

E-mobility: Inevitable, or not?

Results Presentation

A study for the European Climate Foundation (ECF)

NOT FOR FURTHER CIRCULATION

2nd November 2021

elementenergy

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Today we aim to present the main findings of the project and ECF's plan for dissemination

Objectives

We have conducted a Europe wide survey of new car buyers and the results have been incorporated into an EV uptake model. Today we will present the findings and discuss what key messages we want to draw from the research.

Today we will:

- Provide an overview of the findings from the consumer survey and the resulting consumer segmentation
- Summarise the baseline EV uptake the results – which demonstrates high demand of EVs
- Briefly discuss findings from the sensitivity analysis and what conclusions can be drawn from this
- Highlight the core attributes which are most important consumer decision making

Agenda 1h

1. Project overview and recap *5 min*
2. Overview of consumer segmentation *15 min*
3. EV uptake projection results & discussion *35 min*
4. Project next steps & dissemination *5 min*

Project overview and recap

Overview of consumer segmentation

EV uptake projection results

Project next steps & dissemination

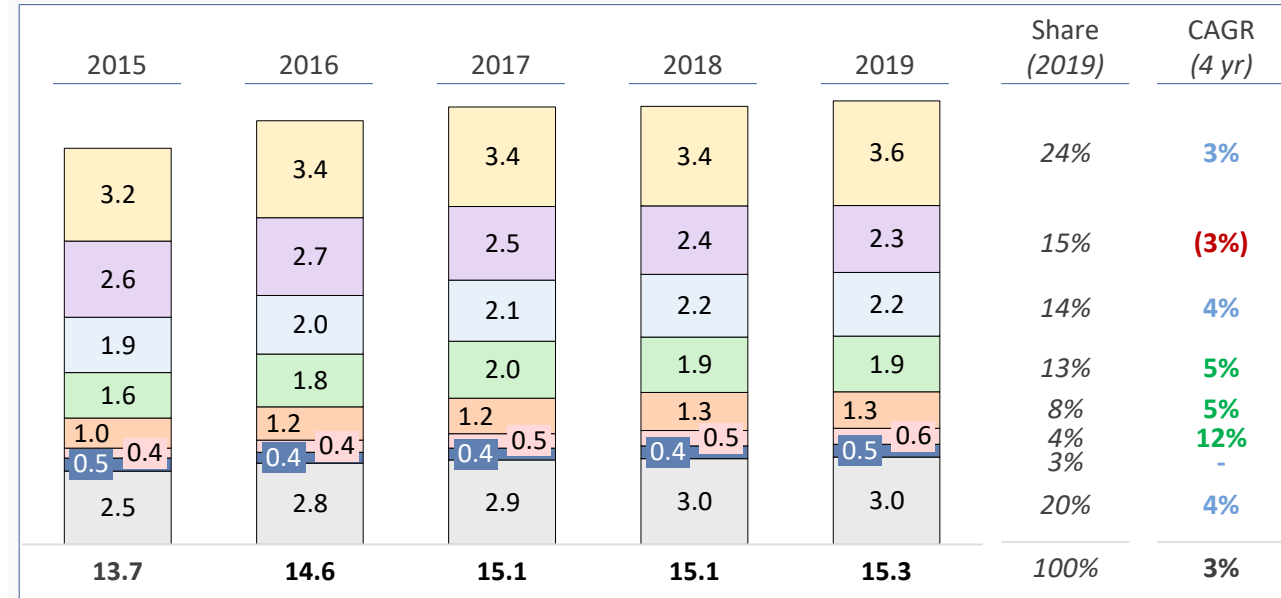
Appendices

Countries in project scope: study markets cover 80% of European new car registrations, with strong 2020 growth in the BEV sector for the three largest, covering 53% of registrations

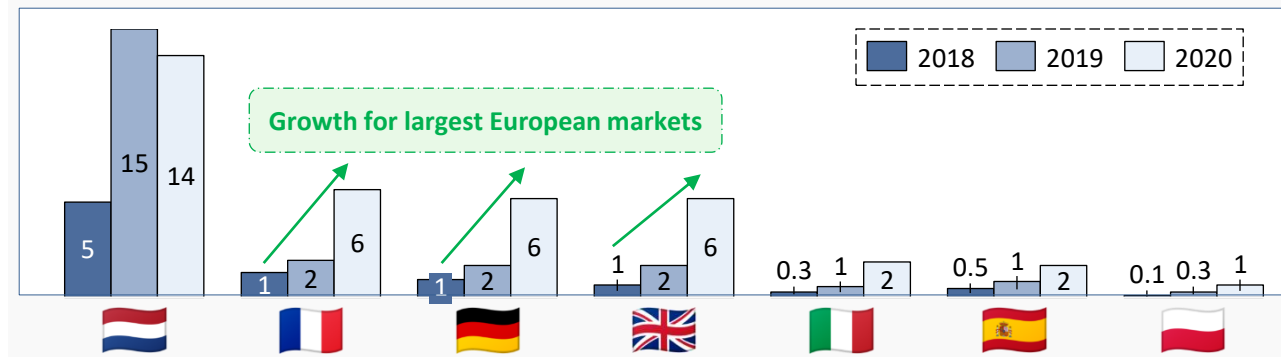
Project focus markets



Market share of new registrations (millions of registrations, EU incl. UK)



BEV % New Car Sales



RECAP - The project will see the largest car buyer quantitative survey rollout in Europe (14,000 participants across 7 countries) to bring the last piece of evidence on EV uptake

WP1 – Study scoping with stakeholders

- Completed in February through 2 workshops

WP2 – Consumer survey and choice experiment

- Design and rollout consumer survey in seven European countries (Germany, France, Spain, Italy, UK, Poland & The Netherlands) to reveal attitudes towards different car powertrains
 - Design and pilot completed on sample of 100 x 7 countries .
 - Main survey on-going (2,000 participants x 7 countries)
- Establish consumer segmentation and choice coefficients – *Completed*

WP3 – Update European choice model

- Update Element Energy’s European consumer choice model, to be able to explore how EV sales are likely to evolve. *Completed*

WP4 – Develop uptake scenarios

- Develop uptake scenarios in partnership with stakeholders. Scenarios and narratives to be discussed at workshop. *Completed in June*
- Run the model and generate results. *Timeline: September – October*

Report writing & dissemination

Timeline: November – December

Scope Markets



– France



– Germany



– Italy



– UK



– Spain



– Poland



– Netherlands

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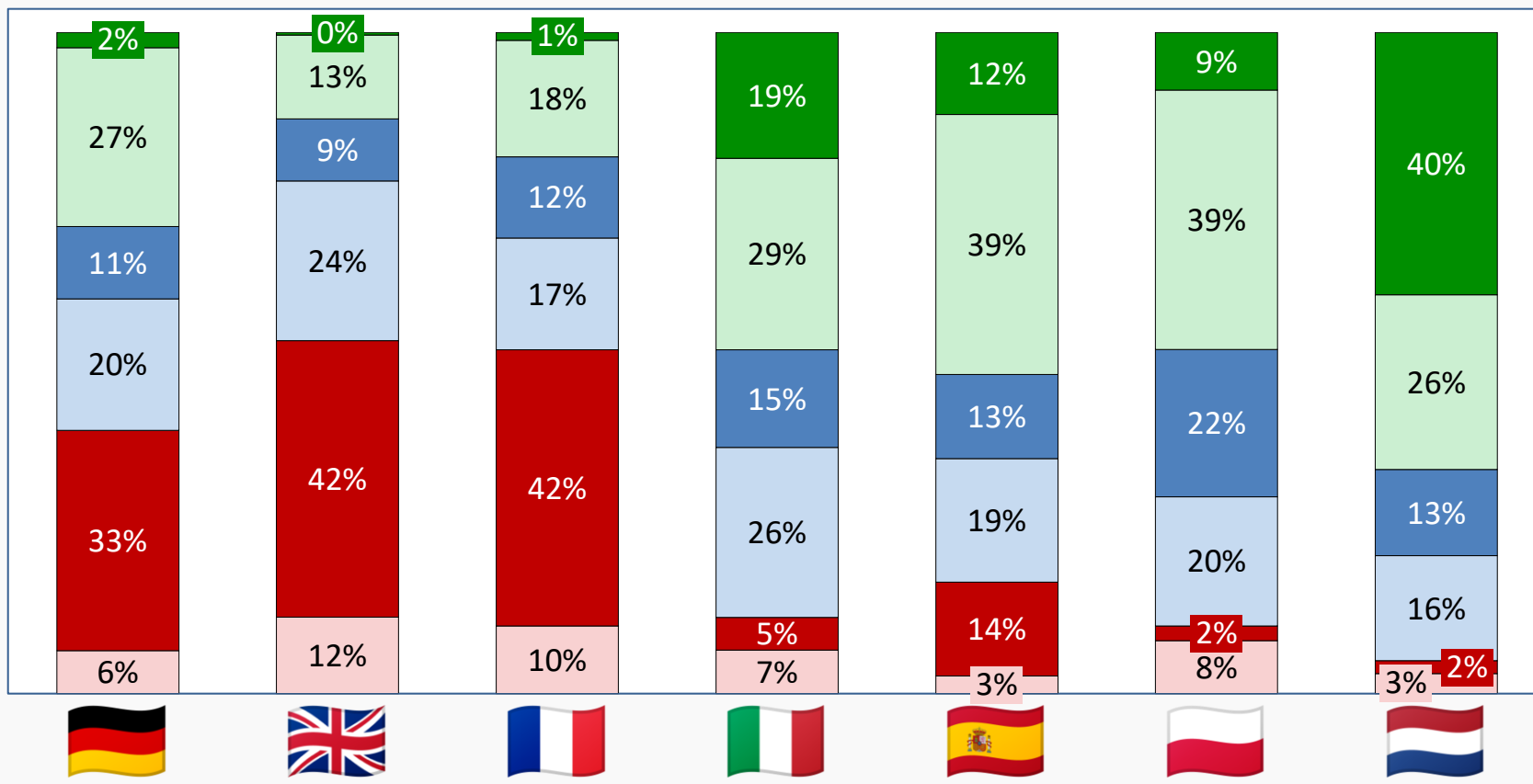
Description of 2021 European consumer segments

	Enthusiasts		Pragmatists		Potential rejectors	
	Trailblazers	Wealthy adopters	Environmentalists	Cost conscious greens	Uninterested rejectors	Unmet needs
Relative income	High	Highest	High	Lowest	Medium	Low
Employment	Lowest (30%), high share of retired (40%)	High (80%)	High (80%)	Medium (50%)	Medium (60%), sizable share (25%) retired	High (70%)
Average age	56	43	40	41	47	36
Gender	High male predominance	Slight male predominance	50/50	High female predominance	Slight female predominance	High female predominance
Parking type¹	47% private 70% off-street	56% private 79% off-street	64% private 81% off-street	53% private 72% off-street	61% private 80% off-street	59% private 76% off-street
Driving patterns	Average annual mileage 70% <u>never</u> commute by car	Average annual mileage 85% commute <u>>2x</u> a week by car	Very high annual mileage 80% commute <u>>2x</u> a week by car	Average annual mileage 60% commute <u>>2x</u> a week by car	Average annual mileage 40% commute <u>>2x</u> a week by car	Very high annual mileage 75% commute <u>>2x</u> a week by car
Attitude towards environment	Environmentally conscious	Environmentally conscious	Most environmentally conscious	Environmentally conscious	Negative attitude towards environment (relative)	Very environmentally conscious
Attitude towards EVs	Embrace EVs	Neutral attitude towards EVs	Neutral attitude towards EVs	Slightly hesitant towards EVs	Hesitant towards EVs	Hesitant towards EVs – concerns around cost
Attitude towards new cars and tech	Uninterested	Very interested	Very interested	Neutral	Very uninterested	Interested
EV awareness	3% own EV 63% considered buying EV	6% own EV 71% considered buying EV	9% own EV 71% considered buying EV	3% own EV 66% considered buying EV	3% own EV 53% considered buying EV	4% own EV 69% considered buying EV
Global share	12%	27%	14%	20%	20%	7%

1) Private includes private garage and private driveway. Off-street also includes shared garage and semi-private car parks

Consumer shares vary widely across the different markets, with most consumers represented in each country

Private car buyers - consumer segment shares by country



■ Trailblazers ■ Environmentalists ■ Uninterested rejectors
■ Wealthy adopters ■ Cost conscious greens ■ Unmet needs

