Q3 2023
Automotive industry demand forecast

December 2023

ADVANCED PROPULSION CENTRE UK
Accelerating Progress

Q3 2023 – Automotive industry demand forecast

ADVANCED PROPULSION CENTRE UK

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.

Note: This quarter, APC reviewed the battery materials loading which is the basis for the battery [material] demand.

The loading was changed to reflect changes in material mix and demand.

The review was prompted by access to more sources and the loading was changed to reflect the input from additional sources.

Disclaimer

These forecasts provide an estimate of electrified powertrain demand and are by no means an accurate statement of future markets and industry intentions. The data should be used in good faith and APC UK cannot be held liable for any inaccuracies in the data, views expressed or underlying assumptions.

Q3 2023 – Summary

Summary – Changes to projected demand by region

Q3 vs. Q2 2023

General notes	• This quarter sees a revision of battery material loading for different chemistries resulting in a change to forecast battery material demand compared to Q2	
Global demand update	• Total world battery demand and vehicle production relatively unchanged • LG Chem and Huayou Group's subsidiary Youshan to build a Lithium Ferrophosphate (LFP) cathode plant in Morocco, intended to serve US market and potentially eligible for United States' Inflation Reduction Act (IRA) subsidies under the free-trade partnership	page 8
European demand update	• The United States' Inflation Reduction Act has shifted investment momentum away from Europe • BEV production plans potentially being held back by supply chain localisation challenges • LFP demand revised down based on slower than expected development of LFP supply chain in Europe compared to US and China	page 10
UK demand update	• Three new fully electric Nissan models confirmed and further investment in UK gigafactory capacity • Increased battery demand by 4 GWh, in 2027, based on increased production of BEV passenger cars • ZEV mandate and UK investment starting to see impact in higher BEV numbers • LFP demand revised down based on slower than expected development of LFP supply chain in Europe	page 21

Summary – Trends insight

Q3 2023

3 Li Lithium	Lithium chemistry insight	• Analysis of demand for lithium carbonate and lithium hydroxide • Exploration of supply chains for lithium carbonate and lithium hydroxide from hard rock and subterranean sources • Insight into environmental impact of different supply routes • Potential for UK to produce reduced environmental impact lithium and export R&D in lithium exploration and extraction technology	pages 13-22

