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Users and preferences: What really drives BEV adoption in Germany?

S. Hasselwander, M. Bergfeld, M. Kleinermann, ATZlive – Elektrische Antriebe und Energiesysteme, May 20th, 2026

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Our facts: We have been keeping things moving - since 2002

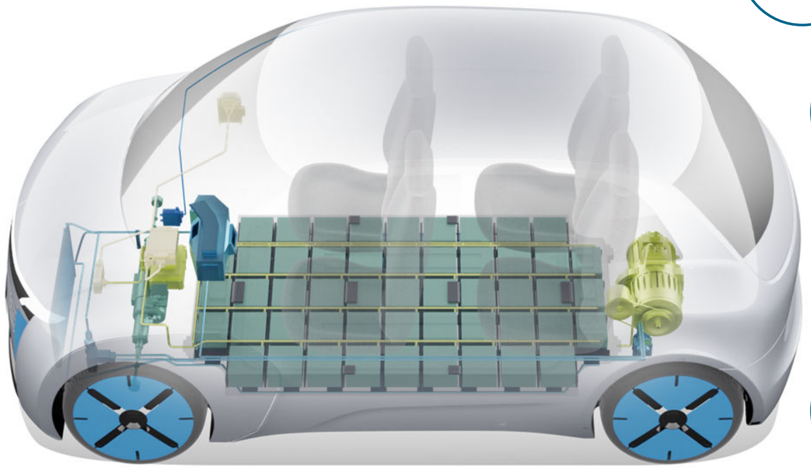
160
Multidisciplinary researchers

37%
Third-party funds

22 m€
Annual budget

6
Fields of innovation

Structure



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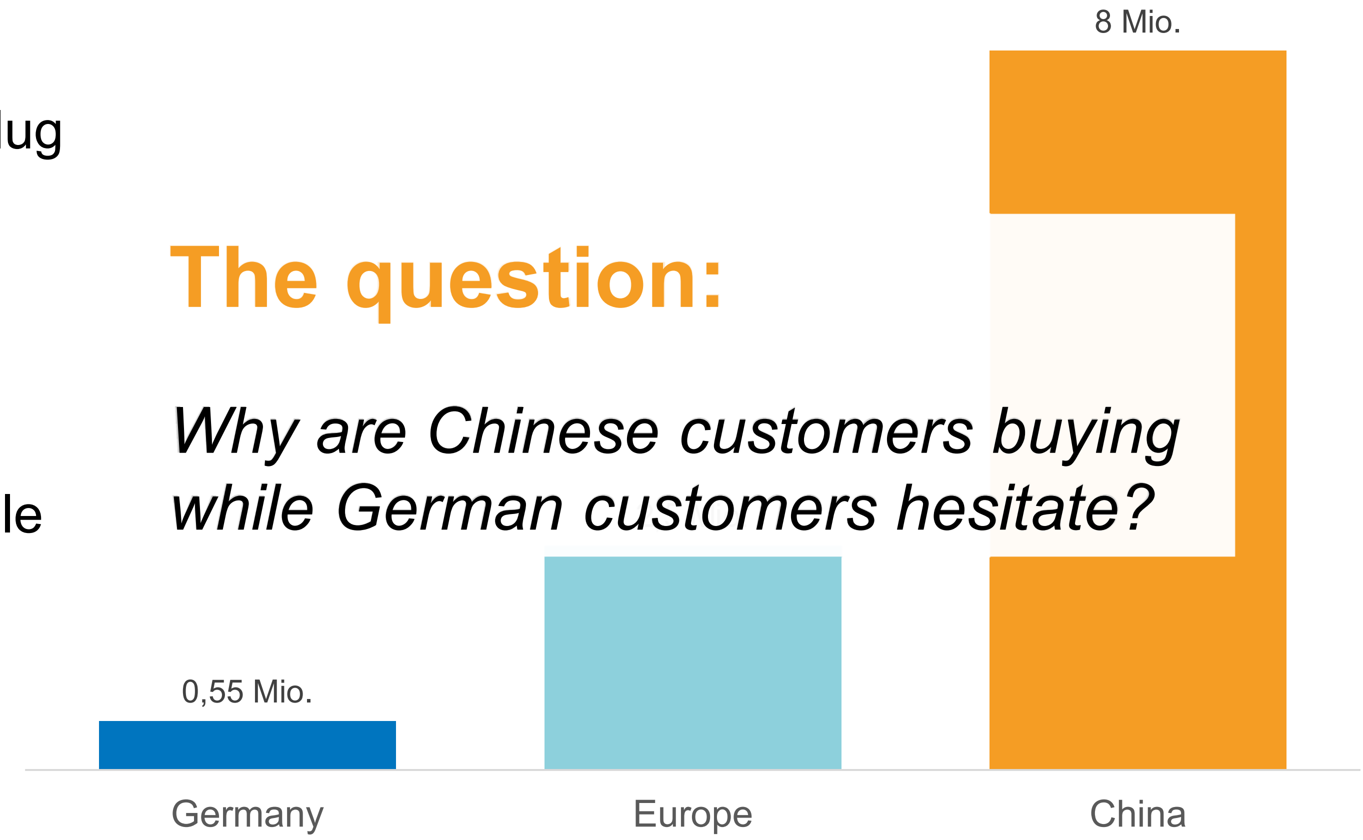
The electric vehicle paradox

China is leading the transition
- More than 50% of new sales with plug
- Cheap BEVs available
- Vehicles from local manufacturers

Germany: Technology is ready, …
- 30% EV sales, of which 19% BEV
- More than 180 BEV models available
- 8 of the 10 best-selling BEVs produced by the VW Group
- **but adoption is delayed**

Battery electric passenger car sales 2025



The question:

Why are Chinese customers buying while German customers hesitate?

