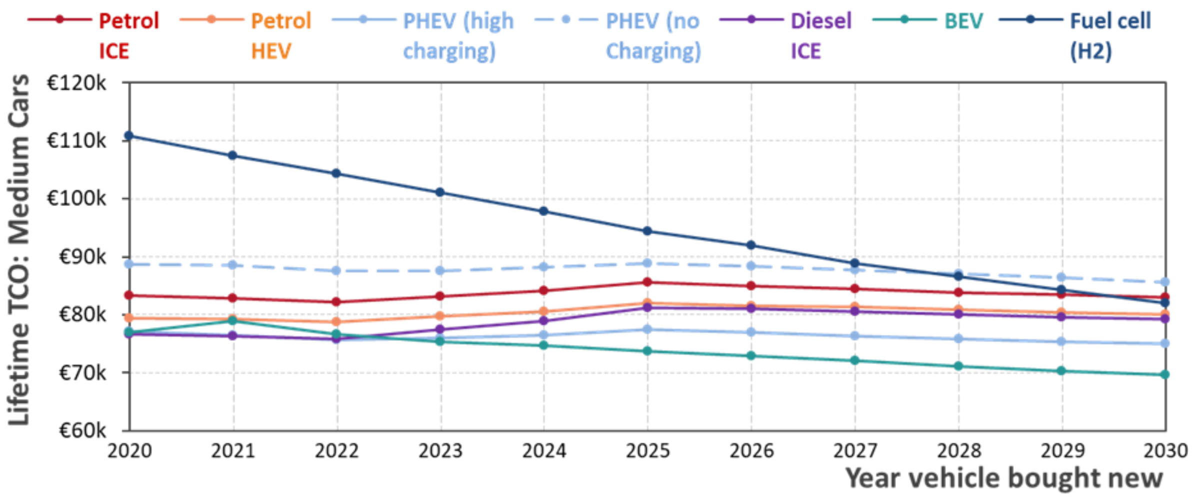

Figure 1: lifetime TCO comparison between different powertrains in Cyprus for a medium car. Year indicate when the car was originally bought new.

[1] ICCT 2021 pocketbook http://eupocketbook.org/

[2] LPG and CNG have been excluded due to low market share, very limited growth potential & OEM investment and because they achieve minimal emission reductions.

It is important that policymakers in Cyprus consider the significant benefits BEVs offer to less affluent consumers when compared to other powertrains. A medium BEV bought new today will save a total of almost €8,700 for its combined second & third owners over a Petrol ICE and achieve reductions to CO_2 tailpipe emissions, crucial for decarbonisation, while reducing the adverse health impacts from air pollution in urban areas. Tightening EU manufacturer emission targets and encouraging OEMs to sell more BEVs will benefit the least affluent consumers most by increasing the available stock of used BEVs more quickly.

Short term purchase subsidies are needed to drive BEV uptake in Cyprus

A significant barrier to BEV market growth is high upfront purchase prices driving greater depreciation costs for first owners. This is especially important as first owners determine the market stock mix and therefore the vehicles available for eventual used car buyers. Figure 2 illustrates the first owner TCO saving for a BEV compared to a Petrol ICE with and without a €5,000 purchase subsidy (which represents the now suspended subsidy that was previously available for new cars under €40,000 excluding VAT).

Without upfront subsidies, small and medium cars do not become cheaper than Petrol ICEs until 2028 and 2024 respectively, however, subsidised by a €5,000 grant, medium BEVs would already be cheaper than Petrol ICEs with small BEVs following in 2023. There is evidence to suggest that to achieve the BEV growth required to meet Cyprus's decarbonisation ambitions, purchase grants would be needed until at least 2024, which is the point when medium BEVs become cheaper for first owners without government support.

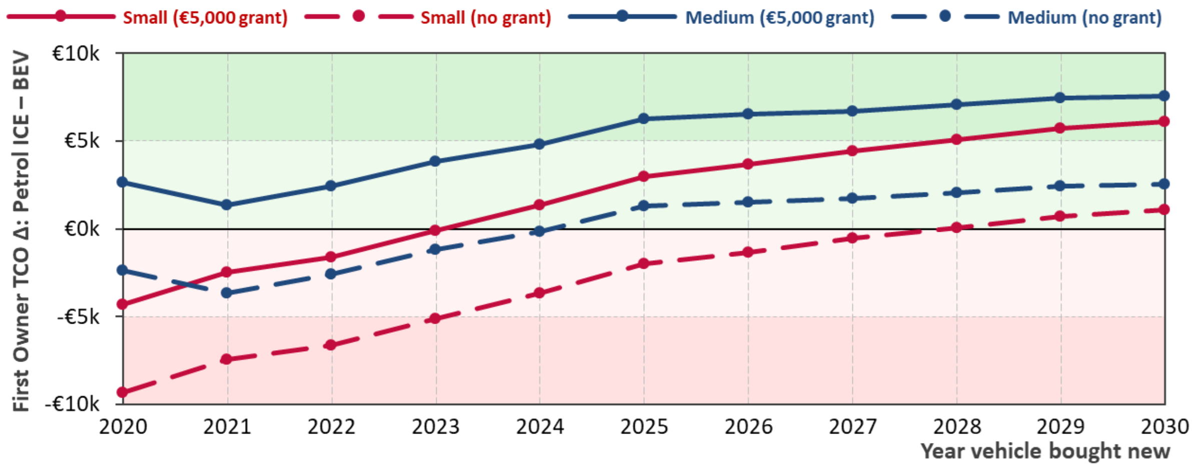

Figure 2: first owner TCO savings for a BEV over a Petrol ICE with & without a €5,000 grant

Cyprus has achieved limited BEV growth due to cheaper ICEV models

As shown in Figure 3, Cyprus 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) said in 2018 was the main reason for not buying an electric or fuel cell car[3], and additional support is needed to stimulate BEV growth and unlock the significant savings available for the eventual used car buyers. To fully eliminate growth barriers, 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 Cyprus.

[3] Transport & Environment (2018): Consumer attitudes to low and zero-emission cars

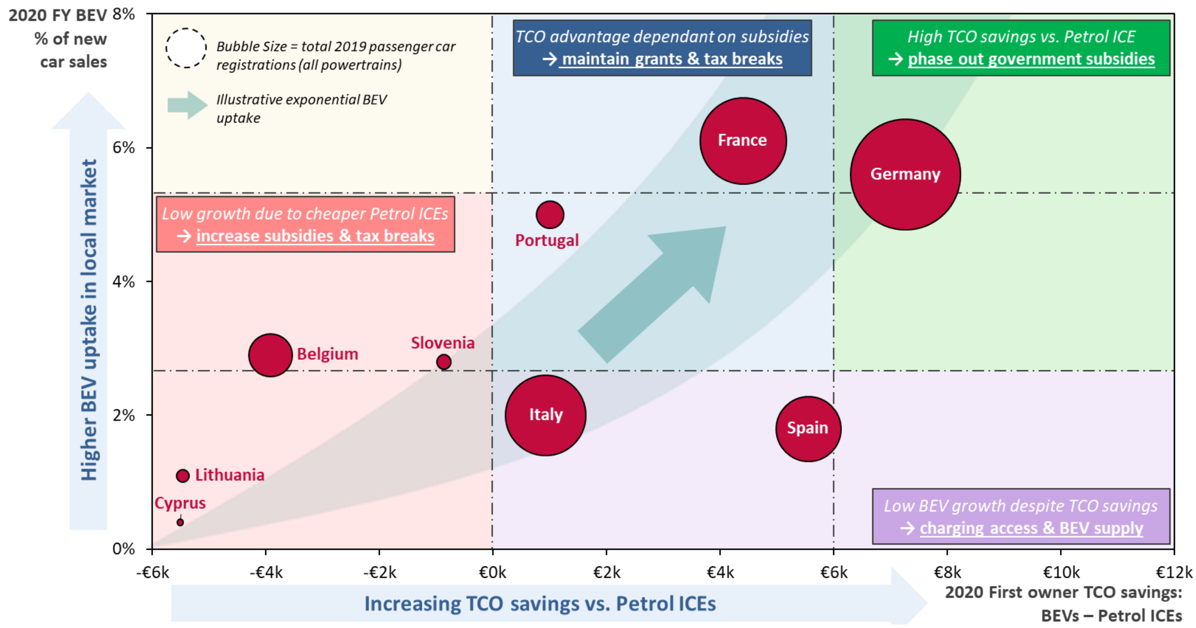

Figure 3: weighted average for small & medium cars showing BEV 2020 share of market sales vs BEV first owner Δ TCO to Petrol ICEs

Specific user groups in Cyprus provide opportunities for early BEV adoption

Sensitivities have been considered for rural users, assuming a higher average annual mileage (20,000km), this is illustrated in Figure 4, where a Nissan Leaf is compared against the lower-medium segment averages of other powertrains. The Nissan Leaf provides savings of €8,900 and €4,700 compared to a Petrol & Diesel ICE respectively over the first ownership. High mileage drivers should be a top priority group for demonstrating the benefits of switching to BEVs. This user group is the largest producer of CO_2 tailpipe emissions and also benefits most on a TCO basis.

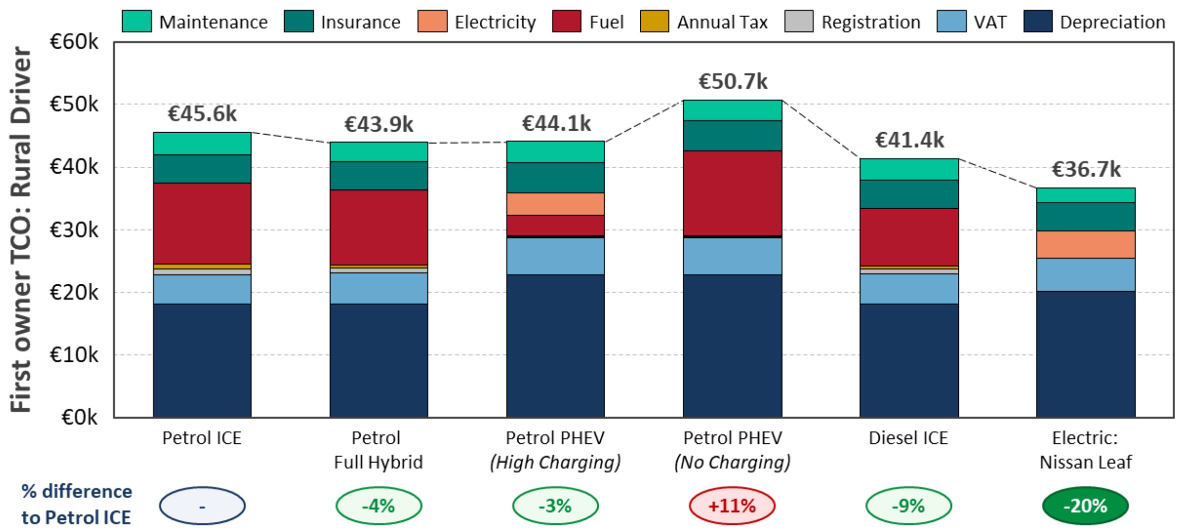

Figure 4: first owner TCOs for different powertrains for a rural car bought new in 2020. A Nissan Leaf and is compared against the lower-medium segment averages of the other powertrains

Users with access to cheaper off-peak tariffs (typically those with off-street parking access) that buy a Hyundai Kona over an equivalent Petrol ICE (SUV segment) can access 22% and 33% TCO savings for second and third owners respectively, which amounts to total savings for its used owners of €13,100.

