Q1 2023 Automotive industry demand forecast

June 2023

ADVANCED PROPULSION CENTRE UK

Accelerating Progress

Q1 2023 – Automotive industry demand forecast

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This demand forecast covers

Markets	Global; European; UK
Vehicles	Light Duty Vehicles (LDVs) Heavy Goods Vehicles (HGVs) 
Materials	Lithium; Cathode Active Material (CAM); Battery foils; Electrolyte and Separator Material

Our process

The data in these demand graphs is based on APC insight gathered from UK OEMs on xEV production; APC and Automotive Council PEMD traction specifications; and powertrain split forecasts from S&P Global IHS Markit. Rho Motion, BloombergNEF (BNEF) and Wood Mackenzie have also guided the demand forecast.

Quarterly updates

Any developments in the sector will change and influence these forecasts. APC will update these on a quarterly basis in line with the impacts of those announcements.

Q1 2023 – Summary

Summary – Changes to projected demand by region

Q1 2023 compared to Q4 2022

Global demand update	• World battery demand much stronger in 2030 on the back of higher BEV production expected from North America, China and other Asian regions • Signs of supply chain issues easing and more clarity around geopolitical strategies	page 8
European demand update	• The United States' Inflation Reduction Act has shifted investment momentum away from Europe, leading to a significant drop in the expected 2030 battery demand in Europe due to BEV production plans potentially being held back by supply chain localisation	page 10
UK demand update	• More clarity over significant battery investments landing in the UK, but battery demand expectations for 2030 lowered in line with European trend • Demand continues to show strong growth with over 90GWh of demand in 2031, delayed by one year • Reduction from 97 to 89GWh demand in 2030 primarily in PHEV and FCEV forecast. PHEV sales in particular slowing compared to other hybrids – reflected in production forecasts. • Overall production reduced from 1.4 to 1.3 million – expectation that some OEMs will focus on fewer models but with higher premiums • Meeting the current timeline for EU rules of origin expected to be a key challenge for UK-based BEV manufacturers	page 21

Summary – Trends insight

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Q1 2023

78 Pt Platinum	**Platinum demand scenarios for 2035**	**Platinum market balances in 2035 modelled** **Demand scenarios analysed:** • Platinum content in ICEVs, PHEVs and FCEVs today and in future • The consequences of shifting some larger BEV production to FCEV	pages 13-21
	**Recycling platinum for a fully-circular future**	**Circularity in the platinum supply chain for automotive:** • Analysis of current primary and secondary platinum usage • Leveraging existing recycling models for autocatalysts in fuel cell stack recycling	pages 15-19

Source: APC analysis

Summary – Supply chain activity

Q1 2023 notes

- The graph refers to Europe's capability to supply battery cells and sub-components that arise from local vehicle production
- It assumes Europe is a self-sustaining bloc with no imports or exports
- 2027 and 2030 are important milestones for rules of origin deadline and the UK's phase-out deadline for ICE vehicles, respectively

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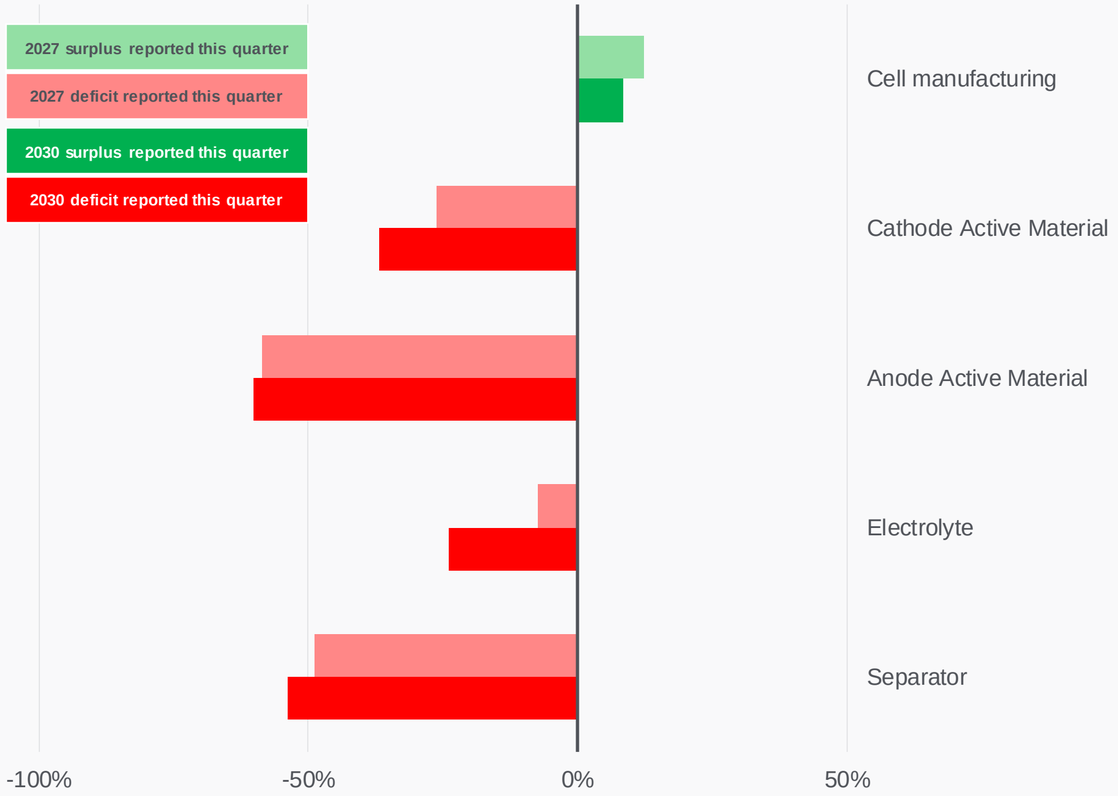
2027 and 2030 European[1] capacity vs demand balances



Status of regional capacity* v demand balance in 2030	Value** (%)	UK supply chain status
Significant plans for cell manufacturing capacity but significant risk of investments moving to USA. This forecast is a snapshot in time considering current risk, the situation is an evolving one.	18%	A gap remains between confirmed gigafactory plans and demand, creating an opportunity for investment
Investment in supply stream is largely focused on CAM which is likely to have a positive impact on reducing CAM deficit but unlikely to fully close the gap	**46%**	Required to be made in the UK from 2027 for UK cells to qualify as local and to avoid EV tariffs in the EU
Chinese supplier Putailai announces plans for Europe's biggest anode plant to date in Sweden to supply Northvolt.	9%	Expected to be the next 'big thing' after CAM. Access to low-cost renewable energy is key to manufacturing competitiveness.
No new major projects announced, but future European electrolyte supply likely to near or match European demand as gigafactory plans clarified	8%	Value in today's liquid electrolyte is relatively low, but semi-solid and solid-state electrolytes are a key investment consideration
Separator materials remains a big growth opportunity for localisation in Europe	7%	Significant opportunities to localise in UK even though typically manufactured in Eastern Europe

Source: APC internal analysis of public announcements, BNEF forecasts (Accessed: 25.05.2023)
1) Europe region includes non-EU countries such as Turkey

*Risk-weighted capacity based on APC internal assessment of announced and under construction projects
**Value in terms of cost contribution to total cell cost based on an NMC811 cell

Q1 2023 – Demand update

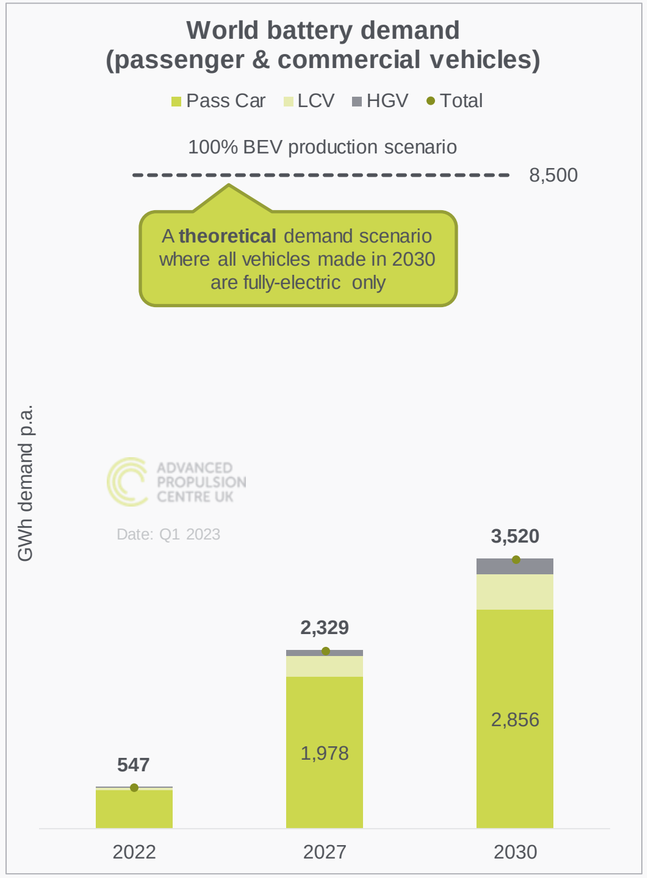
The following section includes battery demand from both Light Duty Vehicles (LDVs) and Heavy Goods Vehicles (HGVs)

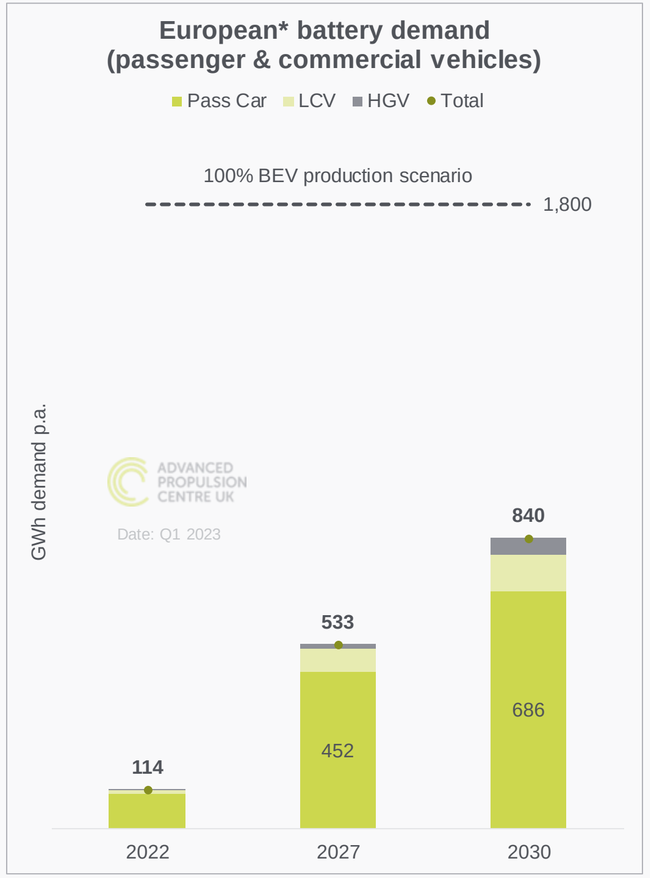
Battery demand forecast

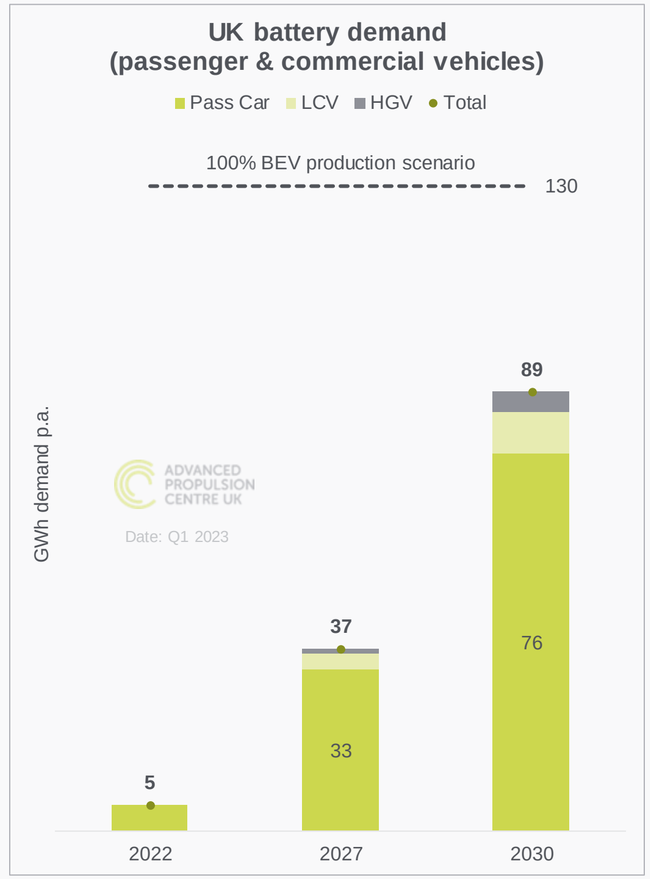
LDVs and HGVs

Q1 2023 notes

- Global battery demand in 2030 boosted by stronger demand in the US and China
- HGV battery sizes adjusted in this forecast leading to higher GWh demand