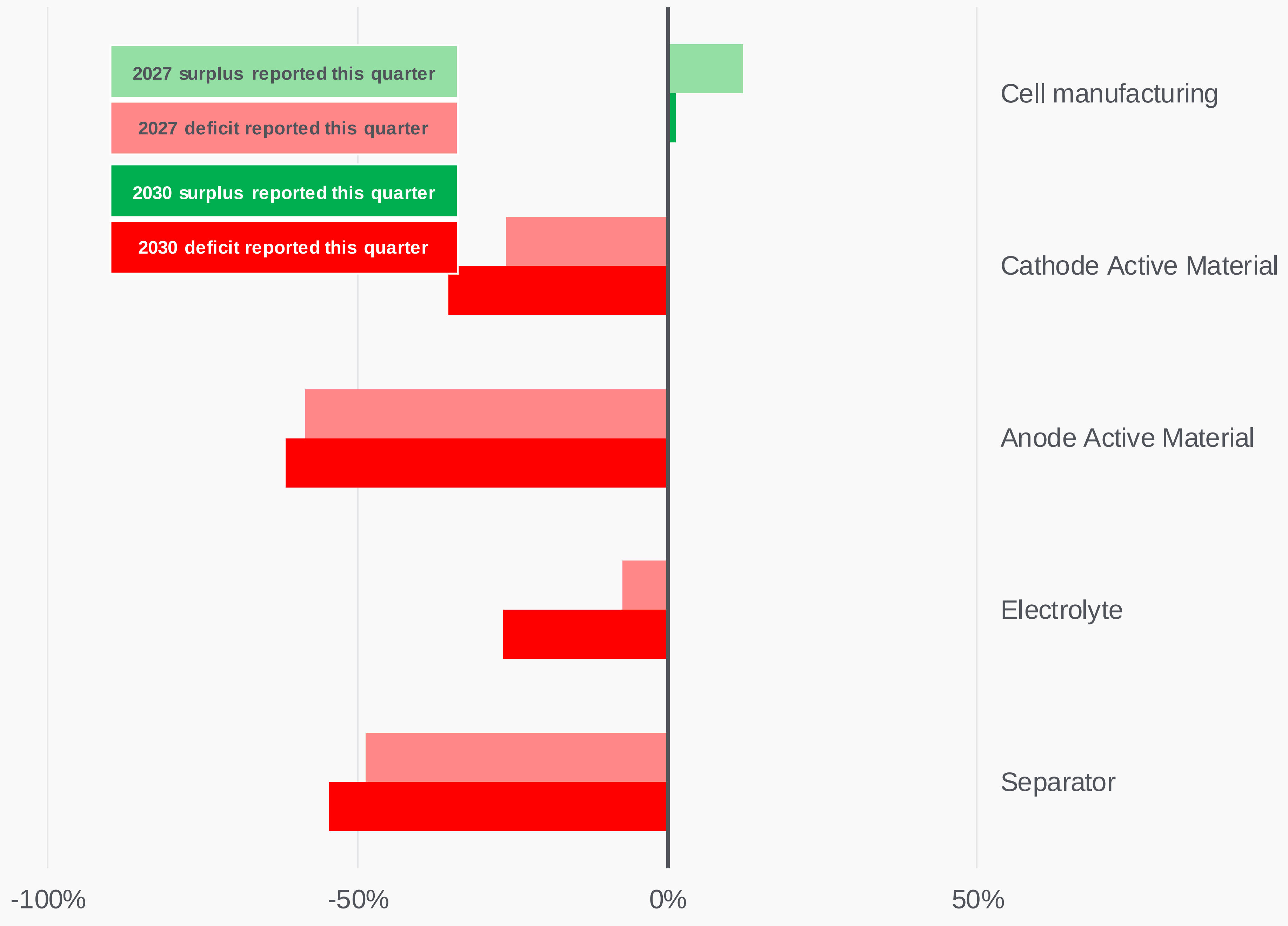
Source: APC analysis

Summary – Supply chain activity

Q3 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.
- Capacity demand and incentives are attracting investment to the USA market from Europe.

2027 and 2030 European[1] capacity vs demand balances



Status of regional capacity* v demand balance in 2030	Value** (%)	UK supply chain status
Capacity plans remain above demand, however, delays and potential cancellations are anticipated. Capacity for LFxP lags behind demand, with only 10% of planned capacity likely to be LFP in 2030.	18%	As part of Nissan's announcement of three EVs being produced in Sunderland, the company said it had initiated a feasibility study to explore potential further gigafactory investments in the UK.
IONWAY announced investment in Nysa, Poland for CAM production, SOP in 2025. XTC France and Orano CAM (JV) announced a NCM cathode manufacturing facility located in Dunkirk, France, with annual capacity of 40,000-tonne; (Q4 2025 - 20,000 tpa, and Q3 2027-20,000 tpa).	**46%**	Required to be made in the region from 2027 for UK cells to qualify as local and to avoid EV tariffs in the EU.
China's Ningbo Shanshan announced it has plans to build a lithium-ion battery anode manufacturing facility in Finland.	9%	UK based Nexeon announced deal to supply Panasonic Energy Co. in USA with silicon-anode material.
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 (October 2023), Wood Mackenzie (October 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