Rudschies W (2026) Marktübersicht: Welche Elektroautos es aktuell zu kaufen gibt. ADAC
CAM (2026) Electromobility Report 2026, vol 2026

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Each chemistry is different: Unique cost, KPIs & degradation patterns

Upcoming →

NMC

Lithium Nickel Manga-nese Cobalt Oxide

- Highest current market share of 64%
- High volumetric energy density (~600-740 Wh/l)
- Higher cell costs (~80-100 €/kWh)
- Trend towards high nickel, low cobalt
- ~1000-1500 lifecycles

LFP

Lithium Iron Phosphate

- Cost-effective alternative (~70-110 €/kWh)
- Less volumetric energy density (~360-450 Wh/l)
- Inherently stable chemistry with low thermal runaway risk
- Low economic incentive for recycling
- ~2000-3500 lifecycles

So-Ion

Sodium-Ion Batteries

- Cost-competitive alternative to lithium-ion
- Lower volumetric energy density than LFP
- High charge rates with inherent structural and thermal stability → extended cycle life
- Low cold-sensitivity: keep ~90% capacity at -40 °C

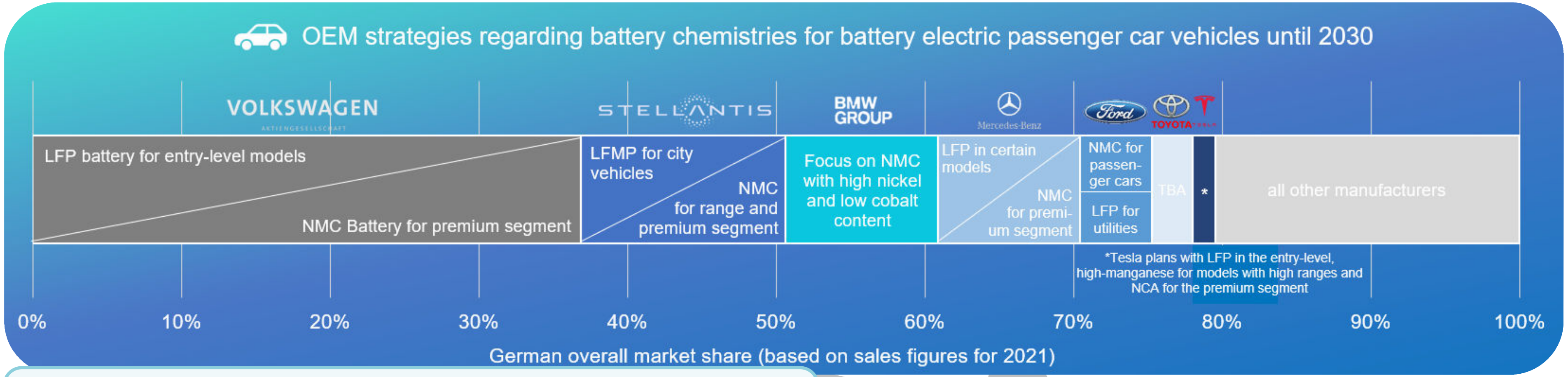
SSB

Solid-State Batteries

- Liquid electrolyte replaced by solid (ceramic, poly, ..)
- Higher energy density via lithium-metal anode
- No flammable electrolyte → inherently lower thermal runaway risk
- Manufacturer heavily investing in startups
- First road tests ongoing

Hasselwander, S.; Meyer, M.; Österle, I.: Techno-Economic Analysis of Different Battery Cell Chemistries for the Passenger Vehicle Market. Batteries 2023, 9, 379. https://doi.org/10.3390/batteries9070379

Beyond technology roadmaps: Understanding customer choices



Do all customers value range equally, or do preferences vary by segment, usage, demographics?

Will customers pay premium for advanced batteries, or choose lower-cost alternatives with 'sufficient' specs?

Does technology availability guarantee adoption, or are there knowledge/infrastructure barriers?

This study: Measuring customer preferences to answer these questions with discrete choice experiments (n=1,510)

Angelehnt an Hasselwander, S.; Meyer, M.; Österle, I.: Techno-Economic Analysis of Different Battery Cell Chemistries for the Passenger Vehicle Market. Batteries 2023, 9, 379. https://doi.org/10.3390/batteries9070379

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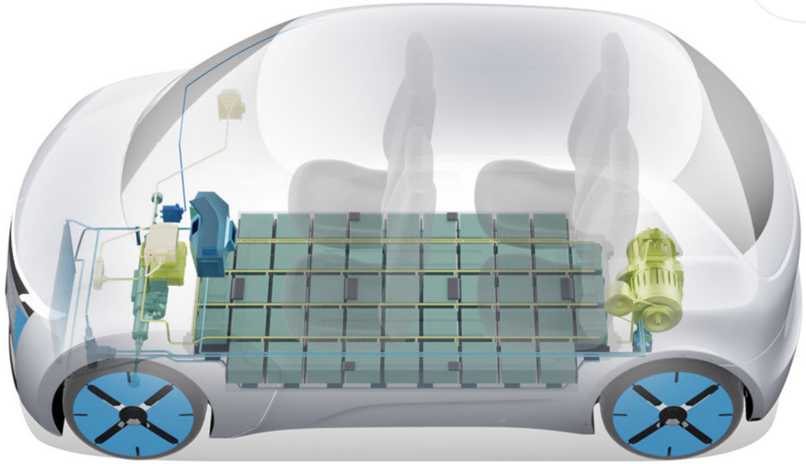

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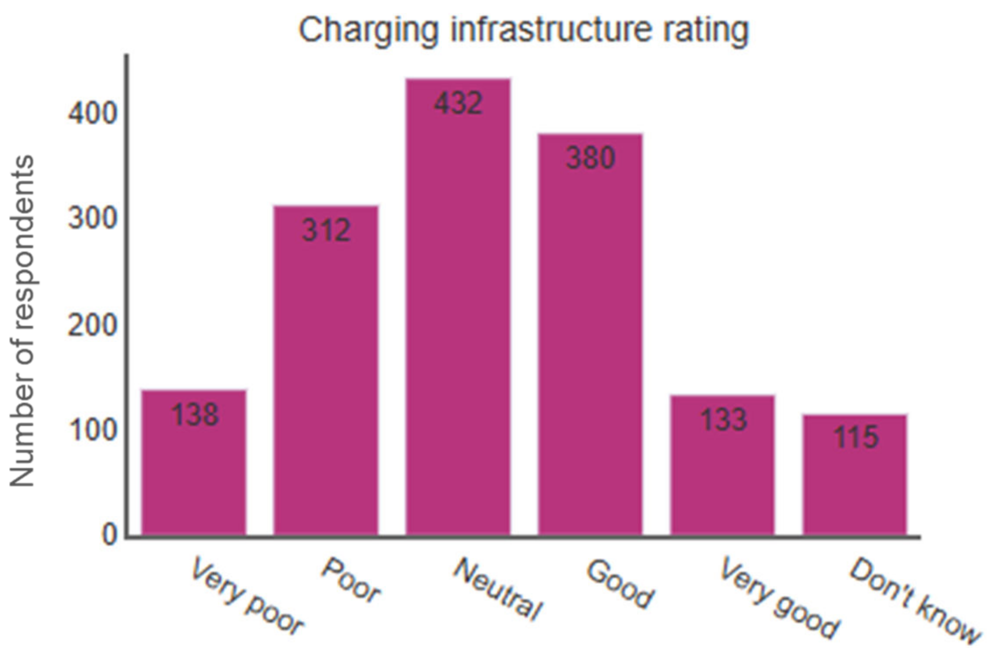
Survey design: Measuring real preferences