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Authors

Laurence Peplow, Consultant

For comments or queries please contact: Laurence.Peplow@element-energy.co.uk

Reviewers

Richard Riley, Principal Consultant

David Garrick, Senior Consultant

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This study was carried out using a continuous peer review process, during which local market experts, from a number of different organisations working on automotive affairs, provided contributions. The **information and views set out in this report are those of the author(s) and do not necessarily reflect the opinions of those individuals or their organisations involved during the peer review process.**

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
SUV	Sport utility 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

1 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 Cyprus. 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.

1.1 EU Level Report

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

The future European CO_2 reduction targets are being reviewed and are expected to be made more stringent compared to the current 37.5% reduction by 2030 target for passenger cars. 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 drive 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 Cyprus-specific report provides policymakers with tailored TCO results and "real word" examples to support arguments for strengthening European CO_2 reduction targets and inform consumers in Cyprus about the opportunities from decarbonisation and associated cost savings.

1.2 Aims of this Study

This report by Element Energy was commissioned by CCA and BEUC (The European Consumer Organisation), to explore the Total Costs of Ownership (TCO) of cars sold in the 2020s in Cyprus. 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 Cyprus-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.

1.2.1 Report Structure

In Section 2, the methodology is detailed with an overview of vehicle scope and cost & performance modelling. The Cyprus-specific ongoing ownership assumptions, including differences to the EU average baseline, covering: fuel & electricity pricing, average annual mileages and taxes & subsidies, are also discussed. Cyprus 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 in the project focus. 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.

2 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.

2.1 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.

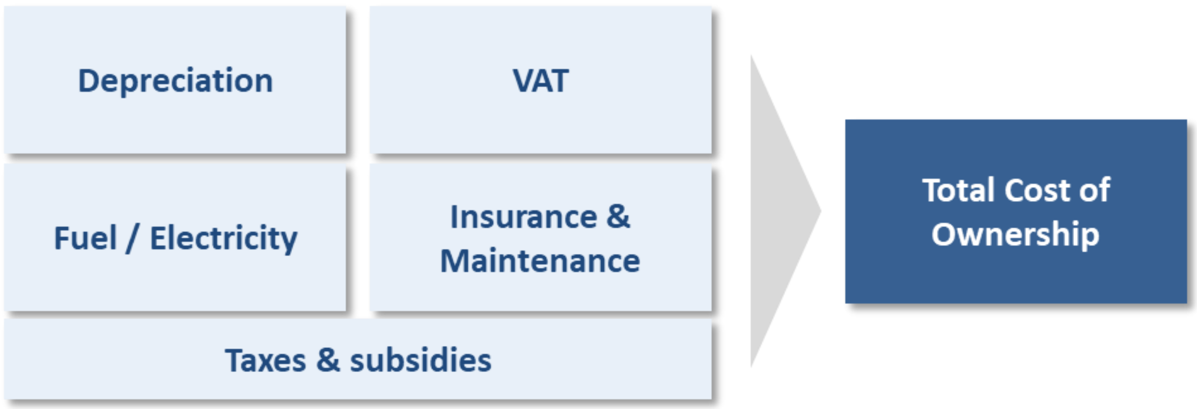


Figure 5: breakdown of the TCO cost components

2.2 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[4], 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[5]. A brief description of each powertrain is included below. Figure 6 shows a graphic representation of the powertrain components included in each powertrain.

[4] Specialist Sport and Luxury Car are excluded from the large segment, to best reflect the choice for an average consumer

[5] LPG and CNG have been excluded due to low market share, very limited growth potential & OEM investment and because they achieve minimal emission reductions.

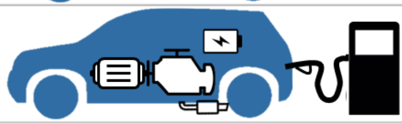
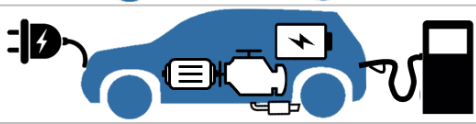
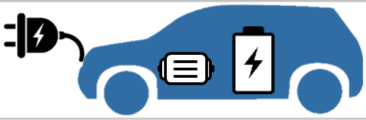
Powertrain	Components and energy sources
ICE	
HEV	
PHEV	
BEV	
H_2 Fuel Cell	

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[6], 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[7]), and for PHEVs which are never charged, and therefore drive under ICE power at all times. Please note that an additional “low charging” scenario is included in the EU-level report.

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.

[6] Transport & Environment (2020) Plug-in hybrids: Is Europe heading for a new Dieselgate?
[7] UN/ECE Regulation 101, Annex 8, pg. 74 https://www.unece.org/fileadmin/DAM/trans/main/wp29/wp29regs/r101r2e.pdf [Accessed 12/03/2021]

H_2 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 power an electric motor.

2.3 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.

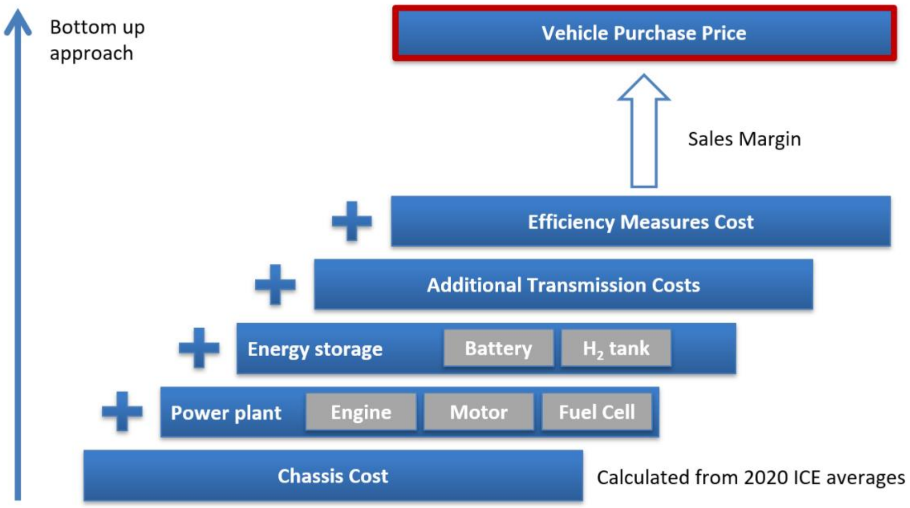


Figure 7: outline of the methodology applied in the Cost and Performance Model

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[8].

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.

[8] Ricardo-AEA. Improving understanding of technology and costs for CO_2 reductions from cars and LCVs in the period to 2030 and development of cost curves. 2016.

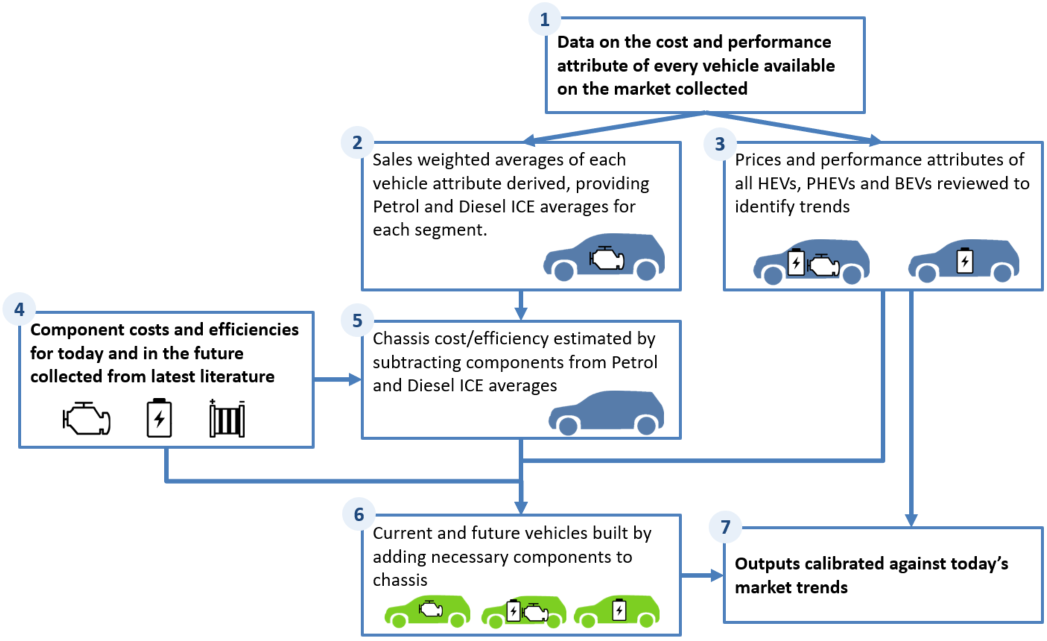


Figure 8: overview of steps taken to construct future vehicles. Numbers indicate modelling order.

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[9,10,11,12] 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 Cyprus-specific pricing modelled using data gathered from a local vehicle website and additional data provided by CCA. 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.

[9] Roland Berger (2014) Global Automotive Supplier Study
[10] KPMG (2013) Automotive Now, Trade in crisis
[11] 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
[12] Cuenca, Gaines, Vyas (1999) Evaluation of Electric Vehicle Production and Operating Costs

2.4 Ongoing Ownership Assumptions

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

2.4.1 Fuel and Electricity Projections

Historic Cyprus fuel prices (ex VAT and fuel duty) were sourced from the European Commission's Weekly Oil Price Bulletin[13] 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). Adjustments were made to 2020 Petrol and Diesel prices based on local market data provided by CCA.

2020 domestic electricity prices were taken from Eurostat. The wholesale, network, CO_2 and tax cost components were then projected forward using the same electricity price scenario used at an EU level. Full fuel and electricity pricing assumptions are detailed in Appendix 6.1.

2.4.2 Ownership Periods & Average Annual Mileage

CCA review, based on local market garage data, showed that annual mileages in Cyprus are around 20% below EU averages. We have assumed mileages of 12,000km, 10,500km & 9,000km for the first (6 years), second (6 years) and third ownerships (7 years) respectively. Ownerships periods have been assumed to be longer than EU averages and were agreed based on a CCA local market review.

2.4.3 Taxes and Subsidies

Engine power and CO_2 registration tax components and annual car tax are based on values from the ACEA tax guide[14]; complete assumptions are detailed in Appendix 6.2. Please note that no purchase subsidies are applied for electric vehicles. A VAT rate of 19% is applied for both new and used cars.

[13] https://ec.europa.eu/energy/data-analysis/weekly-oil-bulletin_en?redir=1
[14] ACEA (2020) Tax Guide

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

3.1 Cyprus TCO Results

This sub-section looks at: (A) the lifetime (19 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 (6 years), which are especially important as they dictate the long-term market stock. Equivalent graphs detailing the second (6 years) and third ownerships (7 years) can be found in Appendix 6.3.

3.1.1 Lifetime TCO

Figure 9 compares the TCOs between different powertrains on a total lifetime basis. Each data point illustrates the TCO over the 19-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 are already the cheapest powertrain for medium cars bought today, and will become the cheapest option for small and large cars in 2024 and 2028 respectively. This is in line with EU averages (excluding taxes and subsidies) for small cars and two years later for large cars. This is driven by annual tax breaks for BEVs being outweighed by the impact of less expensive ICEVs, which are about 10% cheaper than EU averages, and lower petrol prices, which reduce the long term running savings offered by BEVs.

