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Electric cars:

cheaper, more sustainable, and long-lasting

Already today, battery electric vehicles (EVs) can be the most interesting option for consumers who rely on a car and want to reduce their mobility costs. This was the conclusion of BEUC's total cost of ownership (TCO) study published in April 2021.

But, beyond the financial aspects, consumers still have questions regarding the climate impact or the durability of EVs and their batteries. Are EVs truly cleaner than conventional cars? Will I have to change my battery if I buy a second-hand electric car? Is it possible to recycle batteries?

In a new study, BEUC answers these questions and confirms the real potential for electric cars to help decarbonise daily mobility and unlock savings for consumers.

Are cars the only way to get around? No. Consumer groups advocate for alternatives to private car ownership. BEUC **calls for the improvement** of walking and cycling infrastructure, the development of public transport, higher quality rail services, and the integration of new mobility services into the sustainable mobility plans of cities and regions.

BEUC The European Consumer Organisation
The Consumer Voice in Europe

Questions at a glance

1 Do electric cars emit less CO2 than petrol cars over their lifetime?

Yes, between two and three times less CO2e[1] on a lifetime basis. While the production of an EV is currently more carbon intensive, the total life cycle CO2e emissions of an electric car are lower than those of a petrol car.

2 Would electric cars still be cheaper than conventional cars if we were to produce them more sustainably?

Yes. Decarbonising the supply chain of EVs is more expensive, but the savings for consumers from lower running costs still largely outweigh these costs.

3 Is battery-electric power the only sustainable solution for the future of passenger cars?

Fuel cell (hydrogen-powered) vehicles are costly and are not part of car makers' plans in the near future. E-fuels[2] would be way too expensive, not only for the first buyer, but mostly for consumers buying second- or third-hand vehicles for whom fuel costs represent a large share of their car expenditure.

4 How can consumers bear the additional costs of decarbonisation?

When taking a high-cost scenario, an electric car of which the production is decarbonised ('net-zero EV') in 2030 could still be more expensive to buy than a conventional car of which the production is decarbonised, and which would run on e-fuels ('net-zero conventional car'). Electric car owners would save money when driving their car (see question 2). Legislation should push car makers to produce more sustainably at a larger scale and reduced costs. Consumers should be supported in tackling the upfront costs of buying an EV via innovative schemes (financing, leasing, etc.) and promotion of shared use of vehicles.

5 Will consumers need to replace their electric car's battery?

This is very unlikely. Batteries are guaranteed for 160,000 km (or eight years, whichever comes first). This has become the industry standard. Even after the warranty period, any degradation of the battery is unlikely to pose issues for people's daily driving needs.

6 Can batteries be recycled?

Yes. Car makers will take profit from battery recycling, although limited value will directly reach consumers.

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1 CO2e = CO2 equivalent, meaning all greenhouse gas emissions are placed in relation with CO2.

2 E-fuels or synthetic fuels are carbon-neutral liquid fuels produced from CO2 capture and electricity from renewable sources. They can have similar properties to diesel and petrol and replace them in a car's tank.

BEUC's recommendations to policymakers

On accompanying consumers in the transition

- Establish stricter CO2 standards for cars, as this is a cost-effective measure to develop the electric vehicle market across all car segments.
- Design targeted purchase subsidies for small and medium electric cars, and allow consumers to access new financing schemes to mitigate a higher purchase price.
- Help the majority of consumers who buy second- and third-hand electric vehicles via dedicated financing schemes and conversion premiums.
- Promote car sharing schemes to maximise savings for consumers brought by the lower running costs of electric cars.
- Set requirements for company fleets and encourage high mileage drivers to go electric. This will accelerate the availability of electric cars on the second-hand market.

On 'sustainable' cars that are not battery-electric

- Do not promote the use of e-fuels in cars. They are too costly for consumers.

On decarbonisation and life cycle emissions

- Establish a methodology for calculating life cycle emissions of cars. This should promote the large-scale deployment of decarbonised technologies in EV production, maximise the CO2 savings of EVs, and reduce their cost for consumers.

On batteries

- Allow consumers to have easy and direct access to battery data in real-time and the 'state of health' of their batteries.
- Increase the legal warranty period for batteries to better reflect their life expectancy and promote long-life battery design.
- Promote sustainable battery production, due diligence for the whole supply chain, and durability criteria to increase trust.

Detailed questions and answers

Question 1: Do electric cars emit less CO2 than petrol cars over their lifetime?

