

Powertrain 2020

Electric Vehicles – Voice of the Customer

Munich, 2010

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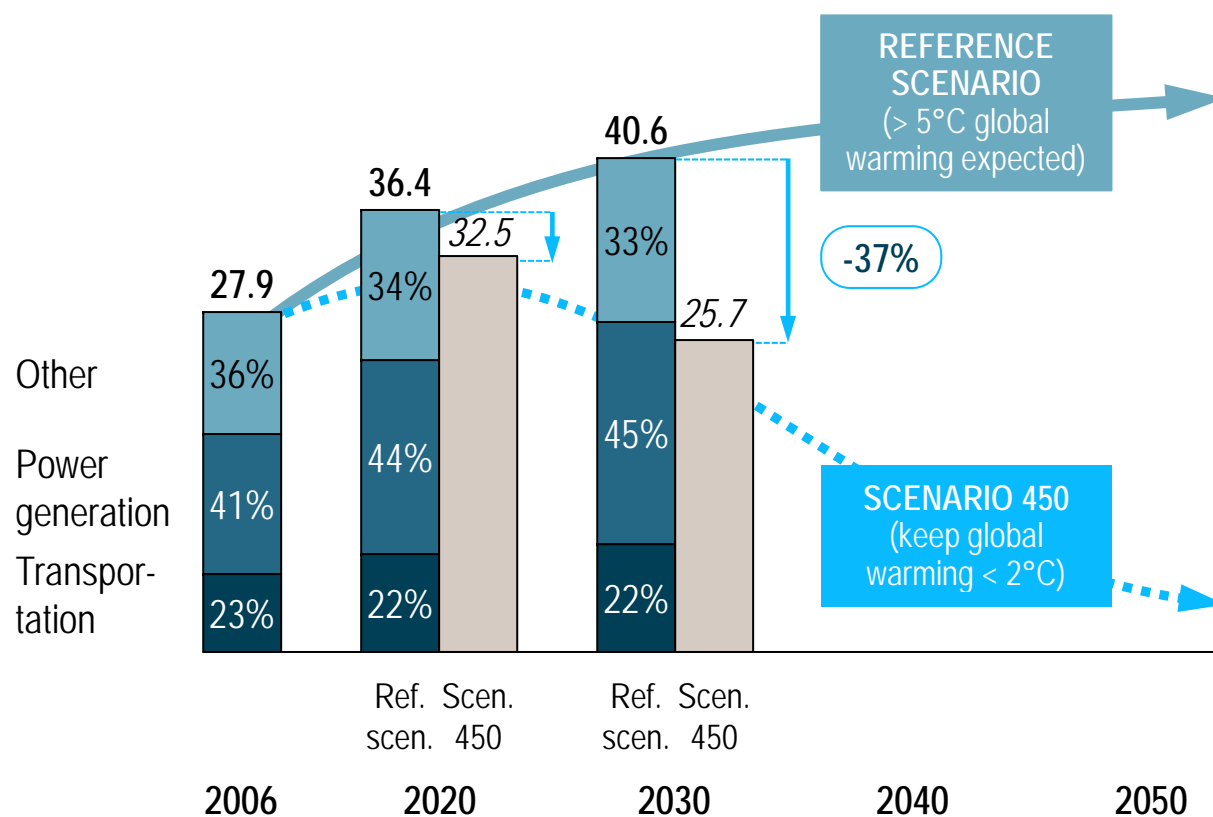
A. Background – Scarce resources and tougher regulations drive the electrification of the powertrain

Roland Berger
Strategy Consultants



Recently, all G8 countries pledged to limit the increase in global warming to 2°C – Significant efforts from all sectors required

Global CO₂ emissions forecast [Gt CO₂]