It should be noted that the introduction of Euro VII requirements between 2022-24 has a significant impact on petrol and diesel lifetime TCOs because VAT is paid on these capital costs three times. 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 maximise the supply of BEVs in the market stock to unlock the substantial benefits to consumers in the used market.

With no charging, Petrol PHEVs become significantly more expensive, providing worst financial value out of any powertrain on a lifetime TCO basis. This is particularly important for second and third owners, who are less likely to have access to off-street parking, and will be more impacted by significantly higher running costs, providing an additional risk to consumer equity. Furthermore, policymakers have little control over PHEV charging after the vehicle is purchased.

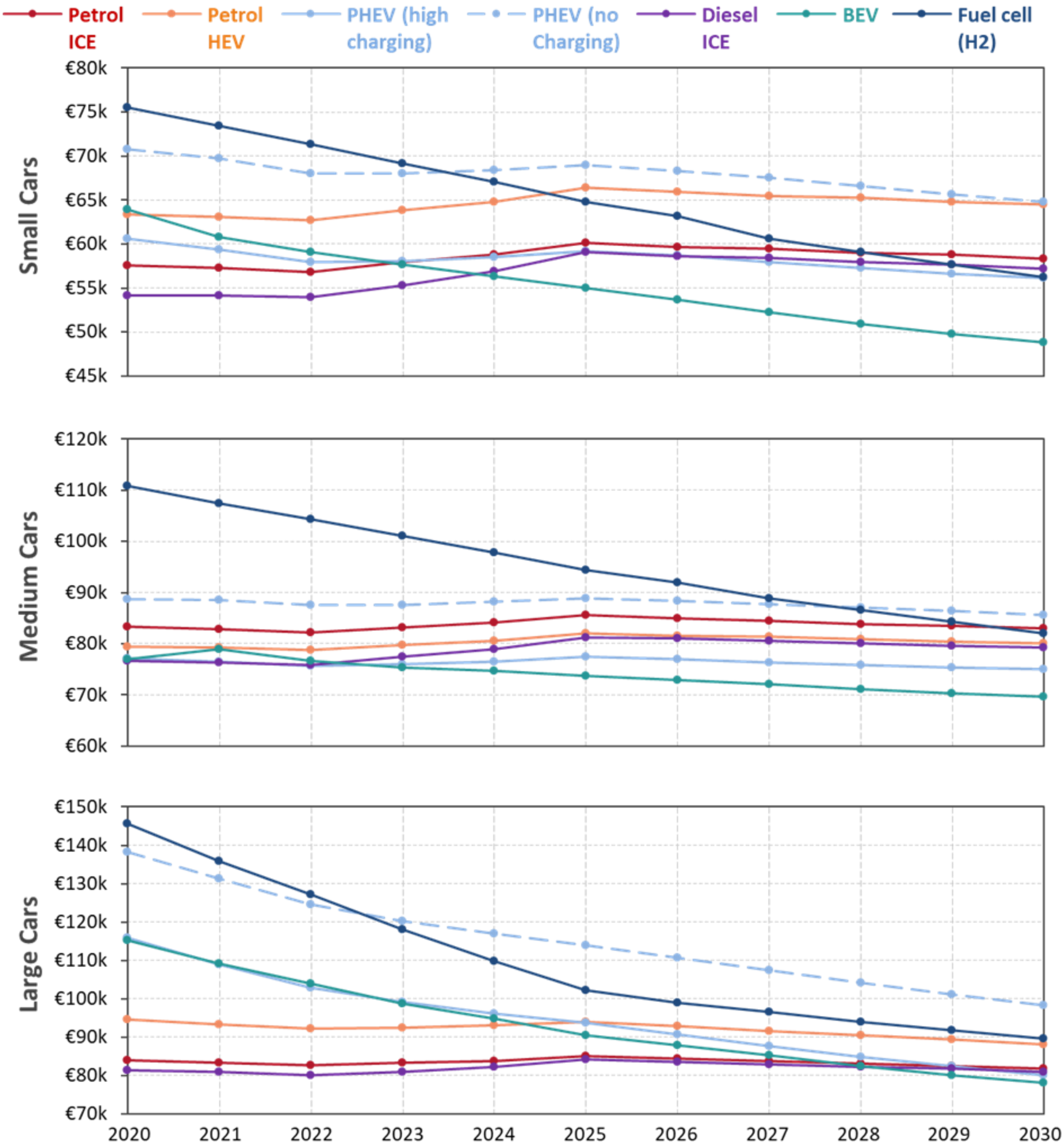


Figure 9: lifetime TCO comparison between different powertrains. Note that the year indicates when the car is first bought new.

3.1.2 First Owner TCO

Although BEVs provide significantly better value for second and third owners, it is especially important to consider the first ownership as this impacts new buyer purchasing decisions, which in turn determines the long-term market stock. 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 will become the cheapest powertrain on a TCO basis for small and medium car sizes by 2028, which is three years behind EU averages (excluding taxes and subsidies), with large cars cheapest in 2030, four years behind the EU baseline case.

Less expensive ICEVs, which are ca. 15% cheaper for small and 5% cheaper for medium cars than EU averages, decrease depreciation costs, the most important cost component for first owners. Further government support may be required to reduce price differentials between BEVs and ICEVs in order to boost the market stock and unlock future savings for eventual BEV used owners. Note the slight increase to costs for medium BEVs in 2021 is due to models with larger battery sizes entering the market.

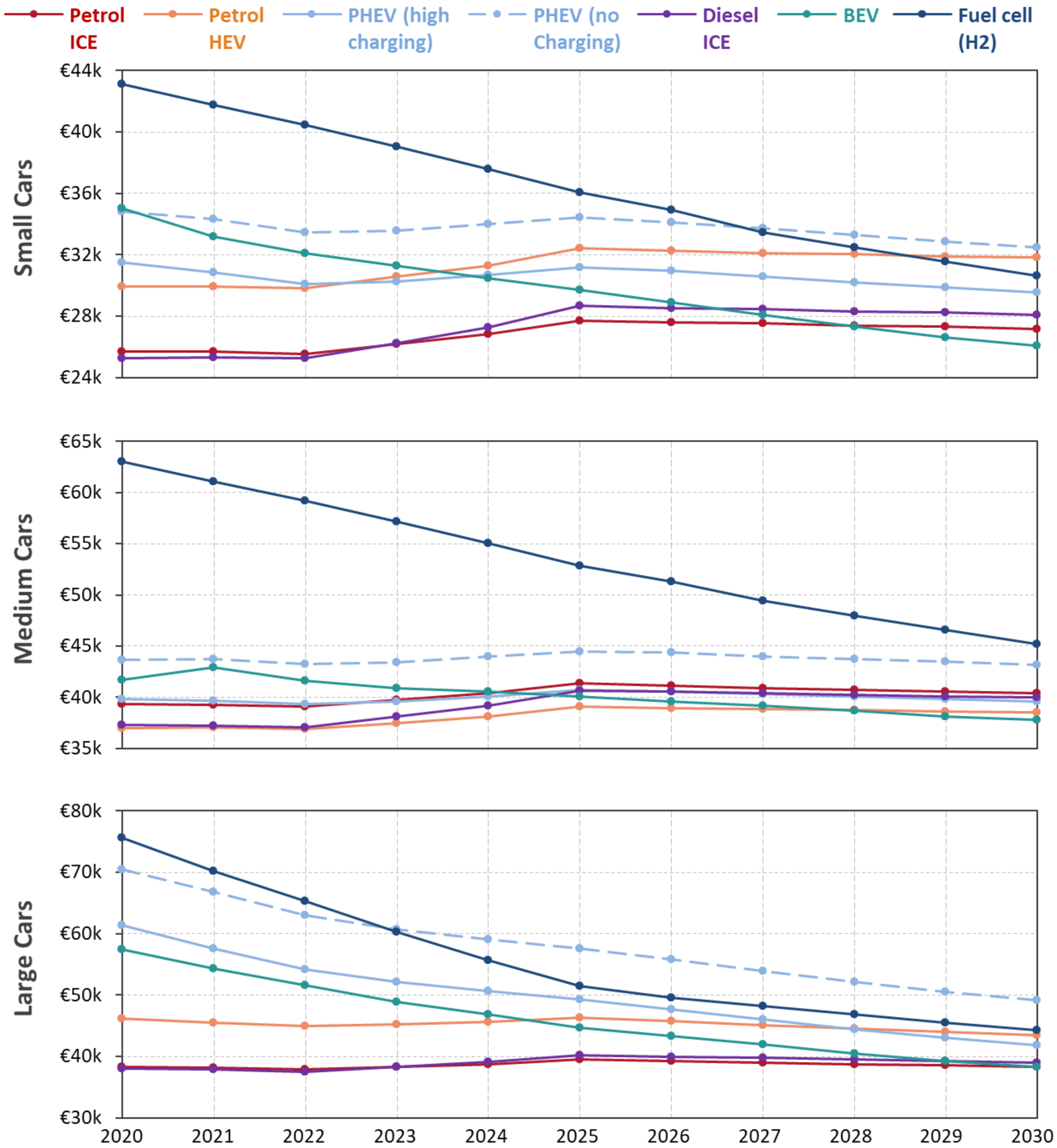


Figure 10: first owner TCO comparison between different powertrains. Note that the year indicates when the car is first bought new.

Figure 11 illustrates the first owner TCO saving for a BEV over a Petrol ICE with and without a €5,000 purchase subsidy. Purchase subsidies for BEVs have historically been available in Cyprus, with a

€5,000 subsidy briefly available for vehicles under €40,000 (excluding VAT), however, this scheme has been suspended and its future is uncertain. Without upfront subsidies small and medium cars do not become cheaper than Petrol ICEs until 2028 and 2024 respectively, however, subsidised by a €5,000 grant, medium BEVs would already be cheaper with small BEVs following in 2023. There is evidence to suggest that to achieve the BEV growth required to meet Cyprus's decarbonisation ambitions, purchase grants would be needed until at least 2024, which is the point when medium BEVs become cheaper for first owners without government support.