Sample

- n = 1.510 complete responses
- Representative for Germany (*with regard to gender, age and location*)
- Conducted in summer 2025

Survey structure

- Demographics & current vehicle usage
- EV readiness & infrastructure access
- Attribute importance rankings
- 6 discrete choice experiments:
  - **Special focus on battery electric vehicle attributes**

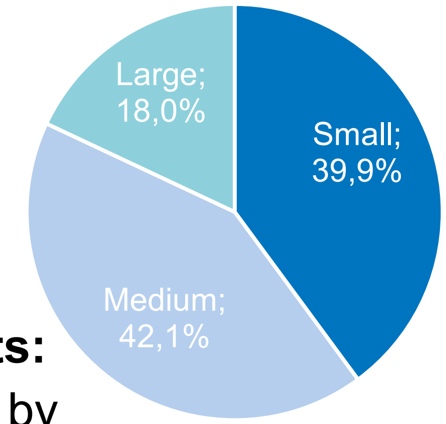


Sample Size	Purchase Willingness	Current EV Adoption	Infrastructure Satisfaction	Solar Panel Ownership
n = 1510	59.8%	7.9%	34.0%	30.0%

How would you decide?

Realistic choice sets differentiated by vehicle segment:

- Small (A/B-segment)
- Medium (C/D-segment)
- Large (E-segment)



Easy to understand units:

- E.g. range gained in km by charging for 20 minutes

Forcing real trade-offs, just like in a showroom

From choices to willingness-to-pay

1 Choice experiment

1,510 respondents × 6 choice tasks = 9,060 decisions
Each choice: 3 vehicle alternatives with different attributes

2 Multinomial logit model (MNL) estimation

Maximize likelihood to find utility coefficients $\boldsymbol{\beta_i}$ that best predict choices
Metric attributes are log-transformed to capture diminishing marginal utility

$$P_i = e^{(\beta_{price} * price + \beta_{range} * range + \dots)} / \sum_j e^{(\beta_{price} * price + \beta_{range} * range + \dots)}$$

3 WtP calculation

Convert utility coefficients $\boldsymbol{\beta_i}$ into monetary values with reference vehicle

$$WtP_{range} = -(\beta_{range}/\beta_{price}) * (price_{ref}/range_{ref})$$

Vehicle range (large segment)

Step 1: β_{range} (from MNL)	+0.36
β_{price} (from MNL)	-0.75
↓	
Step 2: $\mathrm{WtP}_{\mathrm{ratio}} = \beta_{range}/\beta_{price}$	-0.48
×	
Step 3: $price_{ref}/range_{ref}$	141 €/km
↓	
Final WtP Value:	**67 €/km**

[14] Hasselwander S, Bergfeld M, Kleinermann M et al. (2026) Preferences and willingness-to-pay of customers for specific battery electric vehicle attributes in Germany. (to be published)

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Willingness-to-pay varies by segment

Large vehicles with higher WtPs due to higher vehicle prices and specifications

Real world examples:

🛣️ Vehicle Range

6,730 Euro

WtP for additional: 100 km of range

Real-world example: Audi A6 e-tron (+133 km range = 12,800 Euro premium)

Large segment: WtP = 67.3 Euro/km

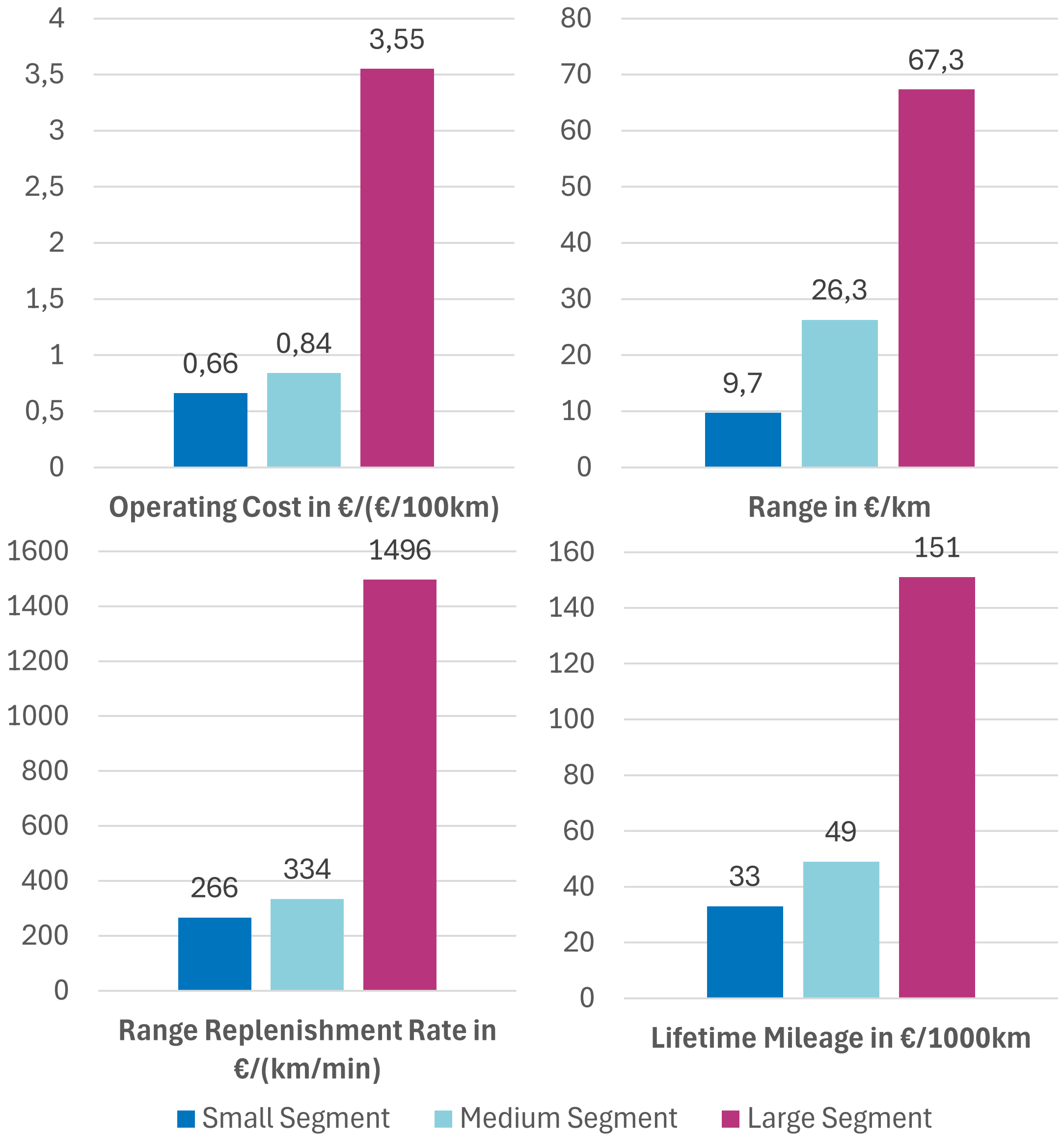
🔋 Range replenishment rate (fast charging)