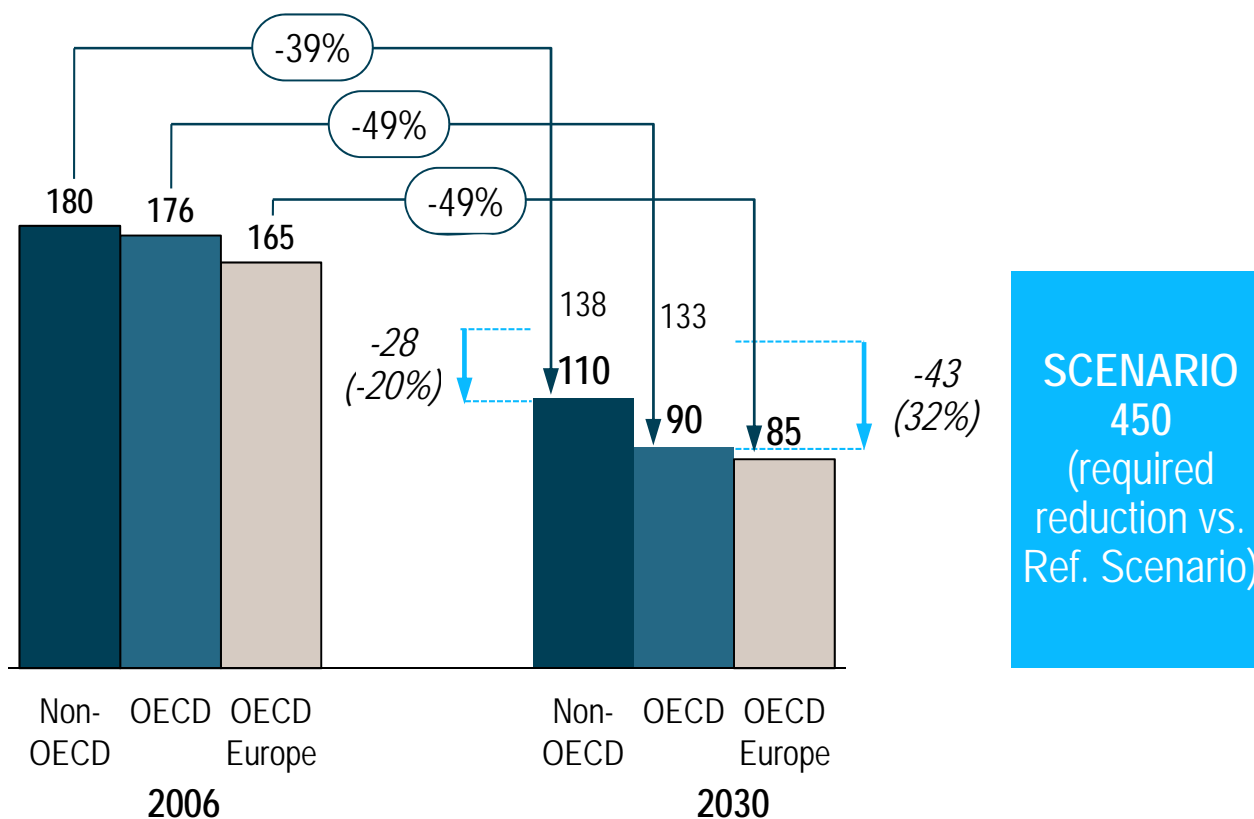


COMMENTS

- > Reference Scenario of 45% increase in CO₂ emissions likely to lead to >5°C global warming
- > Transportation sector emissions grow by 39% with all growth outside the OECD
- > To keep warming <2°C, major CO₂ reductions need to be achieved (Scenario 450)

CO₂ emissions of light duty vehicle stock have to be reduced by 49% until 2030 in OECD countries to meet "Scenario 450"

Average LDV¹⁾ CO₂ emissions [vehicle stock, g/km]



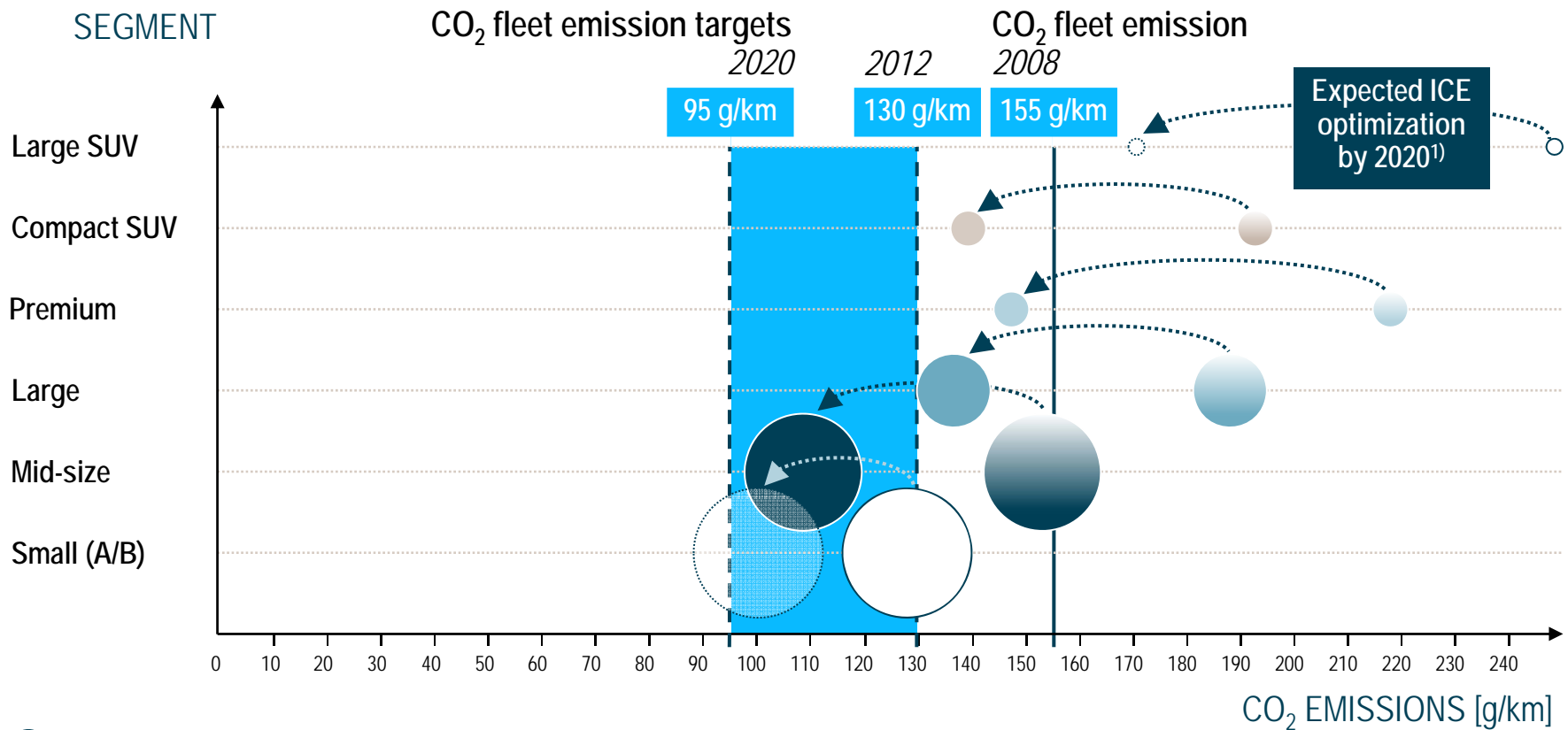
COMMENTS

- > LDV emissions make up about 9% of global CO₂ emissions (and 40% of all transportation emissions)
- > In Scenario 450, OECD countries are required to reduce average vehicle stock emissions by 49% (43 g/km below the expected level in Reference Scenario)
- > Further reduction of certified CO₂ emissions is necessary (i.e. on-road CO₂ emissions are also relevant)

1) Light-duty vehicles

ICE powertrain optimization can help to reduce CO2 reductions by 30% to 40% compared to today