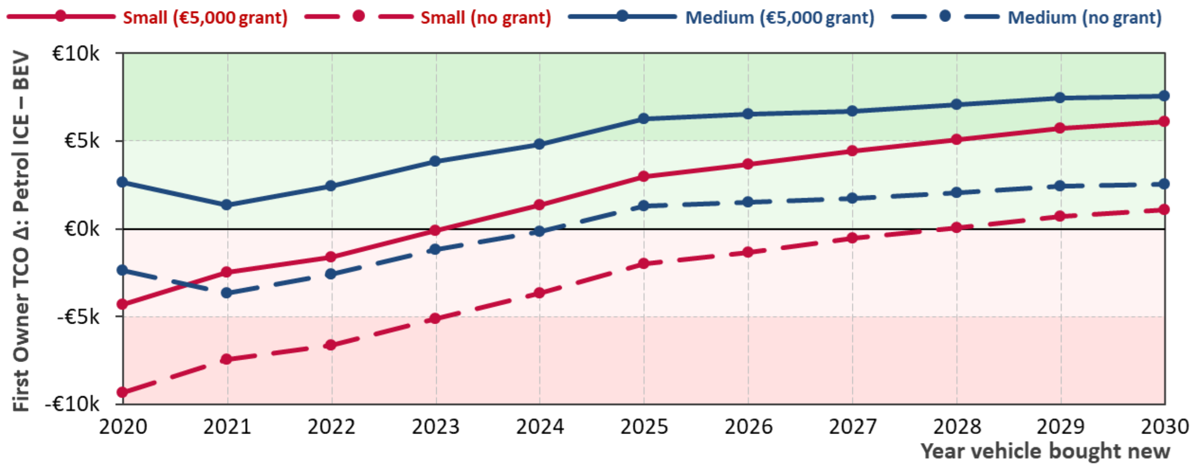


Figure 11: first owner TCO savings for a BEV over a Petrol ICE with & without a €5,000 grant

3.1.3 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, with a BEV currently costing €2,400 more than a Petrol ICE on a TCO basis. This presents a barrier to BEV uptake and delays unlocking substantial savings for second and third owners. The 2020 first owner TCO for PHEVs varies by around €3,800 depending on charging behaviour and, if a PHEV is not charged at all, representative of some consumers that do not have access to home charging or use a fuel card instead of charging, PHEVs will cost over €1,900 more than a BEV for first owners.

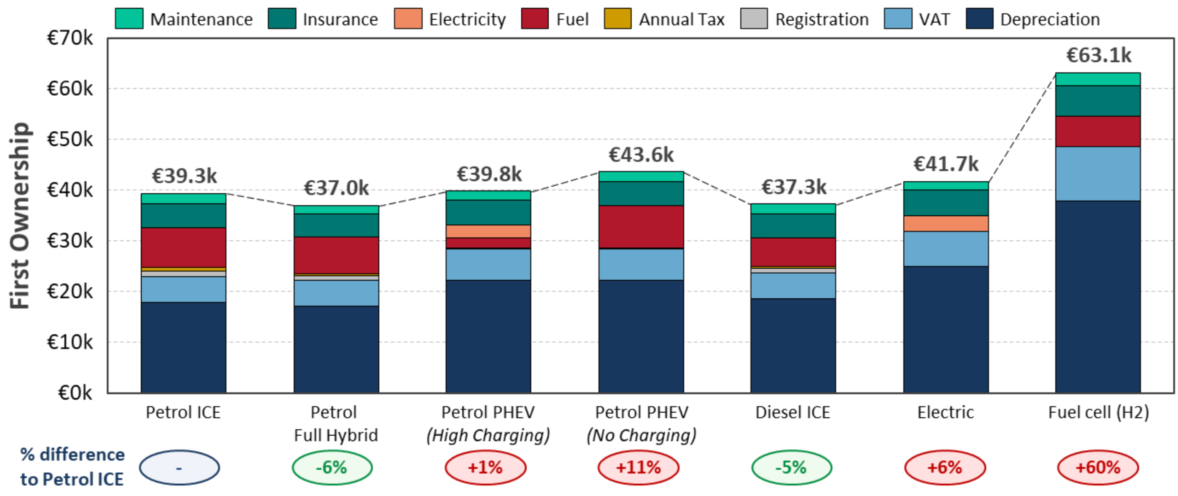


Figure 12: first owner TCOs for different powertrains for a medium car bought new in 2020

Second Owners

As shown in Figure 13, for a second-hand medium car that was originally bought new in 2020 (and therefore bought by the second owner in 2026), depreciation makes up a smaller proportion of the overall TCO, with variation between vehicle powertrains driven largely by differences in fuel/electricity costs. A medium BEV, originally bought new in 2020, will provide a €2,900 saving for its second owners over a Petrol ICE, which amounts to a 13% TCO saving.

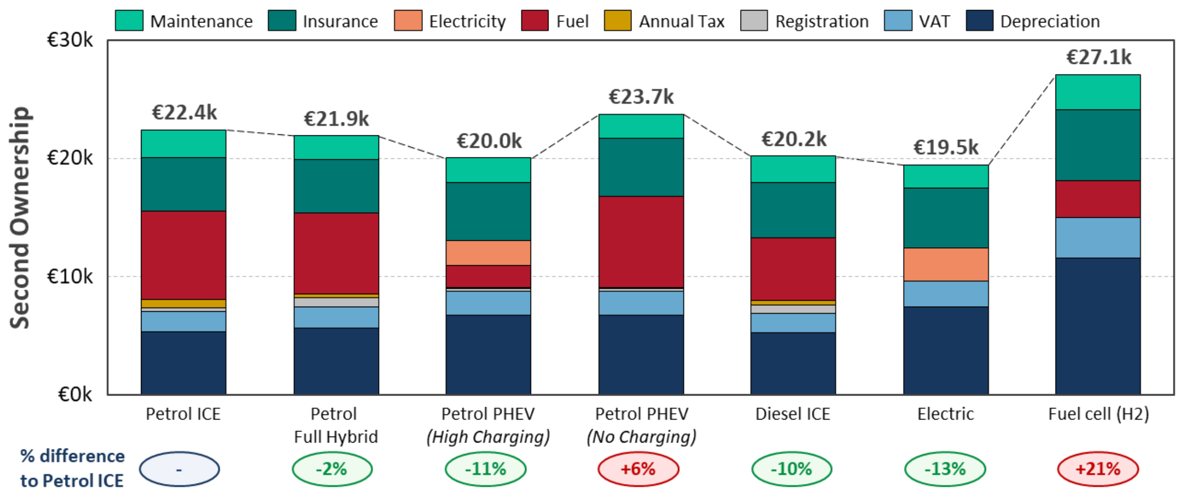


Figure 13: second owner TCOs for different powertrains for a medium car bought new in 2020

Third Owners

A third-hand medium car that was originally bought new in 2020 (bought by third owner in 2032) is shown in Figure 14. Once different powertrains have significantly depreciated, running costs determine TCO savings vs. the Petrol ICE baseline. BEVs offer best value to consumers, with €5,800 and €3,400 savings against 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 €8,700 over the lifetime of the car. This shows that tightening European emission standards, thereby encouraging OEMs to promote earlier BEV adoption, will most benefit the least affluent consumers.

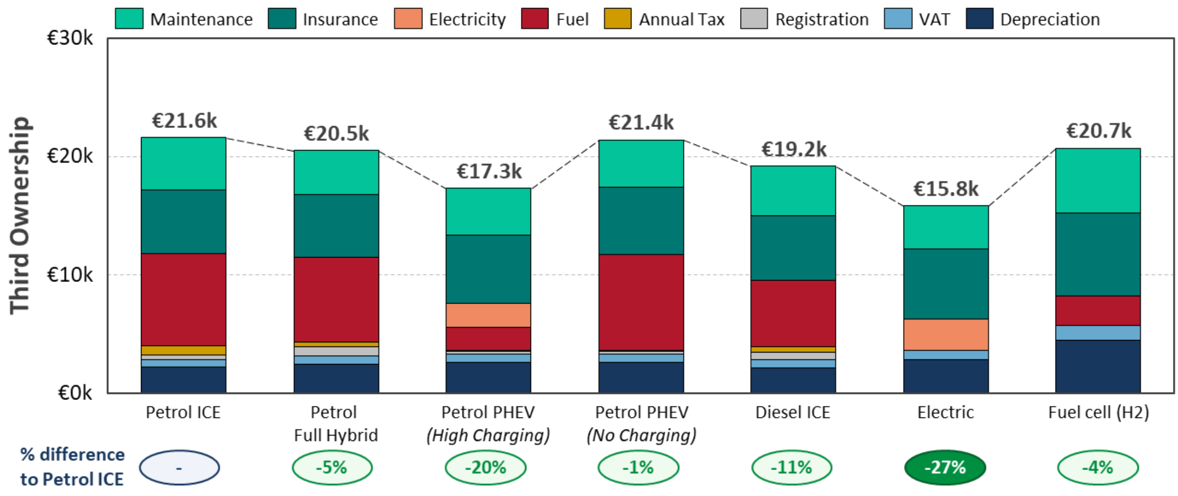


Figure 14: third owner TCOs for different powertrains for a medium car bought new in 2020

3.2 Cyprus compared to other European Focus Markets

For each of the nine European countries assessed in this study, the 2020 first owner TCO difference between BEVs and Petrol ICEs is plotted against current BEV sales[15] in Figure 15. There is a broad exponential correlation between Δ first owner TCO 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, Cyprus has experienced limited growth due to Petrol ICEs (without the upfront purchase subsidies for BEVs seen in other markets) currently being significantly cheaper than BEVs for first owners. Further government support is required to ensure to reduce the price differential and promote first owner BEV uptake.

[15] European Alternative Fuels Observatory (EAFO): EV Market Share of New Registrations (M1)

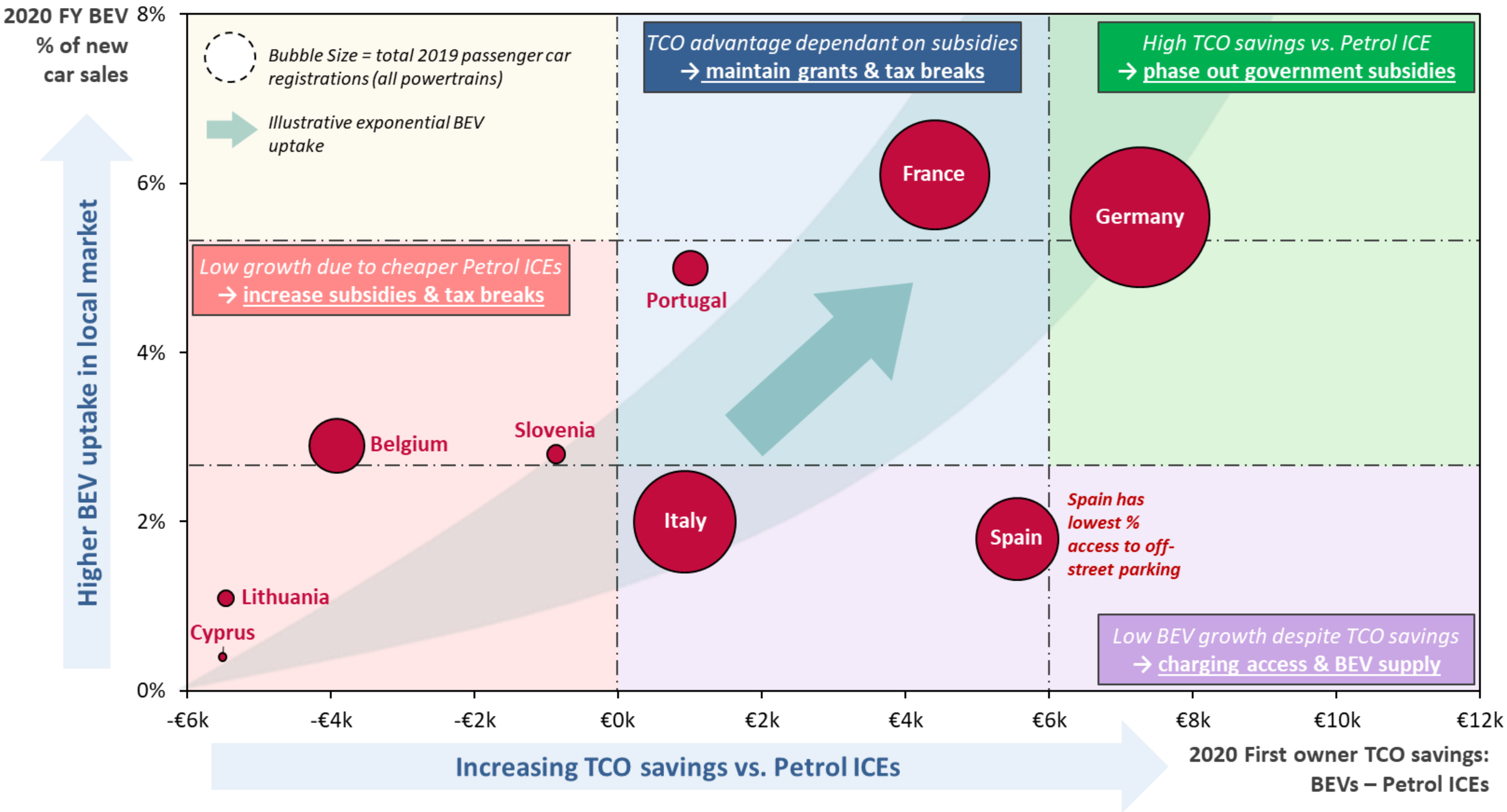


Figure 15: weighted average for small & medium cars showing BEV 2020 share of market sales vs BEV first owner Δ TCO to Petrol ICEs

4 Cyprus Specific User Groups

There is high variation in the driving behaviour and needs of consumers, and the TCOs different powertrains offer 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 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.