Q3 2023 – Demand update

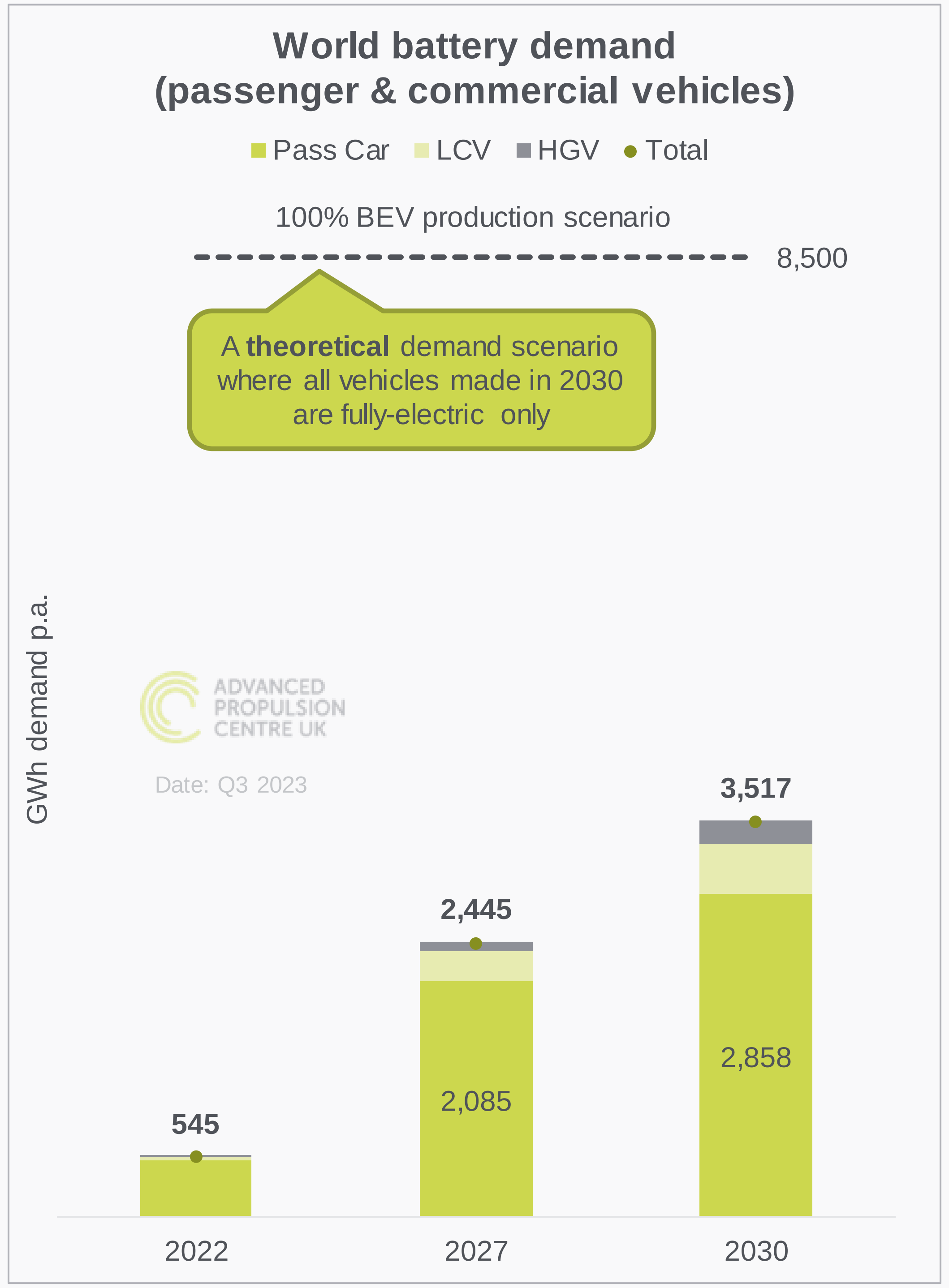
The following section includes battery demand from both Light Duty Vehicles (LDVs) and Heavy Goods Vehicles (HGVs)