Short answer: Yes, between two and three times less CO2e[3] on a lifetime basis. While the production of an EV is more carbon intensive, the total life cycle CO2e emissions of an electric car are lower than those of a petrol car.

Detailed explanation: While our previous study showed the financial benefits of EVs, the carbon footprint of the production of an EV battery often raises doubts among consumers about the real climate benefits of EVs compared to conventional petrol or diesel cars. **Other organisations** have already shown that in terms of CO2 emissions, EVs are better, no matter the scenario.

Our new research confirms this, based on a comprehensive literature review of the total life cycle CO2e emissions of passenger cars. On average, the greenhouse gas emissions from the vehicle when in use account for between 70 and 90% of total life cycle emissions for conventional cars, compared to 15 – 25% for EVs. On a lifetime basis, electric cars therefore emit way less CO2e emissions than conventional cars (see Figure 1).

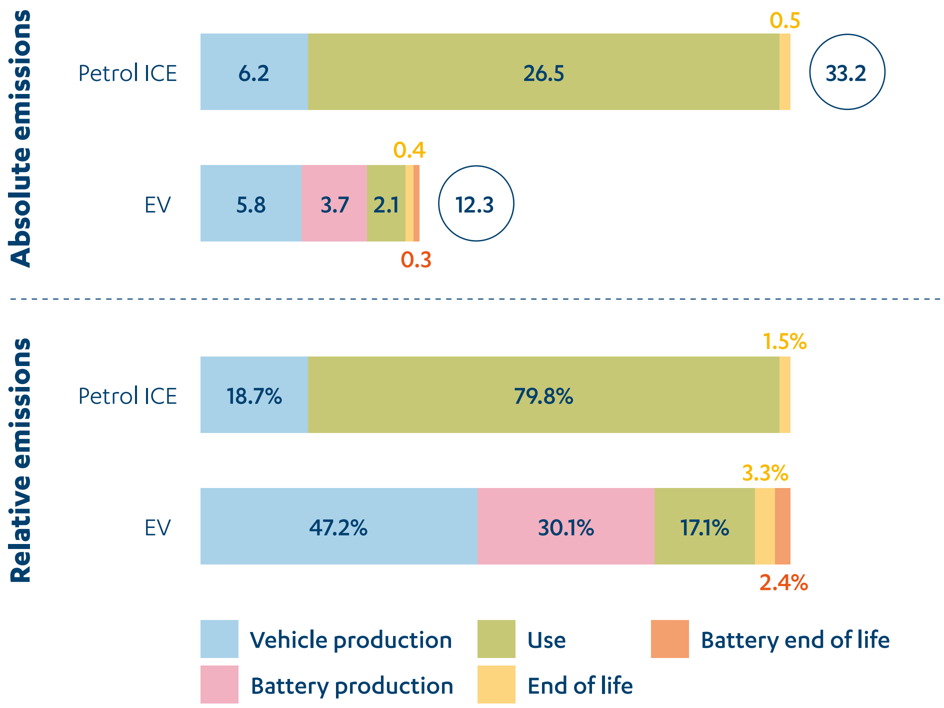
After approximatively 20,000 km, EV emissions fall below those of petrol and diesel cars, with the gap increasing with higher mileage. This shows electric cars' potential for new mobility habits, such as car sharing schemes. With lower running costs and greater climate benefits when in use, electric cars could maximise both consumer and CO2 emissions savings in such schemes (see question 4).

However, the production of an electric car and its battery accounts for the majority of its life cycle CO2e emissions, and the impact of this production is higher than it is for petrol cars. To achieve the climate objectives of the European Union, the decarbonisation of the production phase is essential. An EU-wide methodology on the life cycle emissions is the best way to reach that objective and maximise the CO2 emissions savings of electric cars (also see question 4).

3 CO2e = CO2 equivalent, meaning all greenhouse gas emissions are placed in relation with CO2.

Selected contribution of life cycle stages to total carbon emissions of a small passenger car (tCO_2e)[(A)]

150,000km functional unit, cradle-to-grave analysis, grid carbon intensity of 300 gCO_2e/kWh assumed



(A) How clean are electric cars? Transport & Environment's 2020 analysis of electric car life cycle CO2 emissions.

Figure 1: The life cycle total carbon emissions of electric cars versus petrol cars.
Source: ElementEnergy for BEUC.

Question 2: Would electric cars still be cheaper than conventional cars if we were to produce them more sustainably?

