ELECTRIC CAR OWNERSHIP:
AN AFFORDABLE OPTION FOR ALL CONSUMERS

The role of EU regulation in bringing environmental and financial benefits to Europeans

BEUC The European Consumer Organisation
The Consumer Voice in Europe

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CONTENTS

IN A NUTSHELL

Between July 2020 and March 2021, BEUC, The European Consumer Organisation, and nine of its members commissioned a study on the lifetime cost (Total Cost of Ownership, TCO)[1] of passenger cars. Conducted at European level and within nine countries[2] by consultancy Element Energy, it compares the costs of owning diesel and petrol (internal combustion engines – ICE), hybrid, plug-in hybrid (PHEVs), hydrogen and battery electric vehicles (BEVs) over their entire lifetime – from first to third owner. For simplicity purposes: when this report refers to an 'electric car' it concerns the 'BEV'.

DIESEL AND PETROL ENGINES **HYBRID** **PLUG-IN HYBRID** **HYDROGEN** **BATTERY ELECTRIC VEHICLES**

[1] Total Cost of Ownership is the life cycle cost of a product. It includes the purchase of the vehicle but also the costs of petrol, diesel or electricity consumption, insurance, maintenance, etc. TCO therefore also applies to cars bought second-hand (for the second or third owner).

[2] Belgium, Cyprus, France, Germany, Italy, Lithuania, Portugal, Slovenia, Spain.

KEY FINDINGS

01

A medium-sized electric car bought today is already the most financially interesting solution over the car's lifetime. While the first owner will, on average, be better off by switching to electric as of 2025, every new electric car sold today will bring significant savings to its second and third owners. However, some first owners can see financial benefits already today:

a. High mileage consumers (commuters, company car users, taxi drivers) can already save money today by switching to electric due to lower running costs.

b. The arrival of more affordable electric cars with lower battery range will drive down TCO costs for several user groups should they want to buy new: urban/suburban citizens, pensioners, or families switching (one of) their cars to an electric one.

c. Access to off-peak electricity tariffs at home is a game changer for BEV users. For a medium BEV, first owners with access to such tariffs will already have a cheaper TCO than those driving on petrol.

02

National incentives (bonuses, tax cuts) are important tools for the transition. By tackling higher upfront costs for first owners, they raise the market share of electric cars and fast forward the future benefits for second and third owners.

03

Even when considering purchase incentives for first owners, electric cars are the most equitable powertrain. That is because the first owner, who is most able to afford it, pays a higher proportion of the car's lifetime costs.

04

Plug-in hybrids, even if charged regularly, are not a financially advantageous solution for consumers. Second and third owners – who are less likely to have off-street parking solutions such as a garage or driveway – will be less likely to make use of these cars' limited charging potential. They would therefore rely on the combustion engine alone to power what is a heavier vehicle, causing increased running (and potentially maintenance) costs.

05

E-fuels – which are new synthetic fuels – represent a costly solution for consumers. Price-parity with petrol would only happen by 2037 while electric cars remain permanently competitive.

FINDINGS AND RECOMMENDATIONS

Why this research?

This is the second study of its kind, following one published in November 2016. Since then, the European Union (EU) has increased its climate ambition,[3] while the sales of electric vehicles have taken off thanks to stricter EU CO_2 emission standards in 2020/2021 and new models being brought to the market. This new study reflects on these significant changes and updates the previous TCO models. It also takes a closer look at specific user groups – commuters, pensioners, urban citizens – and, crucially, the many people who buy second and third hand cars.

Who participated in this study?

The following nine BEUC members, national consumer groups, participated in the study: Test Achats/Test Aankoop (Belgium), Κυπριακού Συνδέσμου Καταναλωτών/Kypriakos Syndesmos Katanaloton (Cyprus), UFC-Que Choisir (France), Verbraucherzentrale Bundesverband (Germany), Altroconsumo (Italy), Lietuvos vartotojų organizacijų aljansas – LVOA (Lithuania), DECO (Portugal), Zveza Potrošnikov Slovenije – ZPS (Slovenia) and Organización de consumidores y usuarios – OCU (Spain). The research was coordinated by consultancy firm Element Energy.

What did we find?

The main EU-wide conclusion of this study is that **a medium-sized electric car bought today is already the most financially interesting solution over the car's lifetime. Concretely, this means that:**

- First owners will on average be better off by switching to electric in 2025. That is because they face the bulk of depreciation costs.
- **Second and third hand owners will make savings for each electric car sold new today as they will bear less of the car's depreciation and benefit from low running costs.** This illustrates the value of stimulating a second and third hand market for these vehicles.

Similarly, the first owner of an electric car (BEV) would pay a higher proportion of the car's lifetime costs compared to other powertrains (47%, versus 41% for a petrol car). As such, **BEVs can be considered as the most socially equitable powertrain on the market**, as first owners with more financial means contribute to a greater extent to financing the green transition.

On the value of driving electric for specific user groups

Our findings also show that not all first owners of a medium-sized electric car will have to wait until 2025 to save money. **Commuters, company car users or taxi drivers who usually drive more than the average consumer (over 15,000km a year) have a clear incentive to buy a BEV** already today due to its lower running costs compared to conventional petrol and diesel cars. Moreover, these 'high mileage consumers' usually keep their car for a shorter period and emit a greater share of the total CO_2 emissions from cars. They are therefore key target groups that can accelerate both the growth of a second-hand market, as well as reduce CO_2 emissions.

Yet **pensioners, suburban drivers or families using a second car for short, regular commutes can also look forward to driving electric** before 2025 should they rely on car use and prefer to buy new. There is a role for regulation here. **Stricter CO_2 emission standards for cars will nudge manufacturers to bring more BEVs to market at a more affordable purchase price that will approach the price of equivalent petrol and diesel cars.** Some manufacturers[4] have announced the release of BEVs with lower battery range (200-300km compared to the market average battery size of 479km range) that could fit many consumers' daily needs – 49% of EU consumers drive less than 10,000 km per year. With the upfront costs being kept a competitive level compared to their diesel or petrol equivalents, **these new BEVs can provide savings to their first owners already today**.

The **analysis of user groups in each of the nine focus countries confirms these findings** and provides additional information on the examples mentioned above. Our research considered the national price of fuel or electricity, VAT, consumer habits (annual mileage, ownership length), access to private charging, and possible purchase subsidies in a particular country. The TCO was then calculated for different user types that reflect real consumer behaviour. Scenarios include the purchase of a first-, second- or third- hand vehicle.

[3] The European Green Deal published in December 2019 sets a CO_2 emission reduction target for the transport sector of -90% by 2050 (from 1990). The previous target was -60%.

[4] For example, Renault has recently announced its Dacia Spring, with a battery range between 230 and 305km with a price of €17 000 to €18 500 without considering purchase incentives at national level.

[5] Comparisons are made against an equivalent petrol model. The study analyses each powertrain in more detail.

National examples confirming the EU findings are numerous:[5]

- A Spanish commuter driving over 30,000km per year can expect to save more than €14,000 over the first six years by buying a new BEV (even when partly charging on the highway where prices are usually higher due to higher power delivered).
- A German pensioner with a low mileage (7,500 km per year) would save €300 per year by buying a medium-sized, second-hand BEV (bought new in 2020).
- A resident of Vilnius using a home charging point would save almost €5,000 over five years by buying a second-hand BEV (12,000km a year, bought new in 2020).

On the role of purchase incentives

Despite these clearly established benefits, the study also reveals the need for some purchase subsidies or tax breaks during a transitional period. These should make new BEVs competitive for first owners, accelerate sales and effectively create a second-hand market where the benefits are even greater. For example, in Germany a new small BEV is already competitive with a petrol vehicle today because of generous purchase subsidies, whereas without new incentives first owners would have to wait until 2027 in Slovenia and 2028 in Cyprus.

A major criticism of these purchase incentives or tax cuts is that they would only benefit high-income consumers. However, **even if first owners benefit from a purchase subsidy – say of €7,000 – they would still bear a greater share of the costs of the vehicle against second and third owners than if they had bought a new petrol car.** Seeing the demonstrated savings for second and third owners, this renders the **promotion of BEV sales for a transitional period a socially fair policy. National authorities therefore have the tools to facilitate the uptake of electric cars to the benefit of all consumers.**

On charging and its infrastructure

Similarly, the TCO varies greatly depending on whether users have **access to a home charging point** or a preferential rate at a public charging station. This reveals the **urgent need to develop high quality charging infrastructure throughout Europe**, along roads, at home, at workplaces or in residential buildings. This is particularly the case in Italy and Spain, where BEVs are competitive but their market share remains low, due to the lacklustre development of charging infrastructure.

On other alternatives – beyond electric – to petrol and diesel cars

Finally, the study investigates the potential risks for consumers of technologies which are often presented as alternatives to BEVs: plug-in hybrids (PHEVs)[6] and new synthetic fuels (or e-fuels)[7] to power conventional engines:

- The results show that PHEVs are a more expensive powertrain for consumers compared to BEVs. This is even the case when a PHEV owner mainly drives on electric mode – and thus charges their car a lot – as laboratory tests assume. Such additional costs escalate significantly when a PHEV is charged rarely or not at all, the vehicle becoming respectively 17% and 27% more expensive than a BEV in 2030. More importantly, **an increase in PHEV sales has an impact on second and third owners, who are less likely to have access to off-street (garage, driveway) charging.**
- Even going by the most optimistic projections, e-fuels are currently 80% more expensive than petrol and will not reach price parity until 2037. Moreover, they do not compete with the savings offered by BEVs. By the time the TCO for e-fuels mirrors that of petrol, for a vehicle lifetime between 2030-46, they will remain 23% more expensive for consumers to run than an electric car.