4.1 Rural and City Driver Sensitivity

Figure 16 shows the inputs parameters that test a sensitivity for rural and city drivers. Rural drivers were assumed to have a higher annual mileage and access to off-peak charging, with city drivers having a lower annual mileage. Based on discussions with market experts at CCA, the Nissan Leaf was chosen as the representative model for this sensitivity and is compared to lower-medium car (ACEA segment C) averages for the other powertrains. This sensitivity was considered for first owners only.

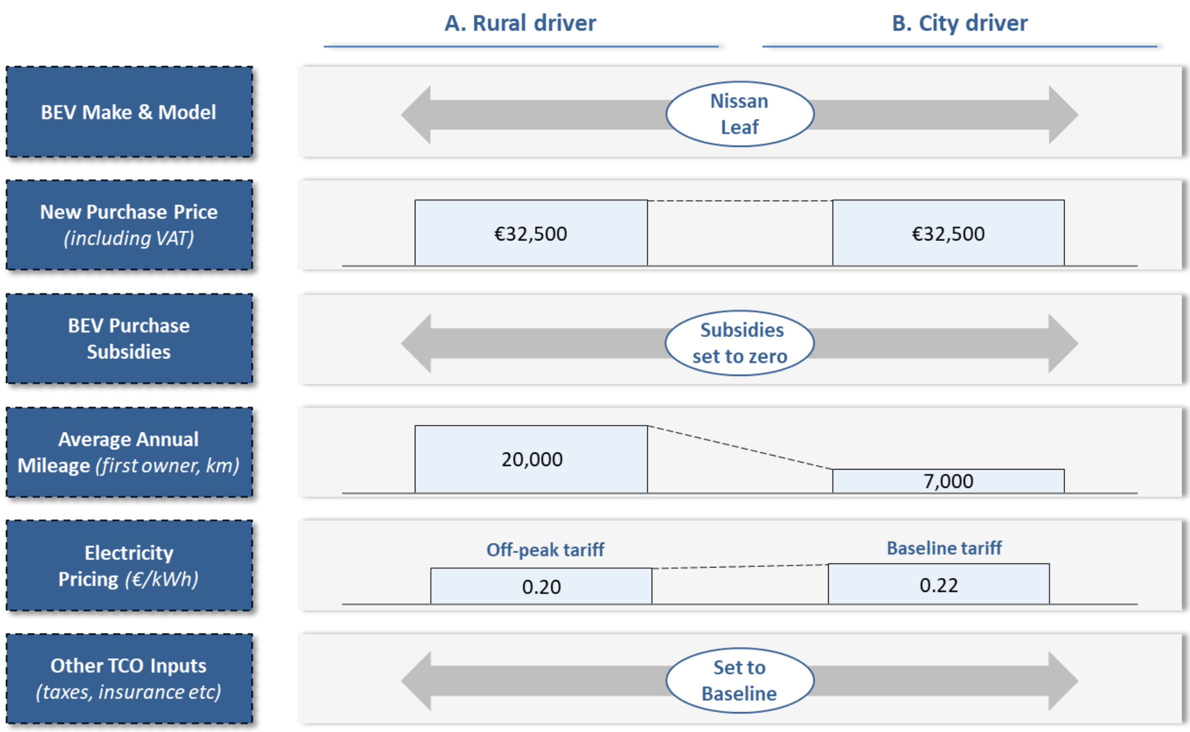


Figure 16: inputs parameters for rural and city specific user groups

The first owner TCO results for a new car bought in 2020 for this sensitivity are shown in Figure 17. For a rural driver, the Nissan Leaf provides consumers with savings over a Petrol and Diesel ICE of €8,900 and €4,700 respectively. This means that with appropriate financing options, a Nissan Leaf could provide these consumers with significant savings from day one. High mileage drivers, such as rural consumers, 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 CO_2 tailpipe emissions. Indeed, even for a lower mileage scenario, the Nissan Leaf still provides savings on a TCO basis for first owners over an equivalent Petrol ICE of €2,300.

In these scenarios, the Nissan Leaf is cheaper for first owners than other powertrains, although medium BEVs on average do not become the cheapest powertrain until 2024 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. This provides an opportunity of early BEV adoption for a mass market that buys smaller and cheaper vehicles and it is crucial for more mainstream BEV models, which have historically been limited, be made available for consumers by OEMs.

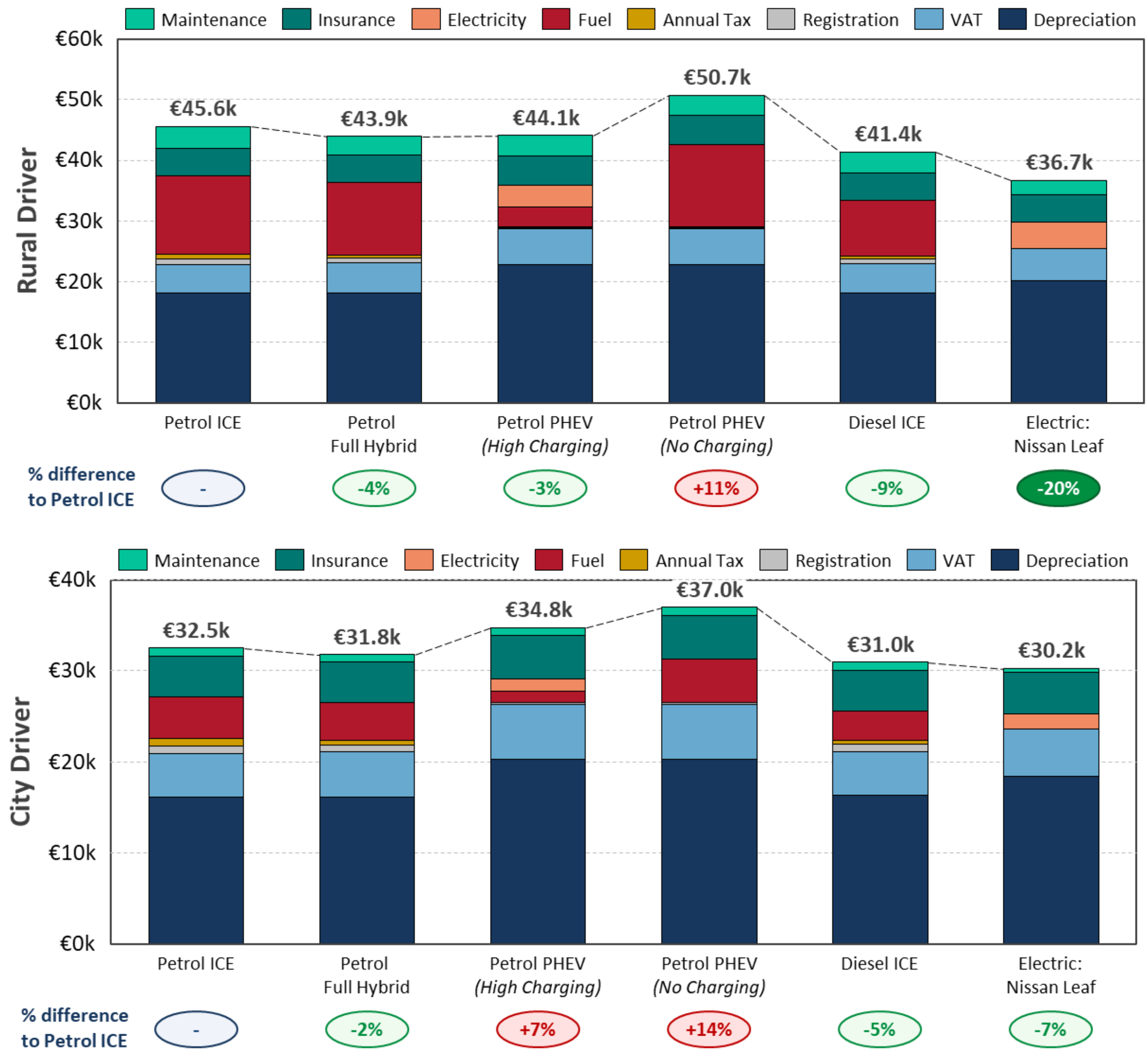


Figure 17: first owner TCOs for different powertrains for a medium car bought new in 2020 for rural and city specific user groups

4.2 Off-Peak & Public Charging Sensitivity

Figure 18 shows the input parameters for a scenario considering off-peak[16] and public charging tariffs. The Hyundai Kona was used as the representative model for this sensitivity, which is compared to SUV segment averages for the other powertrains. Public charging tariffs were assumed to be around 50% higher than domestic tariffs, in line with an Element Energy review of fast charging (11-22kW) tariffs across the EU. It is important to note that public charging is currently subsidised by the Cyprus Electricity Authority (with cheaper prices estimated at 0.18 €/kWh available to consumers), however, as this is likely to be reviewed in the short term, a higher public charging tariff has been used in this study.