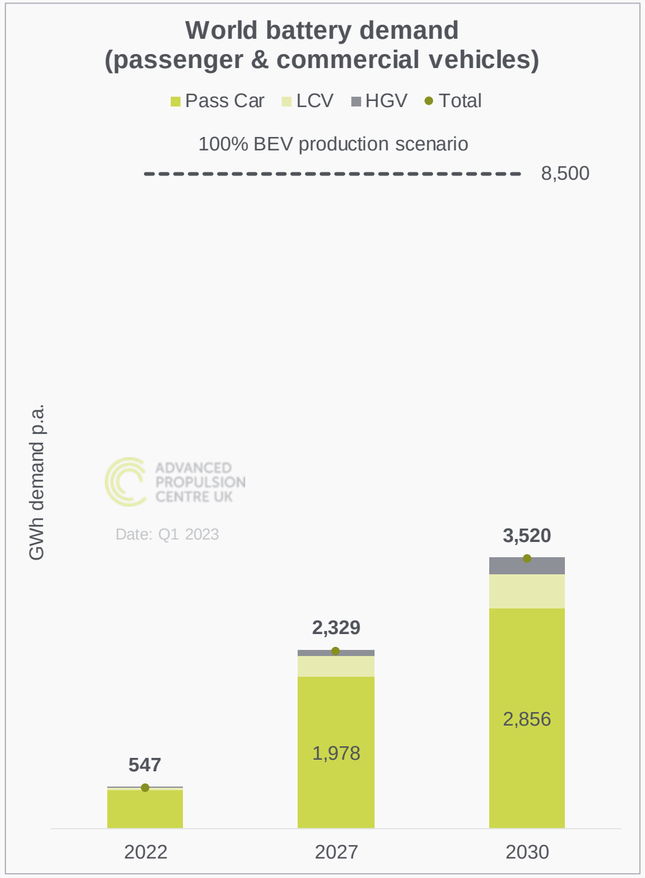
Source: APC Demand Databases using S&P Global AutoTechInsight (Mar 2023), Rho Motion data (Mar 2023), BNEF (Mar 2023), LMC (Mar 2023)
Note: LCV = Light Commercial Vehicles < 3.5t, buses not included. *European forecast includes non-EU countries such as Turkey

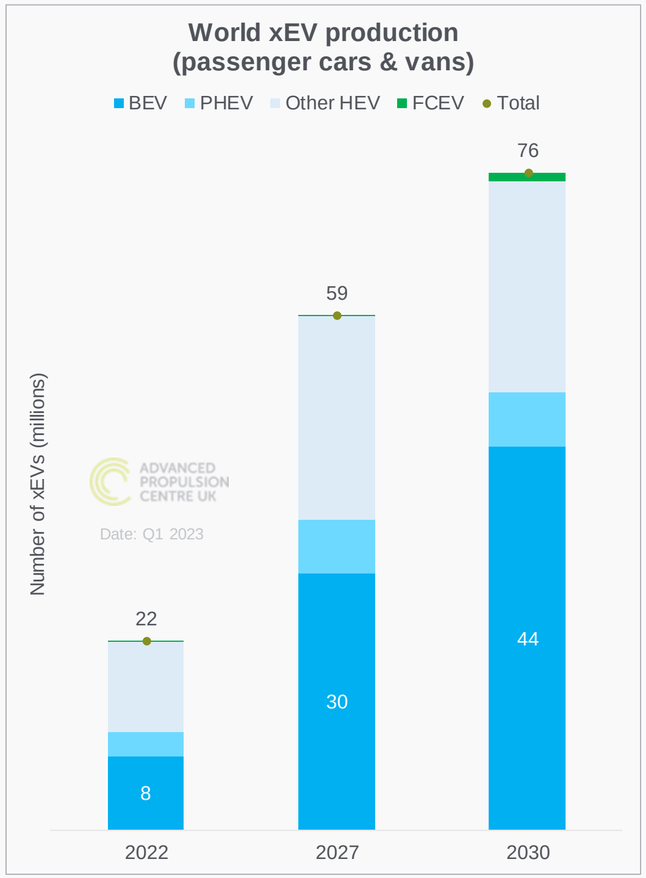
World xEV production

Passenger cars and vans

Q1 2023 notes

- World vehicle production would require 3,500GWh of batteries, with 44 million battery-electric cars and vans produced globally by 2030





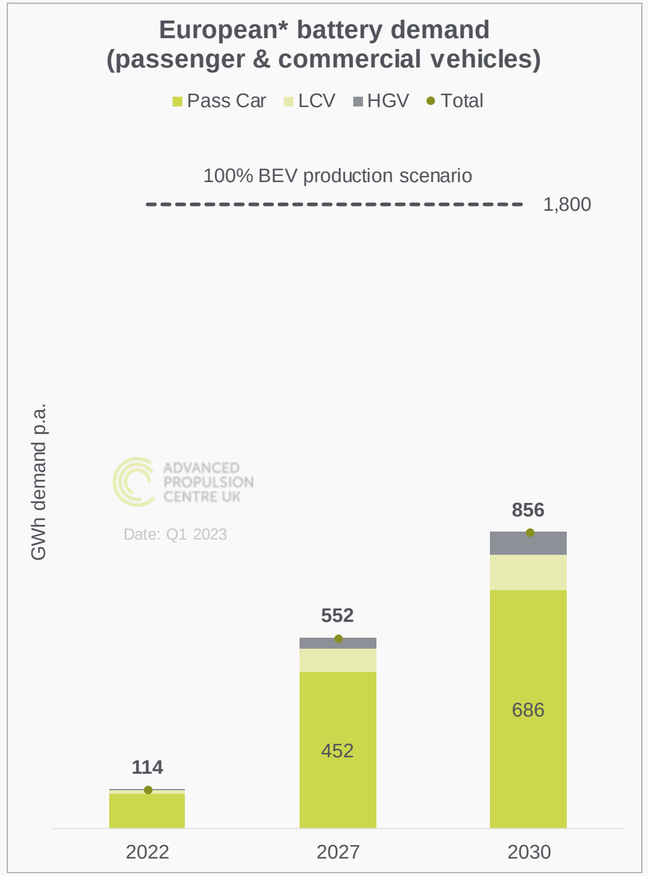
Source: APC Demand Databases using S&P Global AutoTechInsight (Mar 2023), Rho Motion data (2023), BNEF forecasts (2023), LMC (2023)
Note: LCV = Light Commercial Vehicles < 3.5t, buses not included.

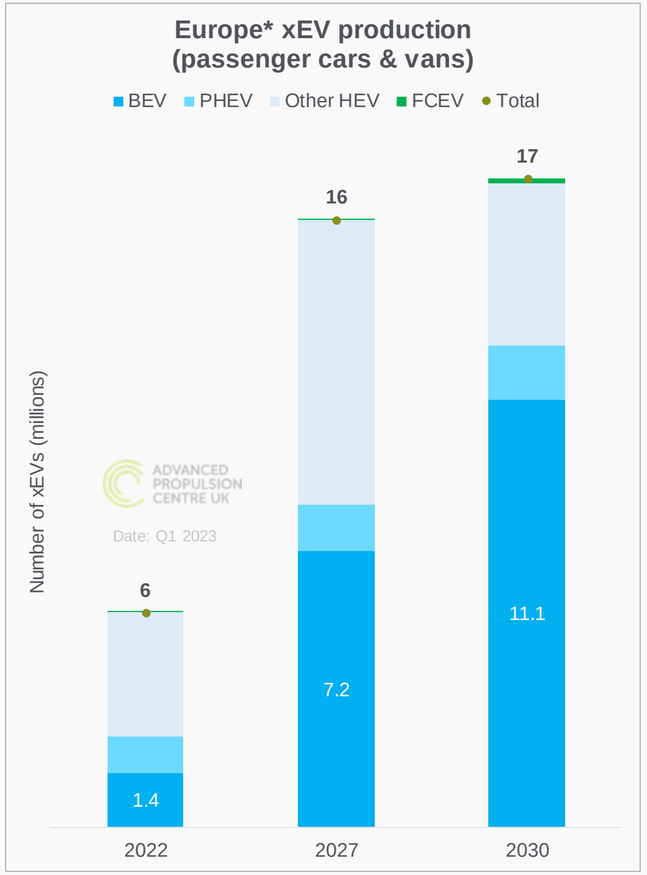
European xEV production

Passenger cars and vans

Q1 2023 notes

- 11 million fully-electric vehicles to be produced in Europe in 2030
- Battery demand to exceed 850GWh as Europe pushes to accelerate localisation of battery supply chains in response to US Inflation Reduction Act





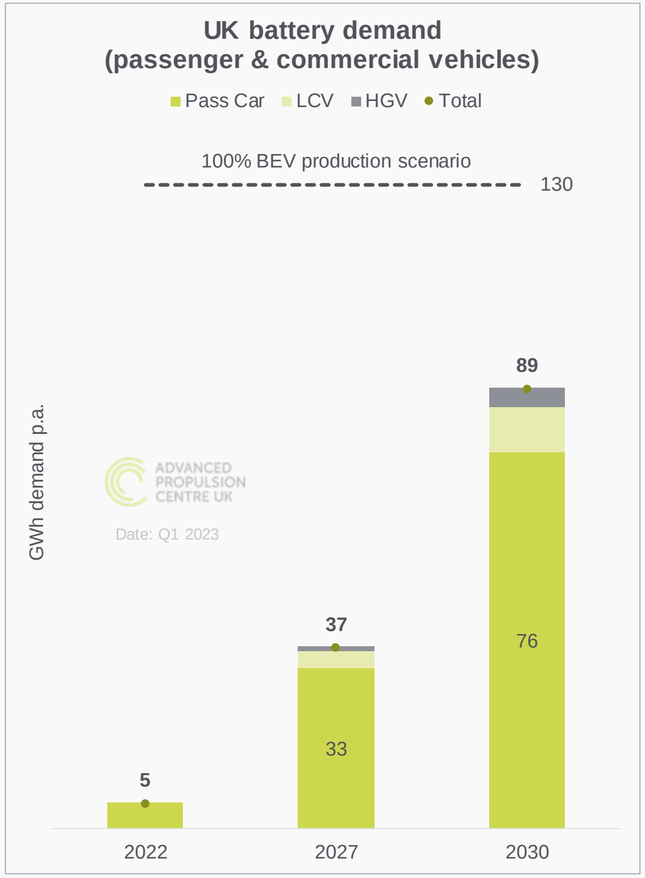
Source: APC Demand Databases using S&P Global AutoTechInsight (Mar 2023), Rho Motion data (2023), BNEF (2023), LMC (2023)
Note: LCV = Light Commercial Vehicles < 3.5t, buses not included. *European forecast includes non-EU countries such as Turkey

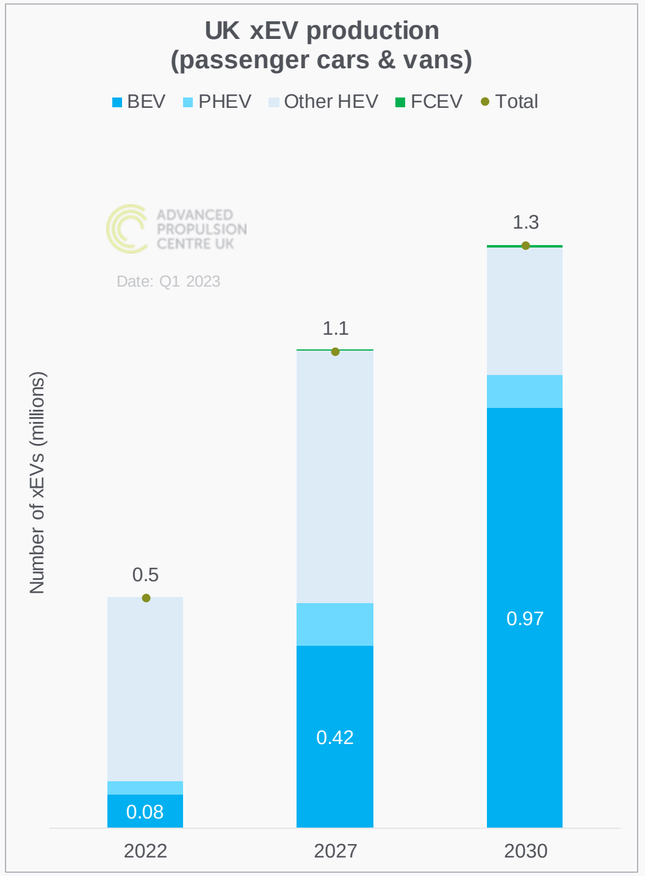
UK xEV production

Passenger cars and vans

Q1 2023 notes

- BEV production expected to near 40% of output in 2027 when new rules of origin come into force
- UK expected to produce almost 1 million BEVs in 2030
- Plans for FCEV production delayed post-2030