On the overall gains for consumers, their health, and the environment

In sum, our analysis emphasises that BEVs are the most cost-efficient long-term driving solution for consumers. Based on the findings of the study, we argue that the benefits from an 'early BEV adoption scenario' in the coming years are fourfold; financial, social, environmental, and health:

- An 'early BEV adoption scenario' would maximise the financial benefits for all segments of consumers.
- It would also be a socially fair policy, as lower-income consumers can benefit to a greater extent from the switch to electric.
- Adopting BEVs as soon as possible offers the greatest potential for reducing emissions. Our study estimates that the growth in **BEV sales could contribute to 75% of the emission reduction from new cars by 2030. Similarly, the impact of the early adoption of BEVs on the emissions from the entire EU fleet (old and new cars) could be extremely significant with regards to the EU's climate ambition by the end of the decade.** An ambitious regulatory framework to promote the uptake of BEVs will therefore contribute to getting consumers on board the green transition.
- Finally, considering the impact of air pollution on citizens' health, the transition to cleaner electric vehicles would benefit everyone, but especially those living in big cities where car traffic is responsible for a high share of harmful pollutants.

[6] Plug-in Hybrids (PHEVs) are cars combining a conventional combustion engine with an auxiliary electric engine that can be recharged from a socket.

[7] Synthetic fuels, or "E-fuels" are liquid fuels produced with the help of electricity, water and CO_2 from the air or industrial emissions.

BEUC RECOMMENDATIONS

- Our research indicates there is a lot of potential for a cleaner automotive market that would bring financial benefits to consumers. Decision-makers must nevertheless regulate to help consumers in this transition. The following recommendations must be considered in this regard: **legislate for more stringent CO_2 emission reduction targets for cars.** This will incentivise car makers to bring more electric models to the market, stimulating their uptake and the growth of second- and third-hand markets. The revised regulation should:
  - Tighten the 2025 and 2030 targets; set an intermediate target in 2027; reach a target of 0g CO_2/km by 2035 at the latest.
  - Remove regulatory mechanisms that allow carmakers to artificially reduce their fleet emissions, emit more, promote the sales of PHEVs, or lower the ambition of their target. Achieving the targets should be done primarily through the uptake of BEVs.
  - Prevent manufacturers from counting the production of e-fuels as part of their effort to reach fleet emission reduction targets (via a crediting system) as they would represent costly solutions to consumers and deter the needed investments in BEVs.
  - Monitor real-life fuel consumption to avoid potentially growing emissions from combustion engines and therefore higher fuel consumption (and costs). The combined effects of diverted investments from conventional engines to electric cars and the increased market share of BEVs could lead to petrol and diesel cars emitting more while manufacturers respect their overall emission reduction targets.

- **Accompany an ambitious regulation on CO_2 emission reductions with other policies:**
  - **Make electric charging a real and convenient option for consumers:**
    - Improve the charging experience with public stations. This requires a swift revision of the EU's Alternative Fuels Infrastructure Directive in order to make payment easy and charging tariffs transparent (in €/kWh).
    - Encourage and facilitate the installation of private charging stations, including for consumers living in flats or without access to private parking. This requires amending the EU's Energy Performance of Buildings Directive.
  - **Give consumers the right information when they are willing to buy a new car:**
    - The 22-year-old Car Labelling Directive was established at a time where electric cars were not on the market. This law should be revised to give trustworthy information for both combustion engine and electric car owners. Specific requirements for the latter would be to show the real driving range, maximum charging speed and average charging time.
  - **Oppose the inclusion of road transport in the EU carbon market:**
    - There is a growing push to include road transport in the EU carbon market – known as the Emission Trading System. Yet this could harm consumers financially, especially those on lower-incomes, without providing sufficient access to more energy-efficient mobility and heating/cooling alternatives.
  - **Protect consumers' health by improving the efficiency of combustion engines:**
    - As air pollution caused by transport remains a major problem across Europe, It is essential to establish stringent emission limits for harmful pollutants such as nitrogen oxides (NOx) and particulate matters (PM) via ambitious post-EURO 6 standards.

- **Support consumers as the world transitions from petrol/diesel to electric cars.** In the run up to cost-parity between these cars – for a medium-sized car slated EU-wide in 2025 – innovative measures and incentives in favour of BEVs at national level must be or remain in place. These should consider the different budgets of European households. Practically this can take the form of:
  - Purchase incentives for BEVs only, tax cuts and targeted financial help for lower-income consumers (such as conversion premiums). PHEVs should not be incentivised due to inconsistent charging behaviours and their detrimental long-term cost effects for second and third owners.
  - Support for the installation of a charging station at home (or within a residential building) via financial means, smoother administrative procedures, or demand-driven rollout schemes for charging stations in the streets.
  - Targeted measures to accelerate the electrification of company fleets, taxis, shared cars.

DETAILED RESULTS AND CASE-STUDIES

Context

Driven by the EU regulation on CO_2 emission standards for cars and vans that requires them to reduce their fleet emissions, manufacturers have been bringing more and more electric car models to the market in recent years. With the overall target of 95g CO_2/km for the years 2020/2021,[8] manufacturers have stepped up the pace in 2020 and sales have soared: in the last quarter of last year, 250,000 battery-electric cars (BEVs) and 227,000 plug-in hybrids (PHEVs) were registered in the EU. These figures represent an increase of 217% and 331% respectively compared to the same period in 2019. In total, more than one million electrified vehicles (BEVs + PHEVs) were registered in 2020, representing 11% of vehicles sold in Europe (compared to 3% in 2019)[9] .

Although not perfect[10], the regulation of CO_2 emission standards is a good example of sectoral legislation leading to significant market effects. The target set for 2020/2021 has resulted in unprecedented emission reduction. As the International Council for Clean Transportation notes: "Average new car CO_2 emission levels went from 122 g/km (NEDC) in 2019 to an estimated level of 107 g/km in 2020. This equals a reduction rate of about 1 g/km per month, while from 2015 through 2019 the rate of reduction was at about 0.6 g/km of CO_2"[11].

BEVs are by far the most energy-efficient solution[12]. This technology is supported by investment announcements from manufacturers and the observed growth in sales of these vehicles, and the installation of new charging stations. Compared to other alternatives (LPG, CNG, hydrogen), BEVs are the most likely to be developed on a large scale in the near future to meet the EU's climate commitments.

However, while the environmental[13] and health[14] benefits of battery-electric cars have been clearly demonstrated, the question of financial benefits for consumers remains divisive, mostly about the affordability of these vehicles for middle and lower-income consumers. In addition to concerns about recharging infrastructure and range[15], several issues remain:

- Due to their higher purchase price, they are still inaccessible for many households, and the limited number of electric vehicles currently available does not sufficiently bring the prices down.
- Subsidies and purchase incentives in many Member States have contributed to an increase in sales but have sometimes insufficiently addressed the needs of middle- and lower-income consumers, while these subsidies vary enormously across Europe – or simply do not exist for the vast majority of Member States.
- The lack of information to consumers on the technical characteristics of electric vehicles is also glaring, especially when it comes to the real-life battery range and charging capacity.
- The promotion, sometimes wrongly, of plug-in hybrids as company cars or for private individuals who cannot regularly recharge their batteries.

Before the publication of a revised proposal for a regulation on CO_2 emission standards for cars in the "Fit for 55" package in June 2021, BEUC wished to clarify this debate on the financial benefits that BEVs can bring through a large study on the Total Cost of Ownership (TCO) of vehicles (all engines combined).

[8] In 2020, a 95% "phase-in" was foreseen by the regulation. This means that manufacturers could exclude 5% of their most polluting cars from the calculation of their fleet emissions. This exemption falls in 2021, with all vehicles being integrated in the calculation.
[9] ACEA (February 2021), *New passenger car registrations by fuel type in the European Union*. Quarter 4 2020, https://www.acea.be/uploads/press_releases_files/20210204_PRPC_fuel_Q4_2020_FINAL.pdf, (accessed 12 April 2021).
[10] The 95g/km for CO_2 emissions is theoretical for 2020. Several mechanisms allow car manufacturers to emit more than the lab-tested limits, while the measurement of real-life emissions is slowly being implemented. Source: European Commission, 'Reducing CO_2 emissions from passenger cars – before 2020' [website], https://ec.europa.eu/clima/policies/transport/vehicles/cars_en, (accessed 12 April 2021).
[11] The International Council on Clean Transportation (January 2021), *Market monitor: European passenger car registrations, January–December 2020*, https://theicct.org/publications/market-monitor-eu-jan2021, (accessed 12 April 2021).
[12] Transport & Environment (March 2021), *From dirty oil to clean batteries*, https://www.transportenvironment.org/sites/te/files/publications/2021_02_Battery_raw_materials_report_final.pdf, (accessed 12 April 2021).
[13] Transport & Environment, *Does an electric vehicle emit less than a petrol or diesel?*, 21 April 2020, https://www.transportenvironment.org/news/does-electric-vehicle-emit-less-petrol-or-diesel, (accessed 12 April 2021).
[14] Matteo Barisione, 'Electric vehicles and air pollution: the claims and the facts' [web blog], *European Public Health Alliance*, 5 March 2021, https://epha.org/electric-vehicles-and-air-pollution-the-claims-and-the-facts/, (accessed 12 April 2021).
[15] BEUC (May 2019), *Making electric cars convenient*, https://www.beuc.eu/publications/beuc-x-2019-032_making_electric_cars_convenient.pdf.

This study carried out at European level and in nine countries[16], gives both average projections for the European Union but also identifies specific categories of consumers (commuters, pensioners, urban citizens, etc.) to give the most realistic estimate possible of the gains from the purchase of a new, second- or third-hand BEV.

The study also looks at several scenarios relating to consumer habits (annual mileage, ownership length), access to home charging, changes in the cost of certain electric car components and the emergence of new synthetic fuels, often called 'e-fuels'.