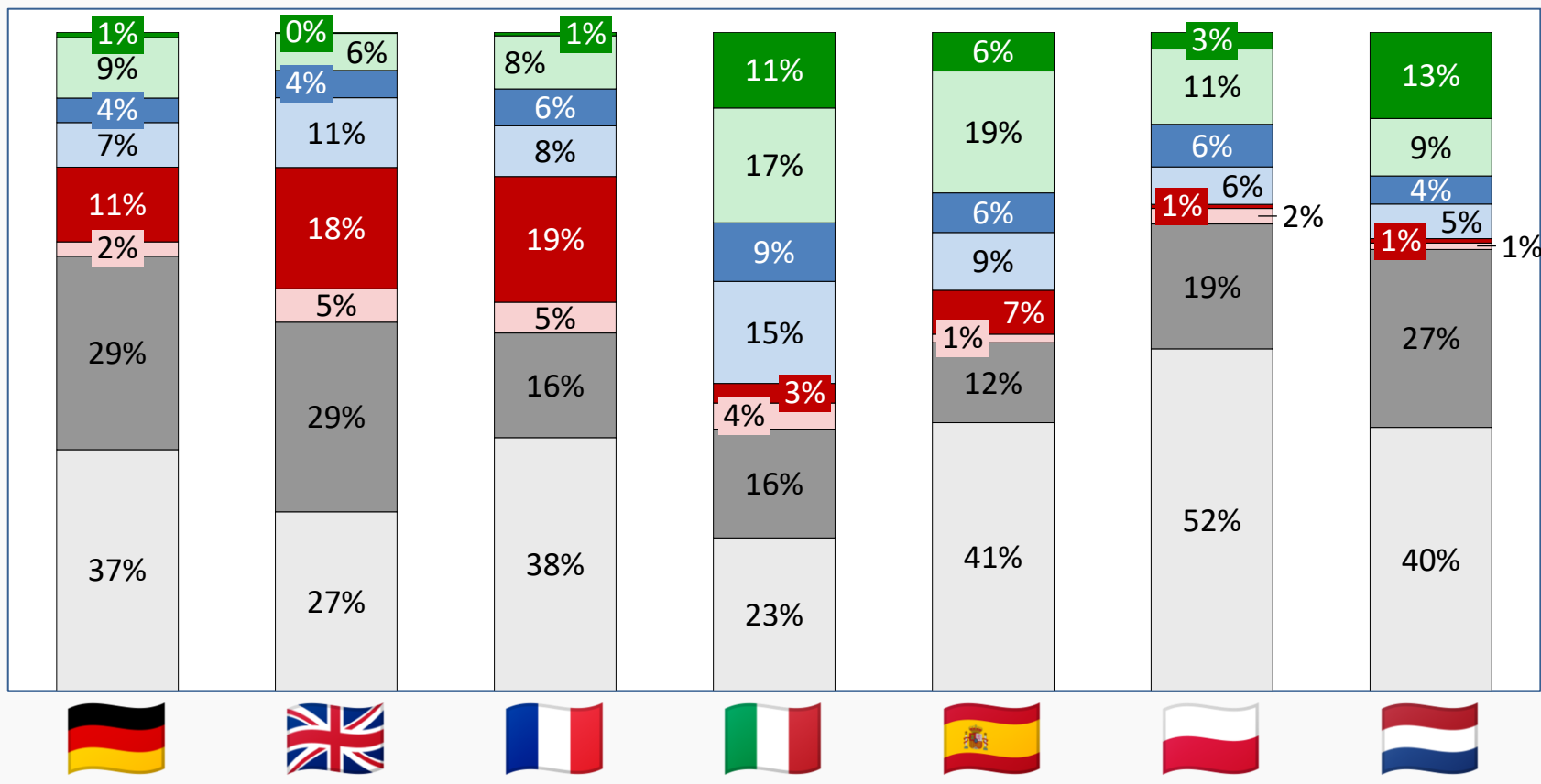
- Private consumer segmentation is derived from analysis of survey results.
- Hierarchical and K-means clustering was performed using respondent demographics and attitudinal responses.

- Common consumer types are found across different European markets, with country not being a major factor delineating consumer types.

- Private consumer purchase decisions are modelled using a choice model built from survey responses. Consumers can therefore be described using their revealed purchase behaviour.

Company car buyers make up a significant share of new car registrations across these markets, and it is assumed that they behave in a more 'rational' way than private consumers

All car buyers - Consumer segment shares by country



- Company car users are split into User Choosers and Non-User Choosers. User choosers represent consumers purchasing a car through their company, making use of company car taxes. Non-user choosers are given a car chosen by a fleet manager, so have limited choice.
- The ratio of user chooser to non-user chooser is based on survey responses indicating who chose company cars.
- This is calibrated against known UK split, using data provided by RouteMonkey and Benefit in Kind statistics from HMRC.
- User choosers behave like private consumers, using the global choice model, but are assumed to lease their car.
- Non-user choosers are also assumed to lease their car, but choose based on TCO.

Key findings from consumer survey



78% of new car buyers have access to off-street parking

59% have access to private parking



46% of respondents said they knew someone who owned an EV, much higher than the share of EVs in Europe today



34% of respondents said they were very or fairly likely to buy a BEV in the next 5 years

For PHEVs, this number is **45%**



88% of current EV owners have access to off-street parking

73% have access to private parking



70% of respondents indicated that they own, or have thought about buying an EV

35% said they had decided not to at this stage



49% of respondents indicated that they would be willing to reduce their car usage in favour of more sustainable modes of transport

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The baseline represents a future where the CO₂ targets continue to drive investment in BEVs, decreasing prices, and where infrastructure continues to roll-out to meet demand

Model levers		Input details
Vehicle characteristics		Latest EE modelling (Q4 2020) – used by UK Department for Transport and recent BEUC TCO study
Fuel cost		WEO 2019 Stated Policies oil price forecasting, including future tax rises announced by national governments
Electricity cost		Residential electricity forecasting from WEO 2019 Stated Policies
Purchase subsidies		Inline with current policies (summer 2021). Where there is no known end date for subsidies, phased out assumed in 2027, when TCO parity is reached with petrol ICEs, unless budget is exceeded first
Vehicle tax		Current national annual, registration and company car tax rates implemented as announced, then kept constant (with list prices & tailpipe emissions changing based on vehicle C&P forecasting)
Perceived charge point access (%)	Home	100% for consumers with access to private garages and driveways. 0% today increasing with 1% building turnover for shared garages driveways from 2025
	Slow public	Growth from 10-15% coverage today to 50-80% coverage by 2050, as discussed in workshop 3
	Rapid public	2021 based on survey response of how frequently consumers expect to drive past rapid EVCP on highway and TEN-T coverage. Linear extrapolation to 100%
EV awareness		Based on survey responses (59-81%), reaching 100% by 2025
Manufacturer showroom withdrawal		Assessed at the segment level in each country. If market share decreases for 5 years in a row, and sales fall below a threshold (0% 2020, 10% 2030, 15% 2050) vehicle removed from sale in market

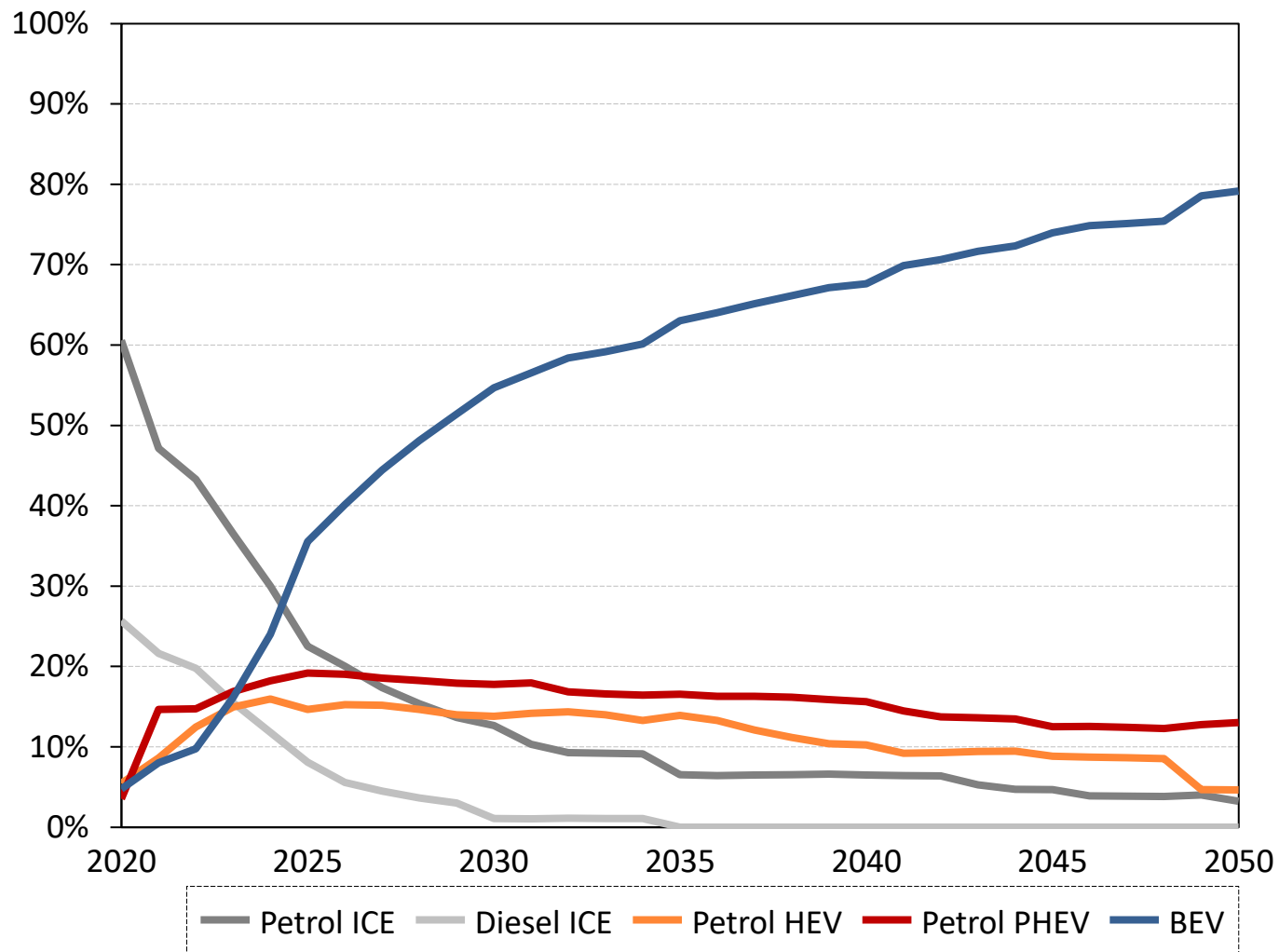
Demand for BEVs is expected to reach 55% by 2030

Baseline results: EU & Country specific

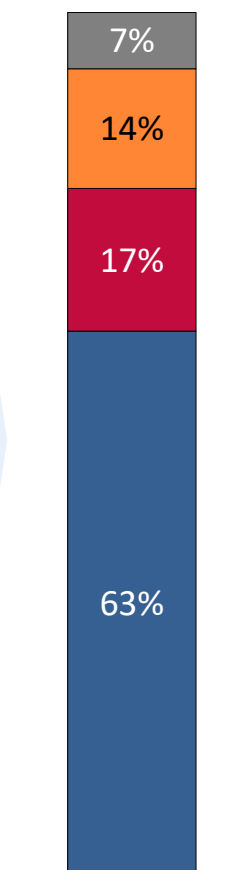
Sensitivity analysis

Conclusions and messaging

Consumer demand for new cars by powertrain across all 7 markets¹



2035



- Demand for BEVs increases substantially over the next decade, driven by falling battery prices, which both reduces upfront cost and improves range.
- From 2030 battery price reductions are expected to taper off, and growth in BEV demand is driven by the removal of poorly performing legacy powertrains by OEMs.
- The last diesel ICE is removed from sale in 2034.

- Despite performing poorly on a TCO basis, PHEV demand is long lived due to a positive bias towards PHEVs (relative to ICEs), potentially due to their environmentally friendly branding.
- It is known that PHEVs emit more in real-world conditions than advertised, so this bias may not persist to 2030.