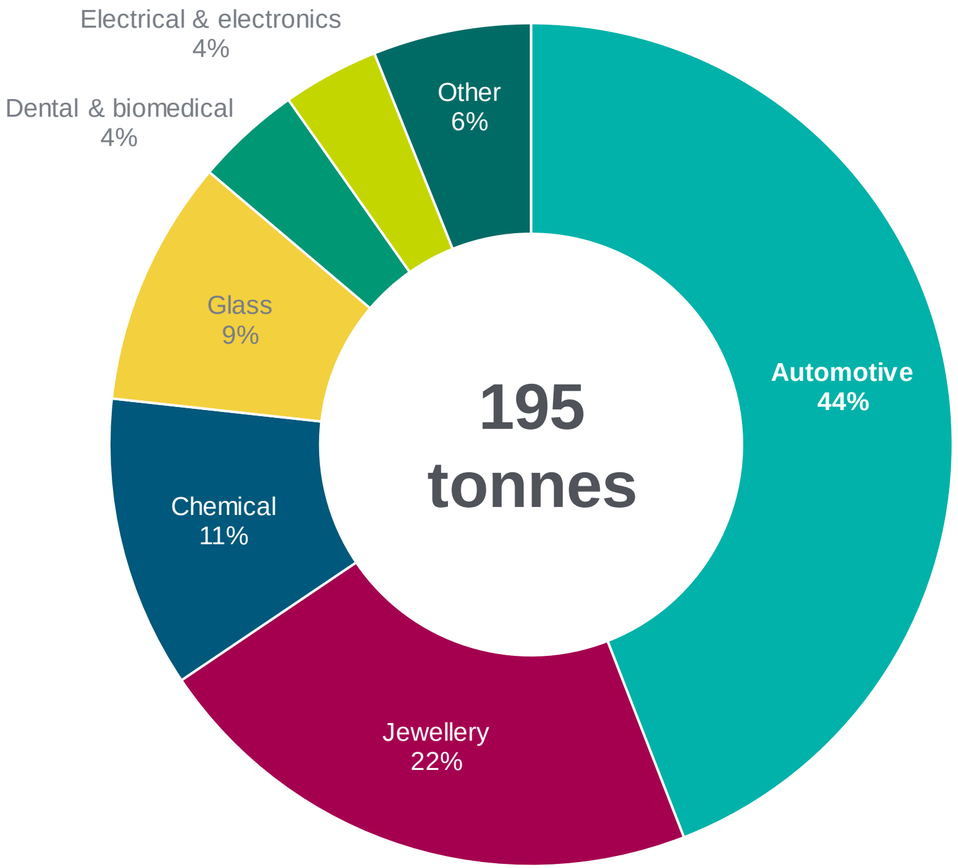


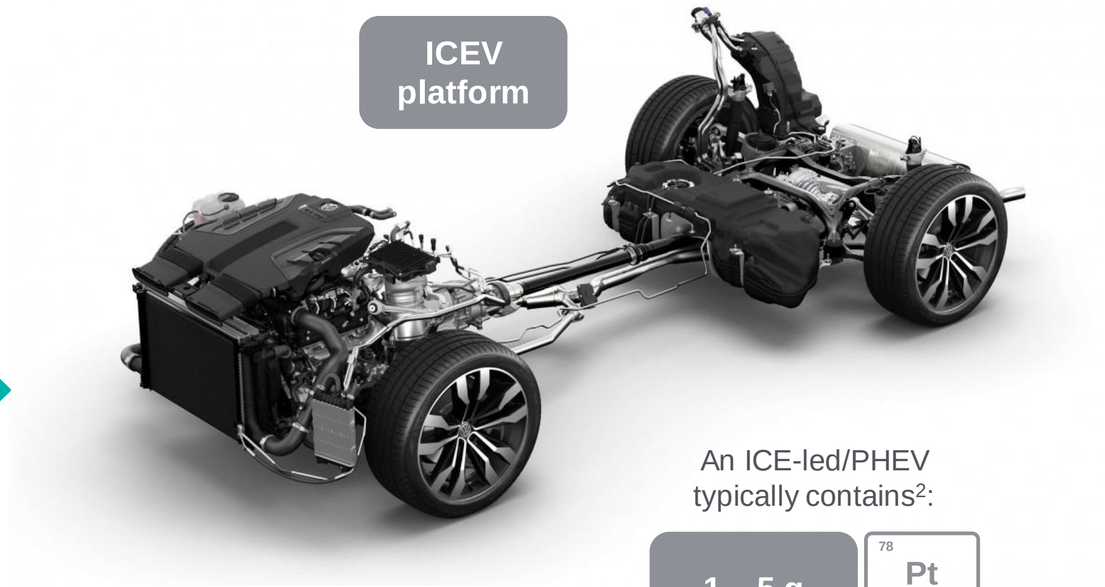
Source: APC Demand Databases using S&P Global AutoTechInsight (Mar 2023), BNEF forecasts (2023)
Note: LCV = Light Commercial Vehicles < 3.5t, buses not included.

Q1 2023 – Trends insight

The automotive sector is currently the largest consumer of platinum metal, with demand being driven by the production of ICE & ICE-hybrid vehicles

2022 platinum demand[1]





An ICE-led/PHEV typically contains[2]:

1 – 5 g

78
Pt
Platinum

Pt is used in the catalytic converters & particulate filters

1: Johnson Matthey PGM Market Report 2023, 2: Based on APC estimates derived from Johnson Matthey PGM Market Report 2023 and other sources
Image: Volkswagen AG

Due to the very low FCEV production numbers seen today, almost all automotive platinum demand is from producing cars and vans with an ICE

An ICE-led/PHEV typically contains[1]:

1 – 5 g 78 Pt Platinum ✖ **74 million**

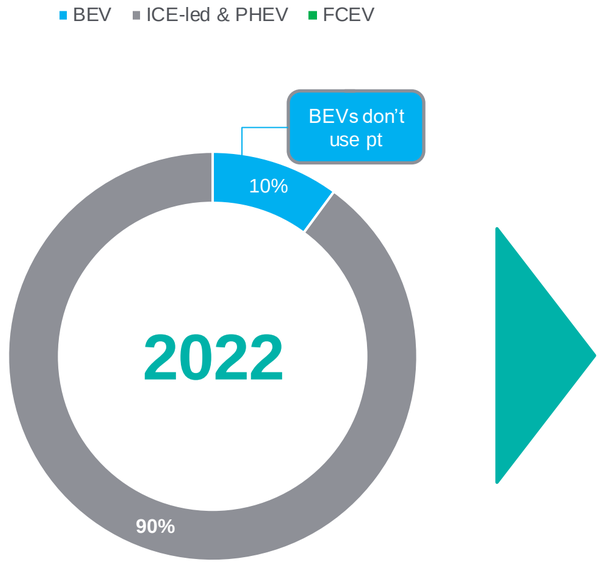
An FCEV today contains[2]:

19 – 44 g 78 Pt Platinum ✖ **16,000**

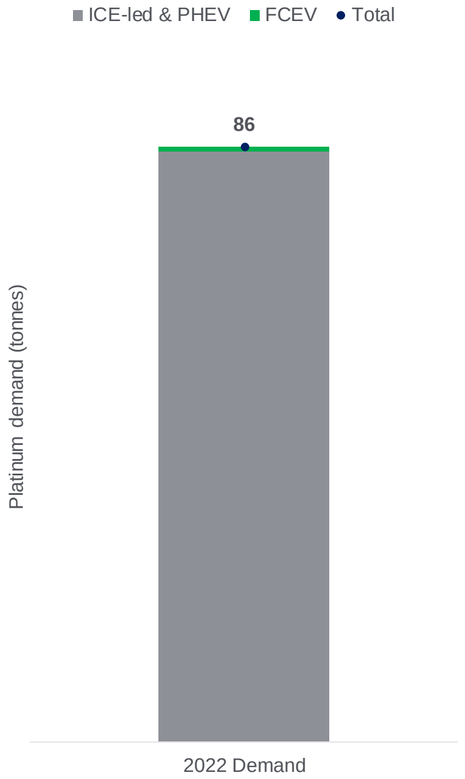
2022 LDV production[3]:

Mirai FCEV

World LDV production[3] (passenger cars & vans)



LDV platinum demand[1] (passenger cars & vans)



1: Based on APC estimates derived from Johnson Matthey PGM Market Report 2023 and other sources, 2: APC estimate based on public data for Hyundai Nexo and Toyota Mirai Gen. 2, 3: S&P Global Mobility (Mar 2023)
Images: Volkswagen AG, Toyota. I Notes: ICE-led includes HEV & ICEV

Deep-dive on platinum in light duty FCEVs: how much is used in the 2nd Generation Toyota Mirai?

The Toyota Mirai FCEV contains[1]:

19 g 78 Pt Platinum

All this Pt is found in the **Fuel Cell Stack**

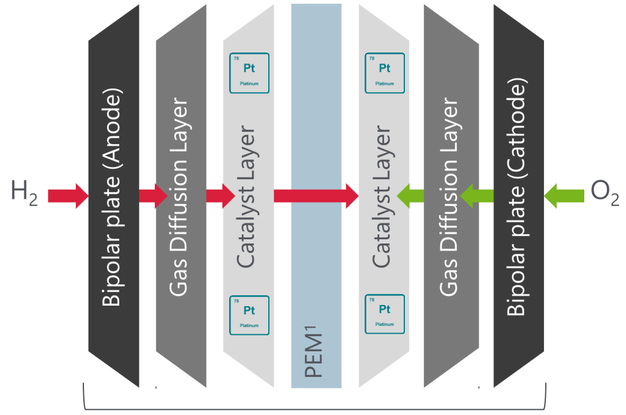
Fuel Cell Stack

This has:

330 fuel cells stacked inside it

Each Mirai fuel cell contains:

~58 mg 78 Pt Platinum



Fuel Cell

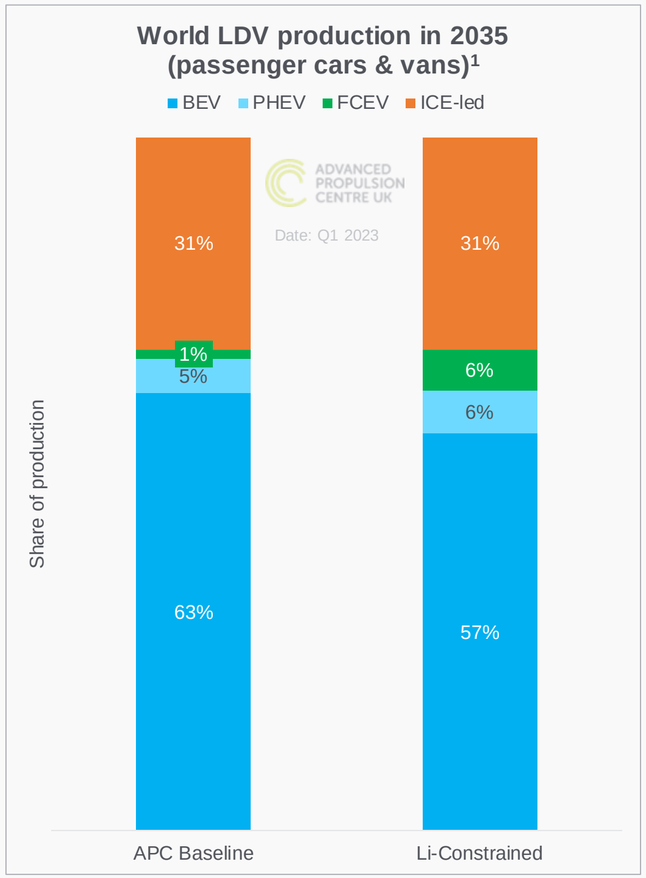
Pt is used in the **catalyst layers** of a fuel cell, with typically more used in the cathode side[2]

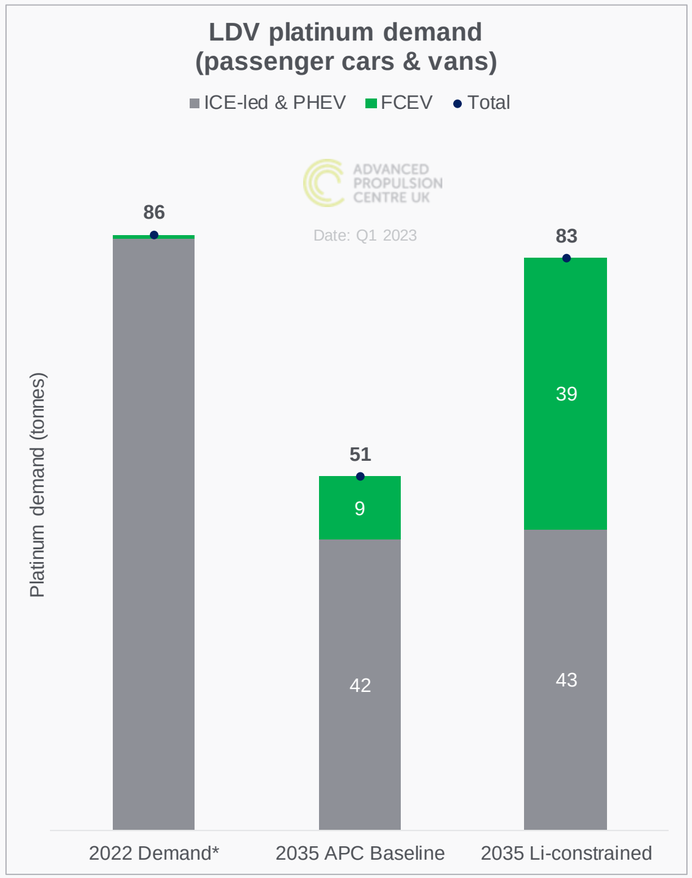
1: Based on APC estimates derived from Toyota's public information, 2: Based on APC bottom-up cost model
Images: Toyota website, FEV I Note: Light duty fuel cell stacks have different platinum loadings to stacks for heavy duty systems

A partial shift in large BEV models to FCEV production would not put pressures on platinum supply

Q1 2023 notes

- The platinum loadings in fuel cells for cars and vans are expected to reduce dramatically by 2035. A 4-fold increase in FCEV production relative to our baseline scenario would still not lead to 2035 pt demand exceeding 2022 levels.