5,000 Euro

WtP for improvement: 15 km/min → 30 km/min

Equivalent to: 180 kW → 300 kW charging power increase

Medium segment: WtP = 334 Euro/(km/min)



Note: Different scales due to attribute units.

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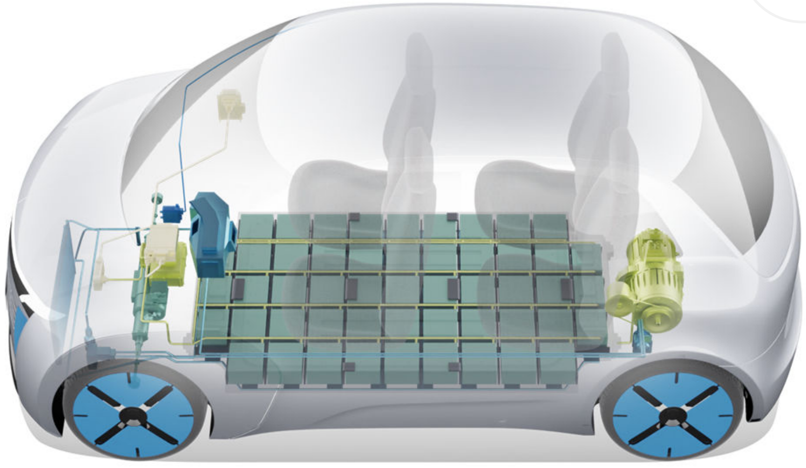
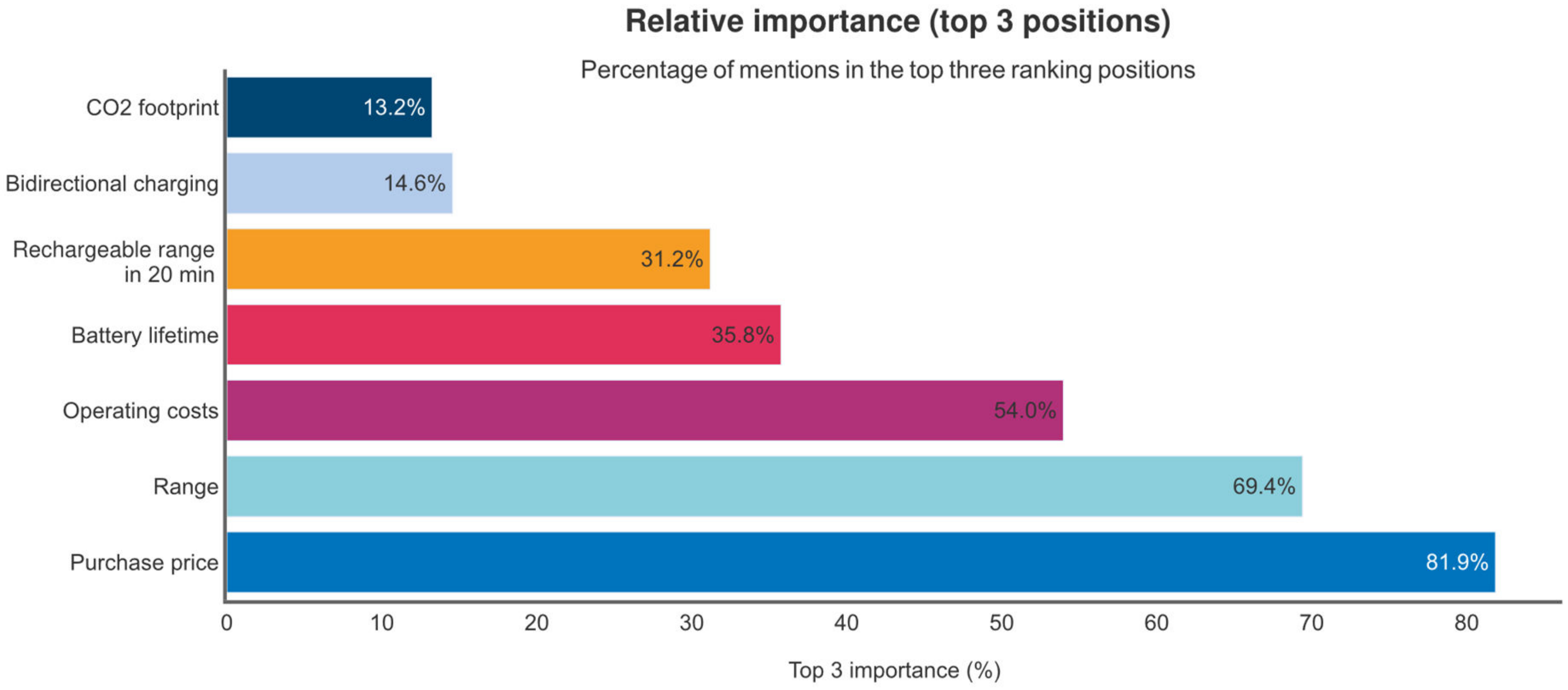
Structure



Finding 1: Attribute importance

Purchase decisions are driven primarily by economics and practicality:

- Purchase price dominates (58.5% #1 and 81.9% top 3)
- Followed by range (69.4% top 3) and operating costs (54.0%)
- Battery lifetime of higher importance than charging speed
- Environmental footprint and bidirectional charging with lower impact