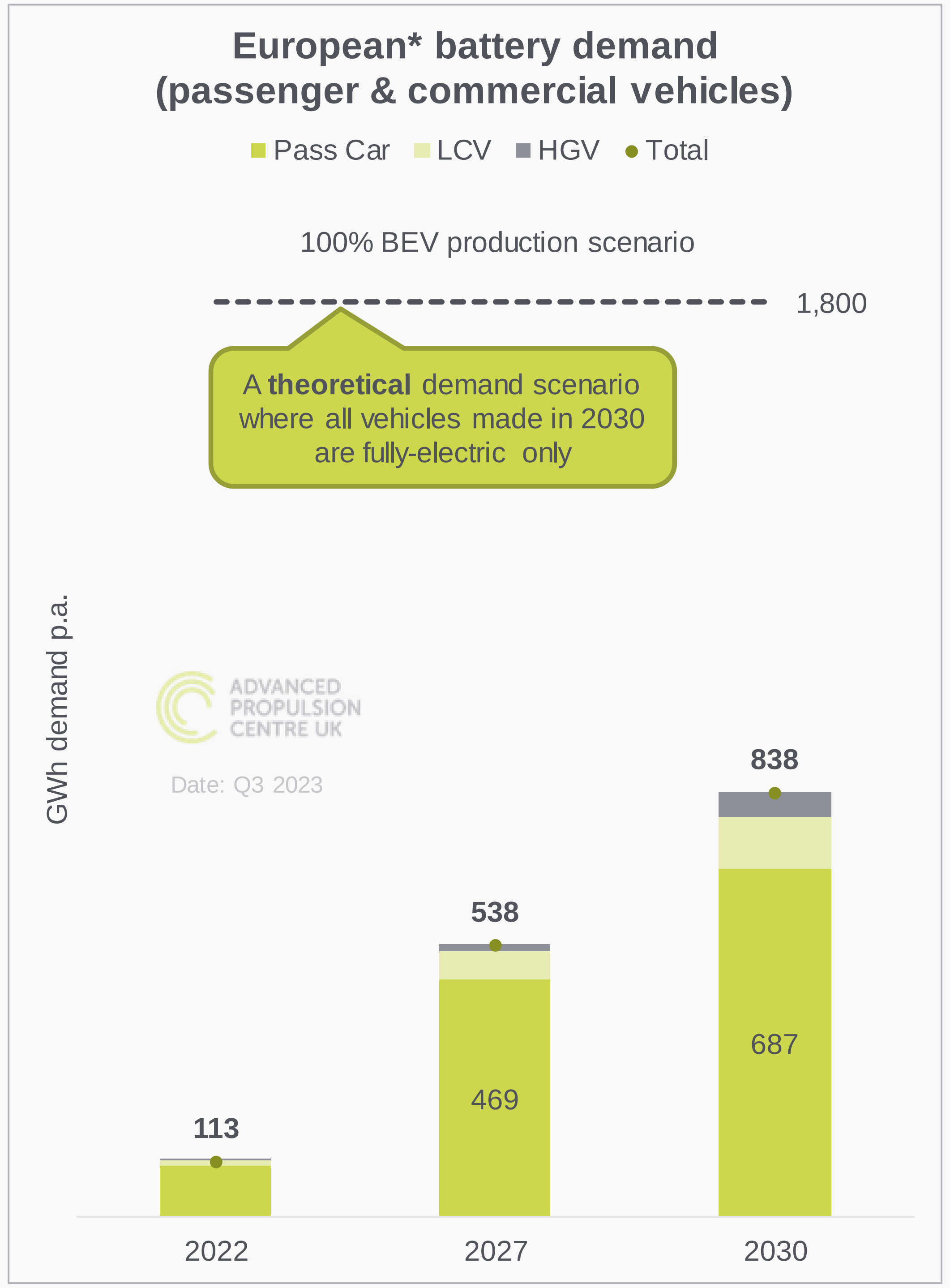
Battery demand forecast

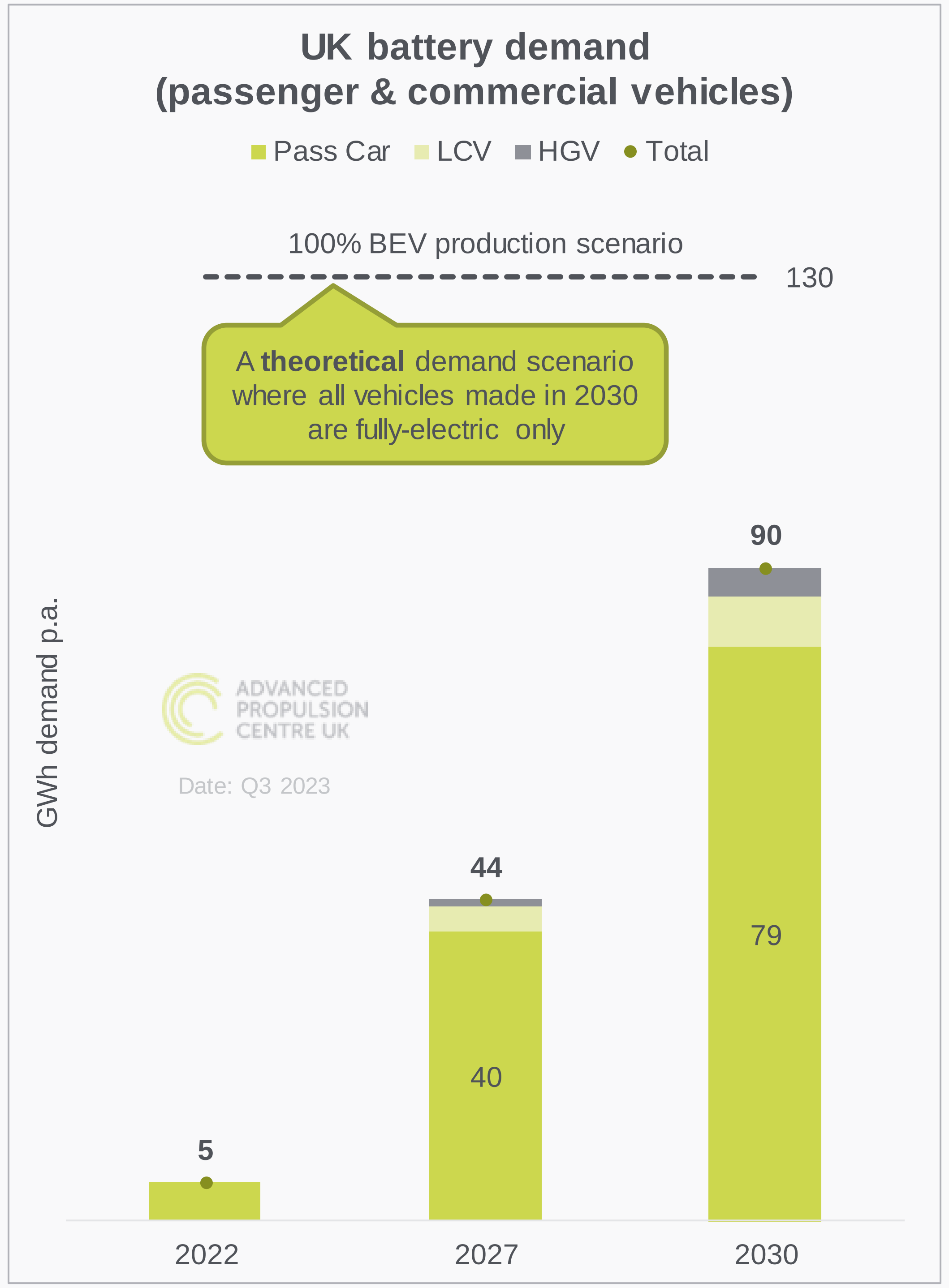
LDVs and HGVs

Q3 2023 notes

- Global battery demand remains strong even though there was an increase in Q3 for demand in 2027.
- Slight decrease in European PV and LCV demand in Europe 2030.
- UK increased by 4 GWh in 2027, commitment of new models from Nissan and BMW Mini confirmed.