Main assumptions:

Pt content in:	Unit	2022	2035
FCEV	g/kW (wavg.)	0.377	0.060
ICE-led & PHEV	g/kW (wavg.)	0.009	0.009

Platinum (pt) content varies significantly across the different available FCEV models. The platinum content in the 2nd Generation Toyota Mirai is significantly below the weighted average assumption for 2022, but the Hyundai Nexo accounted for most of the FCEV production last year.

2035 vehicle production scenarios:

LDV prod.	Unit	2035 Base	2035 (Li-const.)
FCEV	000's vehicles	1,371	5,945
ICE-led & PHEV	000's vehicles	35,629	36,913

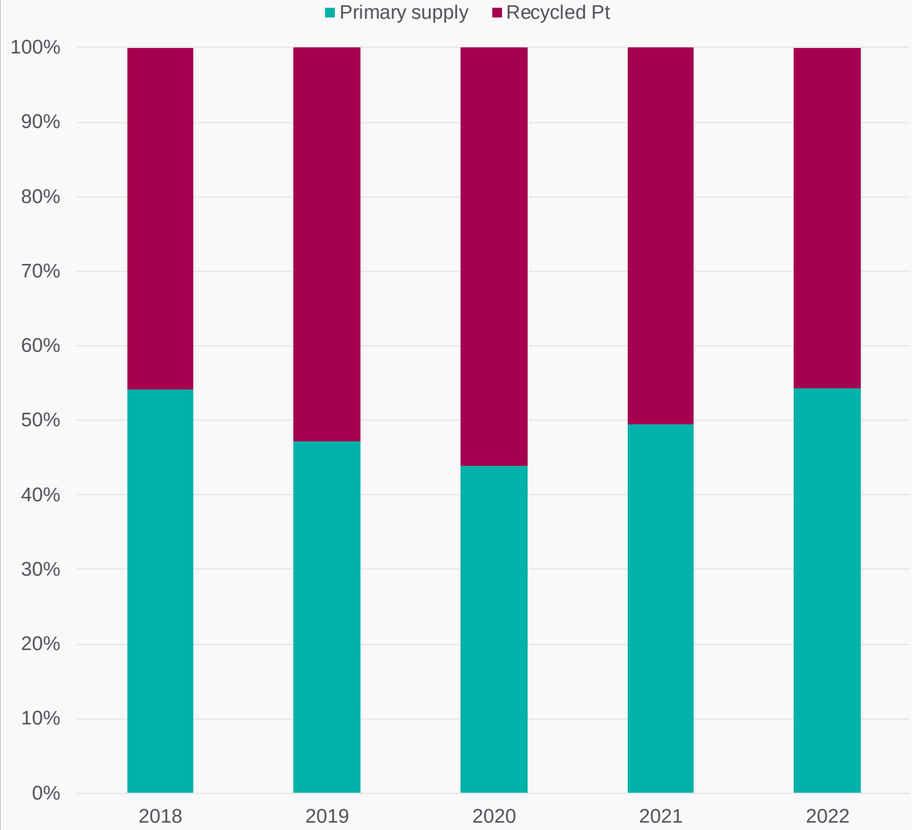
1: APC analysis from Q4 2022 Automotive industry demand forecast, *APC analysis based on Johnson Matthey PGM Market Report 2023
Notes: wavg. is a weighted average based on vehicle production in the respective years

Platinum recycling in automotive already has an established value-chain

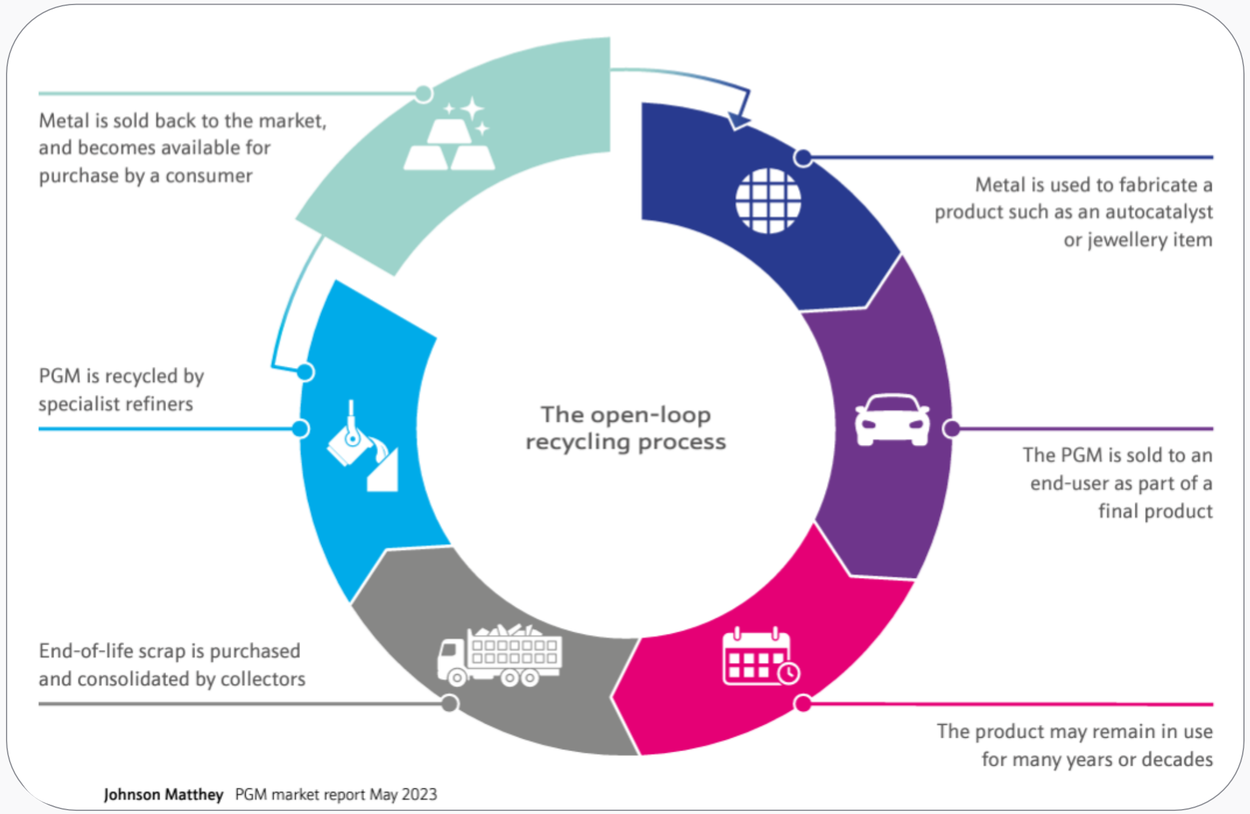
Q1 2023 notes

- The existing circularity in the platinum supply chain for autocatalysts is a key advantage that FCEV producers can leverage, especially where FCEVs are an alternative to producing larger battery-electric SUVs and vans that could be more exposed to volatile battery material markets such as lithium and nickel in the future

Platinum supply for autocatalysts[1]



How platinum is typically recycled in the automotive sector[2]



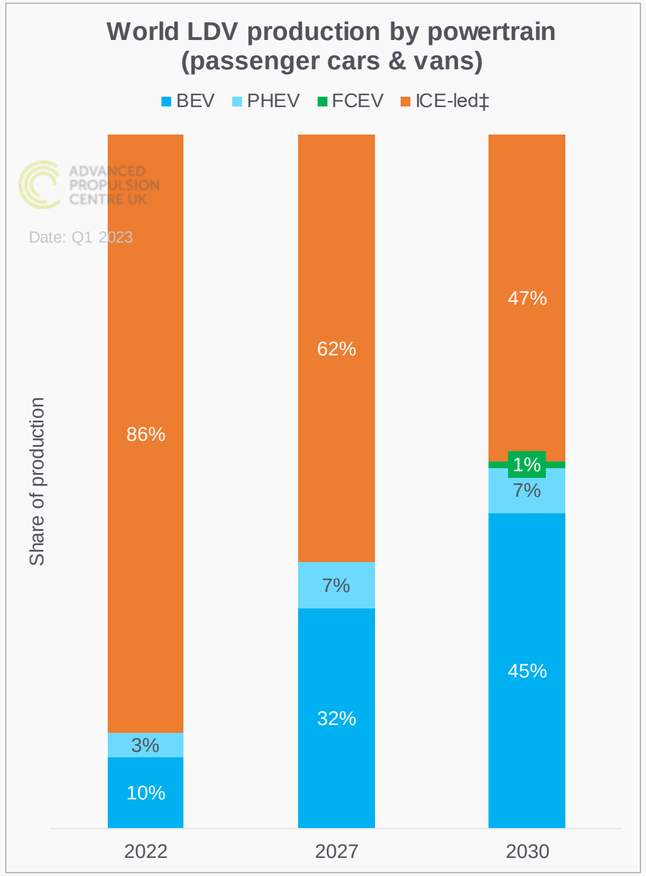
1: SFA Oxford (2022), 2: Johnson Matthey PGM Market Report 2023

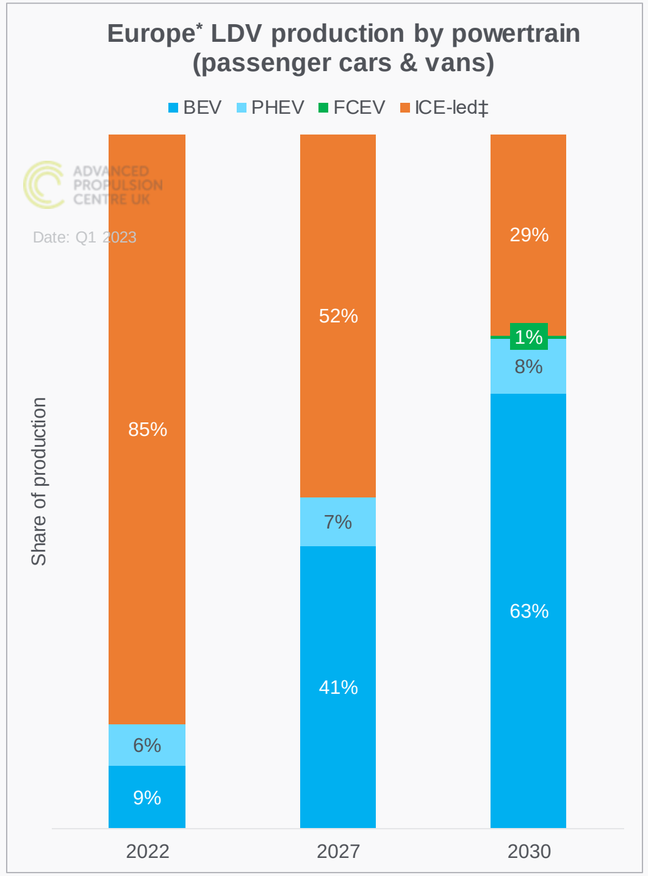
Q1 2023 – Electrified components data

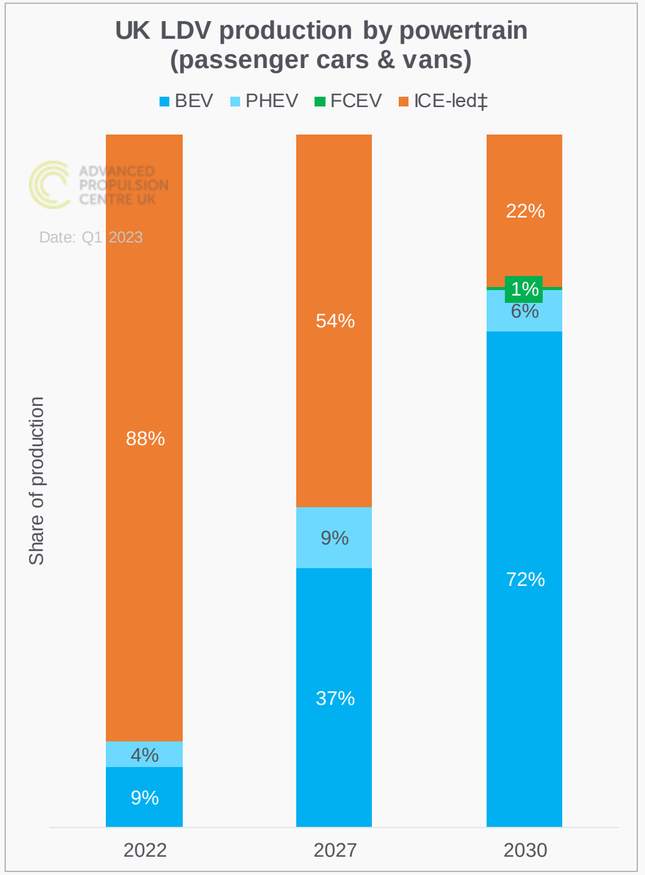
Forecasts for LDV production by powertrain

Q1 2023 notes

- Impact of Inflation Reduction Act reflected in higher global BEV shares in 2027 and 2030, but US BEV share of production still below world average trend
- Future FCEV share of production reduced across all geographies, but global production still expected to approach 1 million vehicles by 2030.