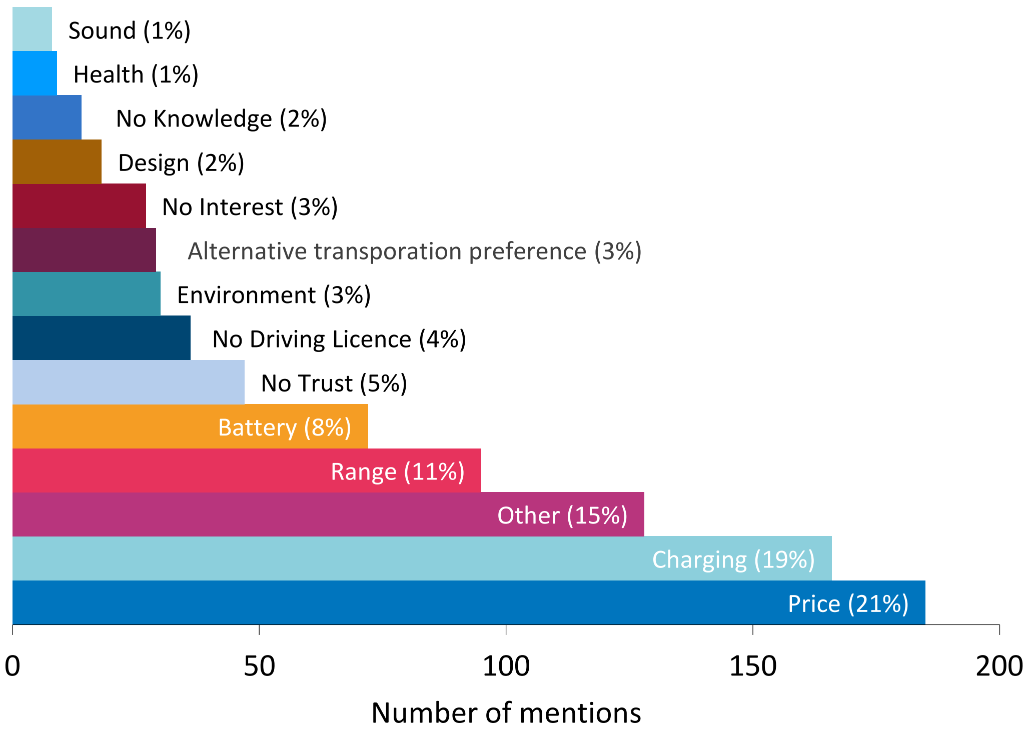
Finding 2: Main BEV barriers

Analyzed **607 free-text responses** from respondents currently unwilling to buy a BEV:

- Price dominates the answers outweighing technical concerns like range
- Charging was mentioned nearly as often as price
- Psychological Barriers: The "Other" category (15%) indicates that for many, the barrier isn't technical it's a lack of desire or lifestyle fit.

Exemplary statements (translated):

- *"I am generally against electric vehicles."*
- *"I don't want such junk; a car has an internal combustion engine and that's it."*
- *"I have a reliable petrol car that I can drive for a long time; I drive very little anyway."*



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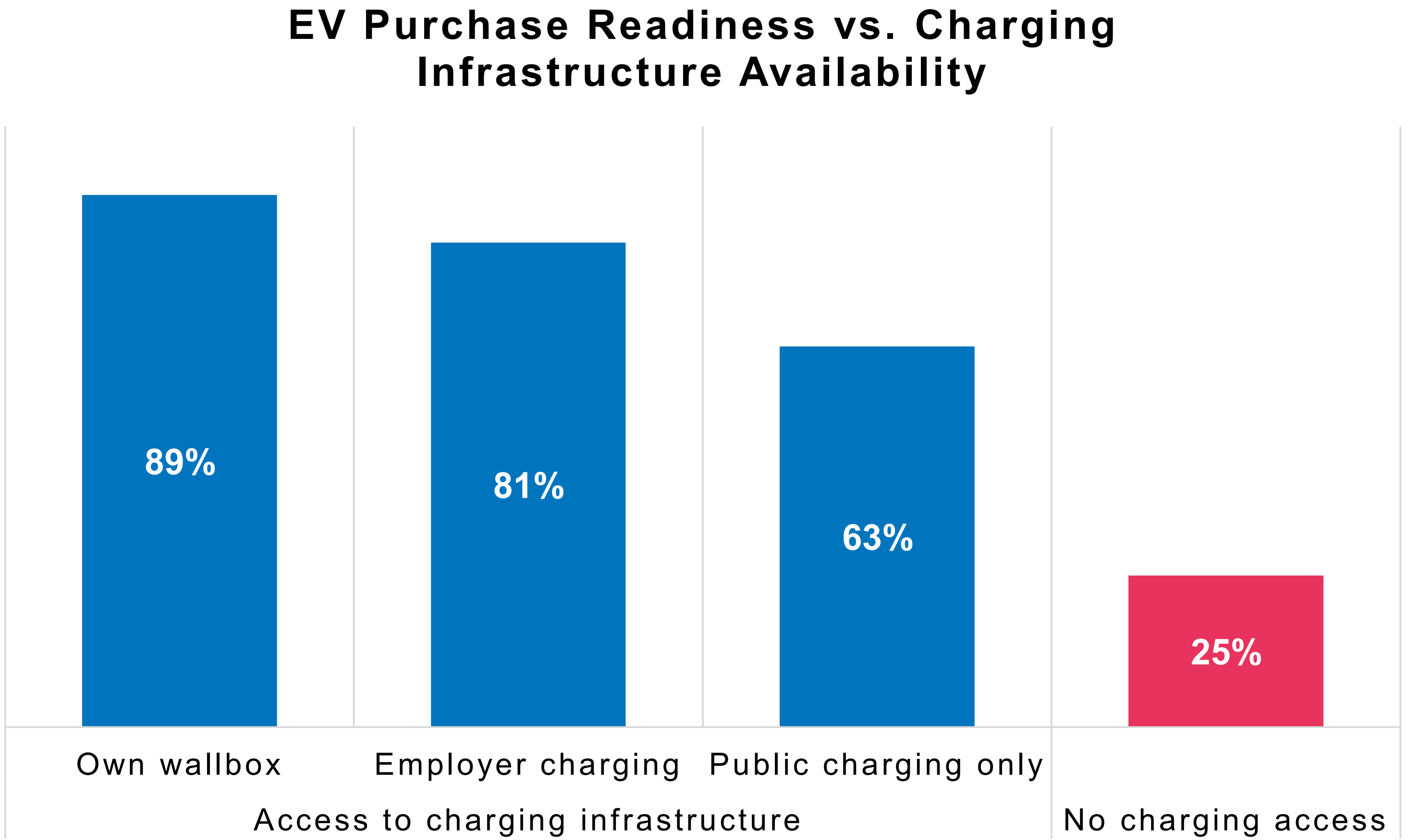
Infrastructure access drives purchase readiness

- 217 of 245 respondents with access to an own wallbox are *“willing to buy an electric vehicle in the near future”* (89%)
- Respondents with the possibility of charging at the employer also with high purchase readiness of 81% (n = 146 of 181).
- Majority of respondents only has public charging access resulting in a purchase readiness of 63% (n = 443 of 699).
- Without charging access the purchase readiness drops critically to 25% (n = 97 of 385).