(1) France, Germany, Italy, The Netherlands, Poland, Spain, UK

Note: this is a projection of demand, with no supply constraints applied to EVs. Potential bans on sales of ICE vehicles not applied

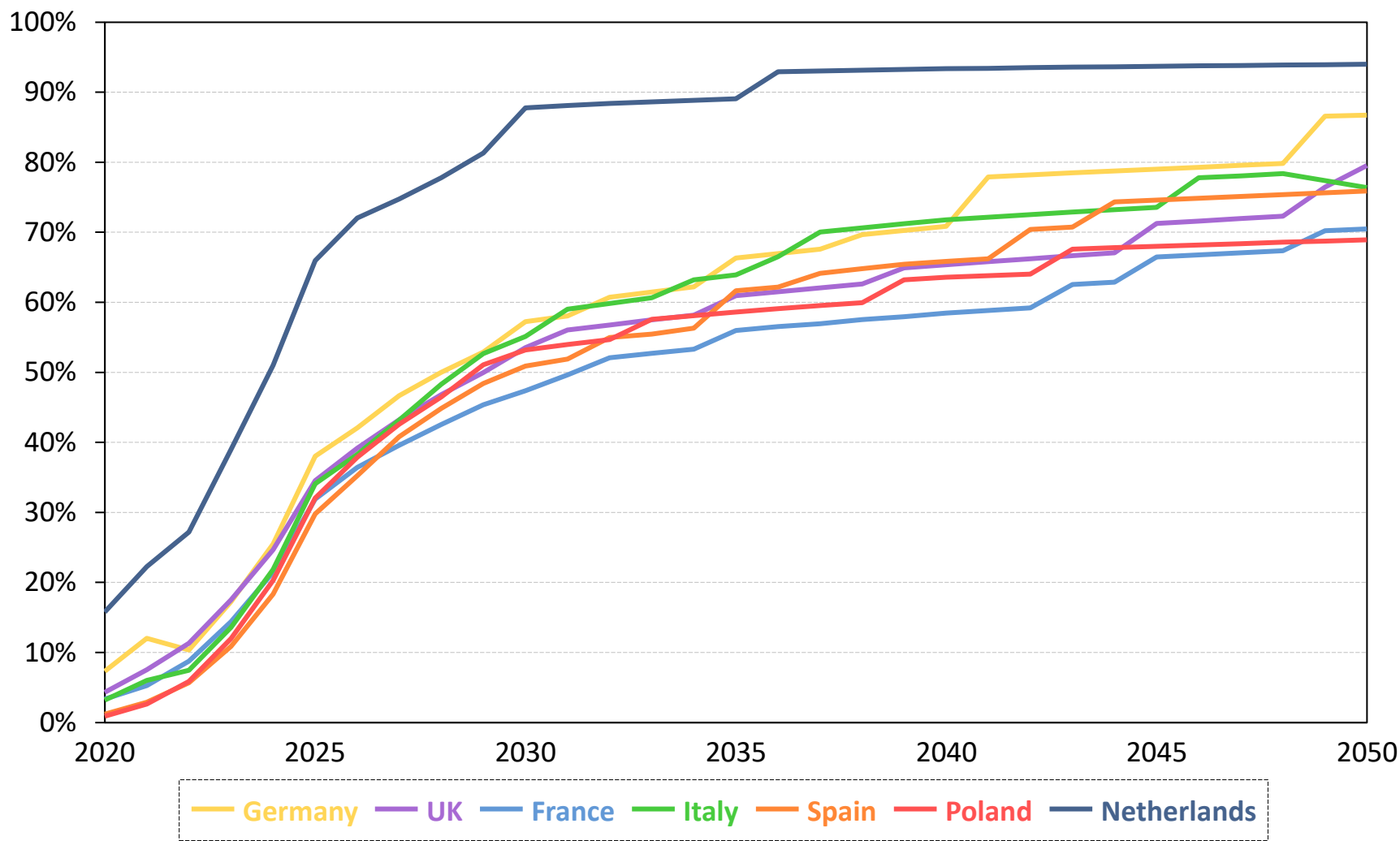
Growth in BEV demand follows projected battery cost reductions, rapidly increasing to 2030 before levelling off

Baseline results: EU & Country specific

Sensitivity analysis

Conclusions and messaging

BEV demand by market (baseline scenario)



- All countries experience a similar growth trajectory for BEVs as uptake is driven principally by falling battery prices, then consolidation of the OEM offering.
- Despite having a similar consumer segmentation to the UK, we project lower BEV uptake for France. This is due to the higher share of small cars, which due to the lower purchase price have a lower absolute difference in taxes between petrol ICEs and BEVs.
- The Netherlands achieves very high BEV uptake, due in part to high BEV subsidies in the form of tax breaks, and due to a very low share of 'rejector' type consumers.
- Poland experiences a lower rate of BEV uptake before 2025 due to a lack of purchase subsidy. Spain has a similarly low rate of BEV uptake as a result of low access to private home charging.

Note: this is a projection of demand, with no supply constraints applied to EVs. Potential bans on sales of ICE vehicles not applied

We have run the below sensitivities to explore a number of ‘what if’ questions

Baseline results: EU
& Country specific

Sensitivity analysis

Conclusions and
messaging

Sensitivity	Narrative and rationale	Model levers used
Early charge point deployment	We know that perceived access to charging infrastructure is important to consumers, but how important? Could early deployment of charging infrastructure support a rapid uptake of EVs?	Perceived access to public charging reaches 100% by 2030.
Introduction of zero-emission zones in major cities (“ZEZ C40”)	Zero-emission zones (ZEZs) are being discussed as a city-led approach to the climate crisis. What is the potential impact of the C40 cities implementing ZEZs by 2030 on Europe-wide EV uptake?	Share of car driving population living in C40 cities experience ICE ban from 2030. <i>In practice, the ban would influence a larger pool of car buyers but there is no solid evidence quantifying this so a conservative approach taken</i>
Dedicated BEV platforms	It is expected that car OEMs will continue to develop dedicated BEV platforms, capable of supporting many different segment types. This is anticipated to further reduce the cost of BEVs, potentially by up to 25% by 2030 (BNEF/T&E).	Manufacturing cost of BEVs reduced from the baseline by 25% by 2030.
Introduction of hydrogen fuel cell vehicles	Hydrogen fuel cells are still discussed as a potential powertrain for passenger cars. However, do they compete with BEVs?	Introduction of medium and large FCEVs in 2025.
E-fuels as an alternative to BEVs	Synthetic hydrocarbon fuels (E-fuels) have been proposed as an alternative for BEVs, but are they competitive?	E-fuels produced using solar PV in the Middle East (without any taxes applied) are blended into fossil fuels 2025-2035.

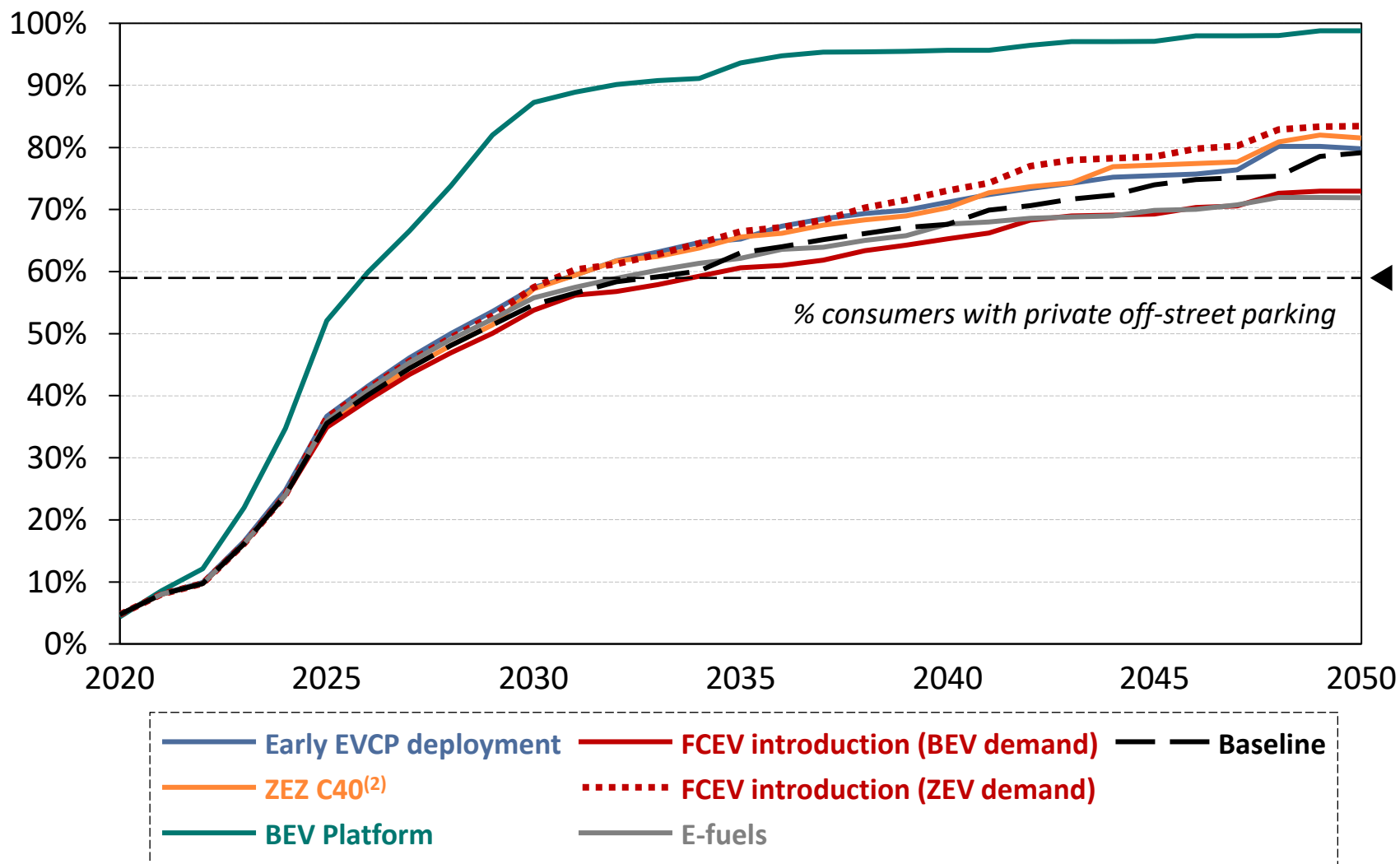
Sensitivities highlight upfront purchase price as the most important driver of consumer purchase decisions

Baseline results: EU & Country specific

Sensitivity analysis

Conclusions and messaging

BEV demand across all 7 markets¹ under a range of sensitivities



The BEV platform sensitivity results in the biggest near-term divergence from the baseline. **This indicates that upfront purchase price is the key driver for purchase decisions.**

The consumers studied did not assign significant value at purchase to slow charging (€2k), or rapid charging (€1k). Home charging was valued at €4k on average. Market shares above 59% require consumers without access to home charging to purchase BEVs – **if public charge point deployment did not keep pace with demand, we expect these consumers to avoid purchasing EVs**

We have assumed that only consumers who live within a zero-emission zone remove non-ZEVs from their choice set. However, if consumers outside the ZEZ also behaved in this way the impact could be much greater.

Both the FCEV and E-fuel sensitivities are discussed further in the appendices.

(1) All 7 markets: France, Germany, Italy, The Netherlands, Poland, Spain, UK (2) assumes that C40 Cities implement an ICE ban by 2030, including PHEVs

Summary of key messages and discussion on which results to focus on

Baseline results: EU
& Country specific

Sensitivity analysis

Conclusions and
messaging

Key takeaway messages focus on what drives consumer purchase decisions

- 1. European car buyers want EVs** – removing ICE vehicles as an option is not going against consumers' preferences, and car OEMs who have ambitious EV sales target will be able to achieve them.
- 2. Upfront cost is the most important factor in the purchase decision** – once price parity is reached the market will rapidly switch to BEV preference.
- 3. Without further government intervention, new vehicle sales will not be fully decarbonised by 2035** – strong government action will be needed to reduce demand for hybrid powertrains.
- 4. Today, perceived access to charging does not significantly impact purchase decisions**, however if charge point deployment does not keep pace with EV uptake, we would expect this to change rapidly, with uptake capped by who has access to guaranteed home charging.
- 5. Legacy powertrains sell poorly from 2030, and it is likely that auto OEMs will remove many from sale.** However enforcement will be required in order for 'phase-out' targets to be effective.

Discussion

- What are your thoughts on the key messages?
- Of the results shown, which do you think are the most interesting / surprising?
- Which sensitivities do you think are of most interest and should be included in the final report?