[16] Off-peak tariffs provided by a local market review by CCA

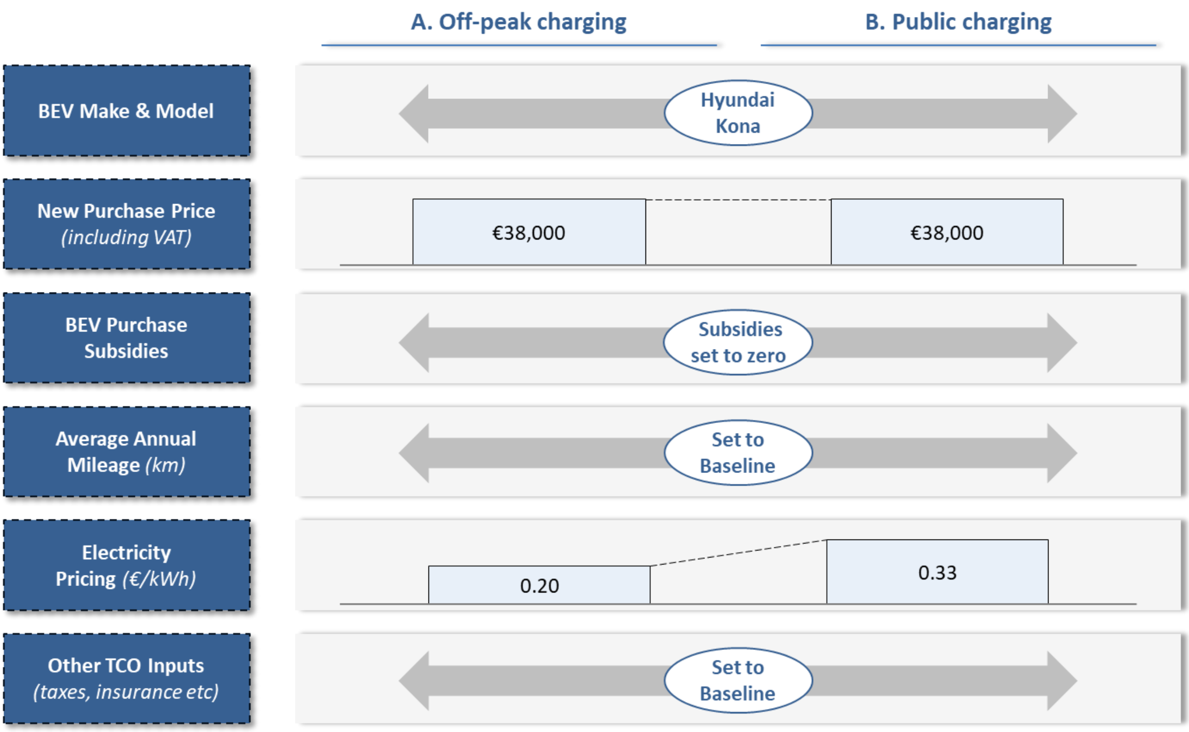


Figure 18: inputs parameters for off-peak and public charging sensitivities

Figure 20 (on the following page) shows the first owner TCO results for consumers using off-peak and public charging for a new car bought in 2020. Note: additional graphs for second and third owners are provided in Appendix 6.3.5 and 6.3.6. The Hyundai Kona provides first owners with access to cheaper off-peak tariffs, usually those with off-street parking access, which is typical of suburban or rural drivers, with 18% TCO savings compared to a Petrol ICE, which amounts to savings of €7,000. However, even when relying on more premium public charging tariffs, the Kona still provides a €5,500 saving vs. a Petrol ICE. It should be noted that SUVs is a broad and growing segment, and direct comparison between different powertrains is challenging, for example, Petrol PHEVs are significantly more expensive on a TCO basis due a greater mix of large, high specification models. Figure 19 shows that savings for both charging scenarios significantly increase for used car buyers, with the Kona saving third owners 33% and 28% over a Petrol ICE for off-peak & public charging respectively.

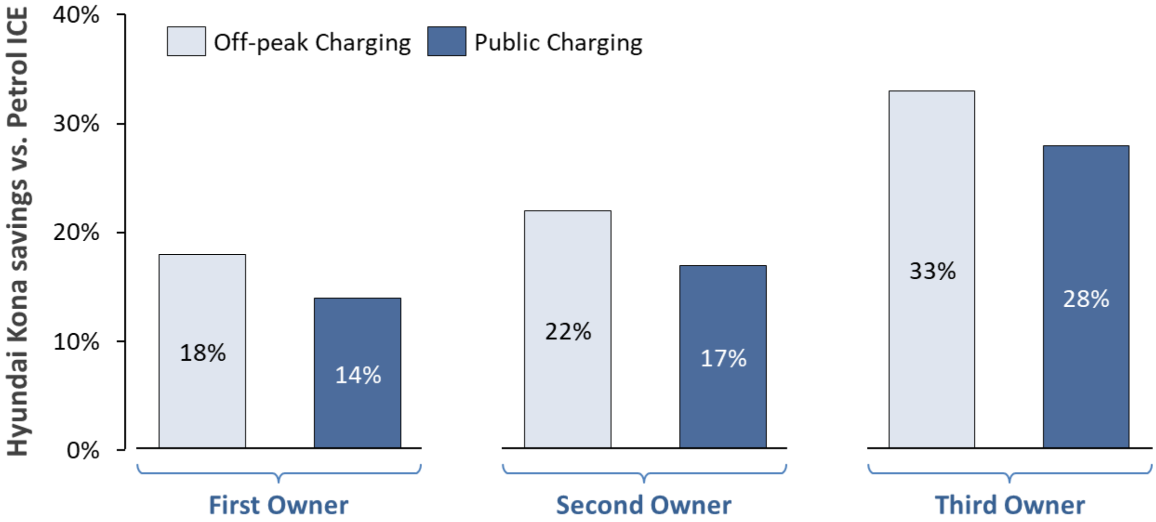


Figure 19: Hyundai Kona TCO savings vs. equivalent Petrol ICE (SUV segment)

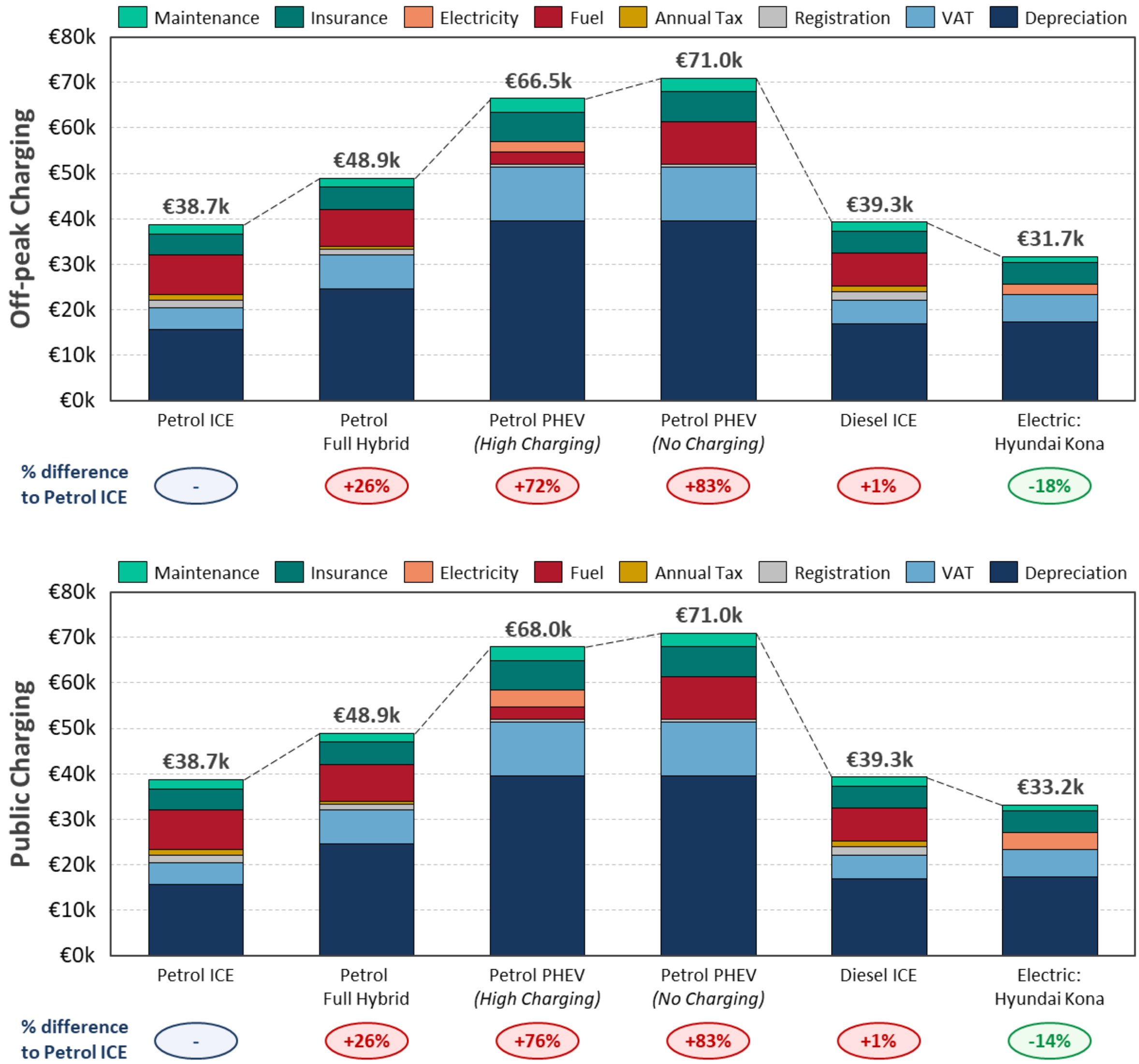


Figure 20: first owner TCOs for different powertrains for a medium car bought new in 2020 for off-peak and public charging specific user groups

5 Conclusions

This study has assessed forecast TCOs for different powertrain cars in Cyprus 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 Cyprus consumers as well as policymakers responsible for leading the decarbonisation transition.

BEVs are already the cheapest powertrain for medium cars bought today and will become the cheapest option for small and large cars in 2024 and 2028 respectively. This is in line with EU averages (but excluding taxes and subsidies) for small cars and two years later for large cars than EU averages.

BEVs offer most savings to less affluent consumers. A medium BEV bought new today will save a total of almost €8,700 for its second & 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 standards, which is the most effective mechanism to encourage OEMs to sell more BEVs, 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, risk being impacted by higher running costs. It is important to view Petrol PHEVs as a risk to consumer uptake of BEVs rather than a “stepping stone” to fully electric vehicles in the decarbonisation transition. Government investment and European policy is better targeted at ensuring the wide-spread uptake of BEVs.

Reintroduction of short-term BEV purchase subsidies is needed to meet Cyprus’ decarbonisation ambitions

BEV growth in Cyprus has fallen behind other European focus markets, many of which have stimulated BEV growth through upfront purchase subsidies. In Cyprus, without upfront subsidies, small and medium cars will not become cheaper than Petrol ICEs until 2028 and 2024 respectively, however, with a €5,000 grant (which was previously available to consumers in Cyprus but has now been suspended), 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 Cyprus’s decarbonisation ambitions, purchase grants would be needed until at least 2024, which is the point when medium BEVs become cheaper for first owners without government support.

While providing a purchase subsidy is advised until at least 2024, 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, which is expected to happen in in Cyprus by the mid-to-late 2020s. While subsidies remain, there is a risk that OEMs may keep BEV prices artificially high, which would limit additional savings made available for consumers. It is important that policymakers in Cyprus find a balance between encouraging earlier BEV adoption, while making sure that investment is targeted where most needed in maximising electromobility, and, in particular, does not compromise the immediate roll out of charging infrastructure.

Removing key barriers to BEV uptake in Cyprus

It is essential that policymakers address the two most important barriers to BEV consumer uptake: (1) access to reliable and affordable charging (2) adequate OEM supply of BEV models. Supply is a particularly important risk in Cyprus, for example, there is no Tesla dealership currently in Cyprus, which means that consumers need to reply on imports and may even have to send their car abroad for repairs[17]. This presents a risk to early BEV adoption as the European market moves to fully electric.