By focusing on these specific categories and addressing the needs of the lowest income households, BEUC and its members aim to engage consumers in the ecological transition by also providing clear recommendations for them when it comes to choosing a car.

Methodology

EU-level analysis

The Total Cost of Ownership calculates the lifecycle cost of a product. This means comparing vehicles beyond their purchase price to estimate the real cost for consumers throughout the ownerships of the vehicle. The following elements compose the TCO of vehicles:

- Vehicle pricing and components costs
- Efficiency measures required by EU regulation (EURO6)
- Market depreciation
- Fuel/electricity costs and consumption
- Taxes (VAT, registration tax, annual tax) and subsidies
- Insurance and maintenance costs

To keep up with market developments in the years to come, the study uses evidence-based assumptions on the evolution of the price of various components, the improvement in fuel/electricity consumption, the development of efficiency technologies, the introduction of new emission-control systems (EURO7) and the progress in batteries' real capacity. The study then constructs future vehicles by gathering assumptions for all components together (see Figure 1).

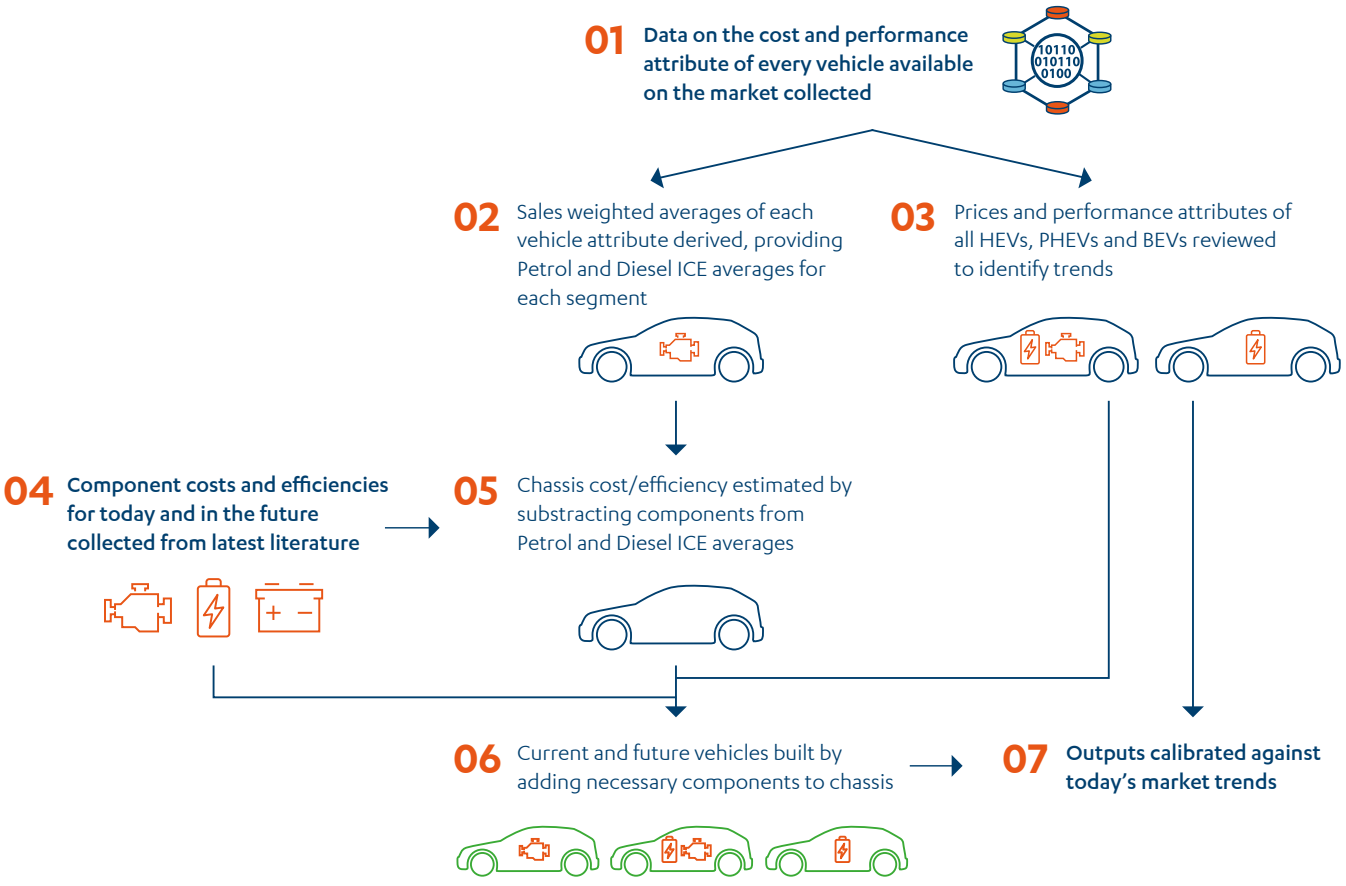

Figure 1: Overview of steps taken to construct future vehicles. Numbers indicate modelling order.

[16] BEUC members Test Achats/Test Aankoop (BE), Κυπριακού Συνδέσμου Καταναλωτών (CY), UFC-Que Choisir (FR), Verbraucherzentrale Bundesverband (DE), Altroconsumo (IT), Lietuvos vartotojų organizacijų aljansas – LVOA (LT), DECO (PT), Zveza Potrošnikov Slovenije – ZPS (SI) and OCU (ES) participated in this study led by Element Energy.

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.

These elements and assumptions allow a comparison of the different powertrains for each vehicle segment. The powertrains studied are: diesel, petrol, hybrids, plug-in hybrids (high, low and no charging), fuel cell (hydrogen) and battery electric vehicles.

CNG and LPG have not been considered in the TCO study as they represent a low and decreasing market share in the EU average fleet (despite some growing markets in Europe because of extremely low sales in gross figures). Moreover, car manufacturers do not plan to reshape their business models around these powertrains.

For ease of understanding, the study classifies the vehicles into three categories: small, medium, and large. Moreover, in order to assess the cost for each owner of the same vehicle, the following values were chosen to estimate ownership periods at EU level:

- First ownership (four years – 15,000 km per year)
- Second ownership (five years – 12,000 km per year)
- Third ownership (seven years – 10,000 km per year)

Note: the graphs presented below show the benefits for second and third owners based on the year the car is bought new and the ownership periods presented above.

National TCO inputs

The values presented hereabove are adapted in our country analysis to better reflect consumer behaviour. Our members provided data on the fuel/electricity price, the annual mileage, the average ownership period or the tax and subsidies in place in 2020.
Additionally, for each of the nine countries considered in this study, the situation of three user groups representing real-life scenarios were analysed to provide consumers with concrete information that can be applied to their respective cases. User groups were chosen among:

- Company car drivers and commuters
- Single or multiple car households
- Consumers with access to home charging / rapid or slow public charging
- New or used car buyers
- Rural or urban citizens, pensioners, part-time workers, ...

For each scenario, the study breaks down the costs of each TCO component to allow consumers to modulate each cost according to their needs and habits. These real-life examples support the EU findings and refine the results. National reports have been published and promoted by our members.

Extra sensitivities

In addition to the elements included in the TCO study, the study includes six sensitivities in its EU-level analysis, each of them representing risks or opportunities for faster BEV uptake:

- **Consumers having higher annual mileage than EU average:** The study assesses the gains and costs of BEVs versus other powertrains for a higher annual mileage than the EU average.
- **Release of cheaper BEVs:** Lower range battery forecasts and the introduction of BEVs with a cheaper upfront cost can boost the TCO of BEVs while responding to the needs of many urban/suburban consumers.
- **Different access to charging:** Charging costs can be highly variable depending on a driver's situation: off-peak residential electricity can cost less than 10 c/kWh while fast public charging can cost over 70 c/kWh.
- **Delayed introduction of EURO7 standards:** The timing of the introduction of EURO7 is still uncertain and could influence TCO-parity between BEVs and petrol/diesel cars.
- **Charging scenarios for PHEVs:** There are various usages of PHEVs, some consumers using the electric engine only while others barely charge their vehicle (for example, company cars with a fuel card). The study considers the TCO costs for three PHEVs scenarios: high, low and no charging.
- **Costs of e-fuels:** There is a growing push for e-fuels to help decarbonise combustion engines. The study assesses the costs of these e-fuels for consumers and their potential competitiveness with other powertrains, notably BEVs.

Findings

Main EU-wide findings and confirmation by national examples

How much consumers can save now or in the future by going electric

Finding: A medium-sized electric car bought today is already the most financially interesting solution over the car's lifetime. While the first owner will, on average, be better off by switching to electric as of 2025, every new electric car sold today will bring significant savings to its second and third owners.