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This project has received and benefited from feedback from a wide range of stakeholders

Stakeholder group

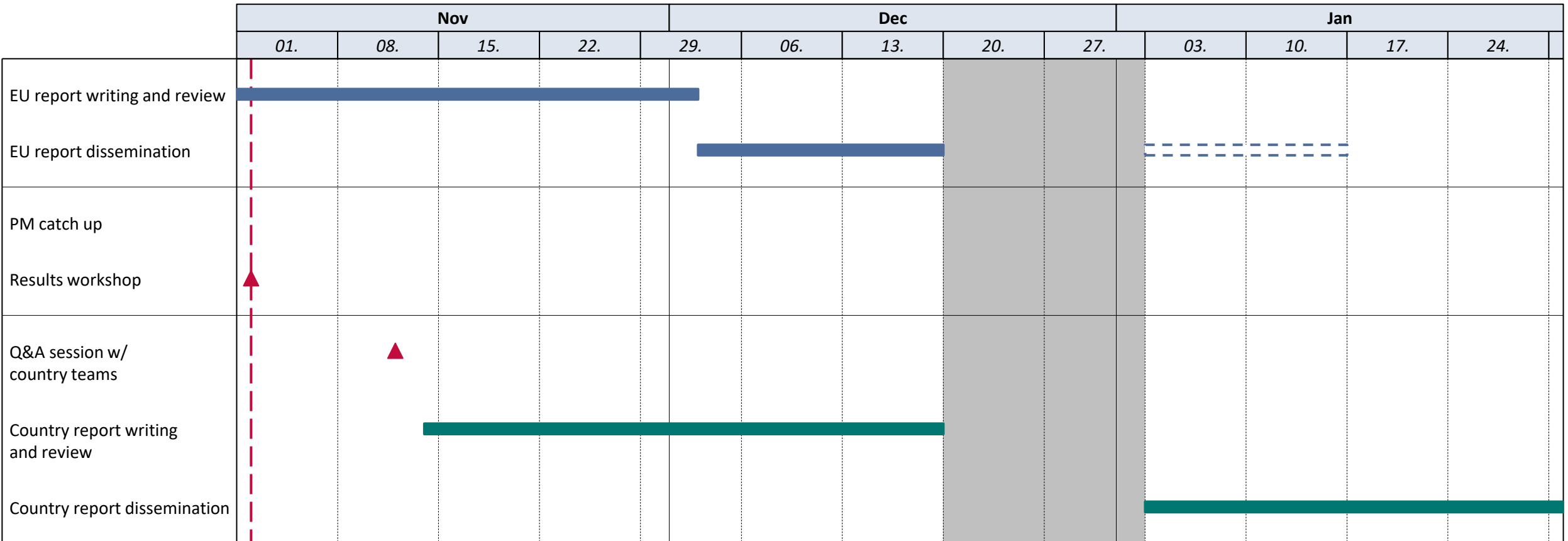


The **Platform for Electromobility** will be leading the dissemination of the final report, and will write a series of recommendations based on the report's findings.

Country level reports will be written by members of the stakeholder group:



Overview of timeline for results dissemination



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Access to parking statistics

Share of consumers who have considered an EV

Details of purchase subsidies

The case of E-fuels

The case of hydrogen fuel cells

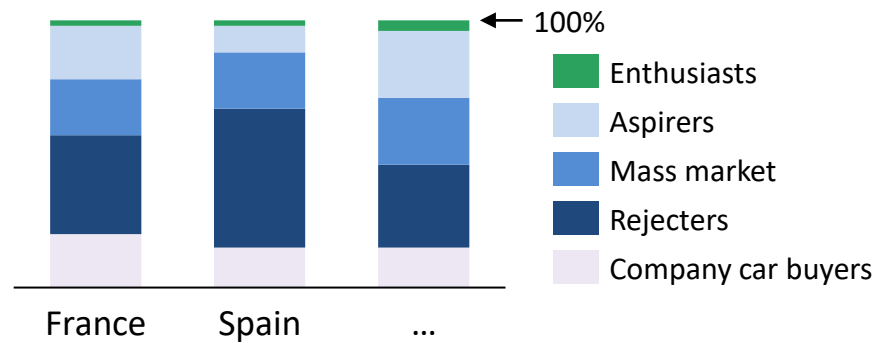
Detailed projected demand by consumer type

The consumer survey and choice experiment will feed into our EU EV uptake model to project EV sales



Consumer survey

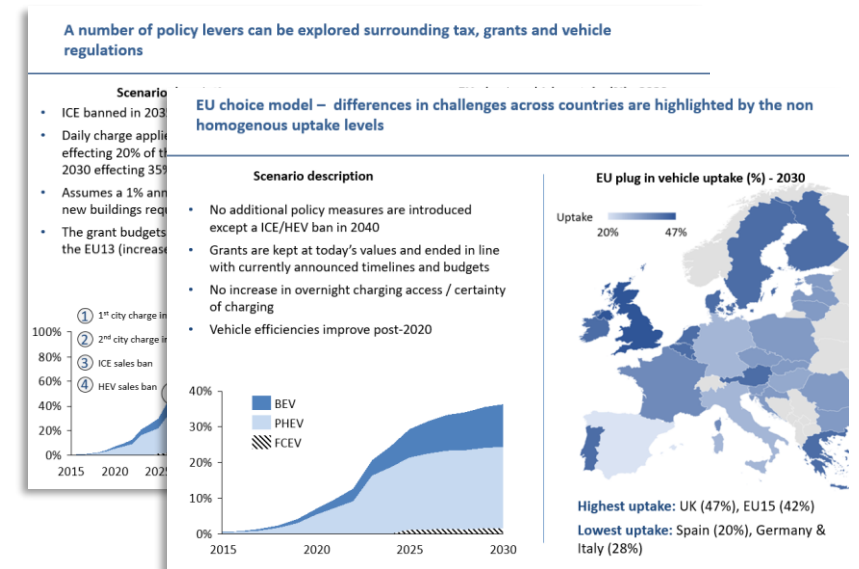
Produces consumer segmentation and coefficients which capture consumer purchasing decisions



Feed into our EU consumer choice EV uptake model

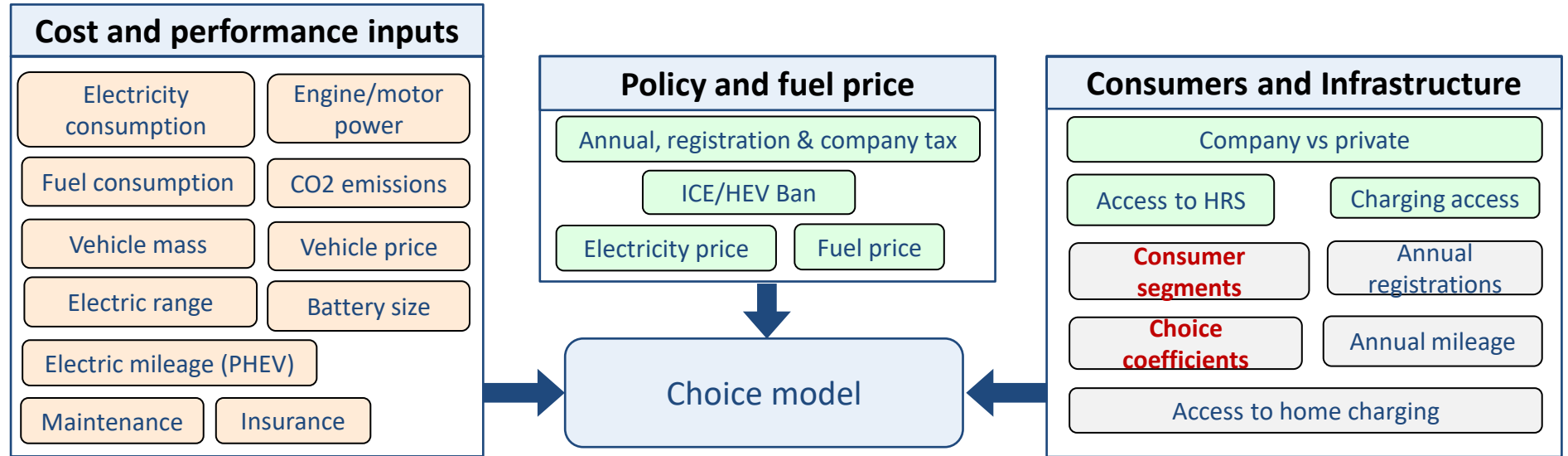
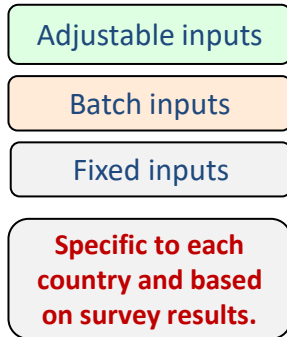


Generates EV uptake projections





Overview diagram



- Projections for vehicle price and characteristics come from EE's recently updated Cost and Performance model, and we have taken many of the country specific inputs from our [TCO work with BEUC, which is now published](#).
- Some sensitivity runs looking at areas of uncertainty or potential policy intervention have also been run.

- Much of the baseline policy and fuel price data is be in-line with our recent work for BEUC (electricity pricing – Eurostat; future oil forecasting – World Energy Outlook etc.)

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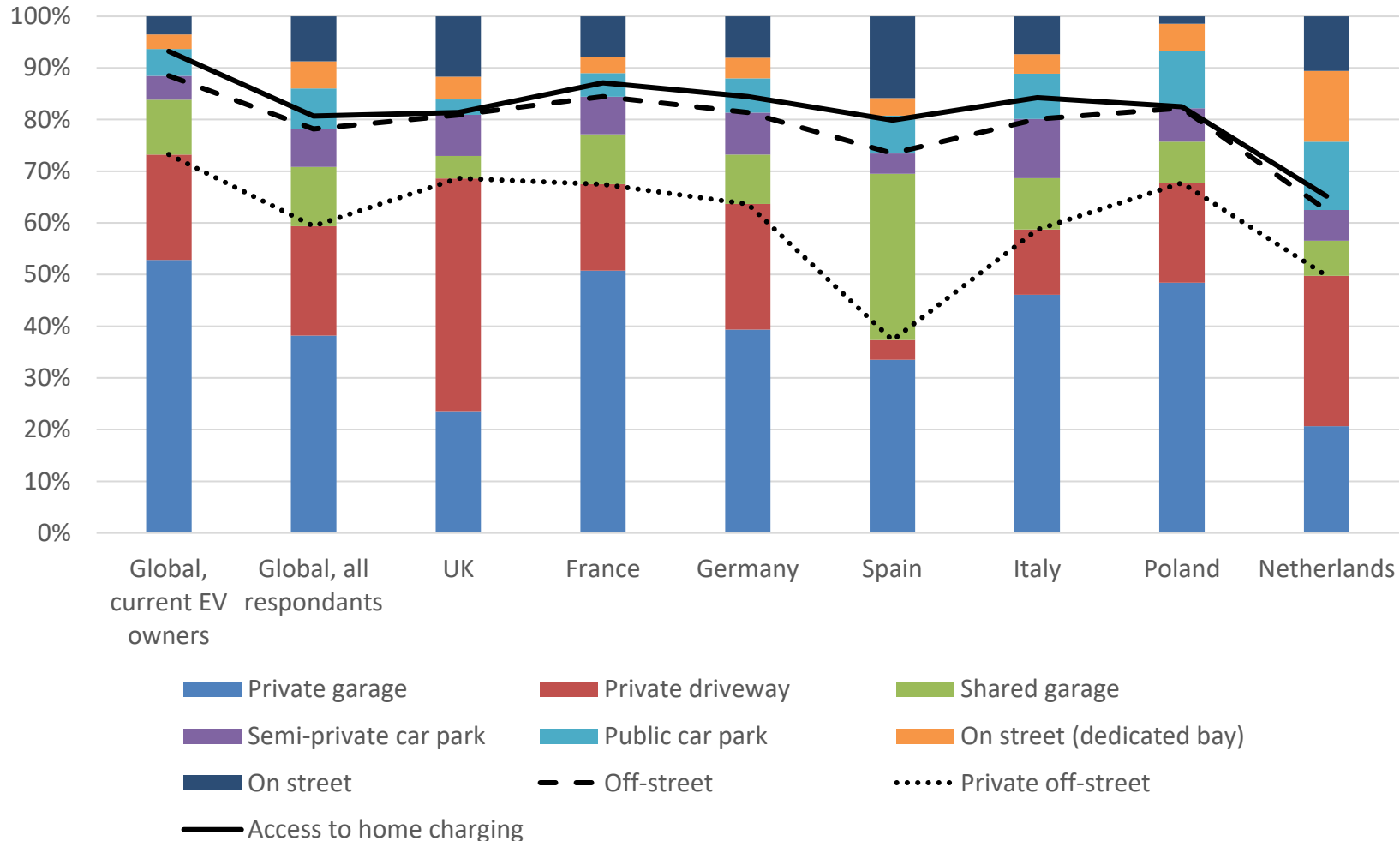
The case of E-fuels

The case of hydrogen fuel cells

Detailed projected demand by consumer type

59% of new car buyers have access to private parking, and a further 19% have access to off-street parking. Existing EV owners are more likely to have access to private parking

2021 access to parking types of survey respondents



- The data on the left shows where survey respondents stated they currently park their cars. Access to parking types clearly varies substantially between European markets.

- As expected, current EV owners have much higher access to private off-street parking than the average new car buyer.

- During the choice experiment, we told consumers that indicated they park at least one car in either private garage, private driveway, shared garage, and semi-private car park that they had access to 'home charging'.
- Shared garages and semi-private car parks (i.e., outside a block of flats) were included in this as it is reasonable to assume that in the future legislation will require these areas to provide charging access to residents.