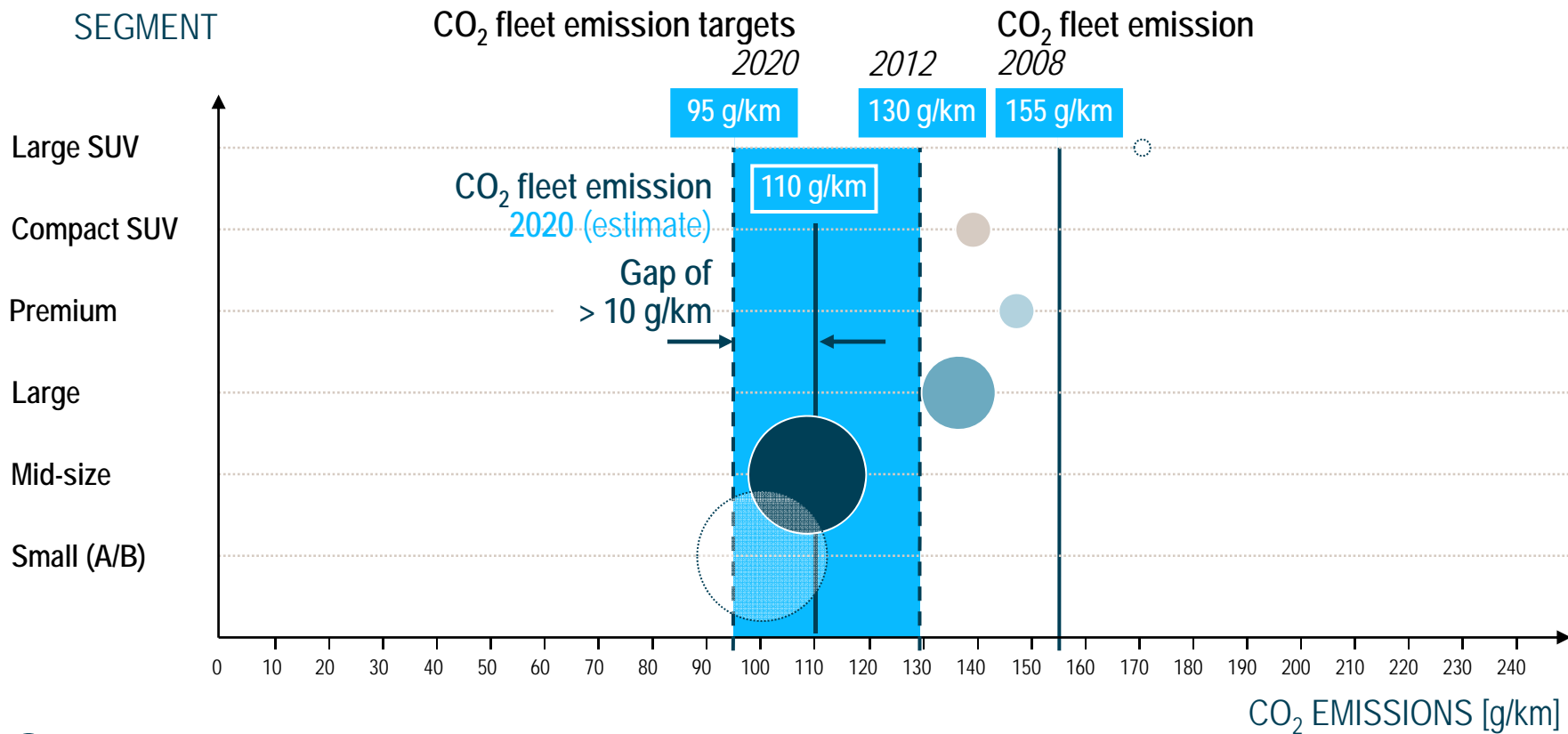
European CO₂ fleet emissions – 2008 and forecast for 2020



Shows the market size for a specific vehicle segment 1) Not considering EV/PHEV

To reach EU CO₂-emission limits of 95 g/km in 2020 (partial) Zero Emission Vehicles (EVs or PHEVs) are needed