Short answer: Yes. Decarbonising the supply chain of EVs is more expensive, but the savings for consumers from lower running costs still largely outweigh these costs.

Detailed explanation: In the first question, we confirmed the lower life cycle CO2 emissions of electric cars compared to conventional cars running on petrol. Yet, to achieve the EU's climate ambitions and to reduce the overall environmental impact of cars and batteries, the production phase of cars needs to be cleaner. And that could lead to more costs for consumers down the road.

In our new research, we estimated decarbonisation costs of the production and distribution of an electric car versus those of a conventional car that would run on e-fuels. These two options would be what comes the closest to a 'carbon neutral' car option for 2030. We looked at the decarbonisation costs of the mining, manufacturing, assembly, and distribution processes, while considering the materials a car is made of (steel, aluminium, plastic, rubber, copper, glass, battery components).

In our previous **'Total Cost of Ownership' study**, we showed that an electric car bought new in 2030 will save its first owner around €3,800 compared to an equivalent petrol car in the four-year ownership period. EV production costs an additional €3,200 to decarbonise, compared to at best €2,100 for conventional cars. The most significant difference is the additional battery decarbonisation cost, which is around €1,200. Note that our scenario took a pessimistic approach for the decarbonisation costs of EVs and an optimistic one for internal combustion engine vehicles (ICEVs).

Despite these higher decarbonisation costs that could be passed on to consumers, EVs will still provide them significant savings. Under a pessimistic case for the decarbonisation of EV production,[4] the first owner of a 'carbon neutral' EV would still save around €2,000 compared to a conventional car running on petrol and between €3,800 and €6,700 compared to a 'carbon neutral' conventional car running on e-fuels.

Electric cars can also be considered more socially equitable engines. The first owner of an EV pays a higher share of the lifetime total cost of ownership of the car, meaning second- and third-hand buyers benefit from greater savings due to lower running costs, which are the most important for their expenditure.

4 There are potential scenarios impacting the decarbonisation cots, notably the price of renewable energy, green hydrogen, and battery material.

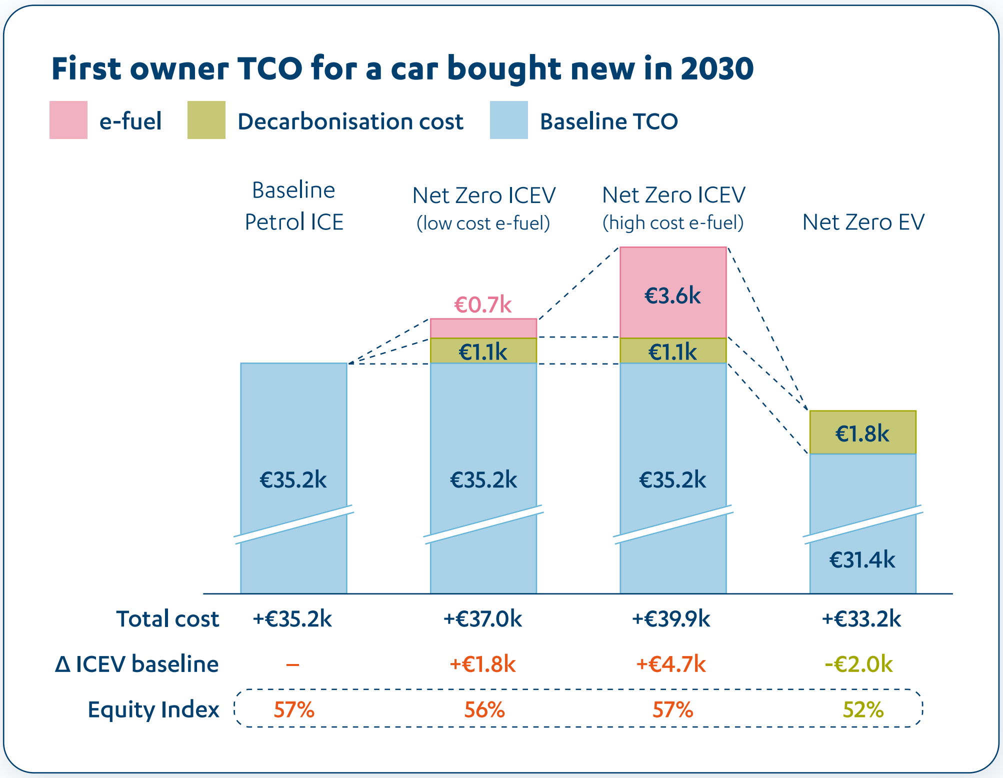


Figure 2: First owner Total Cost of Ownership (TCO) for a car bought new in 2030.
Source: ElementEnergy for BEUC.