Source: survey on ca. 2,000 new or nearly new car buyers in each of the countries (14,052 in total) conducted in 2021. Number of EV owners = 661. Respondent households own collectively 24,015 cars

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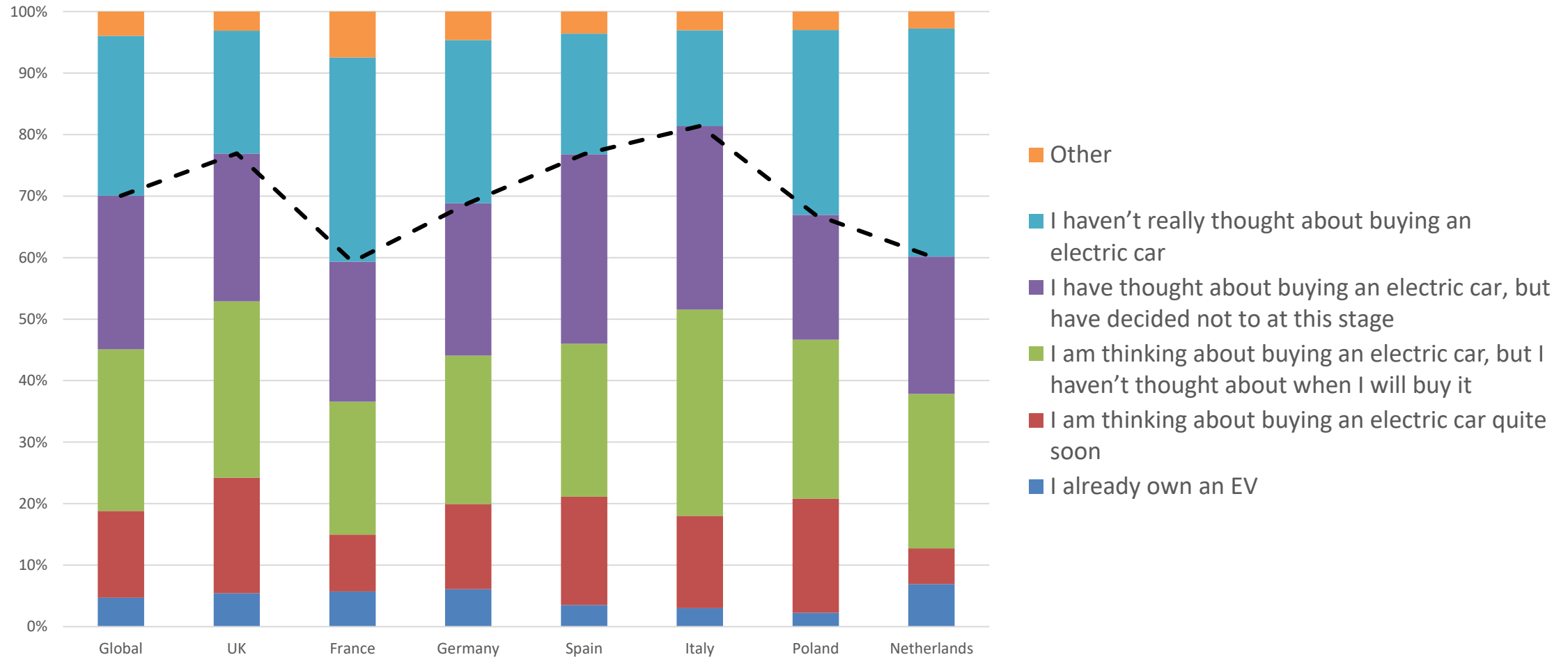
The case of E-fuels

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Detailed projected demand by consumer type

On average across the markets studied, 70% of new car buyers are aware of EVs

2021 EV awareness of survey respondents



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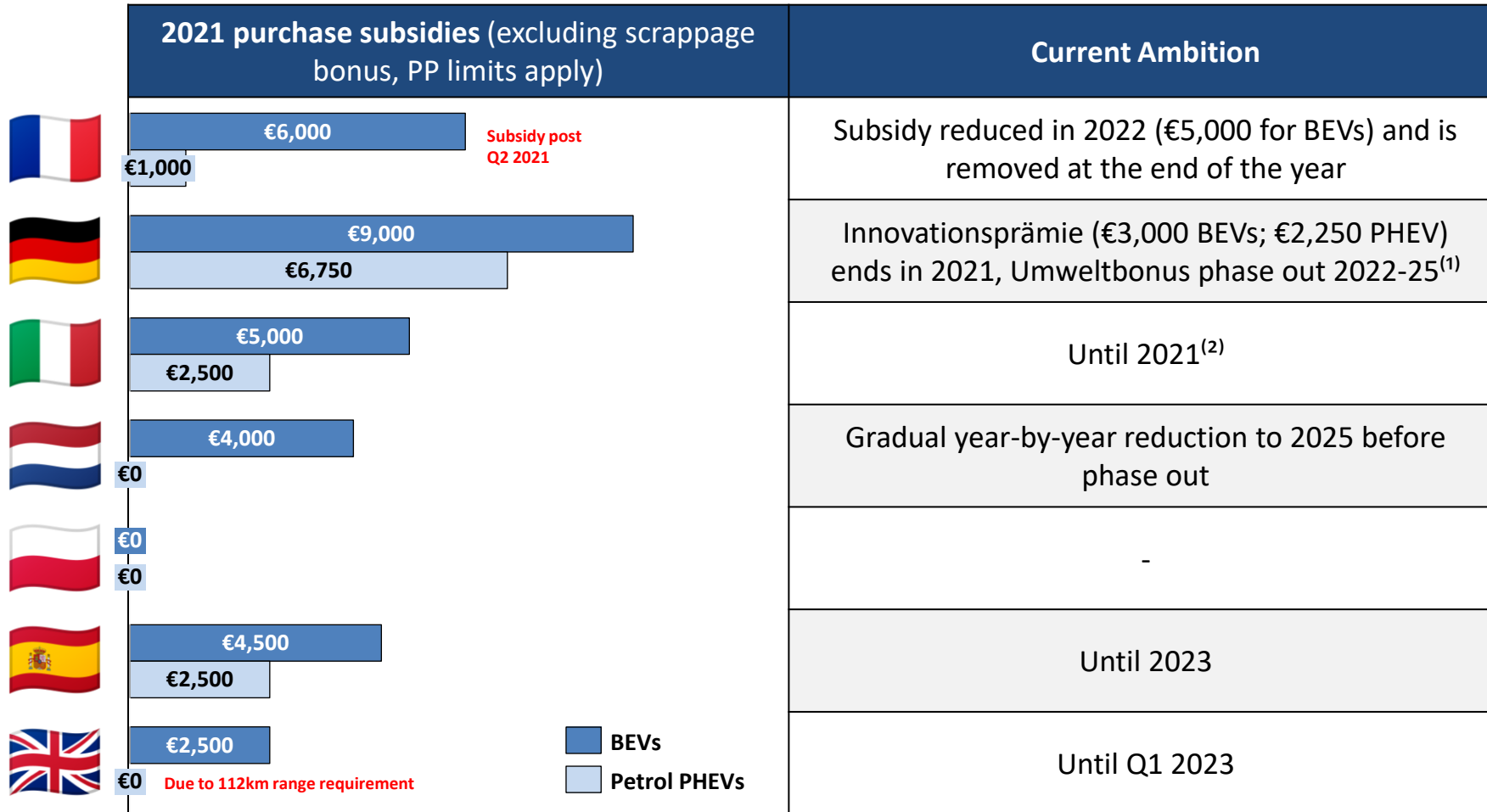
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The case of hydrogen fuel cells

Detailed projected demand by consumer type

Purchase subsidies will be removed as stated in existing policies (as of Aug 2021)



- We don't anticipate Governments significantly extending plug-in grants beyond their current periods.
- The UK for example has already indicated that subsidies will be removed from Q1 2023.
- Where there is no known end date for subsidies, we have assumed they will be phased out in 2027, when TCO parity is reached with petrol ICEs, unless the existing budget is exceeded first

(1) Extension of Innovationsprämie is currently under discussion by policymakers in Germany; (2) reduced subsidy in Italy likely to be extended.
 Acronyms: PP = Purchase Price

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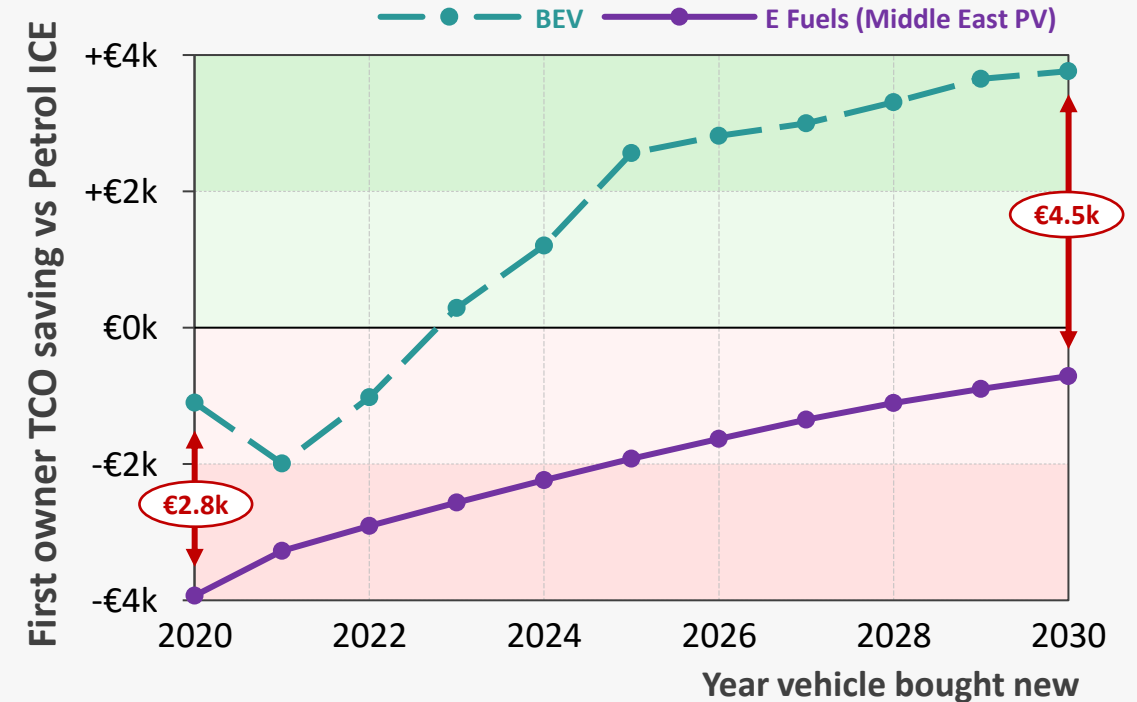
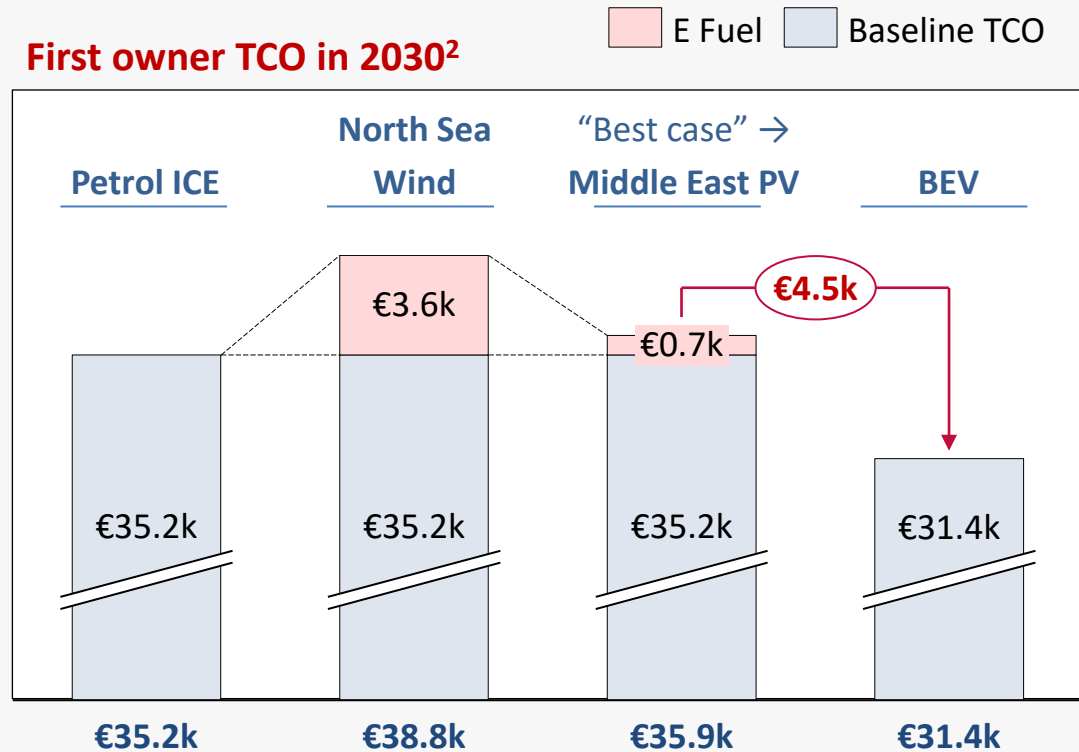
The case of hydrogen fuel cells