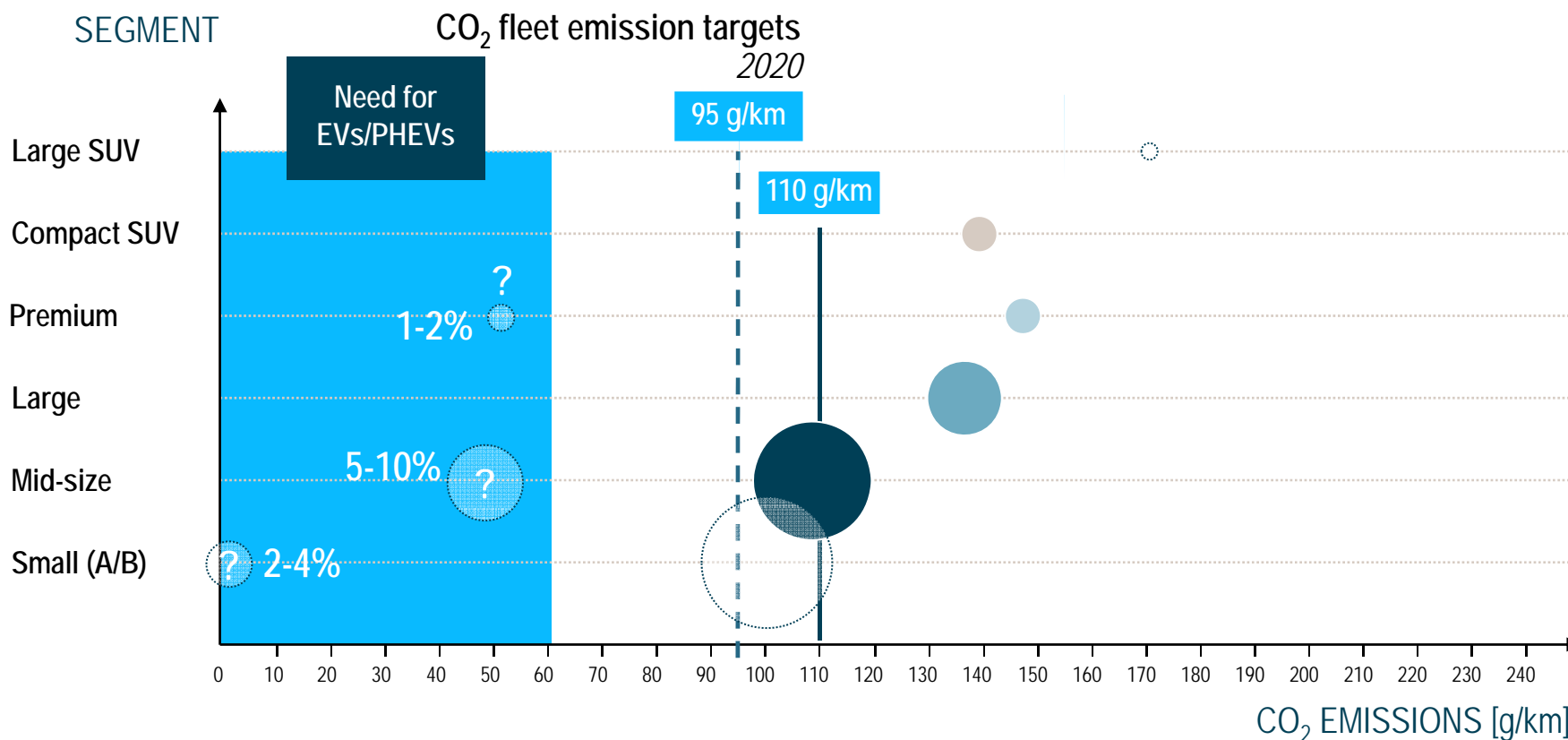
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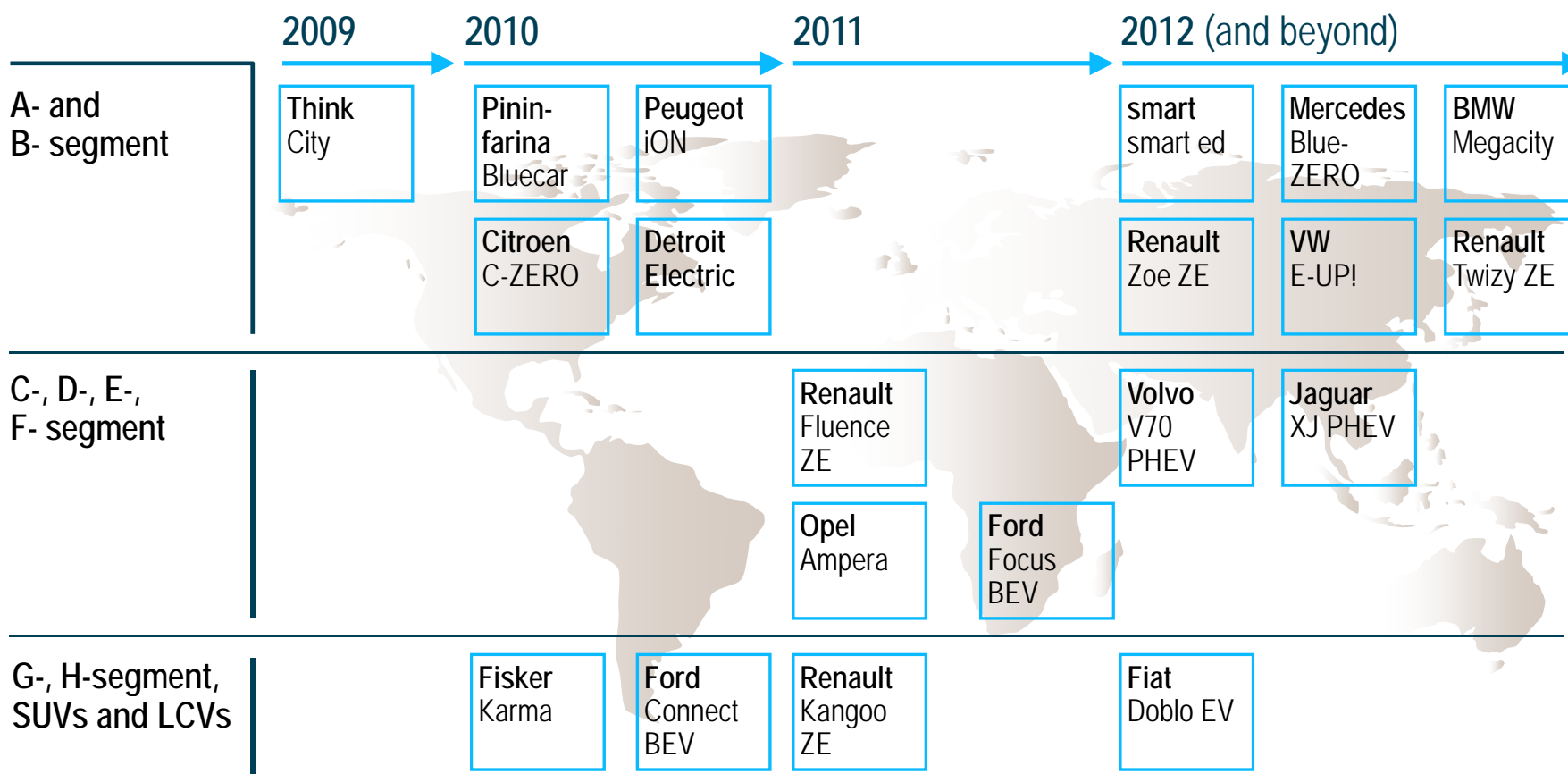
European CO₂ fleet emissions – 2008 and forecast for 2020



Shows the market size for a specific vehicle segment

More than 20 EV/PHEV models will enter the market by 2012 – Customers are then able to select from a wider model range

Expected market launch of the series EV/PHEV models by WE OEMs, 2009-2012





B. Some good news – Customers' affinity to electric vehicles is already high

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Strategy Consultants

tns infratest



Together with TNS Infratest, Roland Berger conducted a study on customers' affinity to electric mobility

European customer survey March/April 2010

OBJECTIVES

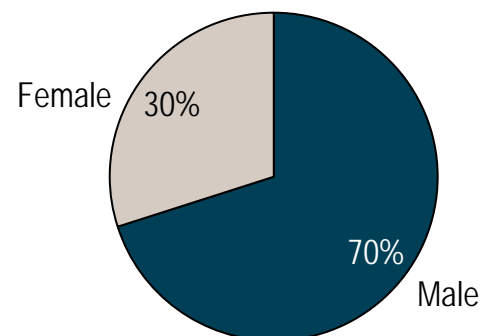
- > Objective of this survey was to assess customers' affinity to electric mobility, specific mobility services and their related willingness to pay