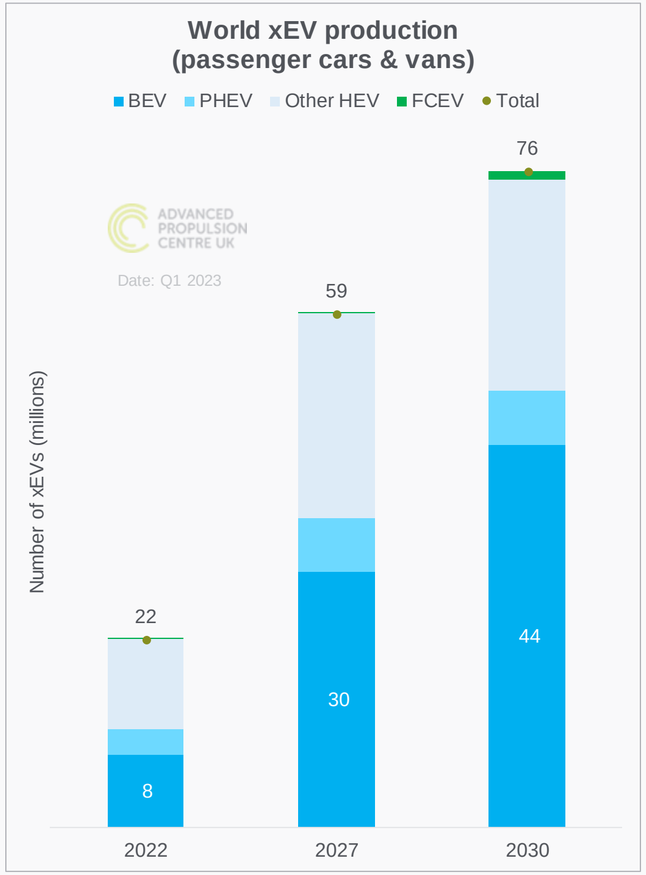


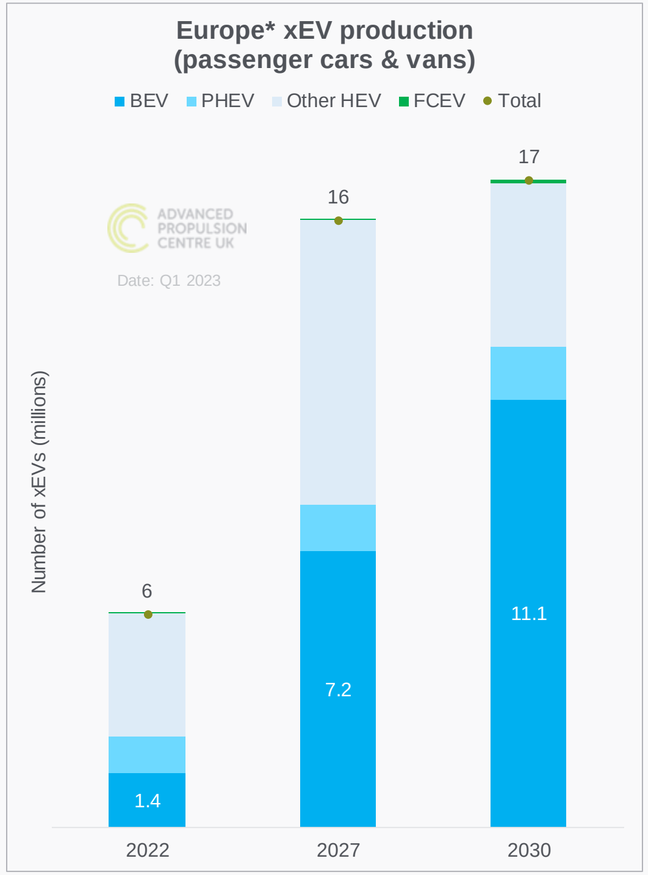
Source: APC Demand Databases using S&P Global AutoTechInsight (Mar 2023), BNEF forecasts (2023)
Note: Passenger cars & Light Commercial Vehicles < 3.5t only, *European forecast includes non-EU countries such as Turkey, ‡Includes non-plug-in HEVs & ICE

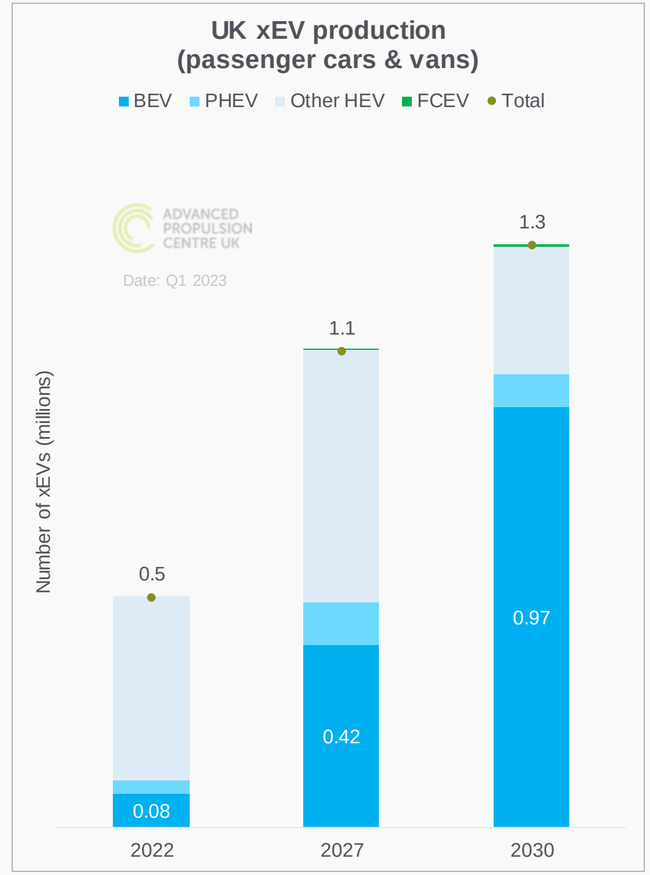
Forecasts for light duty xEV production

Q1 2023 notes

- Despite producing fewer than 1 million light duty vehicles in total last year, the UK is forecast to be producing close to 1 million BEVs by 2030
- Europe is expected to produce 11 million BEVs by the end of the decade, a significant reduction relative to last quarter in line with investment shifts to the US.





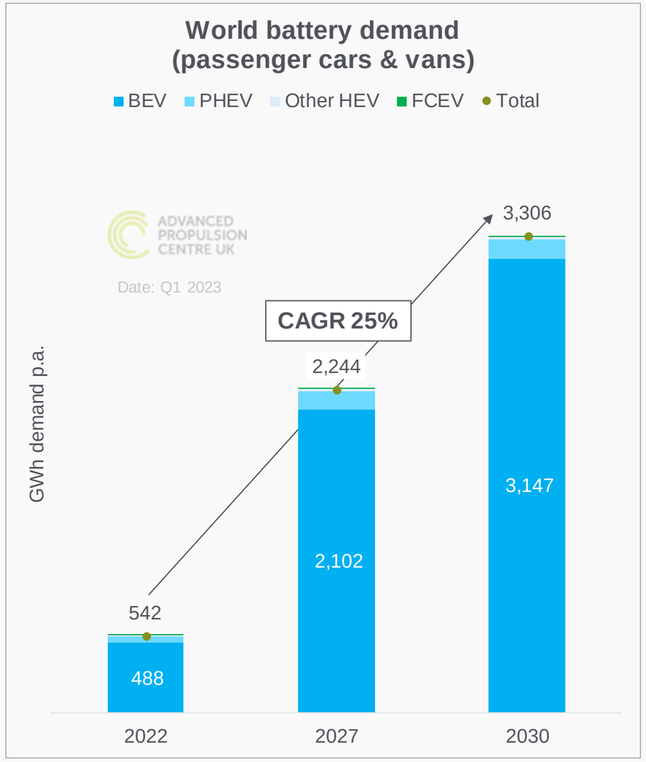


Source: APC Demand Databases using S&P Global AutoTechInsight (Mar 2023), BNEF forecasts (2023)
Note: Passenger cars & Light Commercial Vehicles < 3.5t only, *European forecast includes non-EU countries such as Turkey

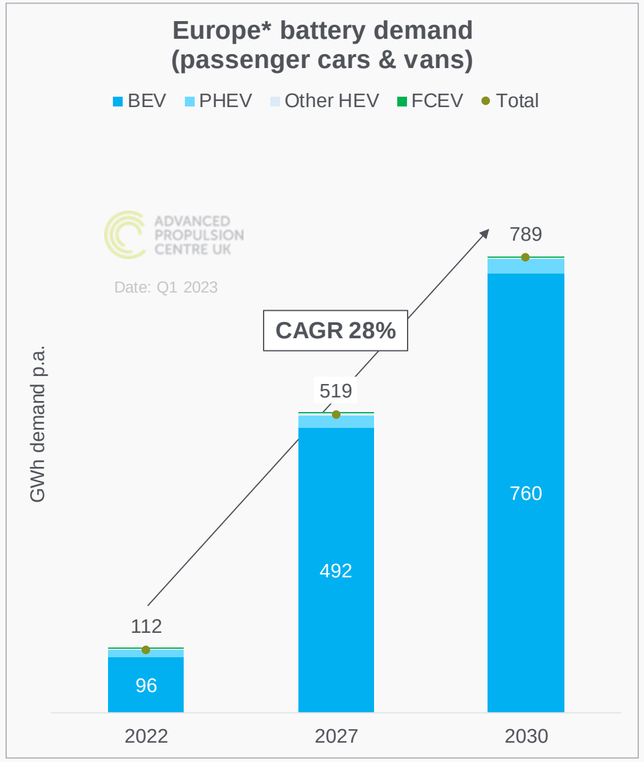
World battery demand for LDVs

Q1 2023 notes

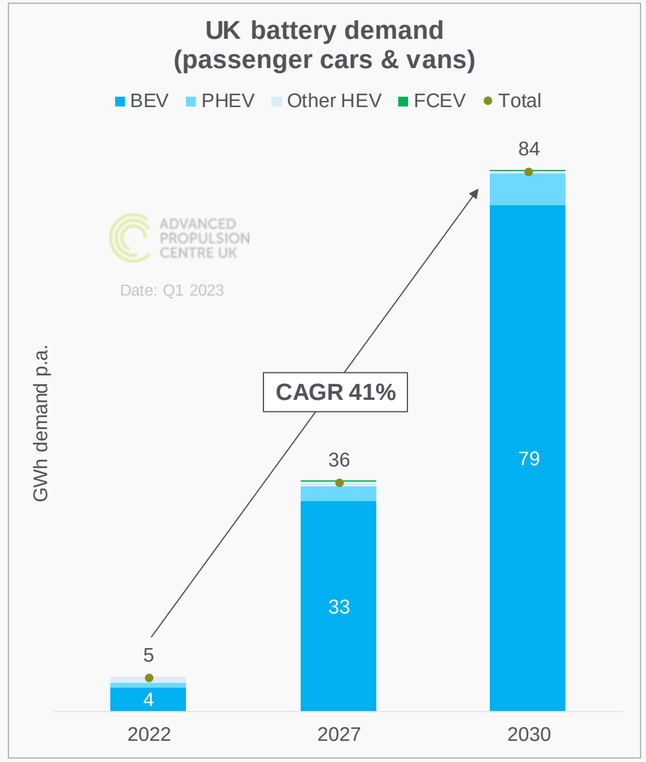
- World battery demand much stronger in 2030 on the back of higher BEV production expected from North America, China and other Asian regions.
- Both European and UK 2030 battery demand remain high but reduced significantly as publicly announced BEV production plans expected to be delayed slightly



- Relative to APC's Q4 2022 demand forecast, 2030 demand increased significantly from 2,903GWh previously



- European battery demand to account for 24% of global battery demand by 2030
- Relative to APC's Q4 2022 demand forecast, we have seen a 100GWh decrease in demand for 2030 due to investment momentum shifting to the US