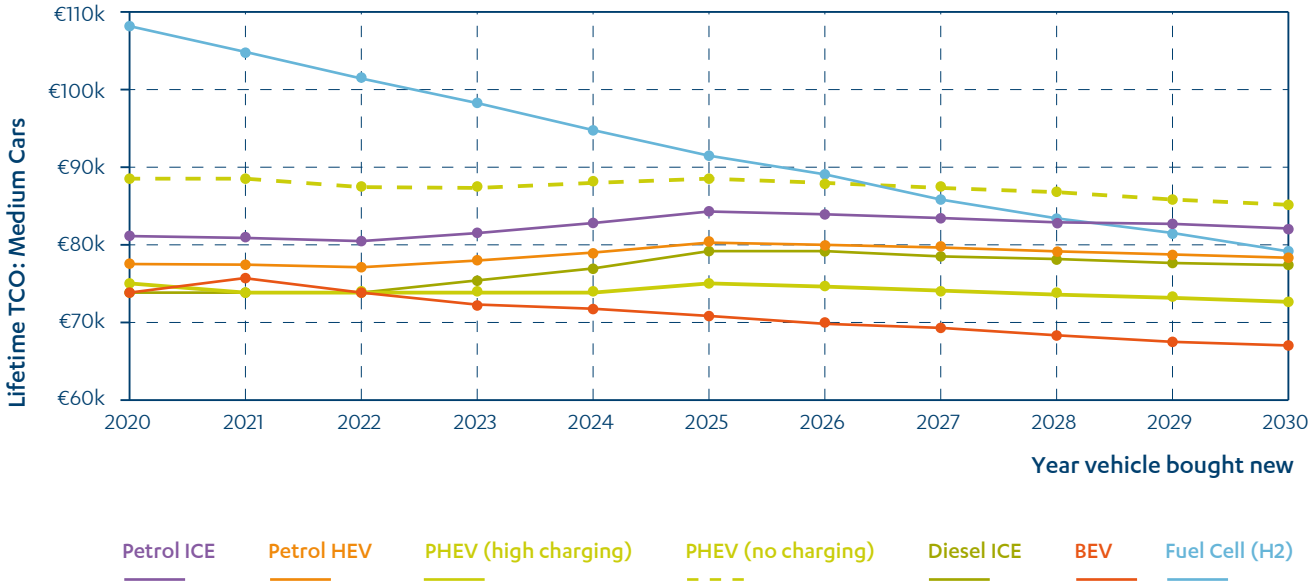

Figure 2: Lifetime owner TCO comparison between different powertrains for a medium car. Note that the year indicates when the car is first bought new.

BEVs are already the cheapest powertrain on a lifetime basis for medium cars bought today, with small and large cars following in 2023 and 2025, respectively. Figure 2 shows that the gap between BEVs and other powertrains (except fuel cell) will keep growing over the years, demonstrating the unambiguous position of BEVs as the future-proof, cost-efficient option for consumers. This also means that carmakers' supply of BEVs is essential so that consumers can find them across segments in the coming years.

For first owners, a medium- or small-sized BEV becomes cheaper than a petrol equivalent by 2025. Depreciation represents the highest cost component for first owners of BEVs. Depreciation represents the highest cost component for first owners of BEVs. But with upfront costs becoming much more comparable to petrol/diesel cars by 2025, the low running costs of BEVs soon give them a better TCO. Figure 3 shows the importance of running costs in the years to come.

The Portuguese case study shows that longer ownership periods also offer greater benefits for BEV owners, with an eight-year first ownership period offering a 17% TCO difference with a petrol car compared to only 8% for a four-year period (car bought new in 2020).

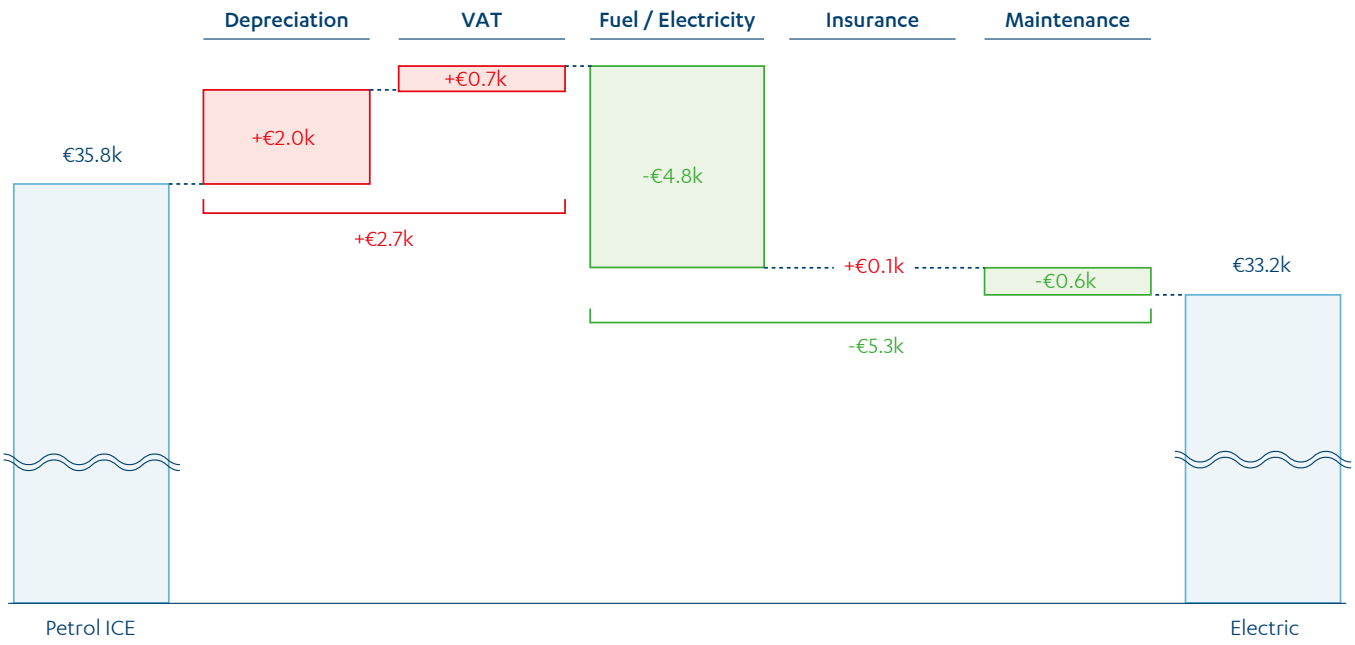

Figure 3: First owner TCO cost components compared for a medium car between Petrol ICEs and BEVs bought new in 2025.

As shown in Figure 4, second and third owners will see even greater benefits as the impact of depreciation becomes significantly less important while fuel costs are the main TCO component for these consumers. While first owners (buying without purchase incentives) will not be better off with a BEV before 2025, second and third owners can expect significant savings. This shows that BEVs can be a solution to get lower-income consumers on board of the green transition. The situation can be summarised as follows:

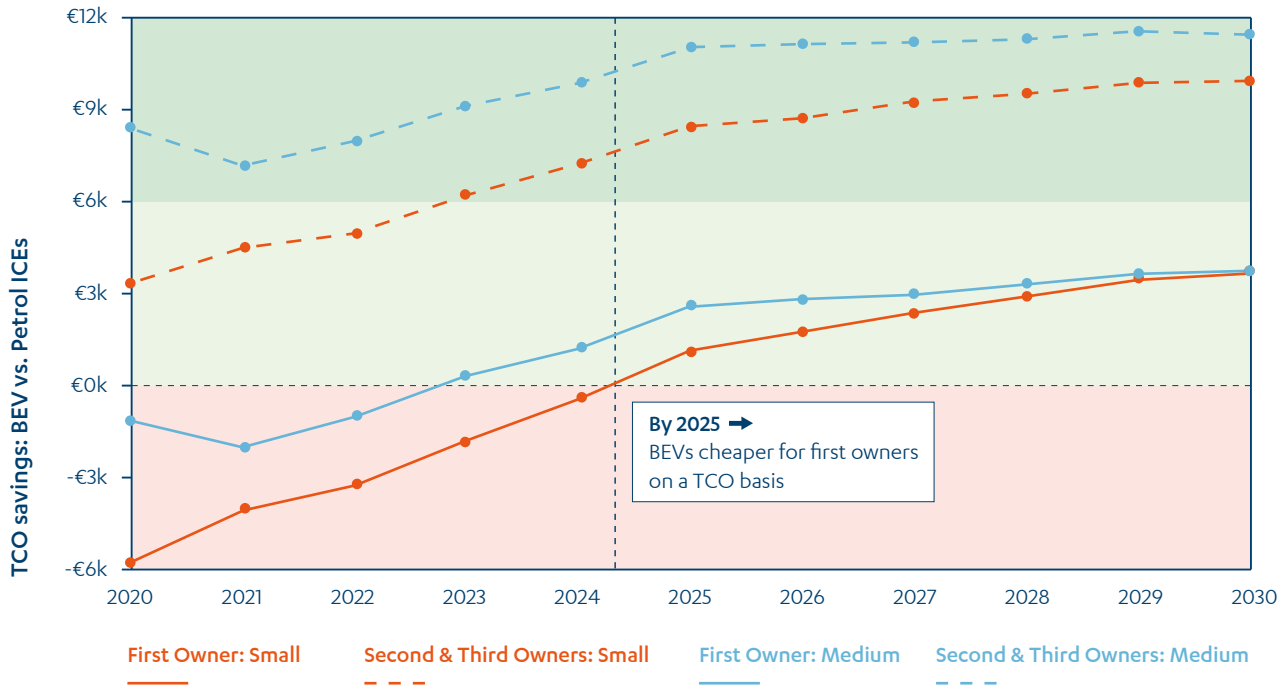

Figure 4: BEV lifetime TCO savings over a Petrol ICE for a medium car bought new by year.

Benefits for those driving a lot

Finding: High mileage consumers (commuters, company car users) can already save money today by switching to electric due to lower running costs.