METHOD

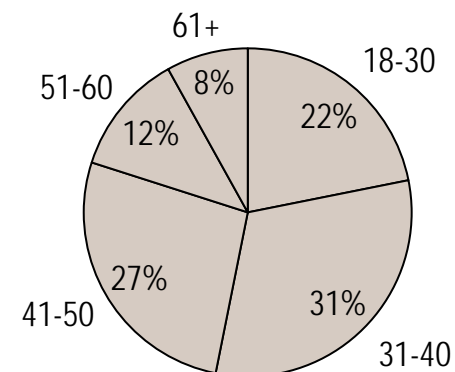
- > TNS Infratest interviewed 483 customers from urban areas in Germany and France
- > The survey was conducted using online interviews during March and April 2010

SURVEY SAMPLE

Gender



Age

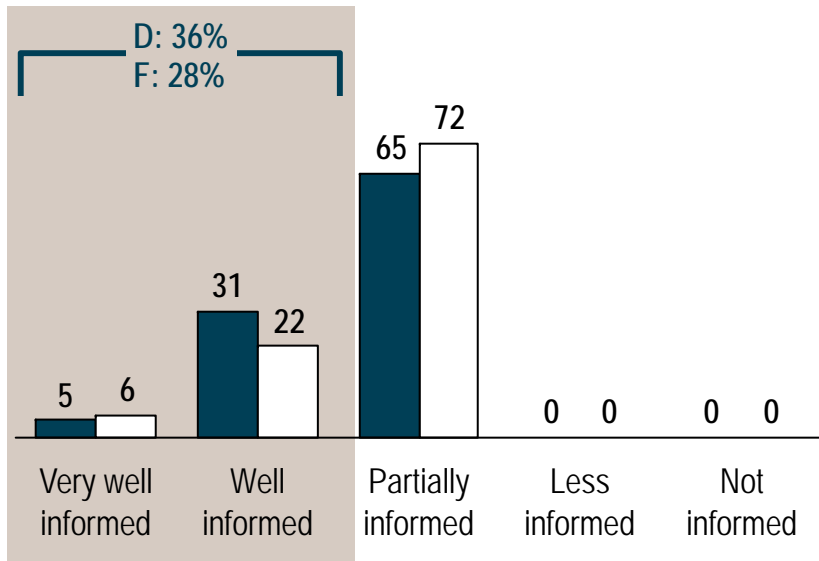


Although two thirds state not to be well informed about electric vehicles, propensity to buy is already high

Level of information and propensity to buy

LEVEL OF INFORMATION

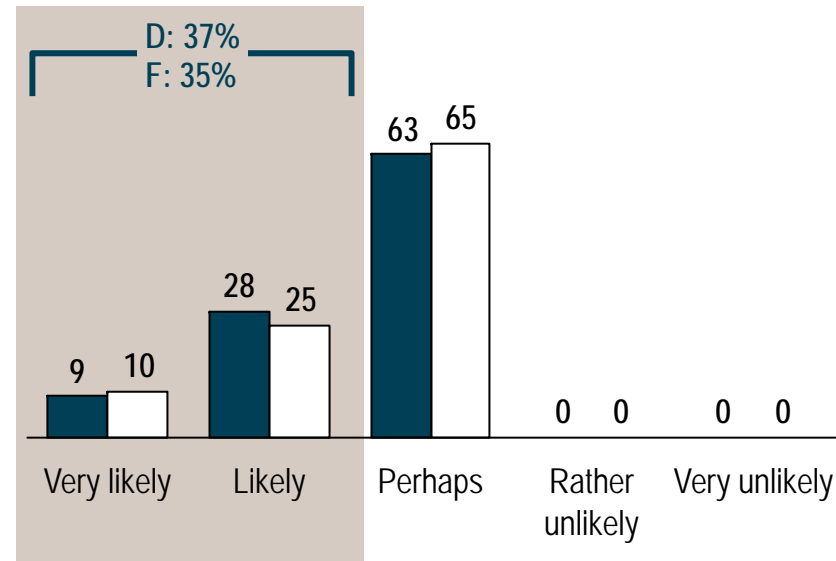
"How well informed are you concerning electric vehicles?" [%]



Germany France

INCLINATION TO BUY

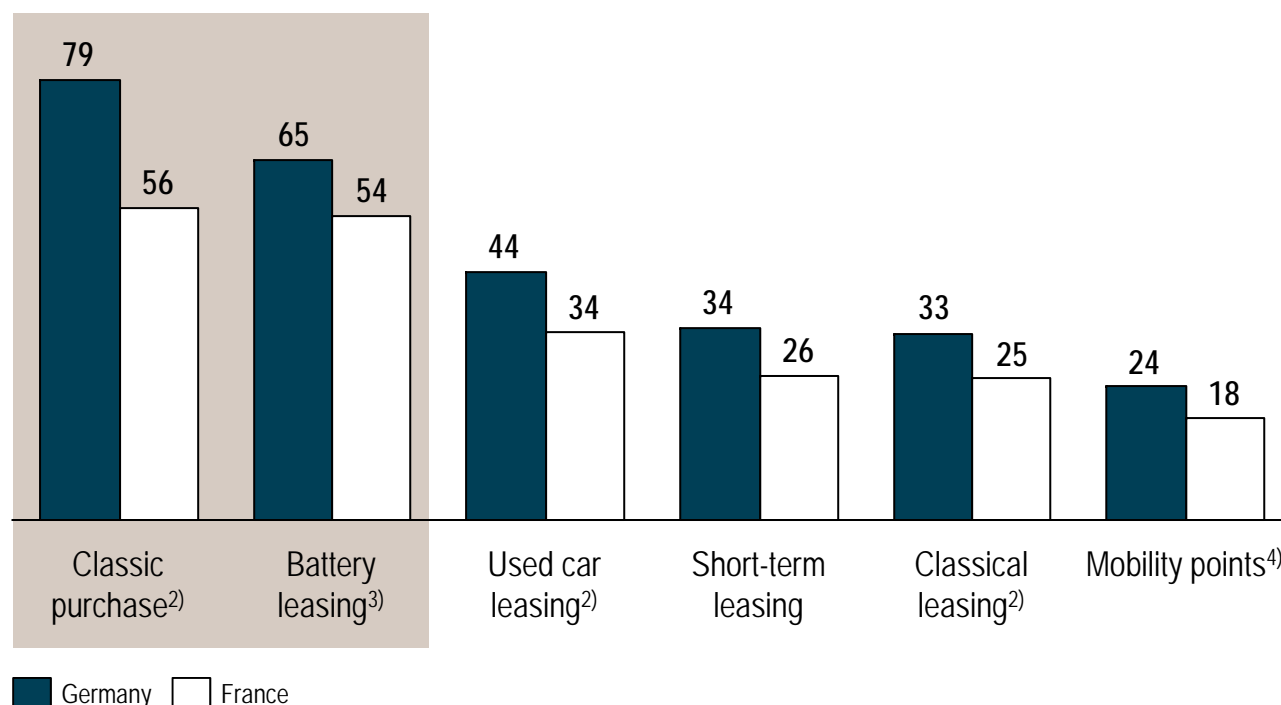
"Would you consider buying an electric vehicle?" [%]