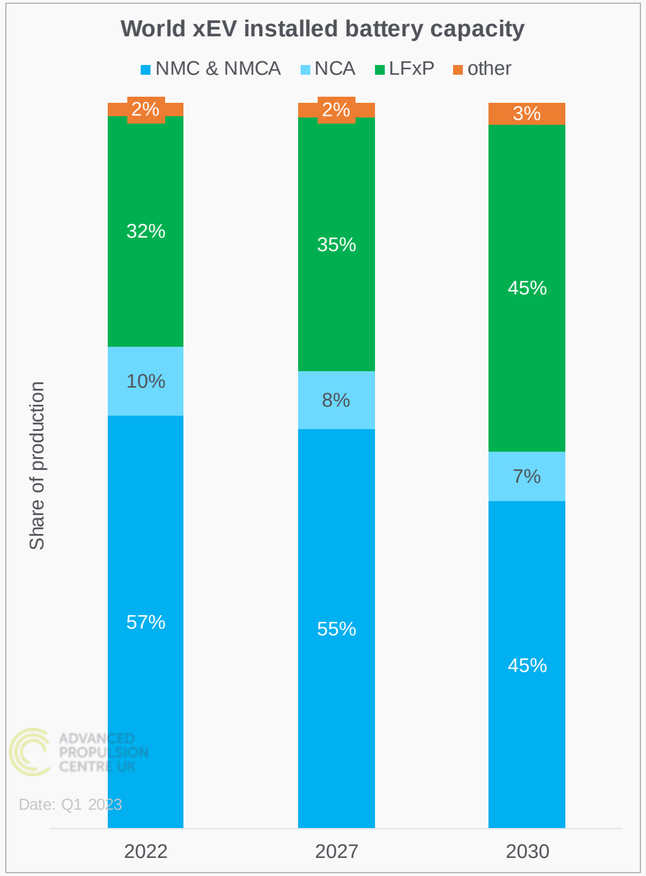
- UK battery demand forecast to account for 10% of European battery demand in 2030
- Relative to APC's Q4 2023 demand forecast, demand from LDVs reduced by 5GWh in 2030 in line with European delays, but stronger in 2027 on the back of recent OEM announcements

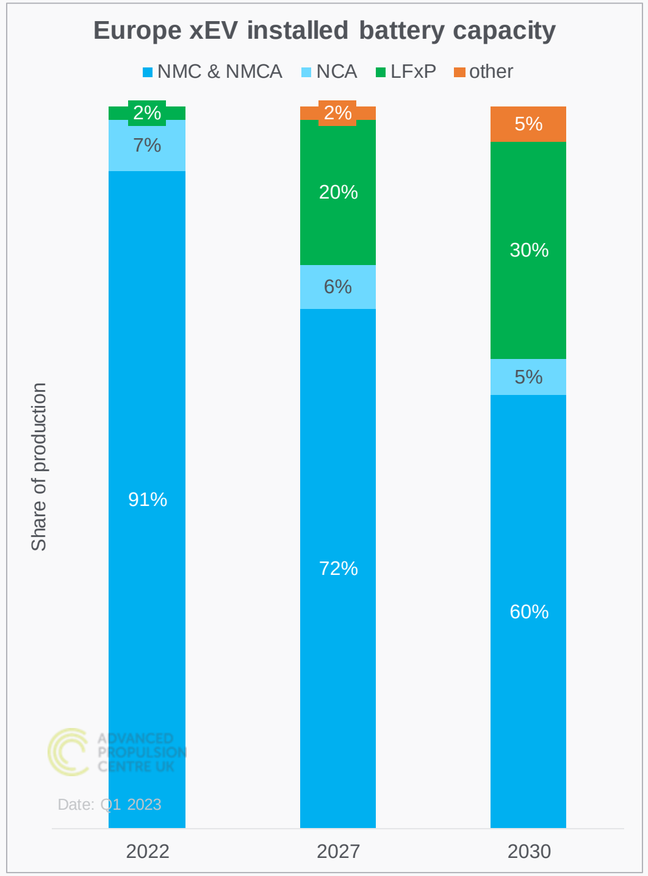
Source: APC Demand Databases using S&P Global AutoTechInsight (Mar 2023), BNEF forecasts (2023)
Note: Passenger cars & Light Commercial Vehicles < 3.5t only, *European forecast includes non-EU countries such as Turkey

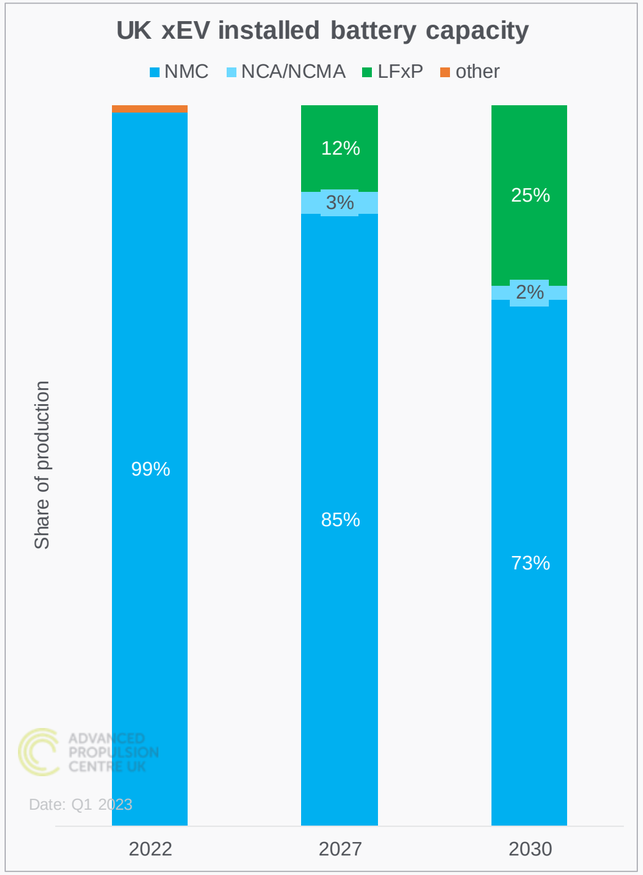
Forecasts for automotive battery production by chemistry

Q1 2023 notes

- Unchanged automotive battery chemistry production forecast relative to Q4 2022
- Globally growth of LFxP pushes NMC share to below 50% by end of this decade
- In Europe and UK NMC continues to dominate for this decade





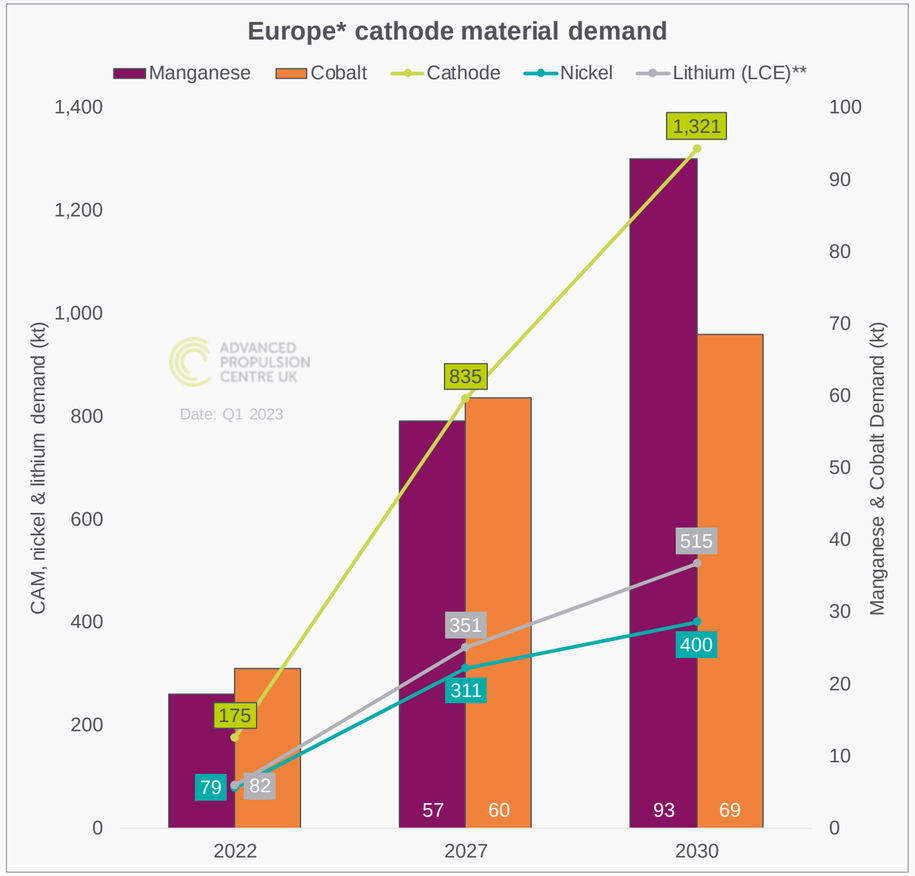


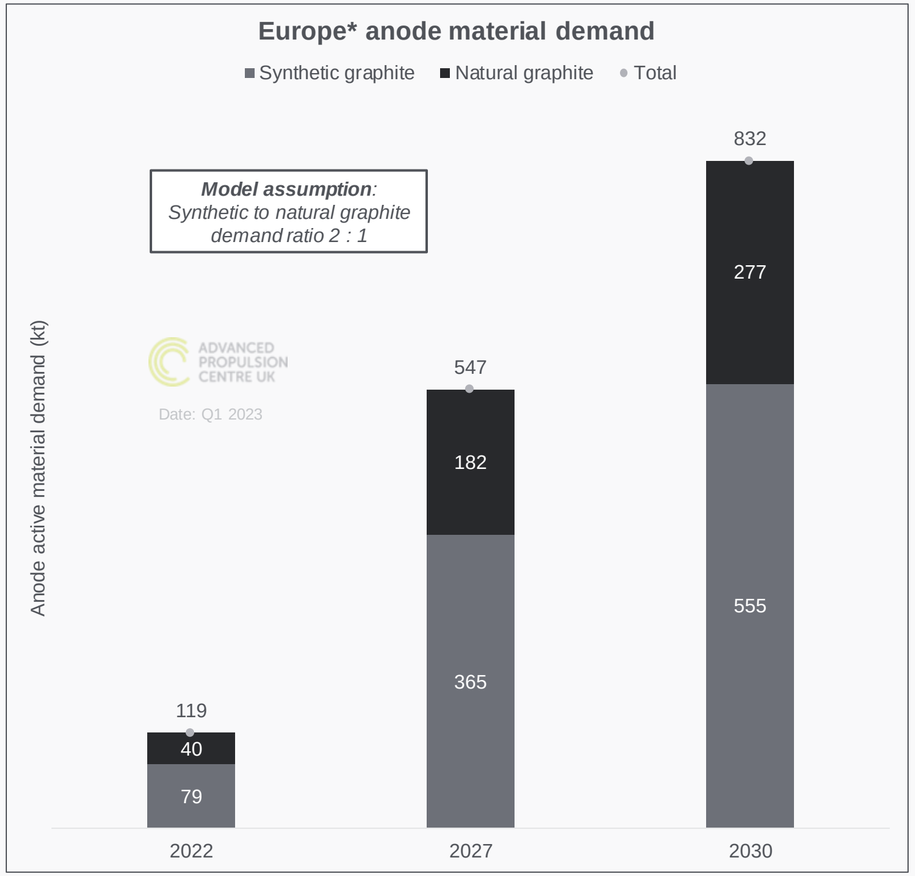
Source: APC Demand Databases using S&P Global AutoTechInsight (Mar 2023), BNEF forecasts (2023)
Note: Passenger cars & Light Commercial Vehicles < 3.5t only, *European forecast includes non-EU countries such as Turkey, ‡Includes non-plug-in HEVs & ICE

European Cathode Active Material (CAM) demand

Q1 2023 notes

- European demand for lithium rises above 500kt in 2030 with a global supply of 1,100 to 2,000 kt
- This is expected to drive adoption of EVs with reduced battery sizes and alternative powertrains such as FCEV