Detailed projected demand by consumer type

E-fuels cost forecasting & consumer implications

E-fuel forecasting excluding fuel duty (Frontier Economics¹)

First owner TCO in 2030²



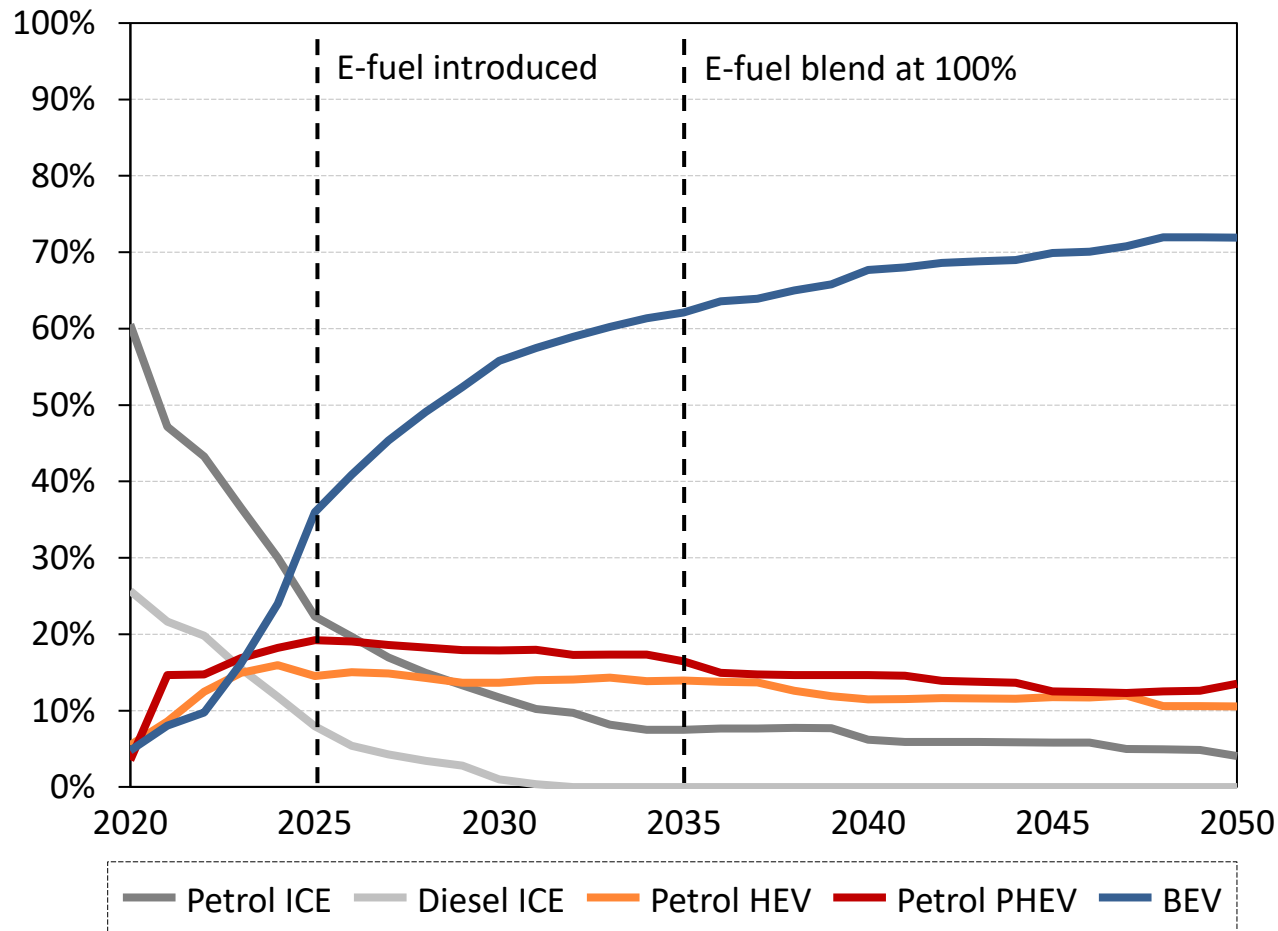
- Costs are significantly increased even for a “best case” E-Fuel scenario relying on cheap Middle East PV and removing fuel duty. No additional CAPEX is assumed, nor any ‘new technology’ bias.

- E-fuels risk diverting investment (with significant subsidies required to bring E-fuels to mass market) away from improving charging infrastructure & accelerating BEV uptake, with no clear long-term benefits to consumers

1) Agora Verkehrswende, Agora Energiewende and Frontier Economics (2018): *The Future Cost of Electricity-Based Synthetic Fuels*
 2) EU average, excludes taxes and subsidies; 15,000 annual mileage for 4 years

E-fuels are not a competitive market offering and are rejected by consumers

Demand by powertrain across all 7 markets¹ if E-fuels² introduced from 2025-2035



- E-fuels do not offer a cost-effective alternative to BEVs** – even under the best case, the TCO of an ICE running on E-fuels is significantly greater than for a comparable BEV. Pushing e-fuels will negatively impact consumers.
- Consumers want BEVs** – BEVs will dominate demand for new vehicles from 2030. Rather than resisting consumer demand by supporting E-fuels, states should focus on the transition to electrified mobility.
- E-fuels will negatively impact the poorest in society** – the high running costs of E-fuels will fall predominantly on poorer consumers who will be reliant on ICEs whilst they wait for the 2nd hand BEV market to mature.

E-fuels cannot compete with BEVs and risk diverting investment away from fully decarbonized powertrains – supply chains should be supported in the transition to electrified mobility rather than investing in a technology with little future in a competitive market.

1) Germany, UK, France, Italy, Spain, Poland, Netherlands

2) Agora Verkehrswende, Agora Energiewende and Frontier Economics (2018): *The Future Cost of Electricity-Based Synthetic Fuels* – Middle East PV scenario

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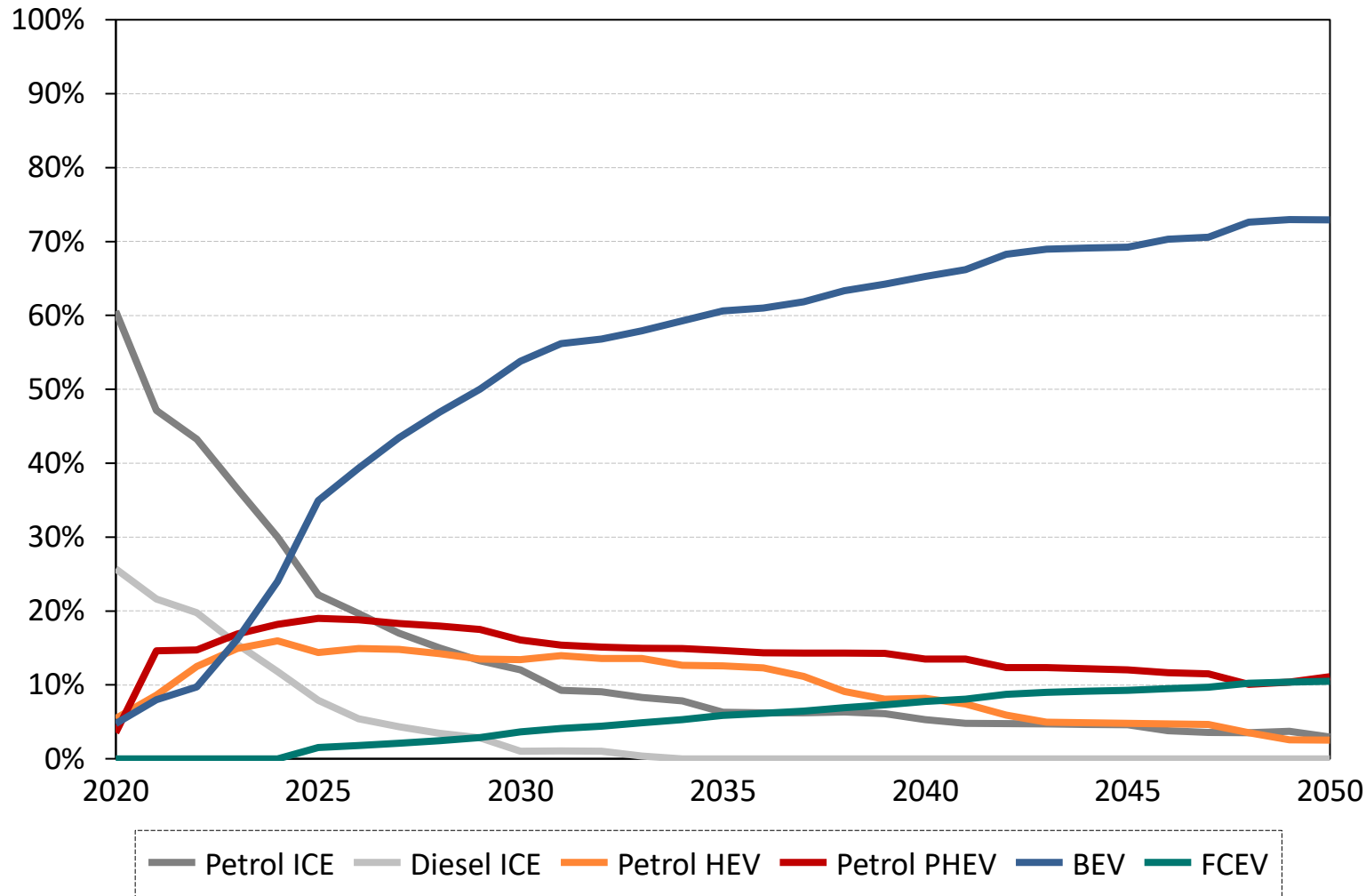
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Detailed projected demand by consumer type

Fuel Cell EVs do not offer a compelling alternative to BEVs, and provide only a moderate increase in total ZEV uptake

Demand by powertrain across all 7 markets¹ if FCEVs introduced from 2025



- FCEVs do not offer a realistic alternative to BEVs, due to substantially higher upfront costs. Range anxiety of BEVs is expected to be a thing of the past by 2030, so the main benefits of FCEVs in the passenger car sector does not apply.

- FCEVs also do not substantially reduce demand for ICEs. As such, their introduction to the market has very little to offer from a policy perspective.

- Green hydrogen is expected to be a scarce resource in the upcoming decades.
- Given the introduction of FCEVs to the passenger car market does not result in reduced ICE sales in the long term, there is very little case to support them from a policy perspective.
- Available green hydrogen would be much better used in harder to decarbonise sectors, such as heavy industry.