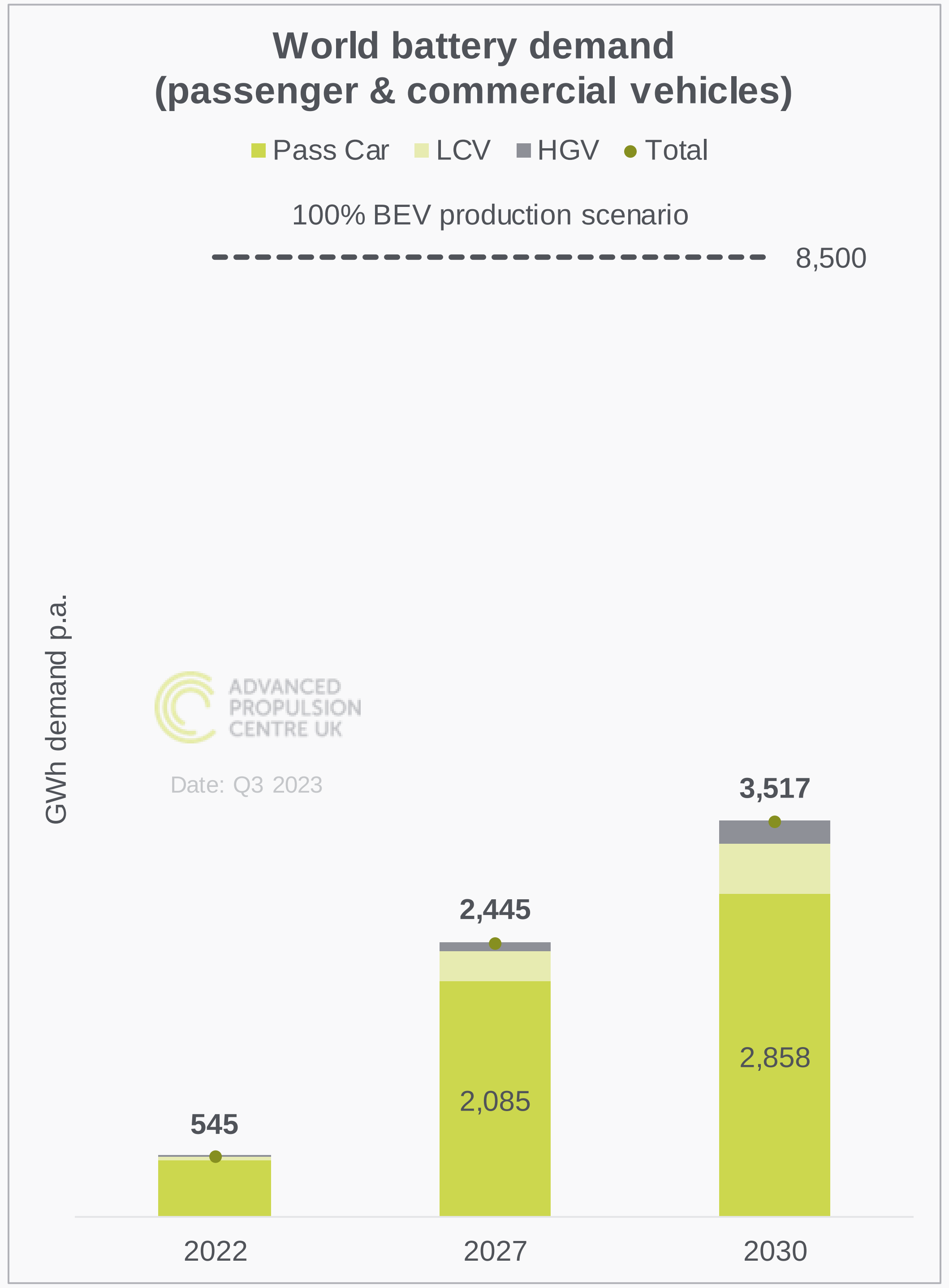
Source: APC Demand Databases using S&P Global AutoTechInsight (Oct 2023), Rho Motion data (Oct 2023), BNEF (Oct 2023), Global Data (Oct 2023)
Note: LCV = Light Commercial Vehicles < 3.5t, buses not included. *European forecast includes non-EU countries such as Turkey