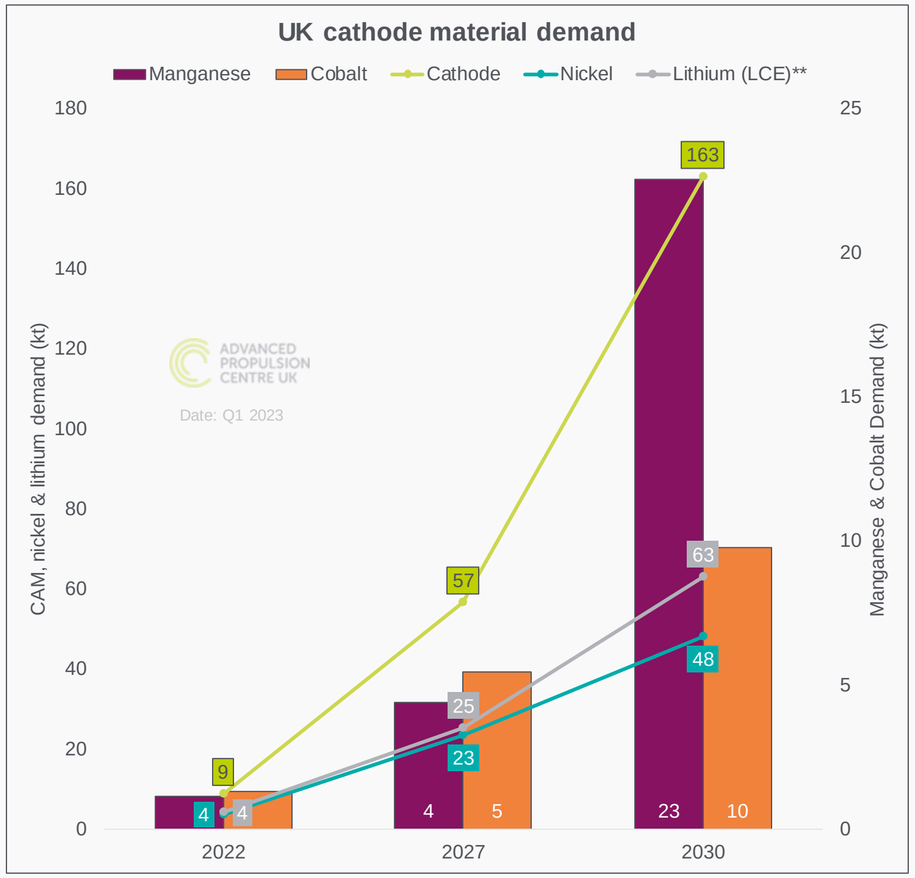


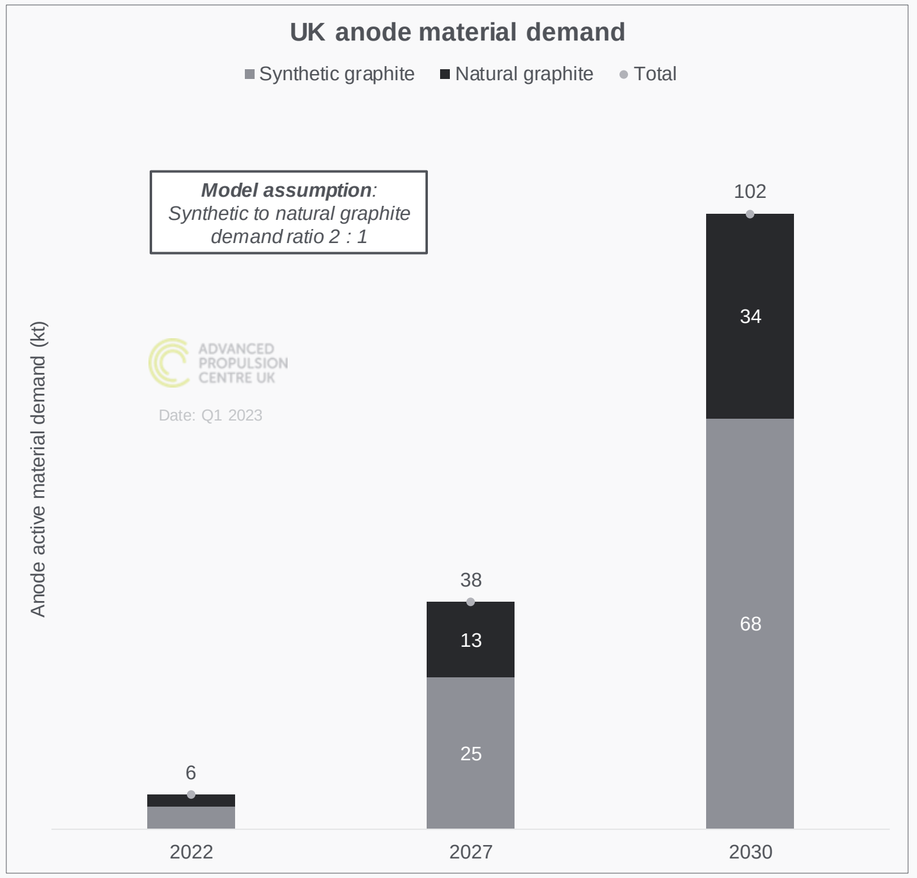
Source: APC Demand Databases using S&P Global AutoTechInsight (Mar 2023), Rho Motion data (2023), BNEF forecasts (2023)
Note: Passenger cars & Light Commercial Vehicles < 3.5t only, *European forecast includes non-EU countries such as Turkey, **Contained Li metal would be 5.3x lower

UK Cathode Active Material (CAM) demand

Q1 2023 notes

- UK based Direct Lithium Extraction projects have the potential to supply at least 50% of 2030 lithium demand



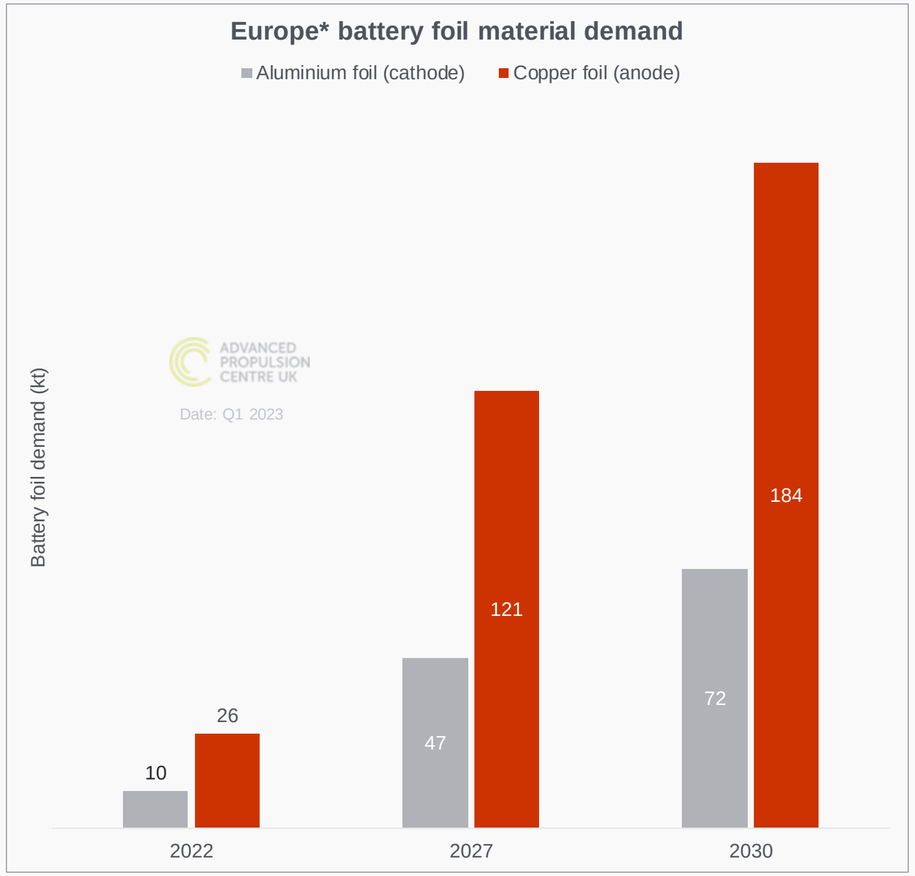


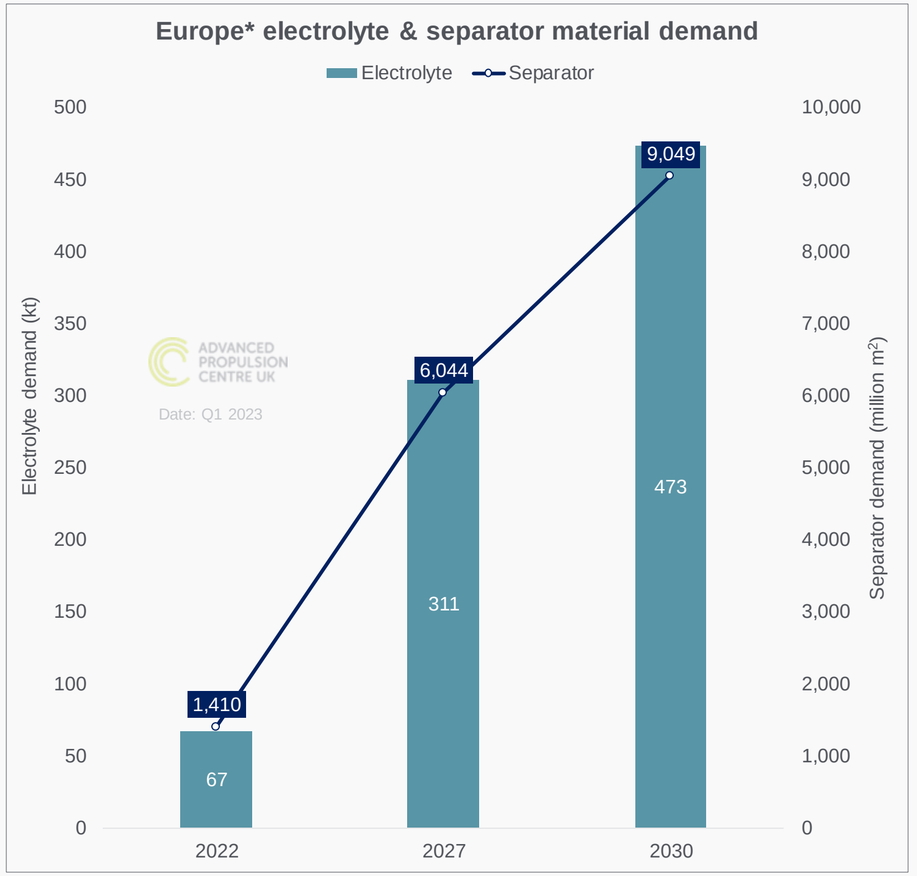
Source: APC Demand Databases using S&P Global AutoTechInsight (Mar 2023), Rho Motion data (2023)
Note: Passenger cars & Light Commercial Vehicles < 3.5t only, **Contained Li metal would be 5.3x lower

European demand for battery foils, electrolyte and separator material

Q1 2023 notes

- Currently separators and electrolyte are an area of under investment in Europe this could impact Europe's ability to produce locally made cells



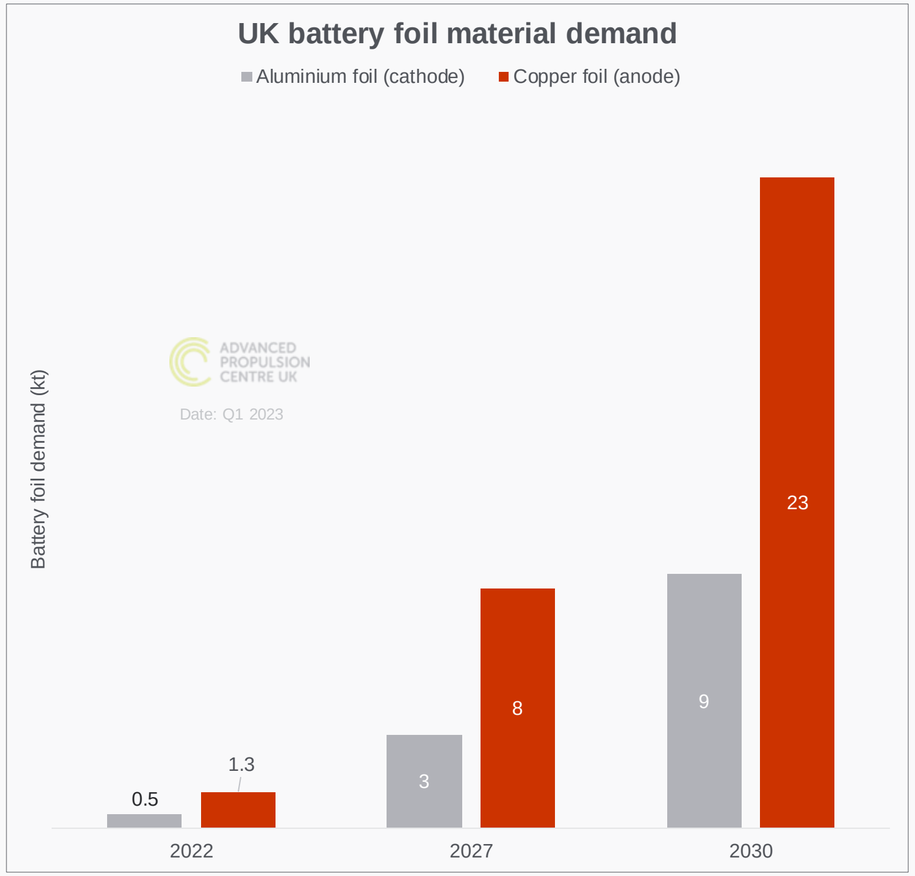


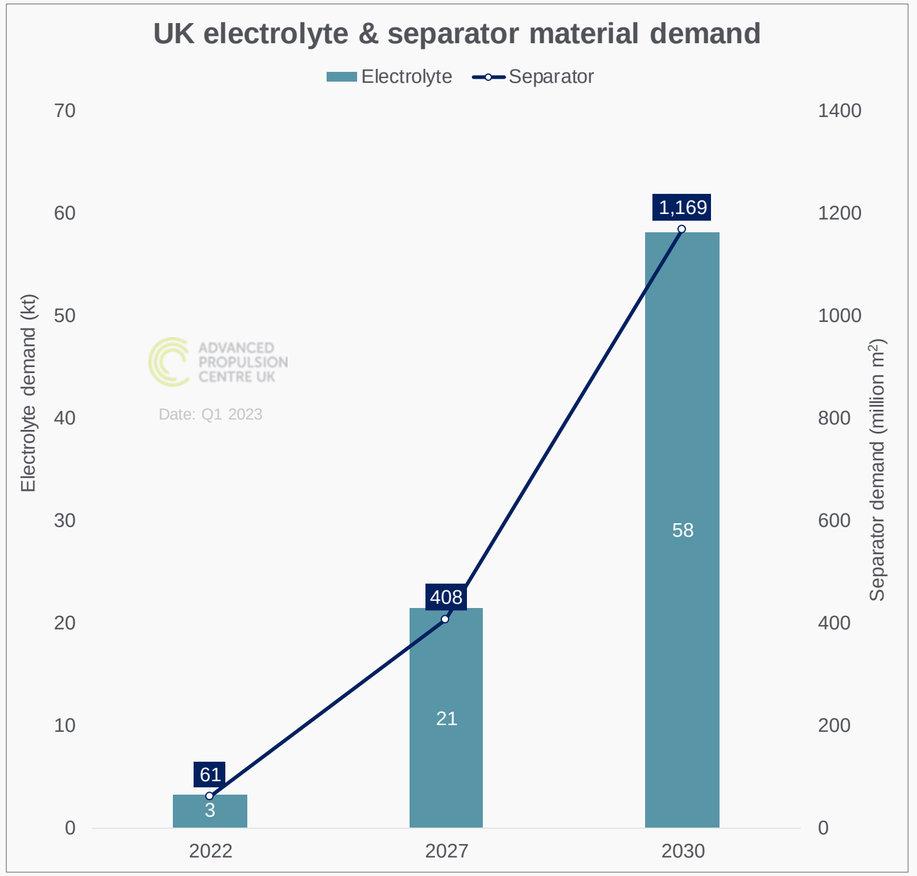
Source: APC Demand Databases using S&P Global AutoTechInsight (Mar 2023), Rho Motion data (2023), BNEF forecasts (2023)
Note: Passenger cars & Light Commercial Vehicles < 3.5t only, *European forecast includes non-EU countries such as Turkey