1) Germany, UK, France, Italy, Spain, Poland, Netherlands

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Detailed projected demand by consumer type

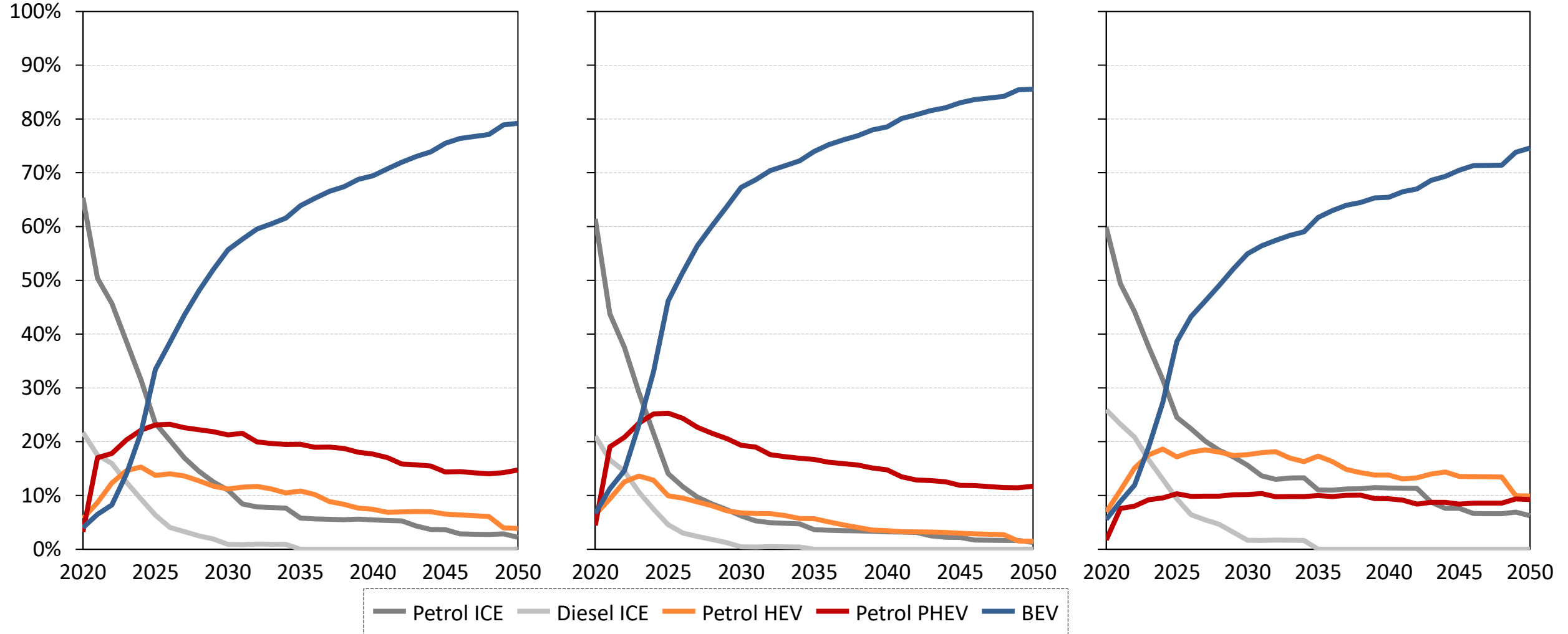
Company car buyers are assumed to lease their vehicles, reducing upfront costs. This results in a faster growth of the BEV segment to 2030

All 7 markets

Private consumers, baseline scenario

User choosers, baseline scenario

Non-user choosers, baseline scenario



Note: this is a projection of demand, with no supply constraints applied to EVs. Potential bans on sales of ICE vehicles not applied
 Results for 7 countries (France, Germany, Italy, The Netherlands, Poland, Spain, UK)

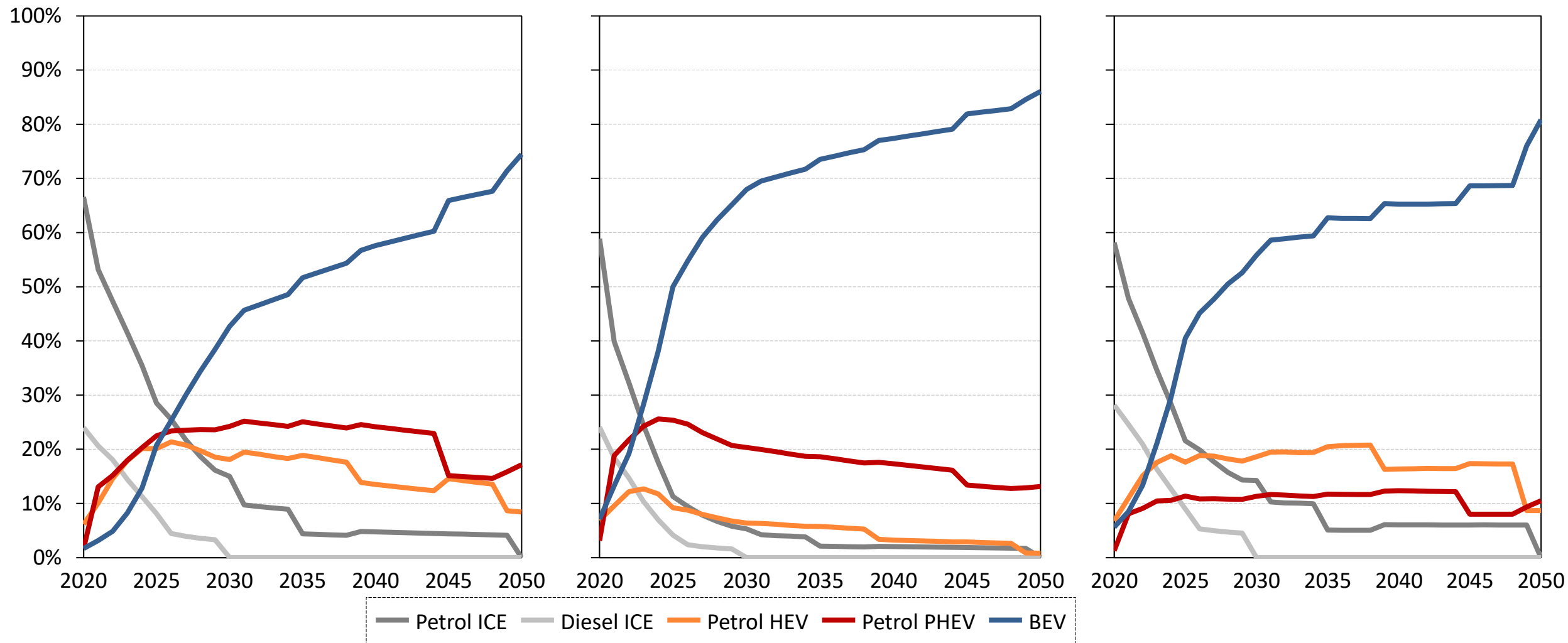
Projected demand for private, user chooser, and non-user chooser consumers



Private consumers, baseline scenario

User choosers, baseline scenario

Non-user choosers, baseline scenario



Note: this is a projection of demand, with no supply constraints applied to EVs. Potential bans on sales of ICE vehicles not applied

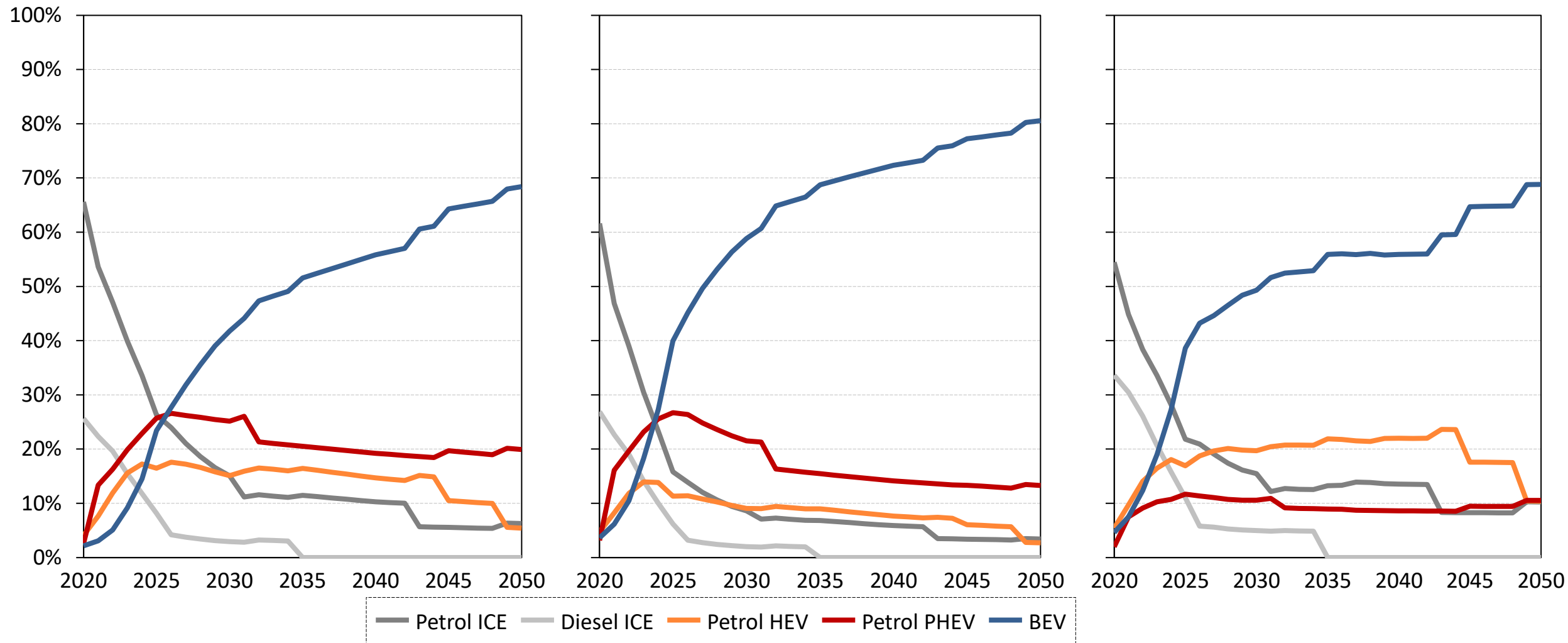
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Private consumers, baseline scenario

User choosers, baseline scenario

Non-user choosers, baseline scenario



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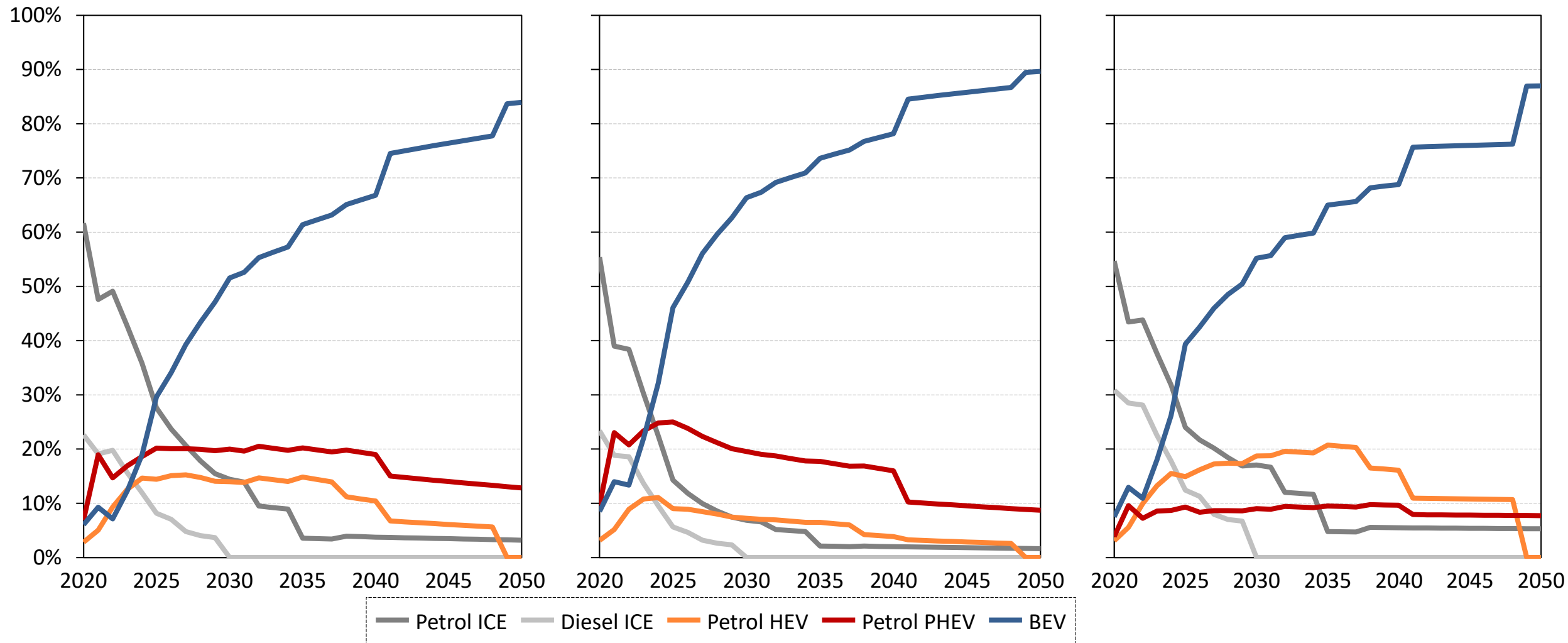
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Private consumers, baseline scenario

User choosers, baseline scenario

Non-user choosers, baseline scenario



Note: this is a projection of demand, with no supply constraints applied to EVs. Potential bans on sales of ICE vehicles not applied