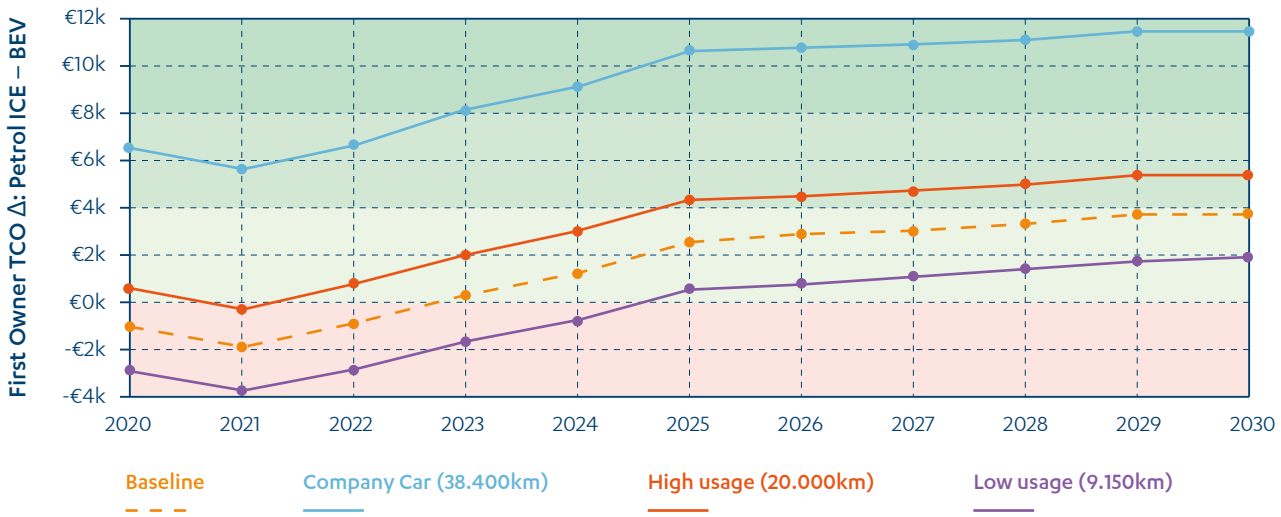

Figure 5: First owner Δ Petrol – BEV TCO for a medium car by mileage group.

As the running costs of BEVs are particularly competitive in comparison with petrol and diesel cars, consumers driving over 20,000 km per year can expect a better TCO already today (see Figure 5).

Moreover, it is estimated[17] that the 24% of European consumers driving more than 15,000km are responsible for 45% of the car fleet CO_2 emissions. Targeting these consumers (commuters, company car users, taxi drivers, ...) to switch to electric will therefore have an even greater environmental impact while providing them with financial benefits.

National examples confirm these findings, with TCO savings of over 20% (compared to a petrol car) for high mileage commuters[18] driving a BEV in Lithuania, Italy, Spain, Portugal, Cyprus, and Belgium. A rural citizen in Cyprus, driving 17,500 km per year can even expect a 40% difference in TCO savings by buying a second-hand BEV.

Benefits for those driving little

Finding: The arrival of more affordable electric cars with lower battery range will drive down TCO costs for several user groups should they want to buy new: urban/suburban citizens, pensioners, or families switching one of their cars to an electric one.

[17] Ricardo-AEA (2014), *Improvements to the definition of lifetime mileage of light duty vehicles*, https://ec.europa.eu/clima/sites/clima/files/transport/vehicles/docs/ldv_mileage_improvement_en.pdf, (accessed 12 April 2021).

[18] Driving 20 000 km or more per year.

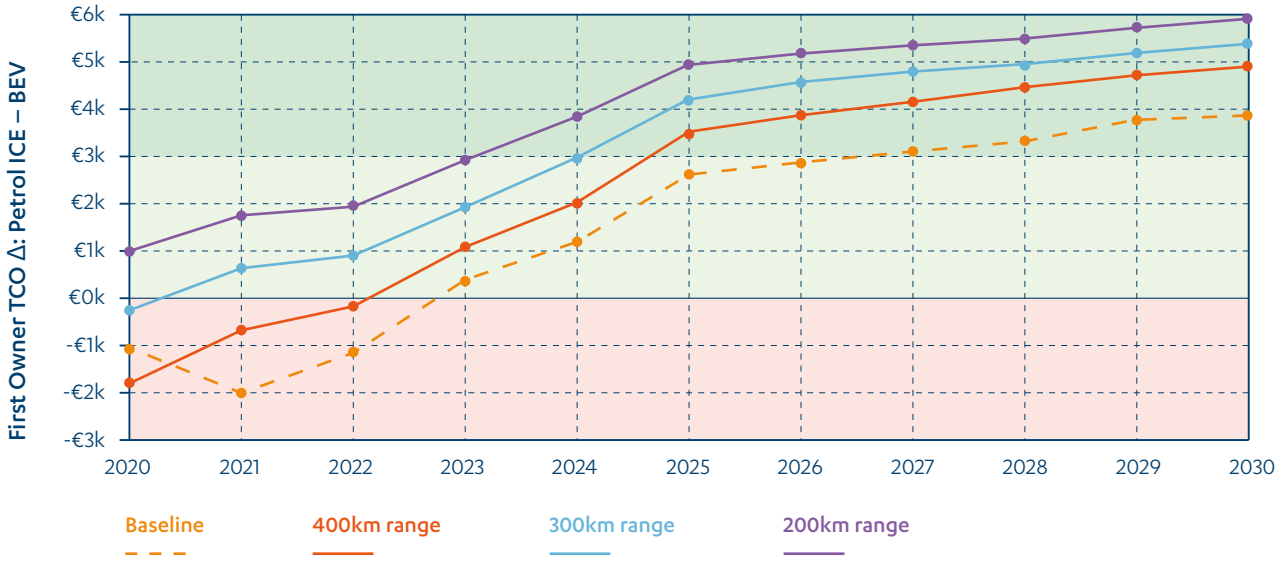

Figure 6: First owner Δ Petrol – BEV TCO for a medium car for smaller battery sizes. Baseline average annual mileage (15.000km) assumed for all scenarios.

Figure 6 shows the additional first owner TCO cost savings vs. petrol cars available for consumers that do not require a high a maximum BEV range. This should be seen in the light of battery costs falling over the years and range anxiety becoming less of an issue thanks to a well-developed charging network. Manufacturers could therefore offer vehicles with lower battery range and less on-board technology that would suit many consumers looking for a 'backup' solution. Think urban citizens relying mainly on public transport or a household using a second car for smaller daily commutes (going to the sports club, shopping for groceries, etc.). With almost 50% of consumers driving less than 10,000 km a year, there is real potential for such cheaper BEVs.

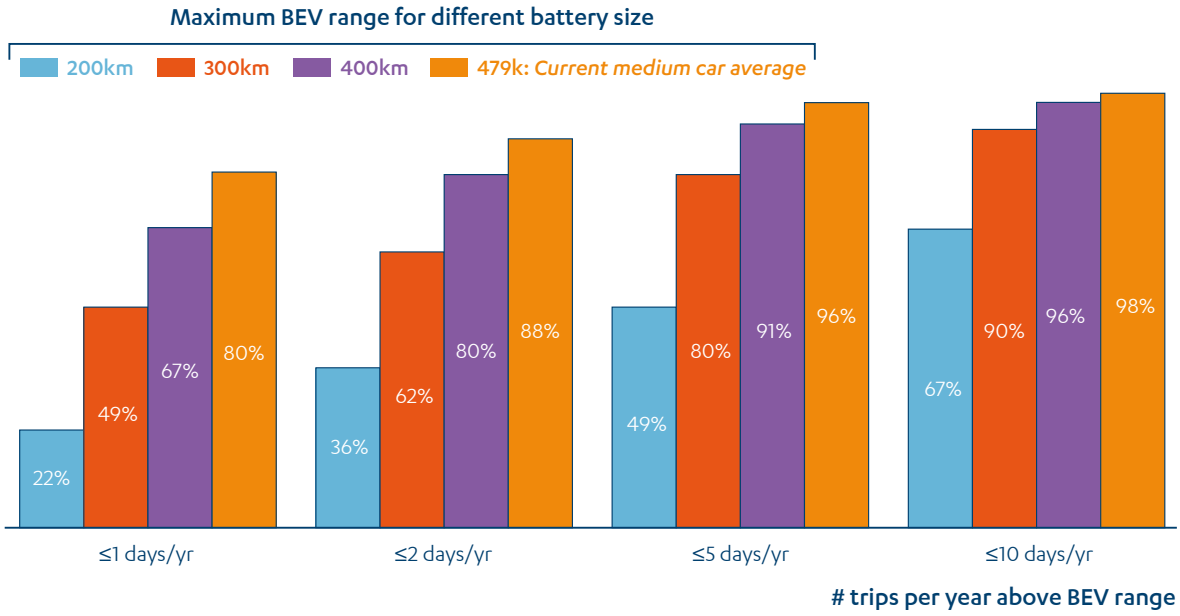

Figure 7: Estimated days consumers surpass their maximum BEV Worldwide Harmonised Light Vehicles Test Procedure (WLTP) range[19] for different battery range scenarios.

[19] For more info – and BEUC's view on this testing method – see: BEUC, 'New and improved fuel test for cars enters into force' [Press release], 1 September 2017, https://www.beuc.eu/publications/new-and-improved-fuel-test-cars-enters-force/html, (accessed 13 April 2021).

Figure 7 illustrates, across different battery range scenarios, the proportion of consumers likely to need to use en-route charging for no more than a few days each year. If equipped with an electric car with a range of 200km, 22% of drivers will on average require an en-route charging session on no more than one day per year, and 49% will exceed their maximum driving range less than five times a year. This shows that smaller batteries are suitable for the needs of many consumers.

Off-peak electricity tariffs as game changer

Finding: Access to off-peak electricity tariffs is a game changer for BEV owners. For a medium-sized car, first owners with access to off-peak tariffs at home will already have a cheaper TCO compared to a petrol engine.

There is a great discrepancy in terms of TCO parity between BEVs and petrol cars for consumers depending on whether they have access to home charging prices. Having to rely solely on public charging (11kW) delays TCO parity up to three years compared to off-peak tariffication. For a medium BEV, first owners with access to off-peak tariffs will already have a cheaper TCO compared to a petrol ICE.