Question 3: Is battery-electric power the only sustainable solution for the future of passenger cars?

Short answer: Fuel cell (hydrogen-powered) vehicles are costly and are not part of car makers' plans in the near future. E-fuels[5] would be way too expensive, not only for the first buyer, but mostly for consumers buying second- or third-hand vehicles for whom fuel costs represent a large share of their car expenditure.

Detailed explanation: Our previous research showed that fuel cell vehicles will not be competitive before 2030 at the earliest.

E-fuels are sometimes presented as an alternative to the electrification of cars, despite strong evidence showing the issues around cost, efficiency, pollutant emissions, and large-scale availability of these fuels. Our research compared the decarbonisation costs of conventional cars, which, to be carbon neutral throughout their lifetime, require the use of e-fuels when the cars are on the road.

5 E-fuels or synthetic fuels are carbon-neutral liquid fuels produced from CO2 capture and electricity from renewable sources. They can have similar properties to diesel and petrol and replace them in a car's tank.

While under the scenario considered in our study the production of a 'carbon neutral' (net-zero) conventional car is cheaper, the use of e-fuels – for the car to be 'carbon neutral' over its lifetime – increases the running costs for all owners of that car. In contrast, the decarbonisation costs of EVs are largely supported by the first buyer – which can be a consumer, but also a leasing company. And BEUC's earlier study already showed that second- and third buyers see the greatest benefits of an electric car due to its low running costs. That is already the case compared to a petrol car.

With running costs being the most prominent ones for second- and third-hand buyers, e-fuels are clearly not a suitable option for them. Our research compared a pessimistic 'decarbonisation cost scenario' for EVs and an optimistic one for ICEVs. But there is high variation regarding the costs of e-fuels when considering a less optimistic scenario (see Figure 2). This risk will be directly passed on to lower-income consumers.

Question 4: How can consumers bear the additional costs of decarbonisation?

Short answer: When taking a high-cost scenario, an electric car of which the production is decarbonised ('net-zero EV') in 2030 could still be more expensive to buy than a conventional car of which the production is decarbonised, and which would run on e-fuels ('net-zero conventional car'). Electric car owners would save money when driving their car (see question 2). Legislation should push car makers to produce more sustainably at a larger scale and reduced costs. Consumers should be supported in tackling the upfront costs of buying an EV via innovative schemes (financing, leasing, etc.) and promotion of shared use of vehicles.

Detailed explanation: In 2030, a medium EV could remain around €1,200 more expensive to buy than a petrol ICEV. These uncertainties about the costs require policymakers to take actions maximising the costs and emissions savings of EVs: first buyers should switch to electric as soon as possible to reduce emissions of vehicles on the road and allow lower-income consumers to easily find second- and third-hand electric cars to save money.

Moreover, decarbonisation costs and new taxation regimes will be shared among car makers and consumers. Legislation should then promote the use of electric vehicles in the most sustainable way: by supporting consumers to tackle the upfront costs of buying an EV, via innovative schemes (financing, leasing, etc.), and the shared use of vehicles.

To complement the mitigation of cost-associated risks, there needs to be a common methodology to assess the life cycle emissions of cars. Such a methodology pushes car makers and suppliers to decarbonise the whole supply chain of a car and promotes recycling. A methodology encouraging 'net zero' production could foster competition, leading to innovative ways to decarbonise at industrial scale.[6] It could also promote lighter vehicles, more efficient batteries, recycling of metals and tyres, or the self-generation of renewable electricity.

The large-scale deployment of decarbonised technologies that reduce life cycle emissions, also promoted via sectoral legislation, is essential to cut the cost impact of decarbonisation for consumers. As mentioned, it also helps lower the higher upfront CO2 emissions associated with EV production.

Question 5: Will consumers need to replace their electric car's battery?

Short answer: This is very unlikely. Batteries are guaranteed 160,000 km (or eight years, whichever comes first). This has become the industry standard. Even after the warranty period, any degradation of the battery is unlikely to pose issues for people's daily driving needs.