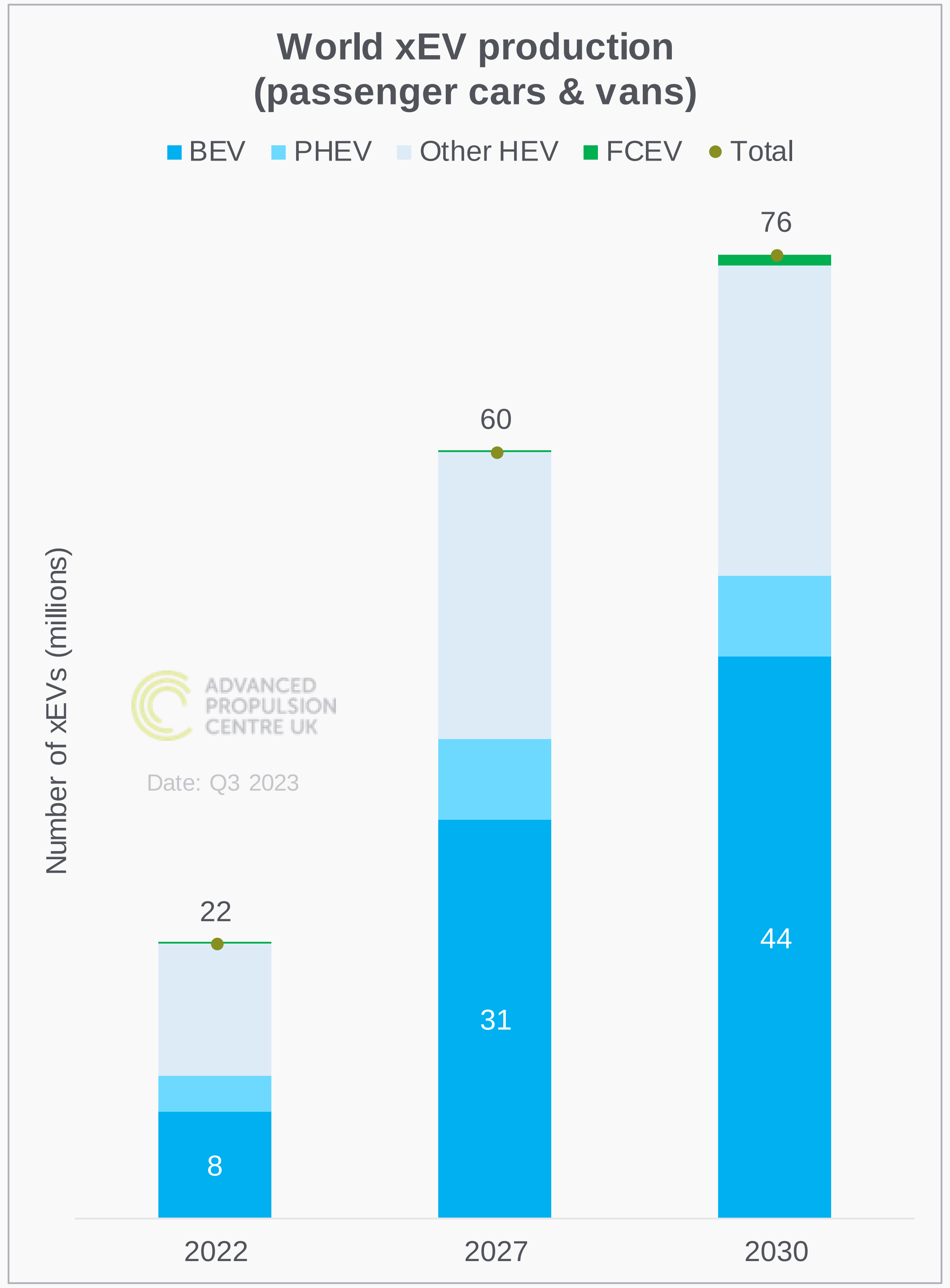
World xEV production

Passenger cars and vans

Q3 2023 notes

- World battery demand fluctuated slightly this quarter compared to last quarter, 2027 increased whereas 2030 decreased.
- World production remained largely the same.