There is also evidence that lack of access to home charging and expensive public charging is already limiting BEV growth (see below). Supporting consumers in the transition is therefore not only a question of purchase subsidies. Public authorities need to make sure they have access to the right infrastructure. As BEUC previously explained in a dedicated position paper, 'range anxiety' remains a strong barrier for consumers willing to drive electric.

National studies support these findings. A French citizen benefiting from the electricity company's 'tarif bleu' can save an extra €1,700 with their BEV than if they relied purely on on-street public charging. With 69% of the French population having access to off-street parking, there is a great potential for off-peak tariffs. On the other hand, a resident of Vilnius relying on public charging for their new BEV would pay an extra €4,000 over the ownership period compared to attractive off-peak tariffs. Similar figures have been reported for Spain, Italy, and Portugal.

Electric cars as 'equitable' solution for those who rely on driving

Even when considering purchase incentives, electric cars are the most equitable powertrain as the first owner, who is most able to afford it, pays a higher proportion of the lifetime TCO.

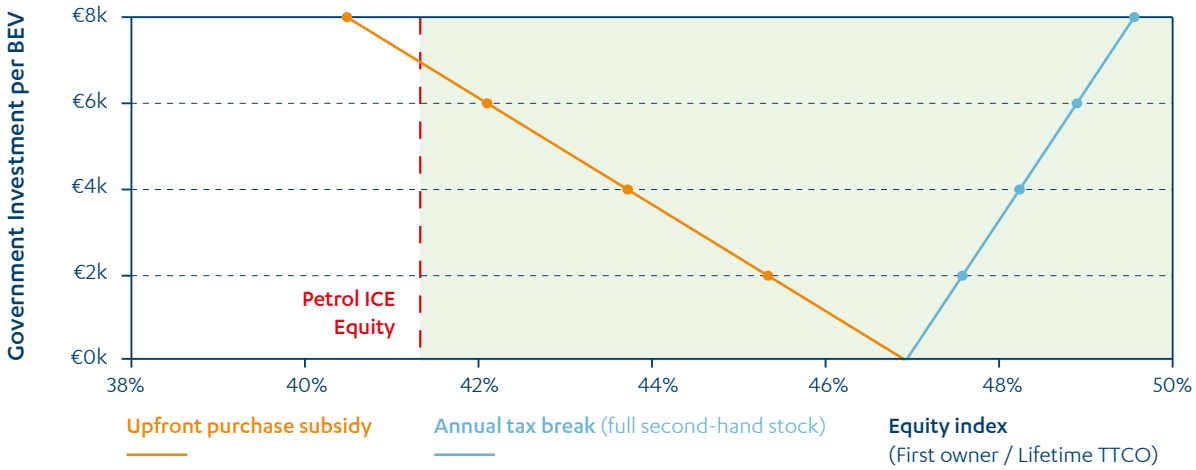

Figure 8: BEV equity index for a medium car bought new in 2020 and changes due to purchase subsidies and tax grants.

Figure 8 shows the market equity index[20] for BEVs with different government purchase subsidies or tax breaks. The conclusion is that BEVs still drive higher market equity over their lifetime versus petrol ICEs even when they have a first owner purchase subsidy of up to around €7,000. Similarly, tax breaks appear as an even more equitable solution as they apply to all users – not just to first owners. However, due to current supply limitations within the BEV second-hand market, this impact is likely to be more limited in the short term. This is another reason why BEUC advocates for regulatory measures that should increase the share of electric cars on the market, stimulating the growth of second-hand vehicles.

The plug-in hybrid factor

Finding: Plug-in hybrids, even if charged regularly, are not a financially interesting solution for consumers. Second and third owners – who are less likely to have off-street parking solutions such as a garage or driveway – will be less likely to make use of these cars' limited charging potential. They would therefore rely on the sole combustion engine to drive a heavier vehicle, causing increased running (and potentially maintenance) costs.

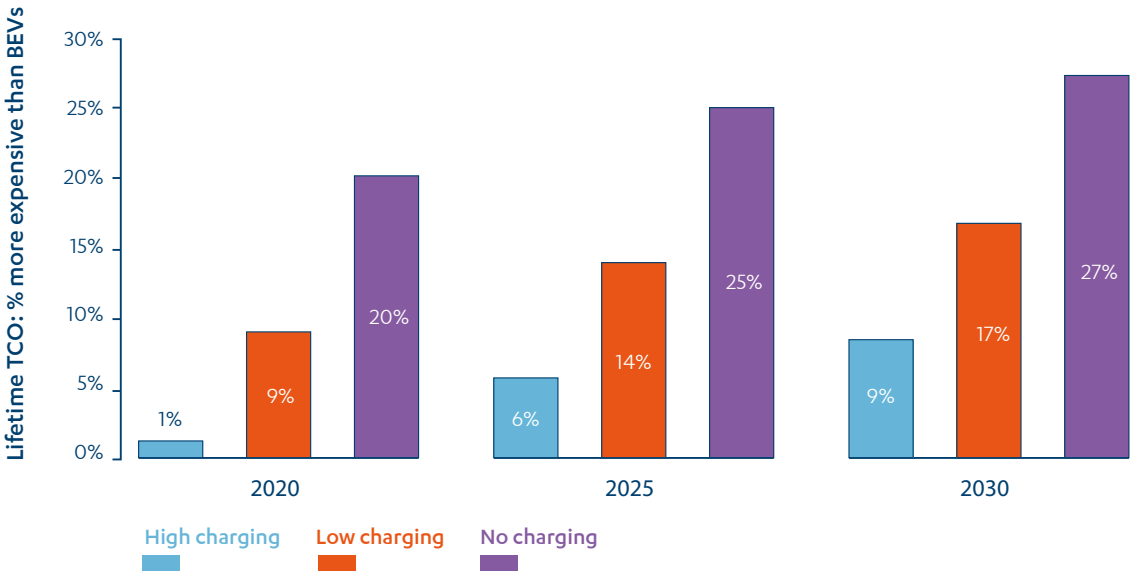

Figure 9: % higher lifetime TCO for a BEV vs. for a new PHEV bought in 2020, 2025 & 2030.

Figure 9 shows the cost difference for PHEVs in comparison with BEVs. Due to the inconsistent charging behaviours from PHEV drivers, three scenarios have been considered:

- a high charging scenario – corresponding to the type-approval testing procedure and representative of a driver that has access to daily home charging while driving mainly in electric mode;
- a low charging scenario – representative of a driver who does not have access to daily home or work charging and relies on destination charging (e.g., at a supermarket) a couple times per week;
- a no charging scenario – a driver who does not charge their PHEV and relies 100% on combustion fuel.

In all three scenarios considered (high, low and no charging), it appears clearly that PHEVs are not a financially interesting solution for consumers. More importantly, PHEVs that are not charged become the most economically draining powertrain to consumers compared to all other powertrains. This is particularly important for second and third owners, who are less likely to have access to

[20] For this study, the equity index has been defined as the percentage of a vehicles' lifetime cost that is paid by the first owner.

off-street and therefore home charging. These user groups will mainly suffer from higher running and maintenance costs.

PHEVs are often in the hands of first owners with little or no incentive to use the battery (company car users whose fuel expenses are reimbursed, for example) or individual consumers attracted by the 'best of both worlds' adverts (a combustion engine and an electric one) while a BEV could meet the vast majority of their daily needs (see section, 'Benefits for those driving little').

While PHEVs are usually found in larger car segments with higher purchase price, carmakers are advertising these cars by exaggerating the fears about electric range and the need for daily long-distance trips. The EU regulation on CO_2 standards also allow carmakers to use PHEVs as compliance cars to reach their fleet targets and make up for their investments in this powertrain. This has led to more PHEV sales in the recent years. For example, in 2020, German carmakers had 43 PHEV models on offer, but only six BEV models.

The TCO results are in line with what BEUC members have already shown in terms of the real-life fuel consumption of PHEVs via several testing projects[21]. The fuel consumption of such cars can be two to three times the one advertised to consumers via laboratory testing values.

Belgium provides an interesting case study for the use of PHEVs. The country has seen a record share of PHEVs in 2020 due to generous tax cuts for company cars, becoming the fourth biggest market in the EU (in gross figures) with more than 31,000 PHEVs sold last year.[22] Yet many companies providing a car to their employees do not facilitate the installation of a charging point at home or provide an 'electricity card'. What is more, some employees still receive a 'fuel card' and have little or no incentive to use their electric engine. TCO results in Belgium show that a company car user driving 30,000 km per year would generate a €15,000 saving over the ownership period by leasing a BEV rather than a PHEV that would almost never be charged.

E-fuels are not part of the solution

Finding: E-fuels will represent a costly solution for consumers. Price-parity with petrol would only happen by 2037 and electric cars remain permanently competitive.

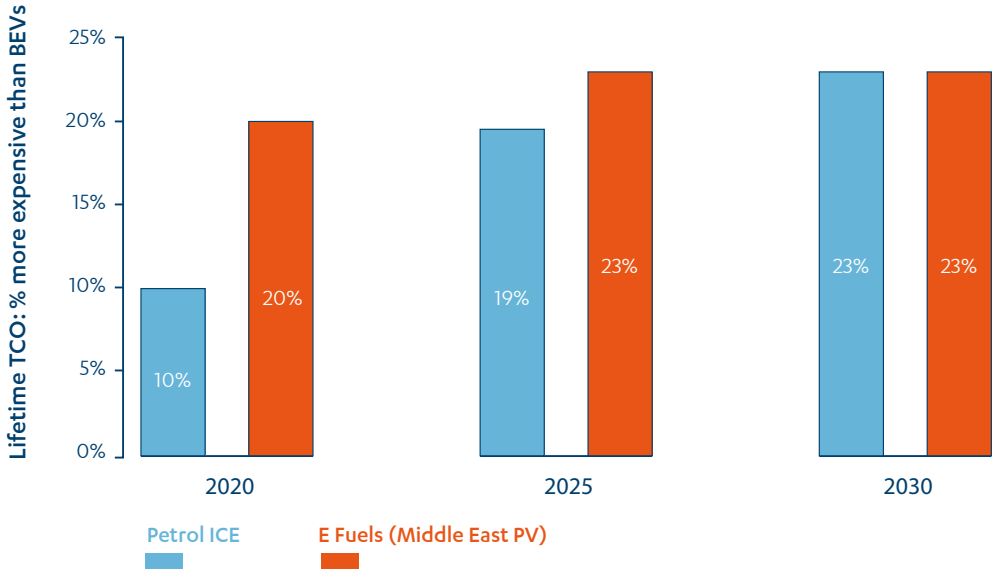

Figure 10: Percentage higher lifetime TCO vs. BEVs for a new car bought in 2020, 2025 & 2030.