The classic purchase is most attractive – Separated battery leasing is already highly accepted

Attractiveness of purchase methods

"How interesting are the following methods of purchase?"¹⁾ [%]



COMMENTS

- > German and French customers prefer a classic purchase of the vehicle (dominance especially high in Germany)
- > Battery leasing, i.e. purchase of the vehicle with leasing of the battery (separate provider, 36-48 months duration), is already highly attractive – in France nearly no difference to attractiveness of a classic purchase

1) Only top 2 boxes of 5 step scale ("Interests me a lot"; "Interests me") 2) Vehicle and battery 3) Classic purchase of vehicle with separate leasing of the battery
4) Purchase of credit points which can be used for various mobility solutions, 80% of points must be used for electric vehicles

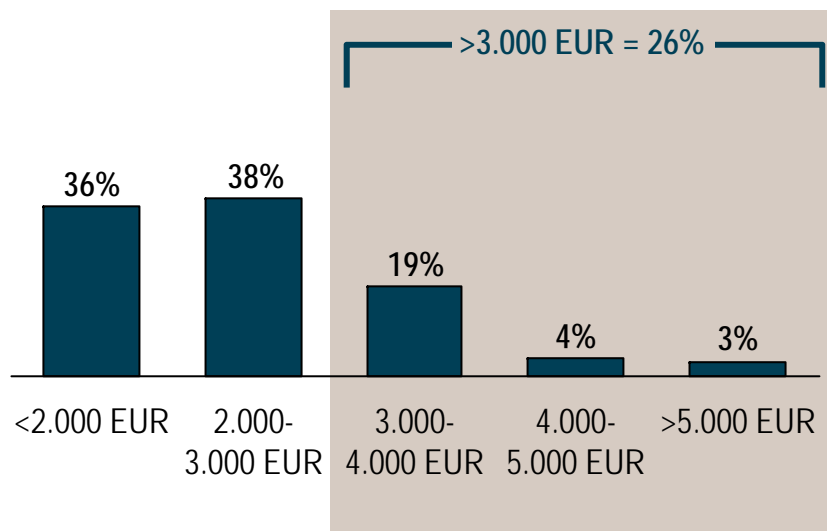
Around 25% would be willing to spend over 3,000 EUR more for an electric vehicle than they would for a conventional car

Willingness to pay for top-two purchase methods¹⁾

CLASSIC PURCHASE

"How much would you be willing to pay more for an EV compared to a conventional vehicle?"²⁾

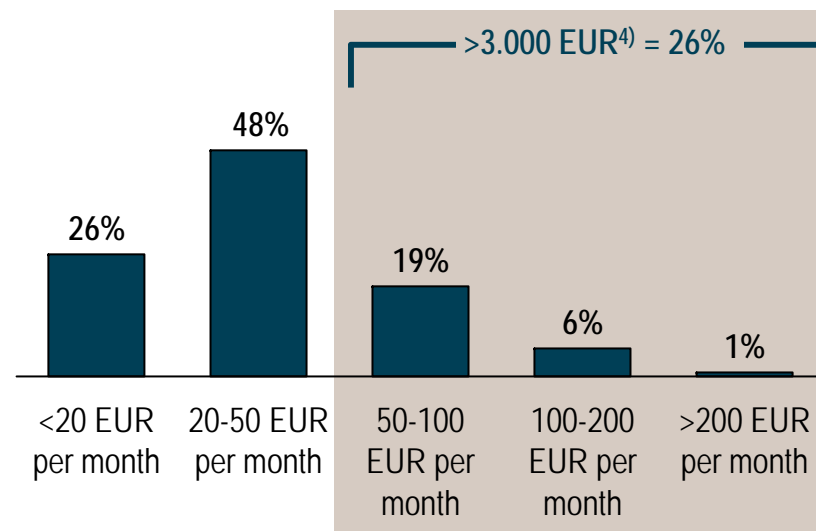
AVERAGE: -2.300 EUR³⁾



BATTERY LEASING (36-48 MONTHS)