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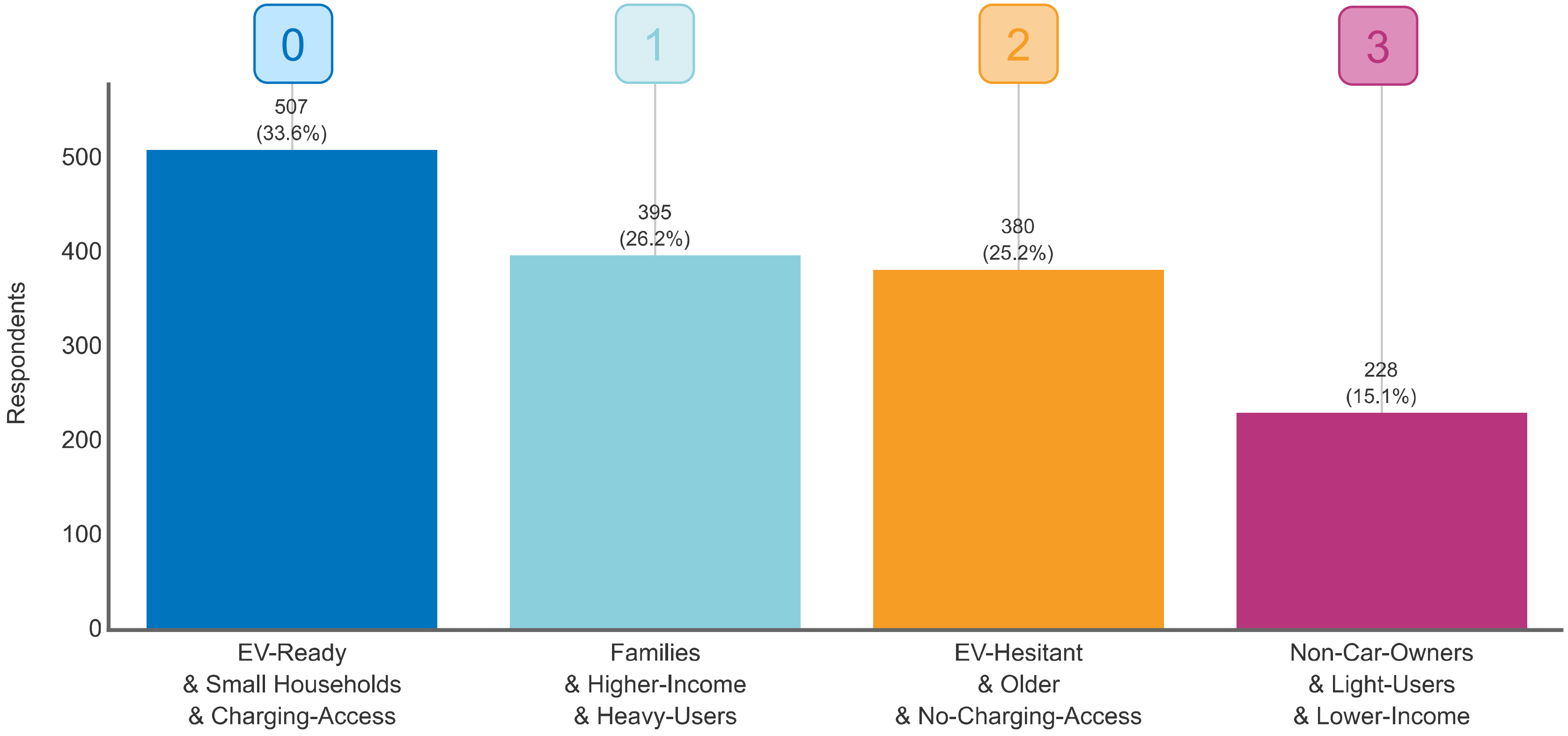
Finding 3: Distinct consumer clusters

- K-means clustering based on socio-economic variables, vehicle usage, EV purchase readiness
- Four distinct clusters identified
- Assessed via bootstrap resampling with an adjusted rand index (ARI) of 0.85 indicating high reproducibility
- Clustering procedure described in detail in accompanying study [14]



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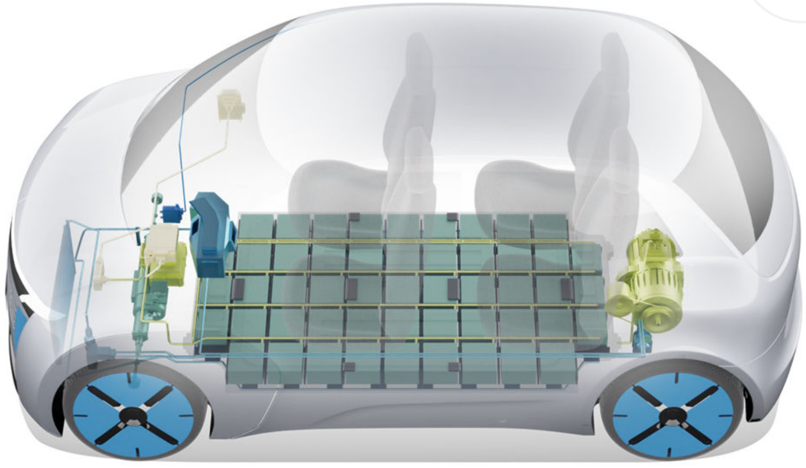
Preference heterogeneity: Sensitivity changes compared to average respondent

↓ **Lower Sensitivity:** Attribute is less important (e.g., other attributes outweigh price)

High annual mileage (>15.000 km)	↓ Price	*TCO-based logic: Respondents accept higher purchase price for long-term savings*
High daily driving distance (>30 km)	↑ Operating Cost	*Intense daily users show increased sensitivity to operating costs*
Negatively perceived charging availability	↑ Price, Range & Fast charging	*Technical performance needs to compensate for perceived environmental constraints*
Multi-car household	↓ Price	*Likely reflects higher disposable income or the added flexibility of owning a second vehicle*
PV-system ownership	↓ Price	*The possibility to charge at low cost increases the attractiveness of BEVs and reduces price sensitivity*