While strengthening manufacturer emission 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 and 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. Continued investment in Cypris through schemes including the Fund for Renewable Energy Sources (RES) and the Energy Saving Fund, announced in October 2020, that subsidises charging points and smart meters at homes, will be essential to achieve Cyprus' decarbonisation ambitions.

Specific user groups: opportunities to maximise BEV consumer benefits in Cyprus

There are many 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 rural user (annual mileage of 20,000km), where the BEV model is assumed to be a Nissan Leaf. First owner rural drivers can access savings of €8,900 over an equivalent Petrol ICE, and tailpipe CO_2 savings 66% higher than for an "average first owner" (annual mileage of 12,000km) that switches to a BEV. This user group benefits the most on a TCO basis while driving the highest savings of CO_2 tailpipe emissions, and therefore, must be considered a top priority group for policymakers to ensure early adoption of BEVs. 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.

Access to cheaper off-peak charging tariffs has a significant impact on the savings available for consumers that switch to a BEV; this is especially important for used-car buyers, where running costs become the most dominant TCO cost component. Indeed, analysis of a Hyundai Kona with off-peak charging access, bought new in 2020, indicates that it will save its eventual second and third owners 22% and 33% on a TCO basis compared to an equivalent Petrol ICE (SUV segment). 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 in managing peak loads, while allowing consumers to access additional savings.

[17] https://cyprus-mail.com/2020/08/14/tesla-in-cyprus/

6 Appendix

6.1 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.

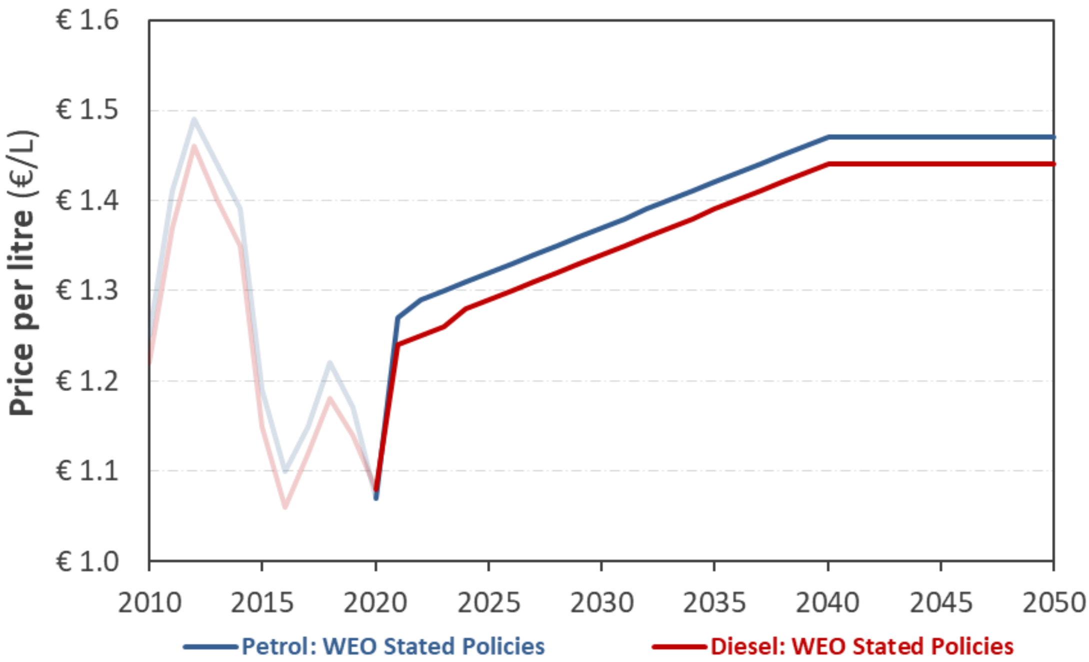


Figure 21: petrol & diesel price forecasting between 2020-50

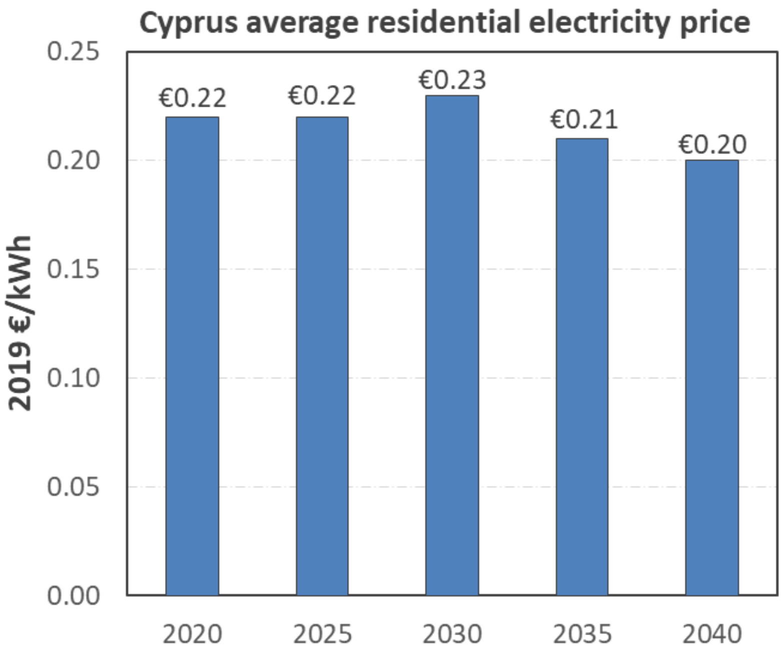


Figure 22: electricity price forecasting between 2020-40

6.2 Taxes & Subsidies

Table 1: registration fee – engine power component

Engine capacity (cc)	Registration fee (€/cc)
≤1,450	0.17
1,451-1,650	0.26
1,651-2,050	0.43
2,051-2,250	0.51
2,251-2,650	1.03
>2,650	1.03

EVs & Fuel Cell (H2) assumed exempt. 15% reduction for vehicles that emit less that 150g CO_2/km. Paid on each purchase by first, second & third owners

Table 2: registration fee – CO_2 based component

CO_2 emissions per km	Fixed fee (€)	€/g CO_2 > lower bound
<120	-	-
120 – 150	-	25
150 – 180	750	50
>180	2250	400

EVs & Fuel Cell (H2) assumed exempt. Paid by first owners only.

Table 3: annual road tax – CO_2 based

CO_2 emissions per km	Fixed fee (€)	€ / g CO_2 > lower bound
<120	0	0.5
120 – 150	60	3
150 – 180	150	6
>180	330	8

EVs & Fuel Cell (H2) assumed exempt.

6.3 Additional TCO Results

6.3.1 Second Owner TCOs

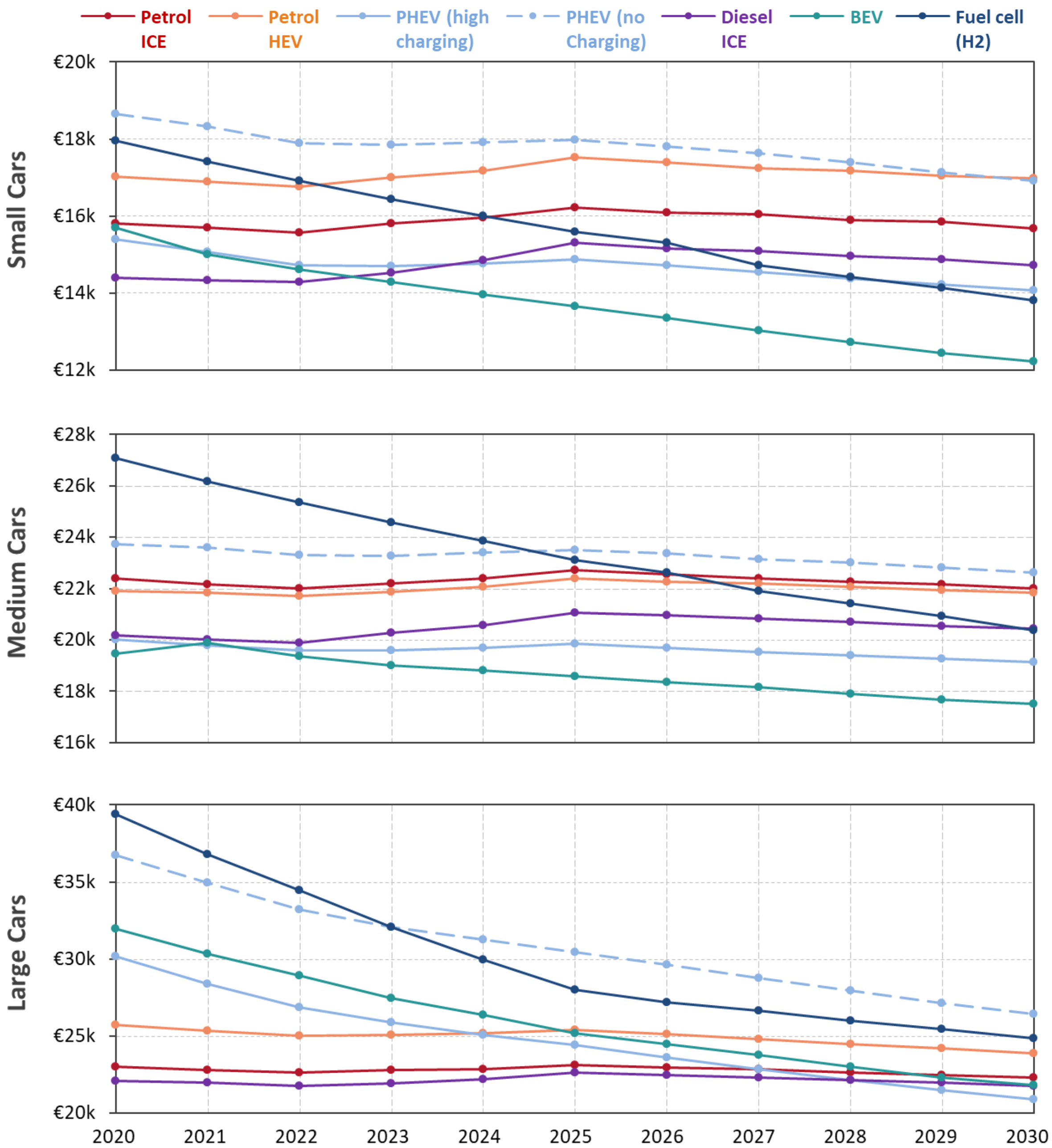


Figure 23: second owner TCO comparison between different powertrains. Note that the year indicates when the car is first bought new