[21] See WHICH? (25 February 2021), 'Plug-in hybrid cars use more fuel than official figures claim' [Press release], https://www.which.co.uk/news/2021/03/plug-in-hybrid-cars-use-more-fuel-than-official-figures-claim/, (accessed 13 April 2021); MILE21, *Discover the real consumption of your car* [website], https://www.mile21.eu/, (accessed 13 April 2021); and GreenNCAP (25 February 2021), 'Plug-in Hybrid Cars: Are They All the Same? [Press release], https://www.greenncap.com/press-releases/plug-in-hybrid-cars-are-they-all-the-same/, (accessed 13 April 2021).

[22] Test Achats (24 October 2020), 'Voitures neuves bientôt taxées différemment en Flandre' [website], https://www.test-achats.be/actions/mobiguide/info/cars/taxe-de-mise-en-circulation-en-flandre , (accessed 13 April 2021).

E-fuels present a significant financial risk to European consumers. Even based on the most optimistic projections – which rely on Middle East photovoltaic production with no additional fuel duty – e-fuels are currently 80% more expensive than petrol and do not reach price parity until 2037. More importantly, Figure 10 shows that while e-fuels powered cars could reach TCO parity with petrol cars by 2030, they would still be 23% more expensive than BEVs.

Lessons learned from national studies

Finding: National incentives (bonuses, tax cuts) are key tools for the transition. By tackling higher upfront costs for first owners, they raise the market share of electric cars and fast forward future benefits for second and third owners.

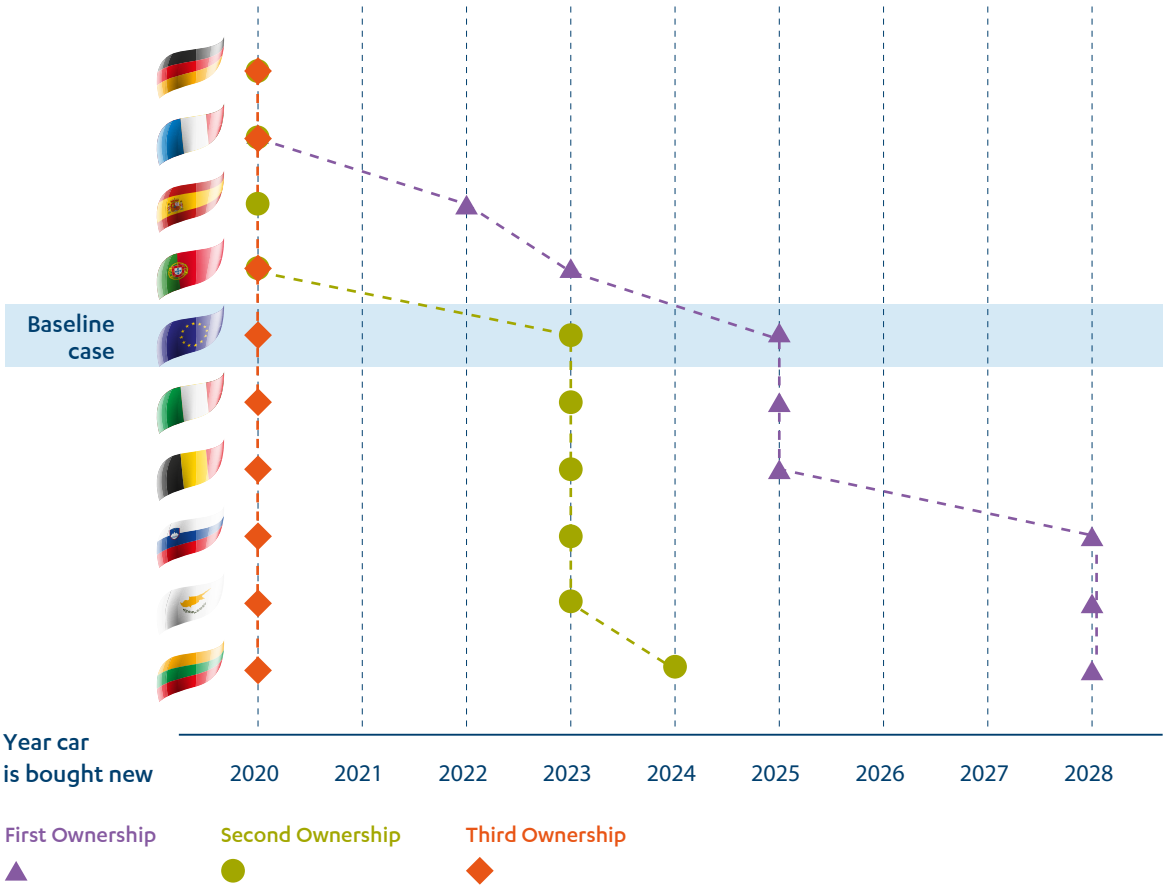

Figure 11: Year that BEVs become cheaper than Petrol ICEs, averaged over all car sizes. Note the year indicated represents when the vehicle is bought new.

Figure 11 shows the impact of national incentives (or the absence of) for first owners in terms of TCO-parity with petrol cars. These incentives consequently have the power to bring forward or delay financial benefits for second and third owners.

Subsidies and financial incentives are certainly market drivers: Germany and France, which offer the most generous conditions for BEV purchase, witness a higher market share for this powertrain and could even envisage phasing out their incentives.

It is particularly striking to note that a German commuter driving 25,000km/year with their BEV sees a 50% TCO difference compared to a petrol car. This is despite generally higher electricity prices in Germany than in the rest of Europe.

Grants and tax cuts are not the only tools for national authorities. For example, Spain sees a low market share of BEVs despite generous subsidies in place and consequent TCO savings for some first owners already today. This is explained by the lack of public charging infrastructure and many Spanish consumers not having access to home charging in densely populated areas. Figure 12 summarises the situation for each of the nine countries and proposes general recommendations for public authorities to deploy BEVs at a larger scale.

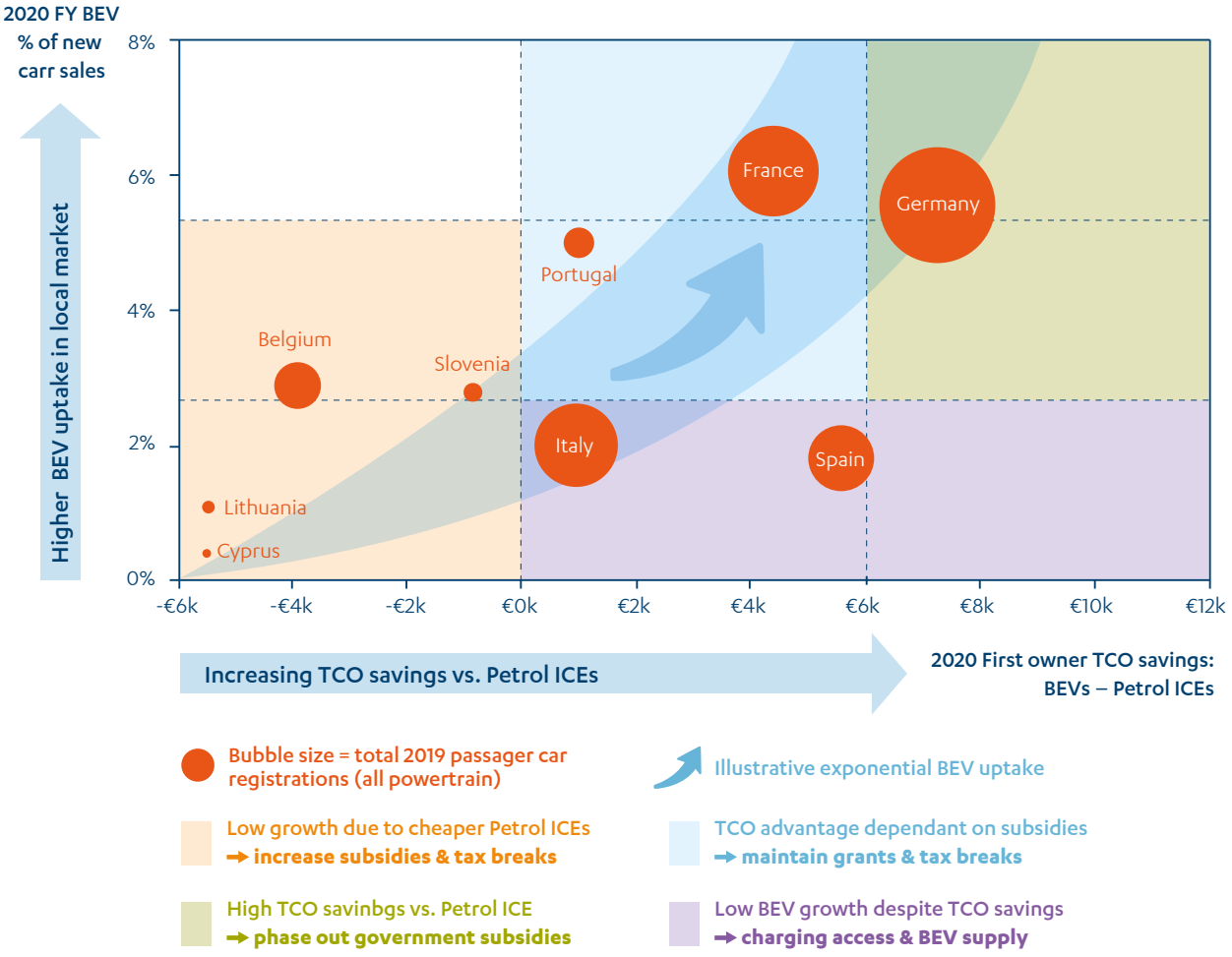

Figure 12: Small & medium cars BEV % of 2020 market sales vs first owner Δ TCO to Petrol ICEs.