Structure



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VECTOR 21
VEHICLE TECHNOLOGY SCENARIO MODEL

- Neutral, scientific market analysis for political and economic decision-makers
- Detailed bottom-up market simulation
- Definition of external framework conditions

Results:

- Market ramp-up of alternative drive concepts for cars and trucks in Germany / Europe
- Economic effects (number of components; cost development)
- Ecological effects (energy consumption, fleet emissions)

Exogenous conditions

Politics & Legislation | Energy & commodity prices | **Battery Techno-Economics** | Infrastructure availability

Supply

Vehicles

dynamic development of available vehicles / powertrain technologies:

- Gasoline, Diesel, CNG
- Hybrid, Plug-in Hybrid
- Fuel Cell
- Battery Electric
  - ✓ **Cell chemistry-specific**
  - ✓ **Bidirectional charging**
  - ✓ **ML-based model config**

Utility Maximization

Discrete purchase decision

Customer agent chooses vehicle that maximizes its individual benefit

Empirical determination of new, BEV-specific utility factors:

- ✓ **Charging speed**
- ✓ **Vehicle lifetime**
- ✓ **Bidirectional charging**

Demand

Customer

with different

- Socio-economic characteristics
- Behaviors
- Preferences
- ✓ **Derivation of new BEV-specific preference criteria**

Results

Market share | Cost developments | **Technology diffusion** | Energy consumption | **Battery capacity** | CO_2 emissions

Deutsches Zentrum für Luft- und Raumfahrt e.V. (2023) VECTOR21: Scenario and Market Analysis Software for Simulating Future Vehicle Markets. https://vector21.de

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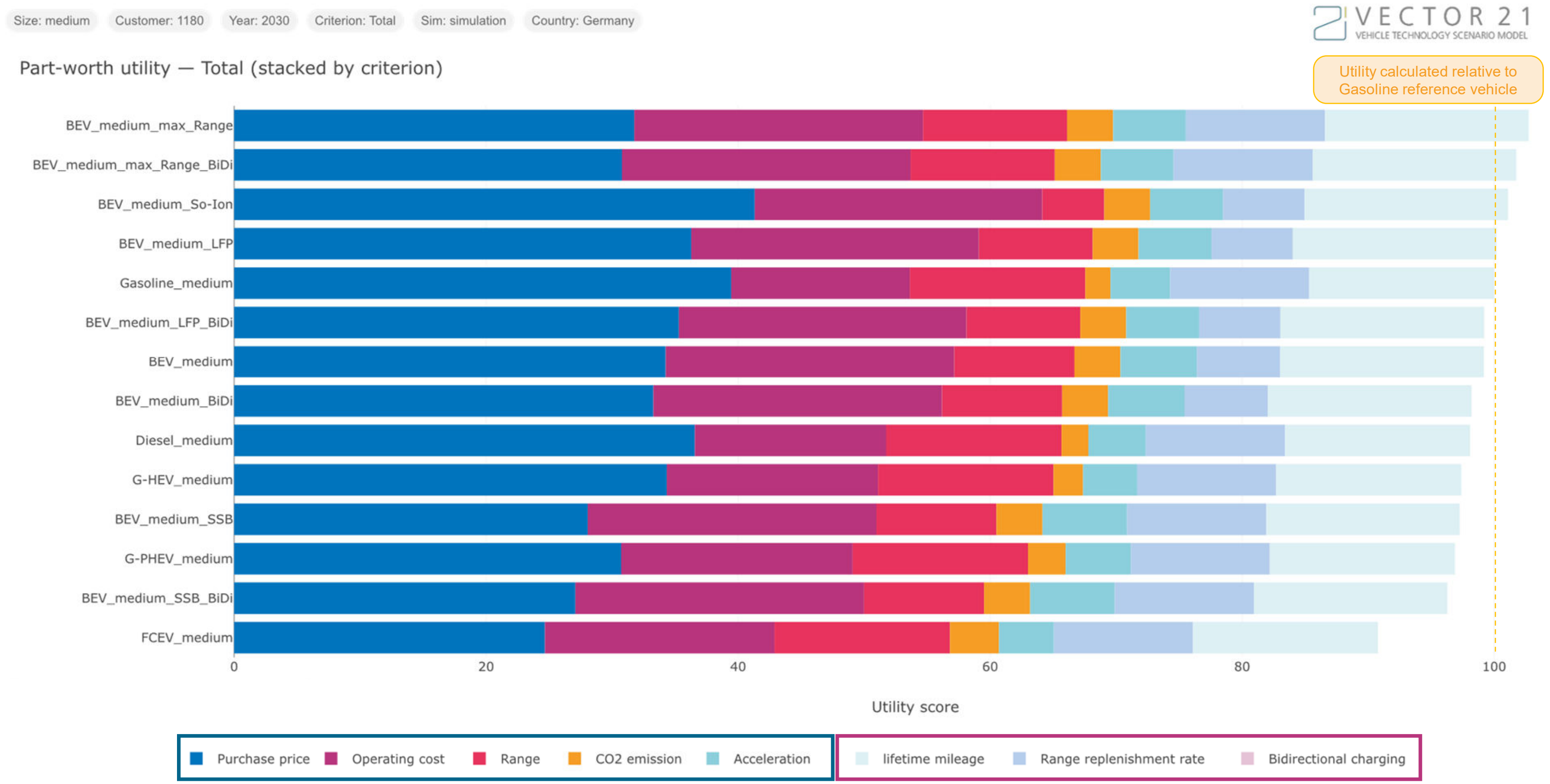
Extension of existing utility factors

New utility factors

- Range replenishment rate
- Vehicle lifetime
- Bidirectional charging

Updated & extended:

- Lifecycle CO_2-emissions
- Range
- Operating cost
- Purchase price



Market scenario of future battery electric vehicles

Main framework assumptions:

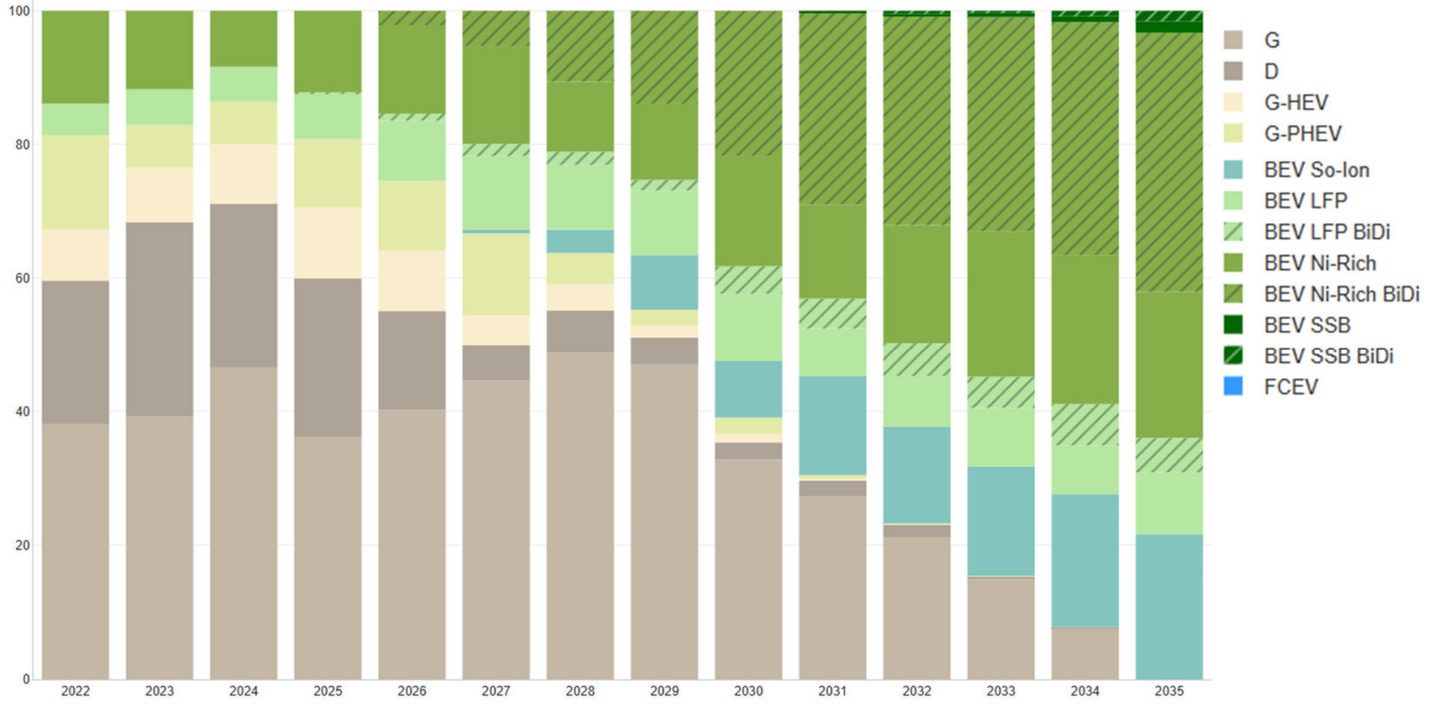
- CO_2 fleet limits of Fit-for-55 regulation
- Energy prices based on Ariadne scenarios
- Vehicle prices calculated bottom-up from market-dependent component costs

Resulting market potential through 2035:

- Ni-Rich and LFP batteries dominate the BEV market (range vs. cost)
- So-Ion could reduce LFP market share if sufficient models become available
- Vehicle models that offer bidirectional charging with high market potential
- +50% market potential increase with ultra-fast charging (446 kW vs. 300 kW baseline)

Market potential of new German passenger vehicles

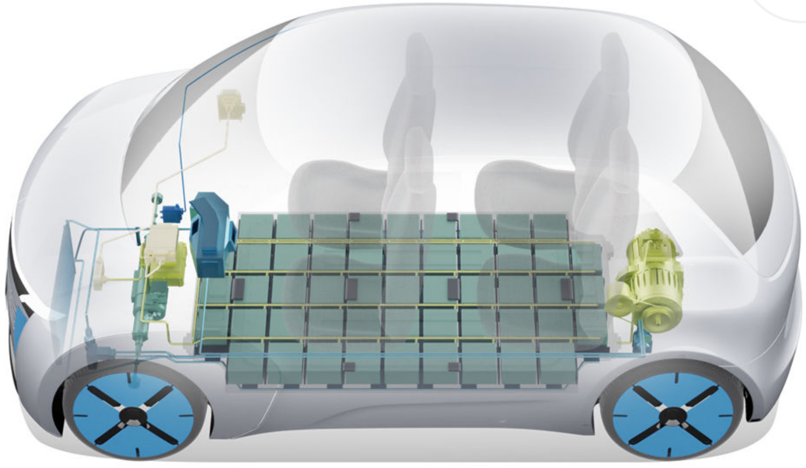
VECTOR 21
VEHICLE TECHNOLOGY SCENARIO MODEL



G = Gasoline, D = Diesel, CNG = Compressed Natural Gas, HEV = (Full) Hybrid Electric Vehicle, PHEV = Plug-In Hybrid Electric Vehicle, BEV = Battery Electric Vehicle, FCEV = Fuel Cell Electric Vehicle, So-Ion = Sodium-Ion Battery, LFP = Lithium Ion Phosphate, Ni-Rich = Nickel-Rich Cell Chemistries, SSB = Solid-State-Batteries, BiDi = Bidirectional Charging

Disclaimer: Simulated market potentials are not the same as the actual market development. Scenarios only represent a draft of a possible future situation resulting from the specified framework assumptions. Core scenario assumptions: Battery cell cost developments are based on the assumption of large-scale production facilities; No limits on the availability of either raw materials, components or batteries considered; No production capacity restrictions assumed; CO_2 fleet reduction quota according to Fit-for-55 proposal; Passenger cars with combustion engines can no longer be registered from 2035

Structure

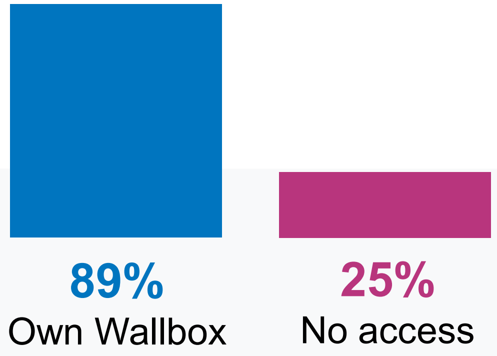


Summary

1

Charging access drives purchase readiness

Private charging infrastructure is the strongest enabler for BEV adoption. Without access, purchase readiness drops by **64 percentage points**.



2

Willingness-to-pay varies by vehicle segment

9.7 €/km
Small Segment
Opportunity for So-Ion

26.3 €/km
Medium Segment
Mix: LFP/NMC

67.3 €/km
Large Segment
Ni-rich dominates

3

Technology can have a high market impact

Vehicle performance compensates for perceived infrastructure constraints: **+50%** market potential increase possible with ultra-fast charging (446 kW vs. 300 kW baseline)

Thank you for your attention

Get in touch:

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