UK demand for battery foils, electrolyte and separator material

Q1 2023 notes

- UK demand for battery foils, electrolyte and separator materials in 2030 reduced due to lower total UK vehicle production in 2030



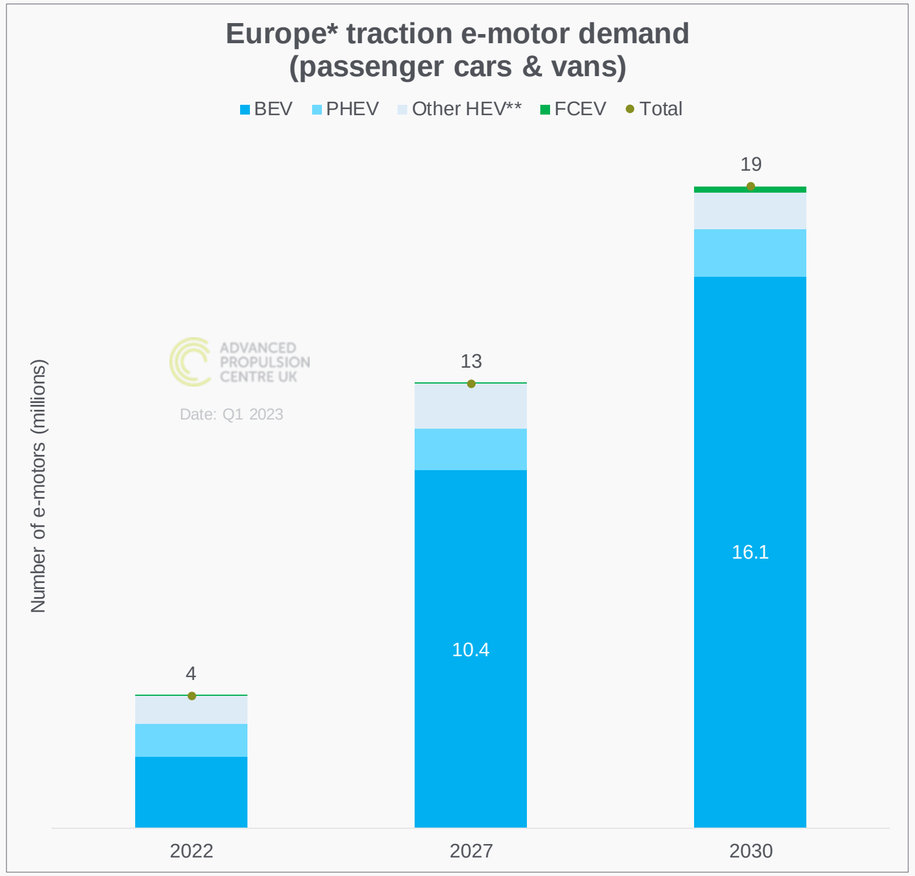


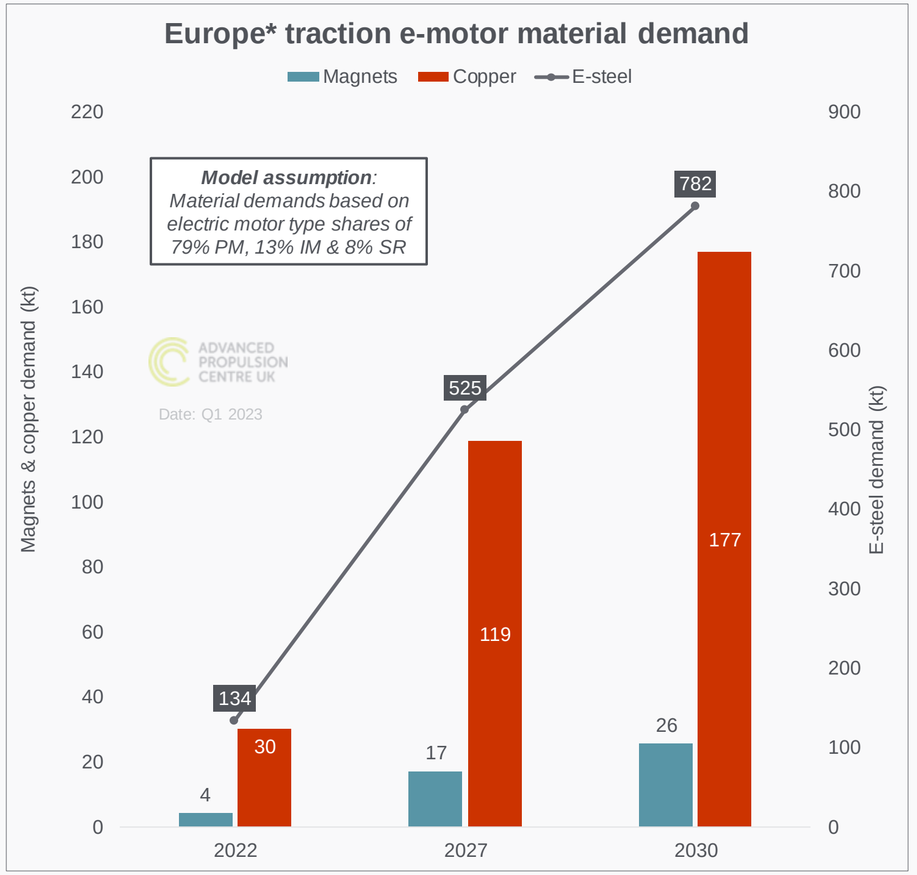
Source: APC Demand Databases using S&P Global AutoTechInsight (Mar 2023), Rho Motion data (2023)
Note: Passenger cars & Light Commercial Vehicles < 3.5t only

European demand for traction electric motors

Q1 2023 notes

- European e-motor demand reduced in line with lower total LDV production forecast, but still on track to require almost 20 million motors in 2030, which will require 26kt of rare earth material for magnets.



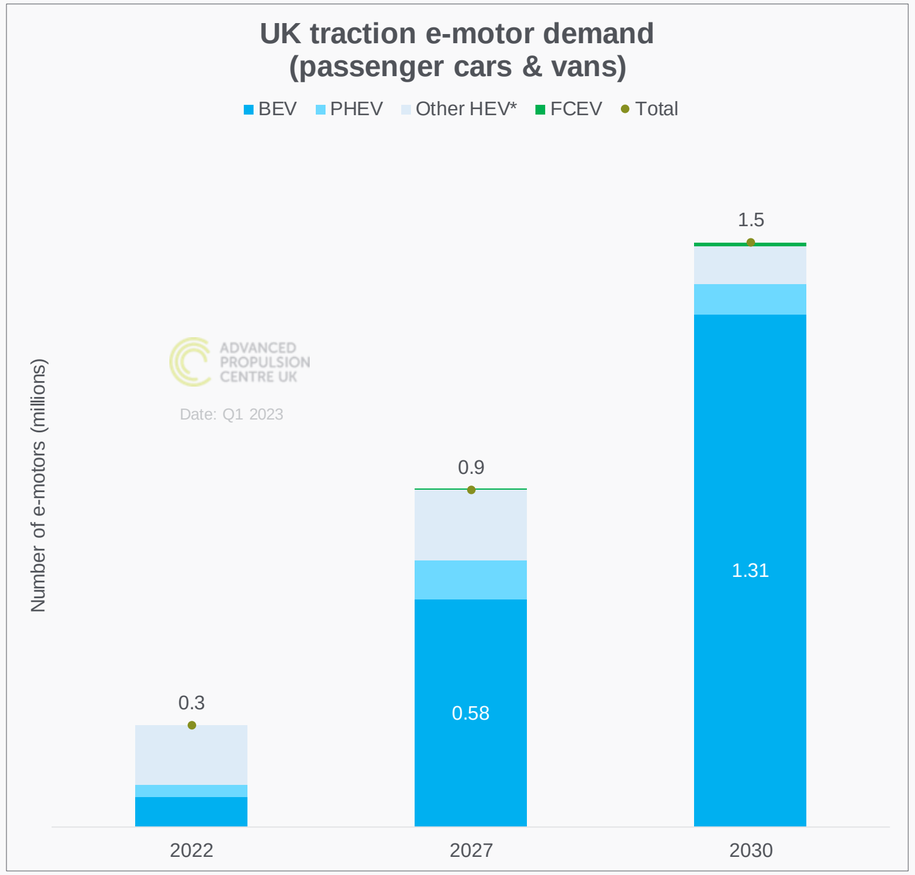


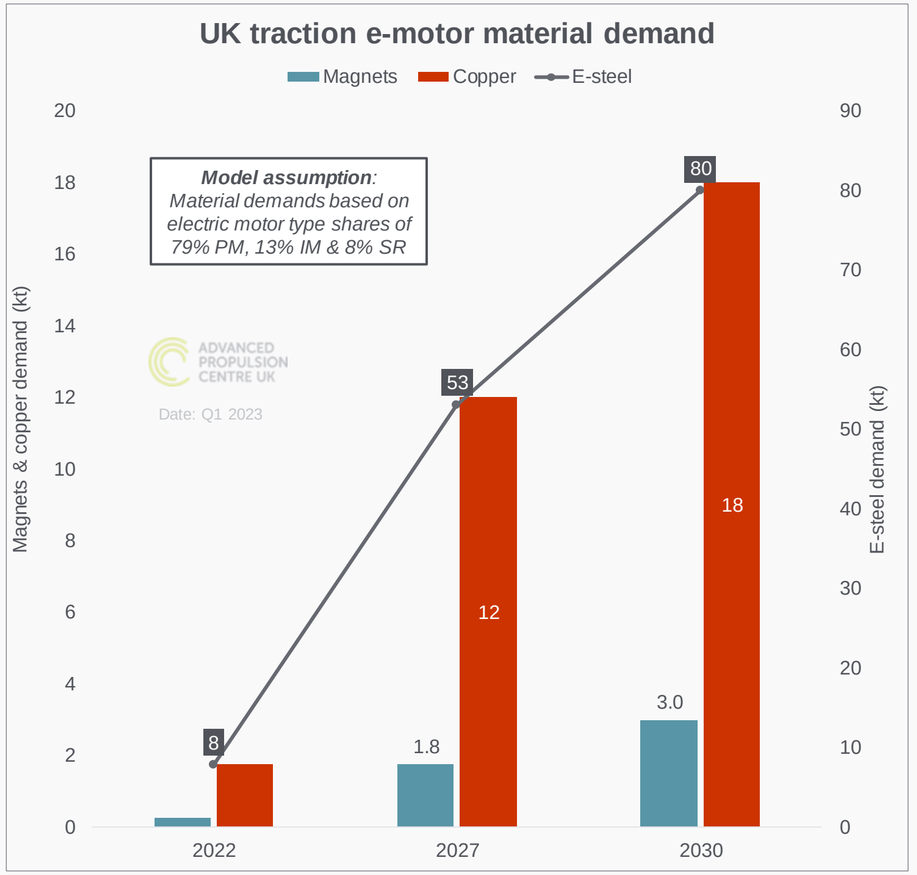
Source: APC Demand Databases using S&P Global AutoTechInsight (Mar 2023)
Note: Passenger cars & Light Commercial Vehicles < 3.5t only, *European forecast includes non-EU countries such as Turkey, **Excluding mild hybrid electric motors

UK demand for traction electric motors

Q1 2023 notes

- UK to require 1.5 million high-power traction e-motors in 2030. UK strength in manufacture of motors can be leveraged to supply both UK and export.
- UK will require at least 3kt of rare earth magnets for motors in 2030





Source: APC Demand Databases using internal insights and S&P Global AutoTechInsight (Mar 2023)
Note: Passenger cars & Light Commercial Vehicles < 3.5t only, *Excluding mild hybrid electric motors

ADVANCED PROPULSION CENTRE UK

This Q1 demand forecast is provided by the Technology Trends team at the APC

If you have any questions or would like more detail on any of the graphs or data email: info@apcuk.co.uk

June 2023