"How much would you be willing to pay for a battery leasing?"²⁾

AVERAGE⁴⁾: -1.850 EUR

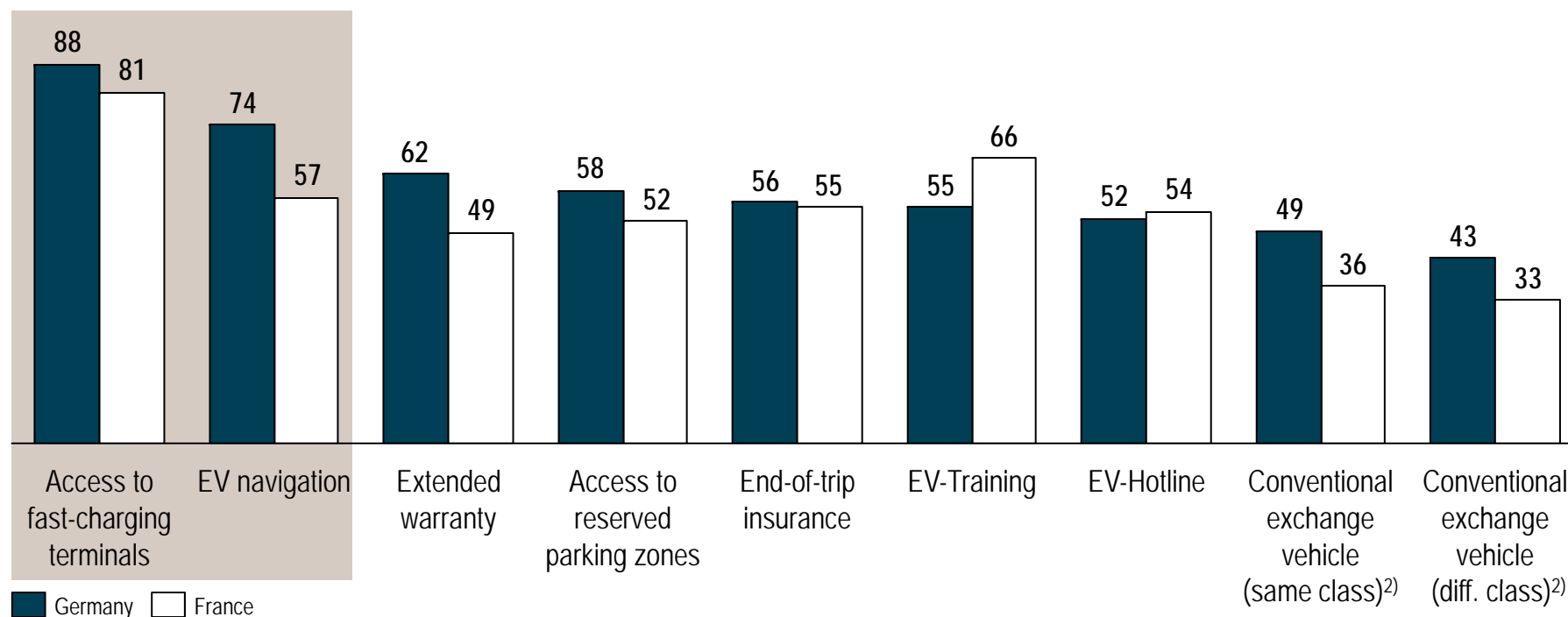


1) Results for Germany and France 2) Only interviewees with positive interest concerning method of purchase 3) Assuming 1.000 EUR for cluster "<2.000 EUR"; 5.000 EUR for cluster ">5.000EUR" and average of end values for each other interval (e.g. 2.500 for "2.000-3.000 EUR" cluster 4) Calculated for 42 months period, assuming 10EUR for cluster "<20EUR", 200 EUR for cluster ">200EUR" and average of end values for each interval (e.g. 75 EUR for "50-100EUR")

Especially services securing all-time availability and convenient charging are interesting for consumers

Attractiveness of EV related services

"How interesting are the following EV related services?" [%]

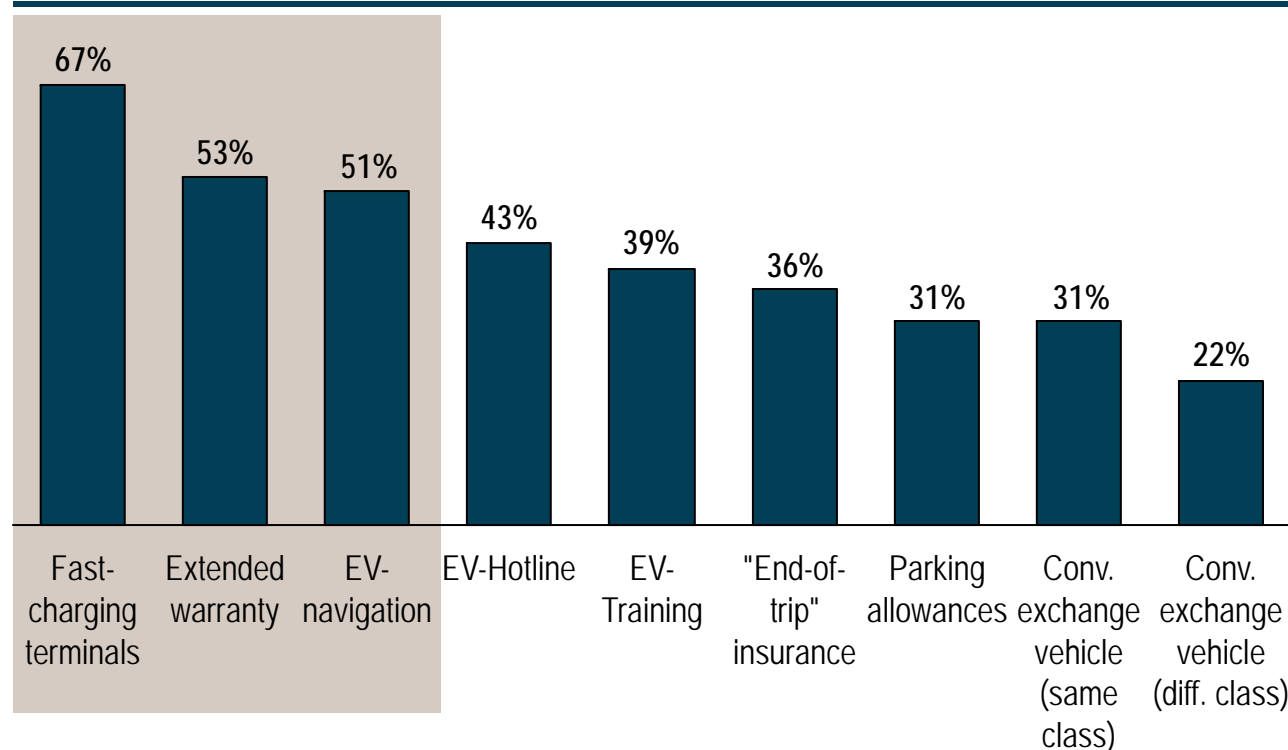


1) Only top 2 boxes of 5 step scale ("Interests me a lot"; Interests me) 2) Right to exchange EV with conventional vehicle (max. 5 times a year for 2-3 times)
3) At train stations, airports, including 5% discount 4) Guarantees arrival at destination (exchange of vehicle within 30 minutes) 5) Charging stations, specific routes, etc.

Fast-charging terminals, an extended warranty and an EV-specific navigation system are regarded as must-haves for Premium brands

EV related services – "Must-haves" for premium brands¹⁾ [%]

"Which services would you regard as must-haves for Premium brands?"