6.3.2 Third Owner TCOs

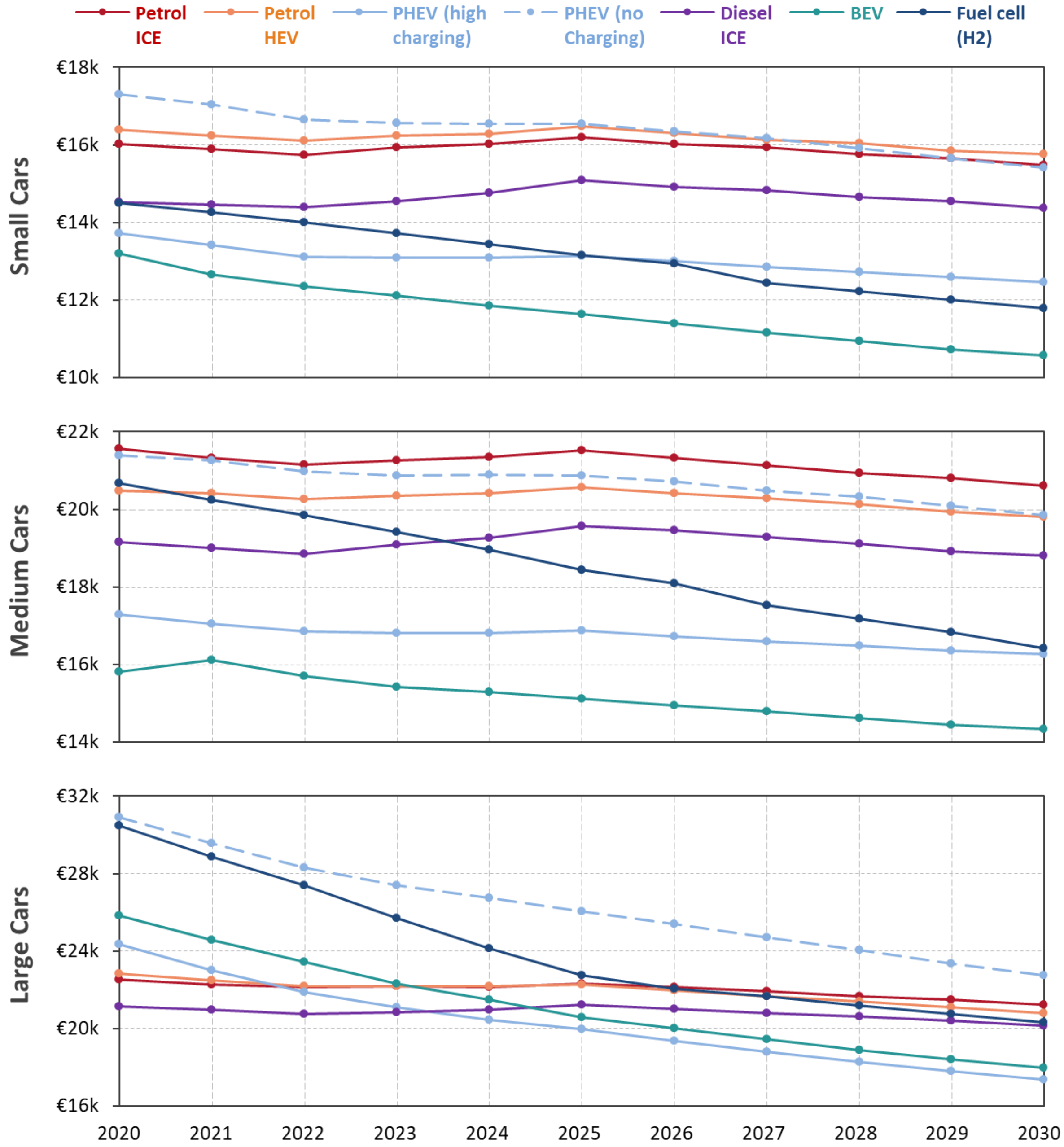


Figure 24: third owner TCO comparison between different powertrains. Note that the year indicates when the car is first bought new

6.3.3 Medium Car Cost Components 2025

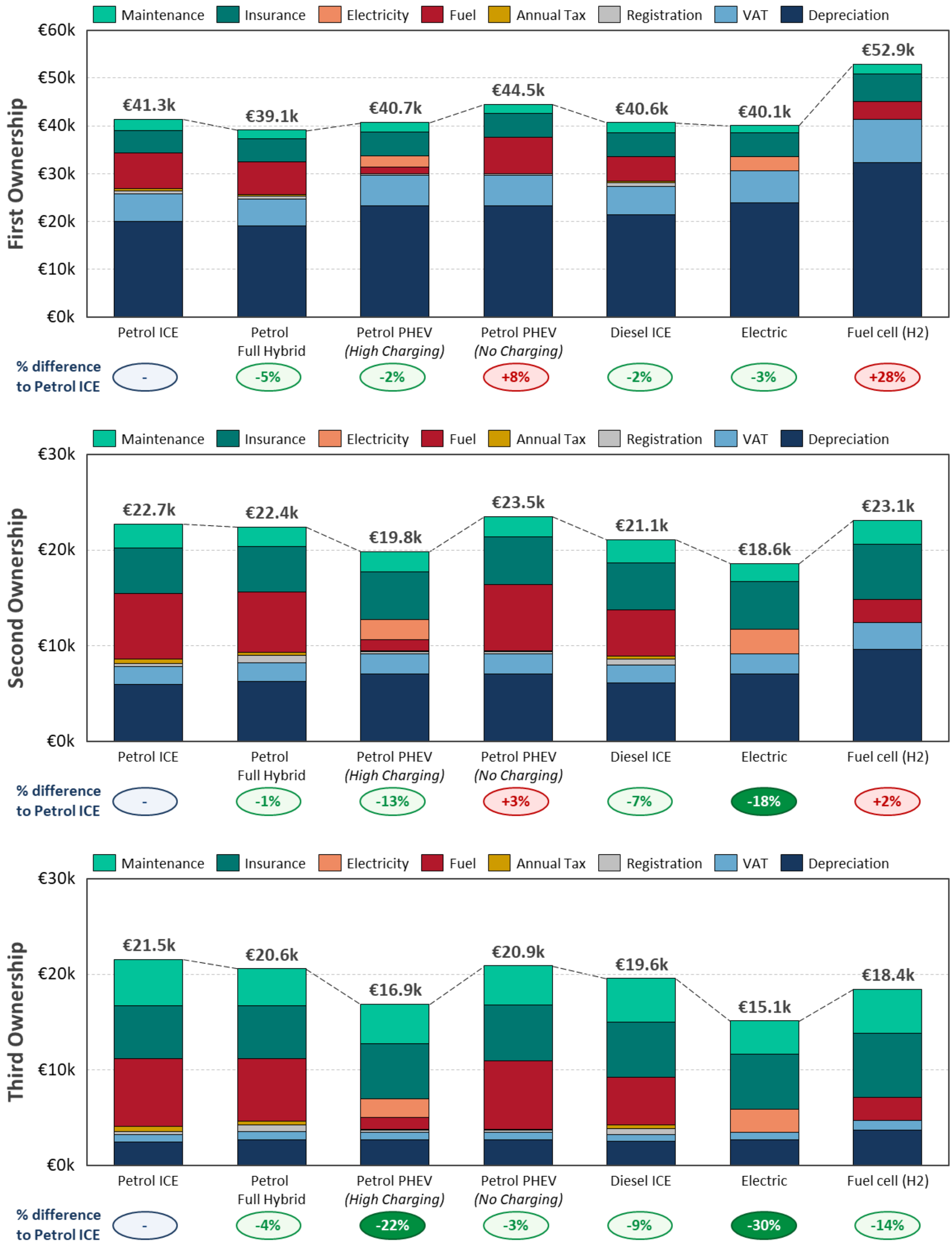


Figure 25: TCOs on a cost component level for different powertrains bought new in 2025

6.3.4 Medium Car Cost Components 2030

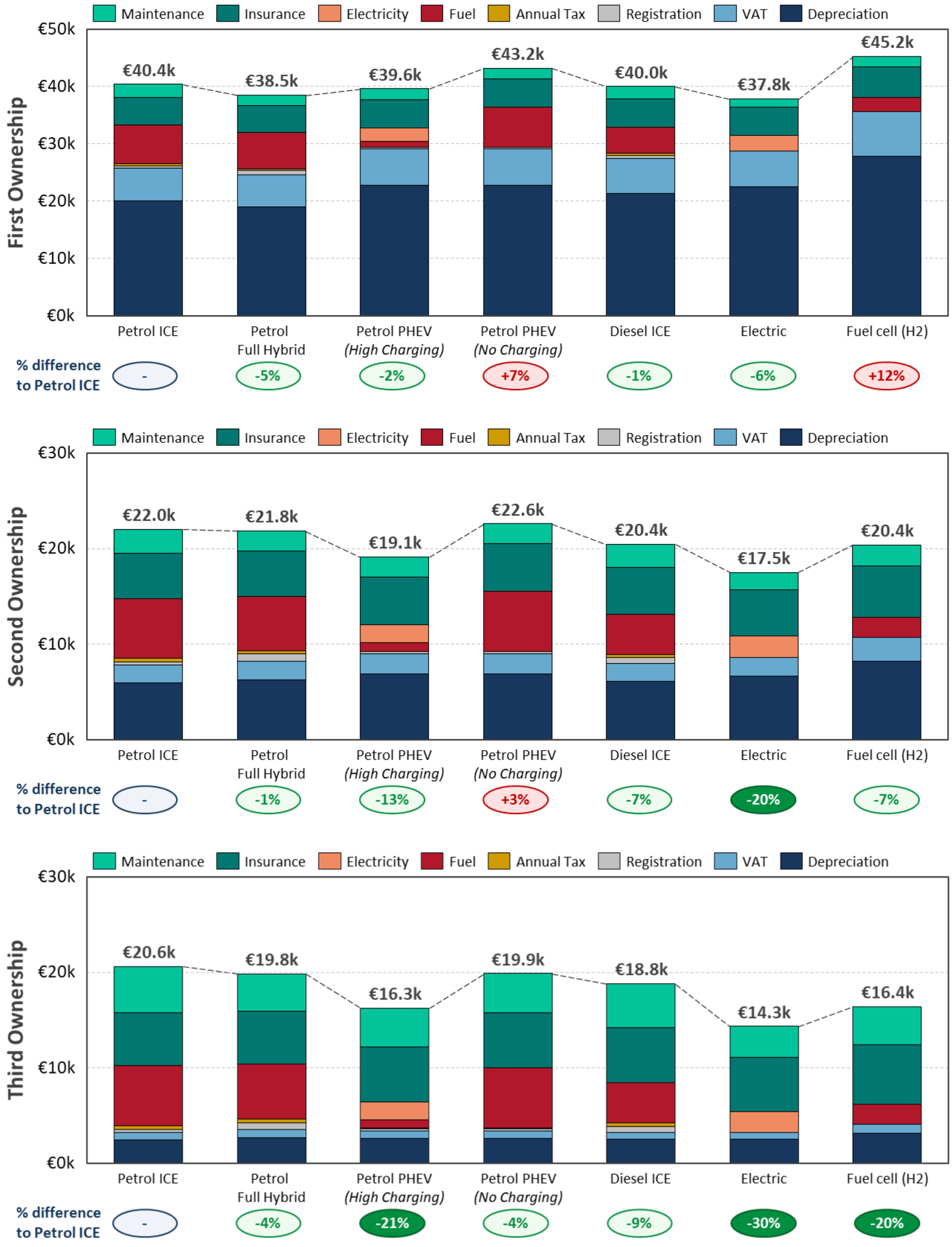


Figure 26: TCOs on a cost component level for different powertrains bought new in 2030

6.3.5 Charging scenario - specific user groups: second ownership (bought new in 2020)

Figure 27: TCOs on a cost component level for different powertrains bought new in 2020

6.3.6 Charging scenario - specific user groups: third ownership (bought new in 2020)

Figure 28: TCOs on a cost component level for different powertrains bought new in 2020