Detailed explanation: Our research shows that consumers are very unlikely to require out-of-warranty battery replacements for current generation EVs. In the last decade, improved battery technology has led car makers to guarantee greater battery mileages and capacities. With larger battery packs and new cooling technologies, degradation is limited.

The 'industry standard' is a 160,000 km warranty (or eight years, whichever comes first) across leading EV models (see Figure 3), which is close to an average car's mileage in its lifetime (approximately 200,000 km). This means that batteries will last at least as long as the car itself, and out-of-warranty battery replacements are very unlikely to be required by consumers.

6 Our study looked in detail at the technologies and industrial processes that decarbonise production and distribution of cars and batteries.

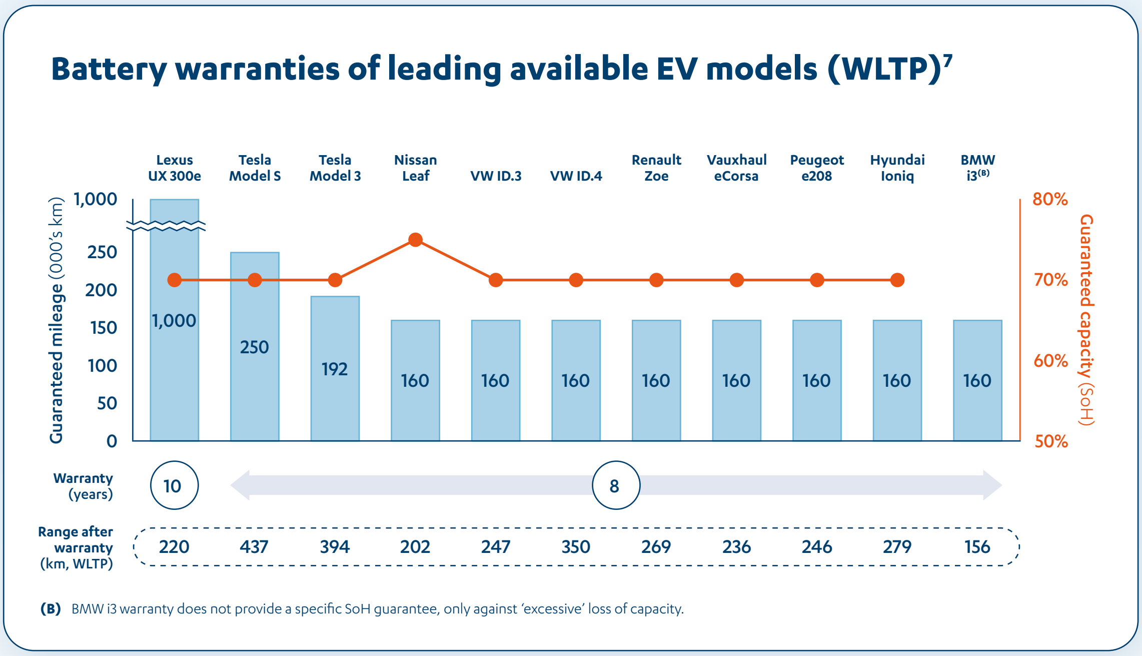


Figure 3: Battery warranties and range after warranty of EVs.
Source: ElementEnergy for BEUC.

'Real world' EV battery degradation data is also becoming available and indicates that cars reach 150,000 km or more before seeing a 20% decrease in their battery capacity.

Moreover, based on previous findings, our research considers that the battery range after warranty is still sufficient for a majority of consumers. A consumer driving 15,000 km per year with a Nissan Leaf (with a battery capacity of 62 kWh) would only need an additional two charging stops a year with a battery at 70% of its capacity at the end of the warranty period.

Finally, it is estimated that current batteries will never require a replacement, with the associated costs of battery replacement being greater than the residual value of the car (see Figure 4). Only older models, such as the 2015 Nissan Leaf, could potentially benefit from a battery replacement, but the demand is so low that the car makers rely only on batteries sourced from cashed vehicles.

Side note: in the worst-case scenario, EVs remain the cheapest option even with battery replacement. That is because 'non-routine' maintenance costs of conventional cars (which were largely discounted in **BEUC's 2020 'Total Cost of Ownership' study***) also increases with increased mileage. Taking into account these 'non-routine' costs of conventional cars when discussing the unlikely need to replace an EV battery allows to level the discussion when it comes to battery replacement, taken as an extraordinary case.*

Legislation allowing consumers to see the 'state of health' of their battery in real time and maximum battery degradation criteria could help boost consumer confidence in the longevity of their EV, particularly for used owners when purchasing a second- or third-hand EV.