COMMENTS

- > More than half of the interviewees regard access to fast-charging terminals, an extended warranty and an EV-specific navigation system as a "must-have" for electric vehicles from Premium brands
- > Ability to exchange the vehicle with a conventional car ranks lowest

1) Multiple responses possible; results for Germany and France



C. The challenge – Business model innovations and new profit sources are needed to cover additional component costs

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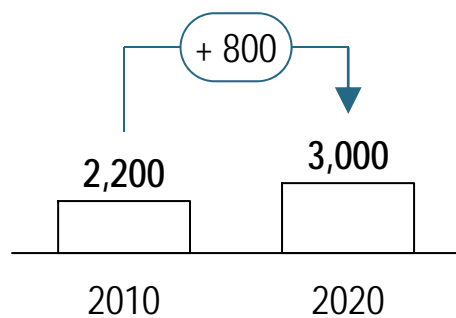


The cost difference between EVs/ PHEVs and conventional combustion engines is unlikely to fall below EUR 4,000 before 2020

Approximate cost of powertrain for mid-size vehicles [EUR]

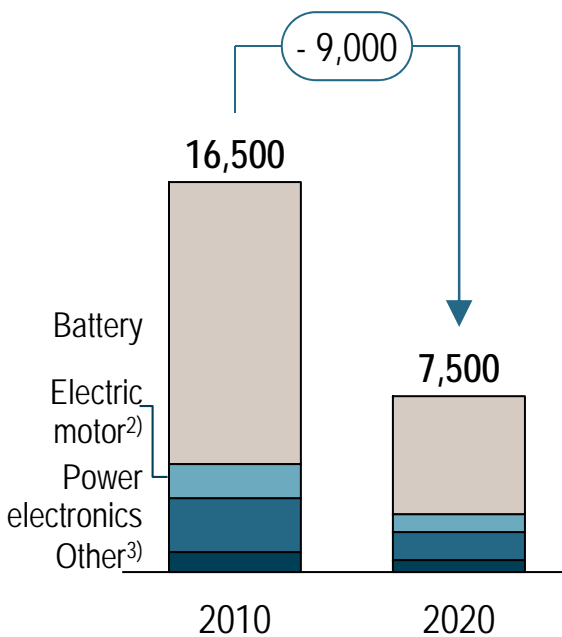
GASOLINE

Powertrain costs



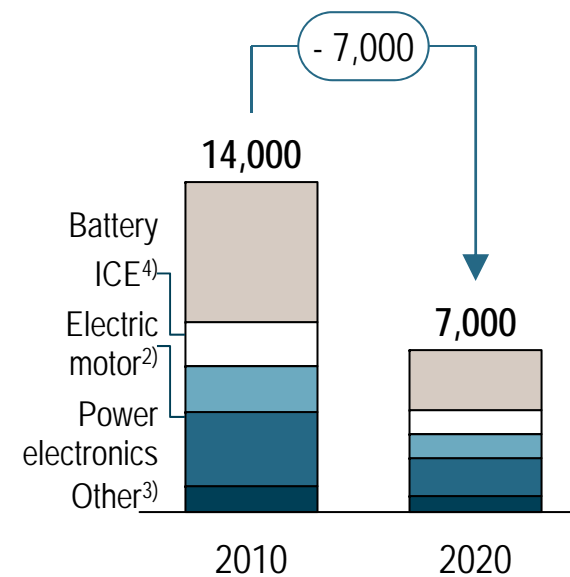
EV

Powertrain costs



PHEV¹⁾

Powertrain costs

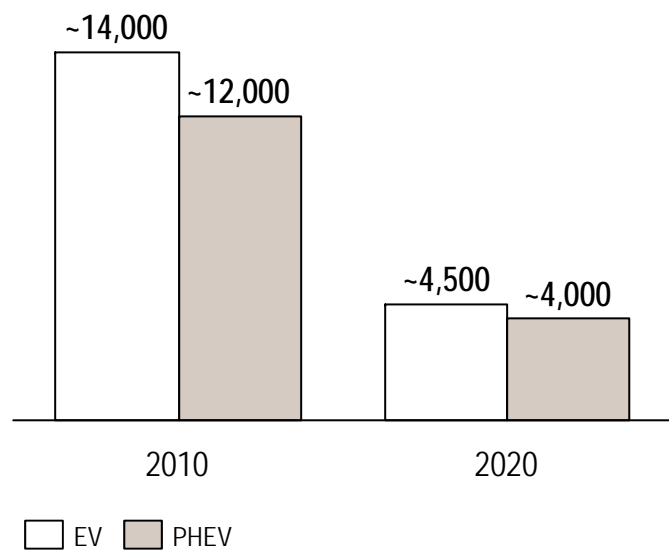


1) Serial hybrid layout 2) Incl. single stage gearbox 3) Cooling, adaption transmission and wiring harness 4) Incl. generator

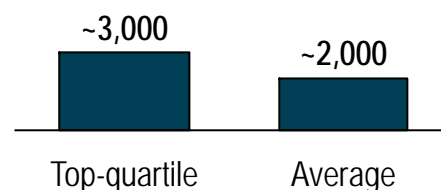
With cost differences still above 4,000 EUR in 2020, additional revenue sources are needed to allow for a profitable diffusion of EVs

Cost difference vs. gasoline engines and customers' willingness to spend [EUR]

Cost difference compared to gasoline engine



Willingness to spend¹⁾



IMPLICATIONS

- > Even under positive assumptions concerning component cost development customers' willingness to spend will not be sufficient to cover the additional costs of an electric powertrain until 2020
- > Additional revenue sources are needed to close the EV profit gap

1) Estimate based on willingness to pay more for an EV in the context of a classic purchase or battery leasing

Additional profit sources from within and outside of the customer have to be explored to close the profit gap related to electric vehicles

Potential additional profit sources for electric vehicles

From the CUSTOMER


- > EV-related **services** (e.g. specific navigation, warranties and insurances)
- > Attractive **financing solutions** including the total cost of ownership advantage in the payment
- > **Mobility flat-fees** including all related cost and allowing free-of-charge mileage within a specific area
- > ...

From OTHER SOURCES

- > **Secondary marketing of the battery** (e.g. for the use after its lifetime in the vehicle)
- > Integration of the vehicle in **smart-grid-concepts** allowing an intelligent charging and the capability to use the battery to balance demand and supply peaks in the network
- > ...



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It's character
that creates
impact!