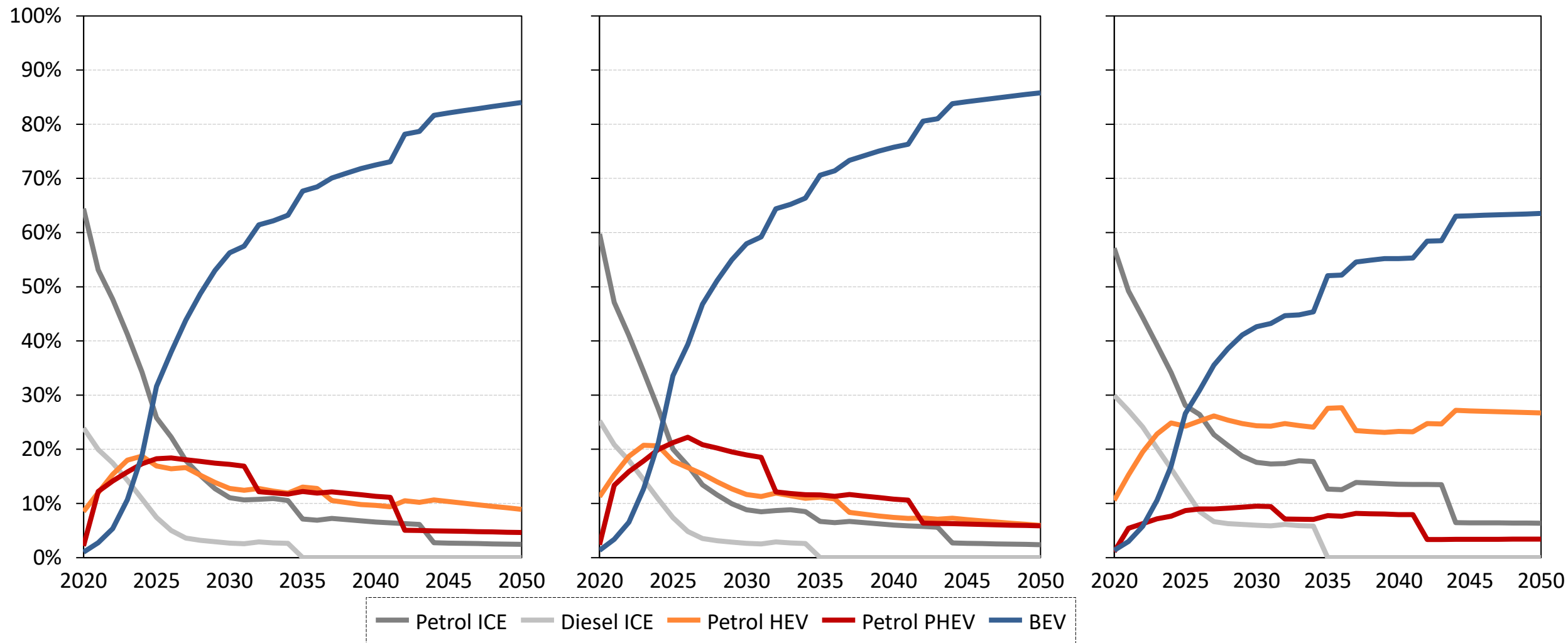
Projected demand for private, user chooser, and non-user chooser consumers



Private consumers, baseline scenario

User choosers, baseline scenario

Non-user choosers, baseline scenario



Note: this is a projection of demand, with no supply constraints applied to EVs. Potential bans on sales of ICE vehicles not applied

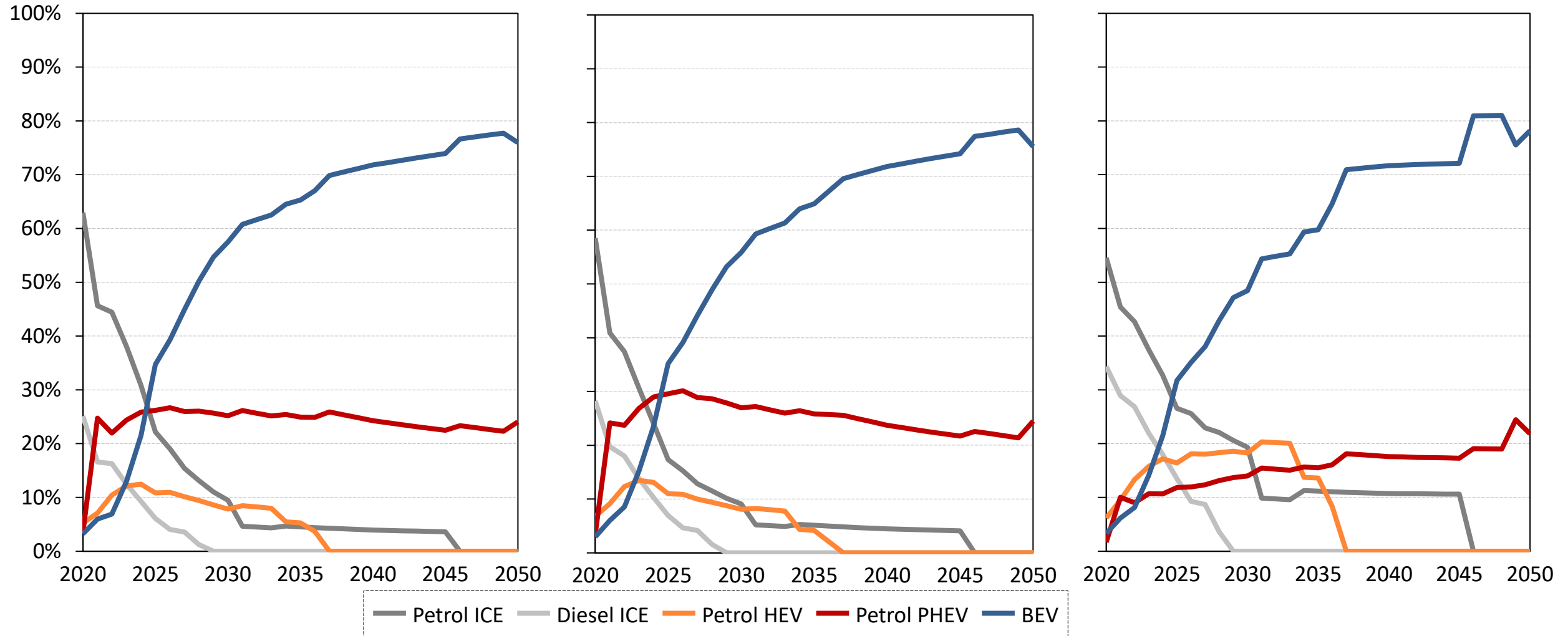
Projected demand for private, user chooser, and non-user chooser consumers



Private consumers, baseline scenario

User choosers, baseline scenario

Non-user choosers, baseline scenario



Note: this is a projection of demand, with no supply constraints applied to EVs. Potential bans on sales of ICE vehicles not applied

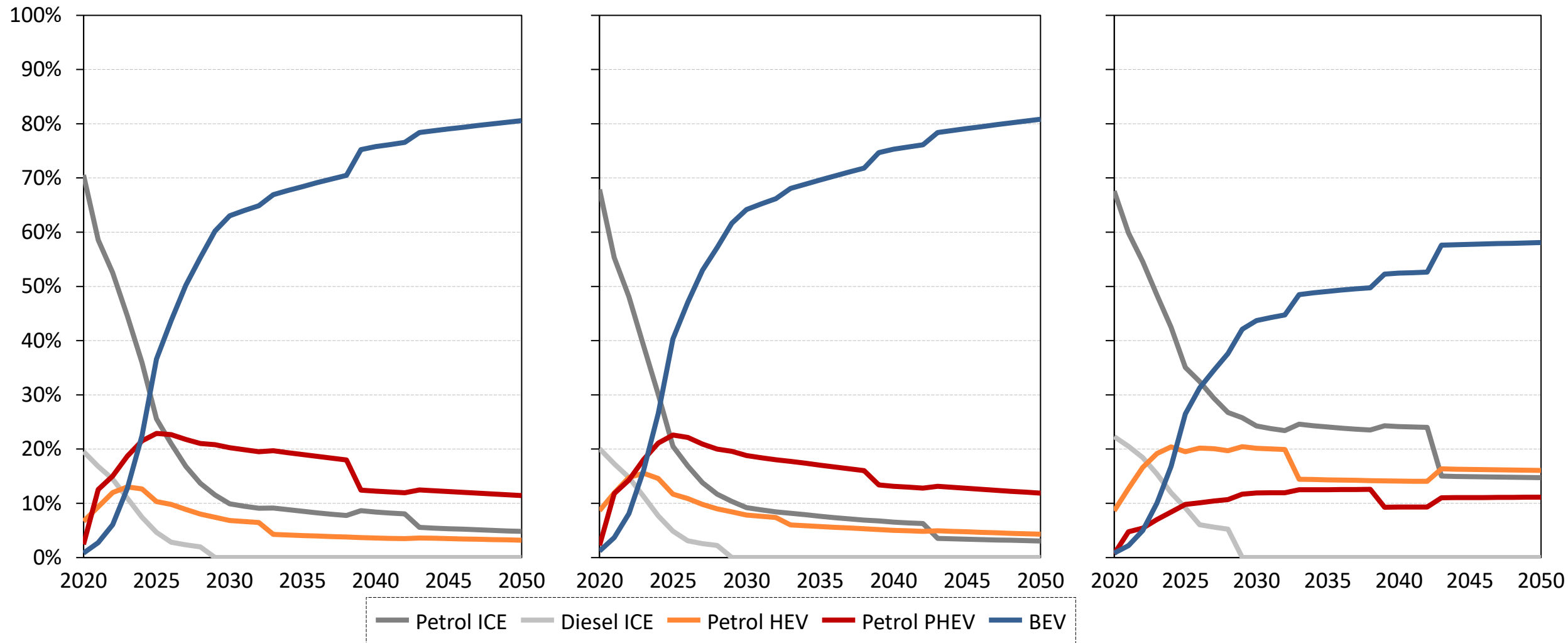
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Private consumers, baseline scenario

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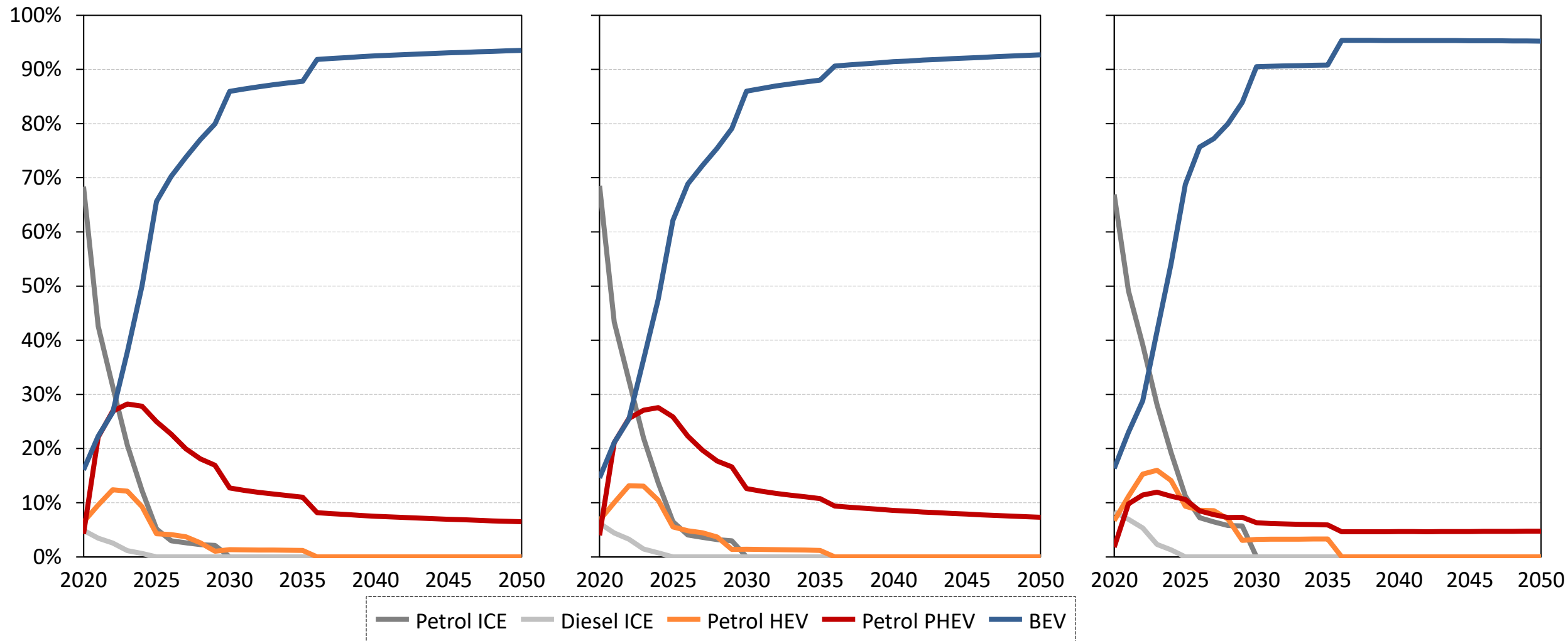
Projected demand for private, user chooser, and non-user chooser consumers



Private consumers, baseline scenario

User choosers, baseline scenario

Non-user choosers, baseline scenario



Note: this is a projection of demand, with no supply constraints applied to EVs. Potential bans on sales of ICE vehicles not applied