7 WLTP = Worldwide harmonised Light vehicles Test Procedure. More info in this **2017 BEUC press release.**

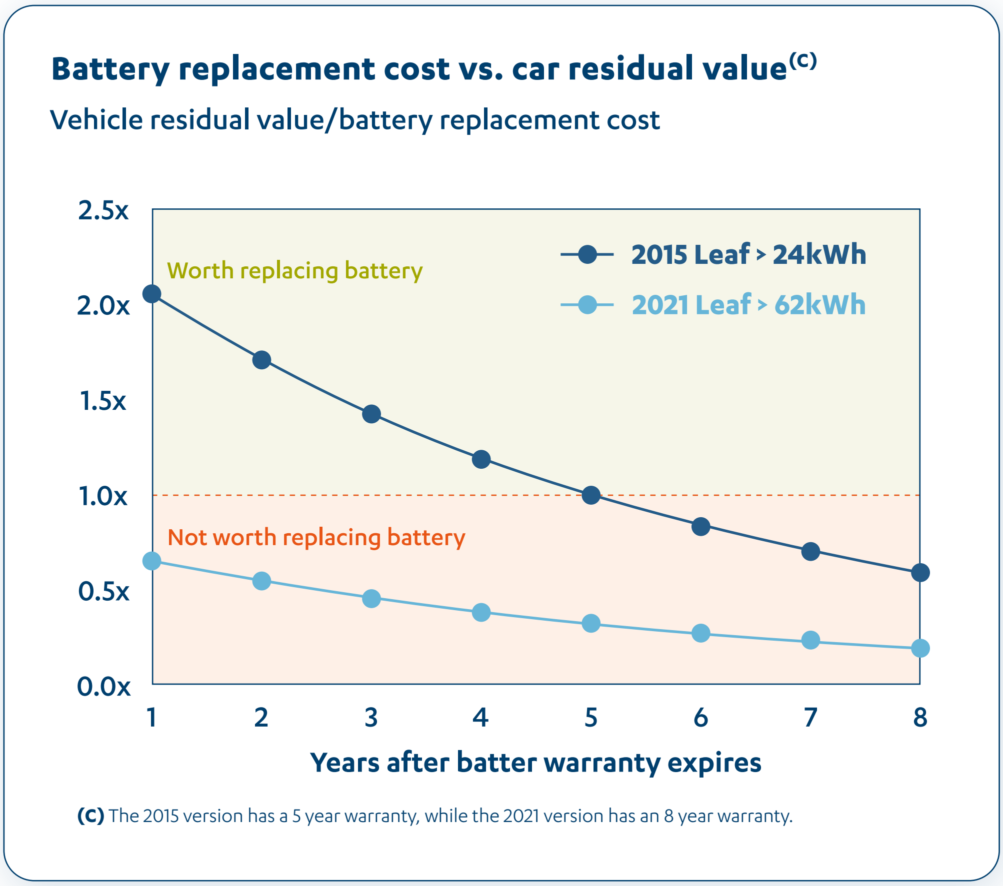


Figure 4: Battery replacement costs versus car residual value.
Source: ElementEnergy for BEUC.

Question 6: Can batteries be recycled?

Short answer: Yes. Car makers will take profit from battery recycling, although limited value will directly reach consumers.

Detailed explanation: Value from battery recycling could cover decarbonisation costs for car makers and make an economical contribution to achieving a 'net zero' car.

Our research estimates that the 'end-of-life' value of a battery can be up to €1,500 by 2040. This could lead to new specialised recyclers making profit from this activity.

There is also a risk for battery recycling to mainly take place outside the EU due to higher additional profitability in China, but the gap between the EU and China could be reduced via automation and requirements on decarbonised recycling techniques.

In the current situation, there is no political or economic reason why significant value from battery recycling will reach the consumer. Battery recyclers and/or car makers are most likely to retain the majority of the profits.

However, this could easily change in the more distant future. Let us imagine a consumer who wants to sell a third-hand electric car to their dealership. In a couple of decades, this car dealer will have a business case to buy this car back and recycle its battery. That is because the materials of an old battery can be used to produce a new one. As a result, once we are in a world where electric cars are reaching their end of life, an EV owner will likely get more money for their old vehicle than the owner of a petrol car.

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Contact: sustainability@beuc.eu

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