Conclusion

With these cost savings brought by BEVs for many user groups in mind, the study concludes that promoting them is a socially fair policy that can maximise both the environmental and financial benefits, as shown in Figure 13. Ahead of the revision of the EU regulation on CO_2 standards for cars, this is a key message to policymakers willing to engage consumers in the green transition.

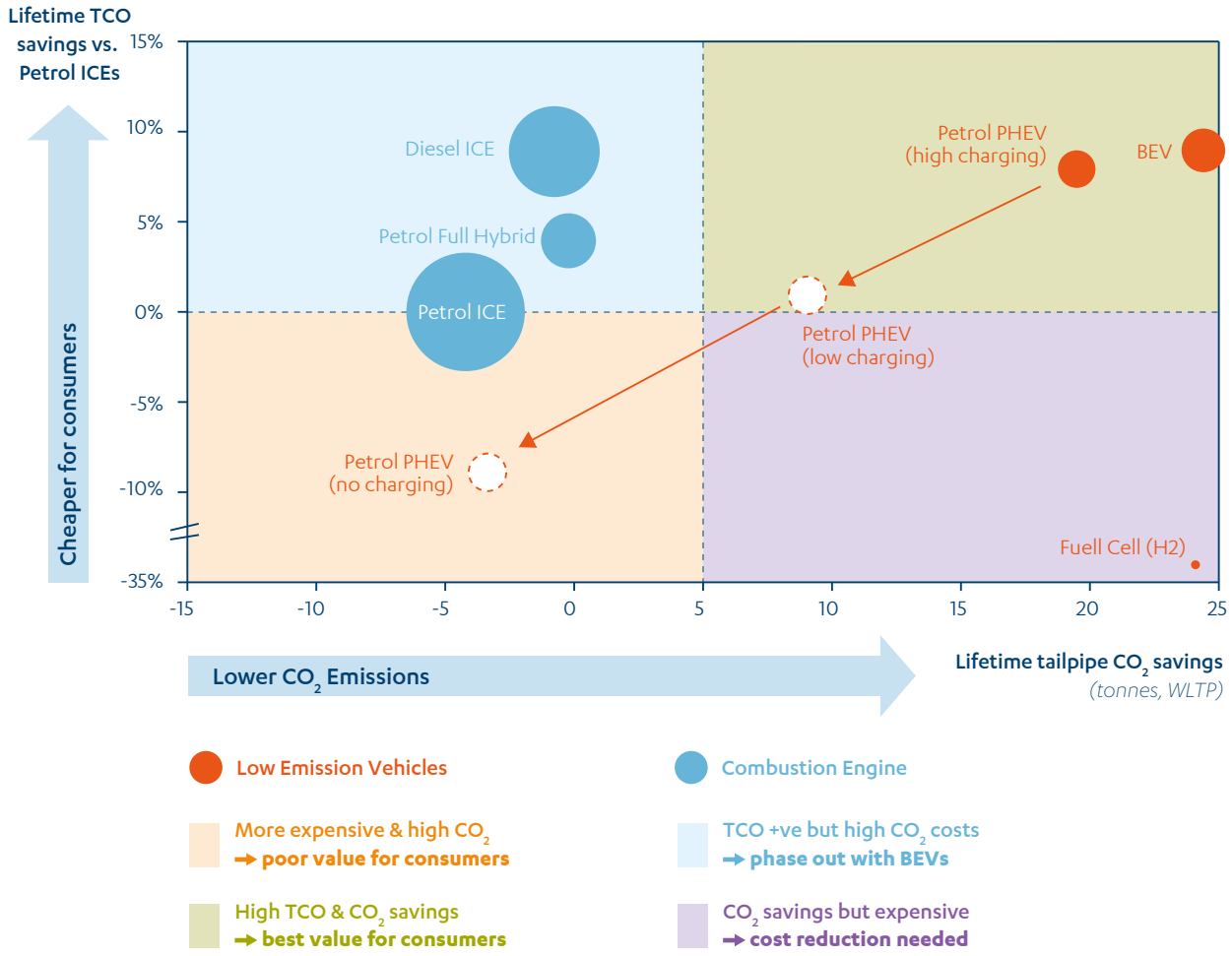

Figure 13: Medium car bought new in 2020 – lifetime savings over a petrol ICE and total lifetime WLTP tailpipe CO_2 savings vs. 2020 baseline (125gCO_2/km) per vehicle.

To quantify the environmental[23] gains, this EU-level study proposes to envisage a 60% BEV uptake (share of new vehicles sold in the EU) by 2030. Throughout the decade, electric cars will become even more competitive, and consumers are expected to buy them as supply goes up. BEVs could therefore contribute to most of the CO_2 emissions reduction from new cars, as displayed in Figure 14.

More importantly, the study also acknowledges that the sooner BEVs enter the market, the greater the environmental and financial benefits. Evidence thus calls for an 'early BEV adoption scenario' as the most cost-efficient way to reach the European Green Deal ambition of a 90% of CO_2 emissions in the transport sector by 2050 compared to 1990.

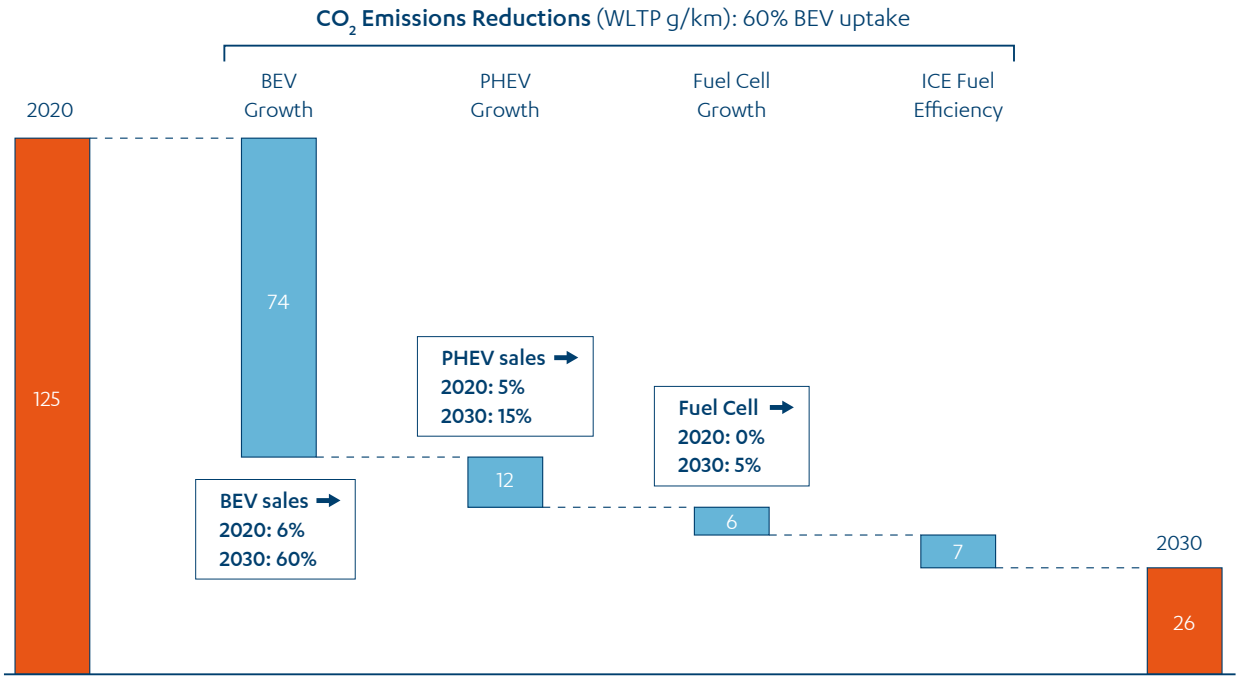

Figure 14: Breakdown of average WLTP emission reductions (new cars) for 60% uptake scenario by 2030.

To harness these financial, social, and environmental benefits (but also the health ones coming from improved air quality), the CO_2 standards regulation must therefore favour the uptake of BEVs over other powertrains as soon as possible, set ambitious emission reduction targets and remove all loopholes and mechanisms allowing car manufacturers to artificially reduce their emissions. A supportive regulatory framework at EU and national levels should accompany this regulation and address consumers' concerns in terms of charging or higher purchase price of electrics. It should also provide better information to consumers when buying a car.

[23] The study looks at the tailpipe emissions of vehicles, and do not compare the environmental impact of their production or the sourcing of materials for batteries. Other studies exist and confirm the environmental benefits of electric cars, notably Transport & Environment (March 2021), *From dirty oil to clean batteries*, https://www.transportenvironment.org/sites/te/files/publications/2021_02_Battery_raw_materials_report_final.pdf, (accessed 12 April 2021).

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