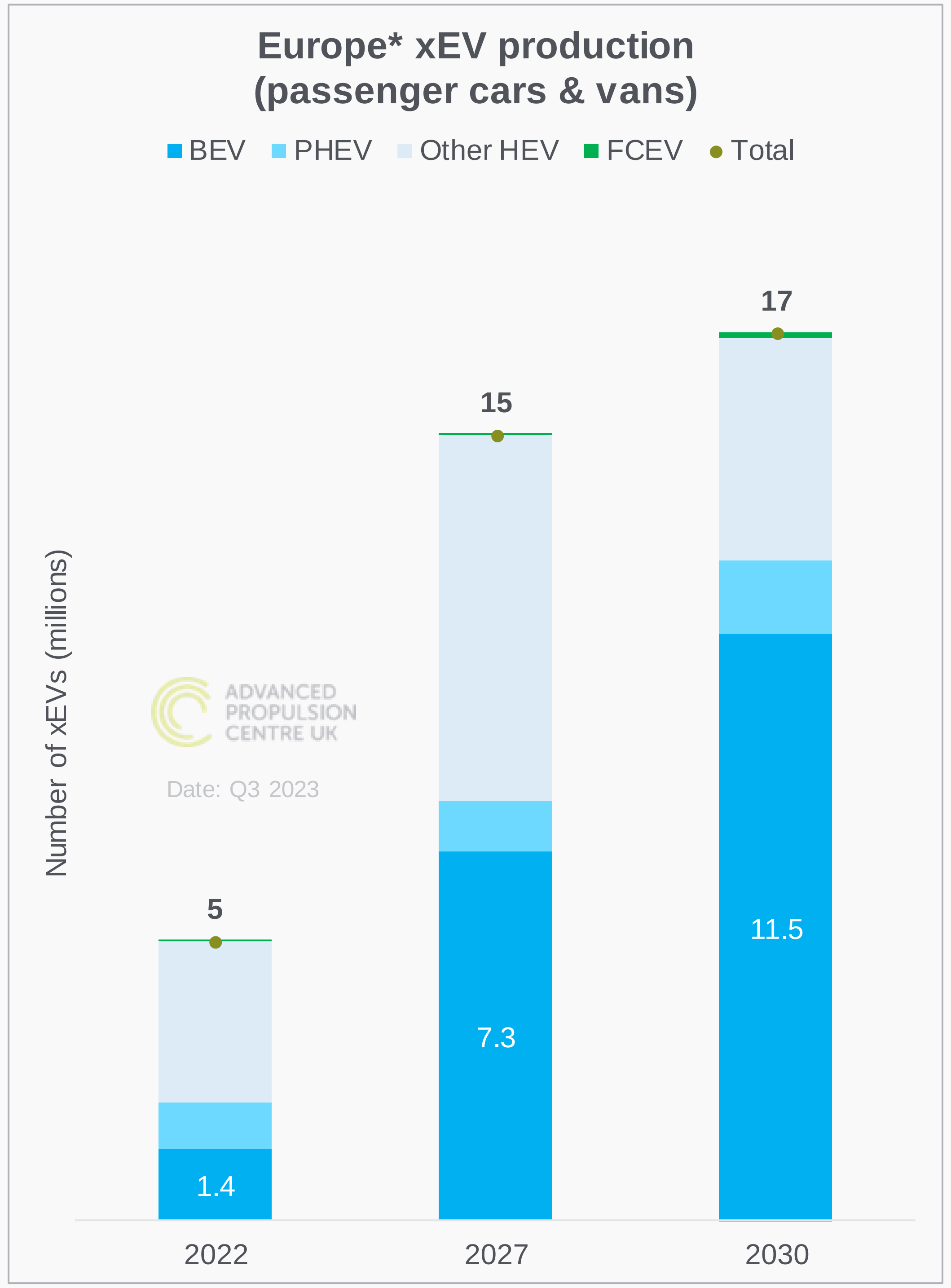
Source: APC Demand Databases using S&P Global AutoTechInsight (Oct 2023), Rho Motion data (2023), BNEF forecasts (2023), Global Data (2023)
Note: LCV = Light Commercial Vehicles < 3.5t, buses not included.

European xEV production

Passenger cars and vans

Q3 2023 notes

- 11.5 million fully-electric vehicles to be produced in Europe in 2030.
- 400k increase since Q2 of BEV in Europe by 2030.
- PHEV production further decreased in 2027 by 200K.



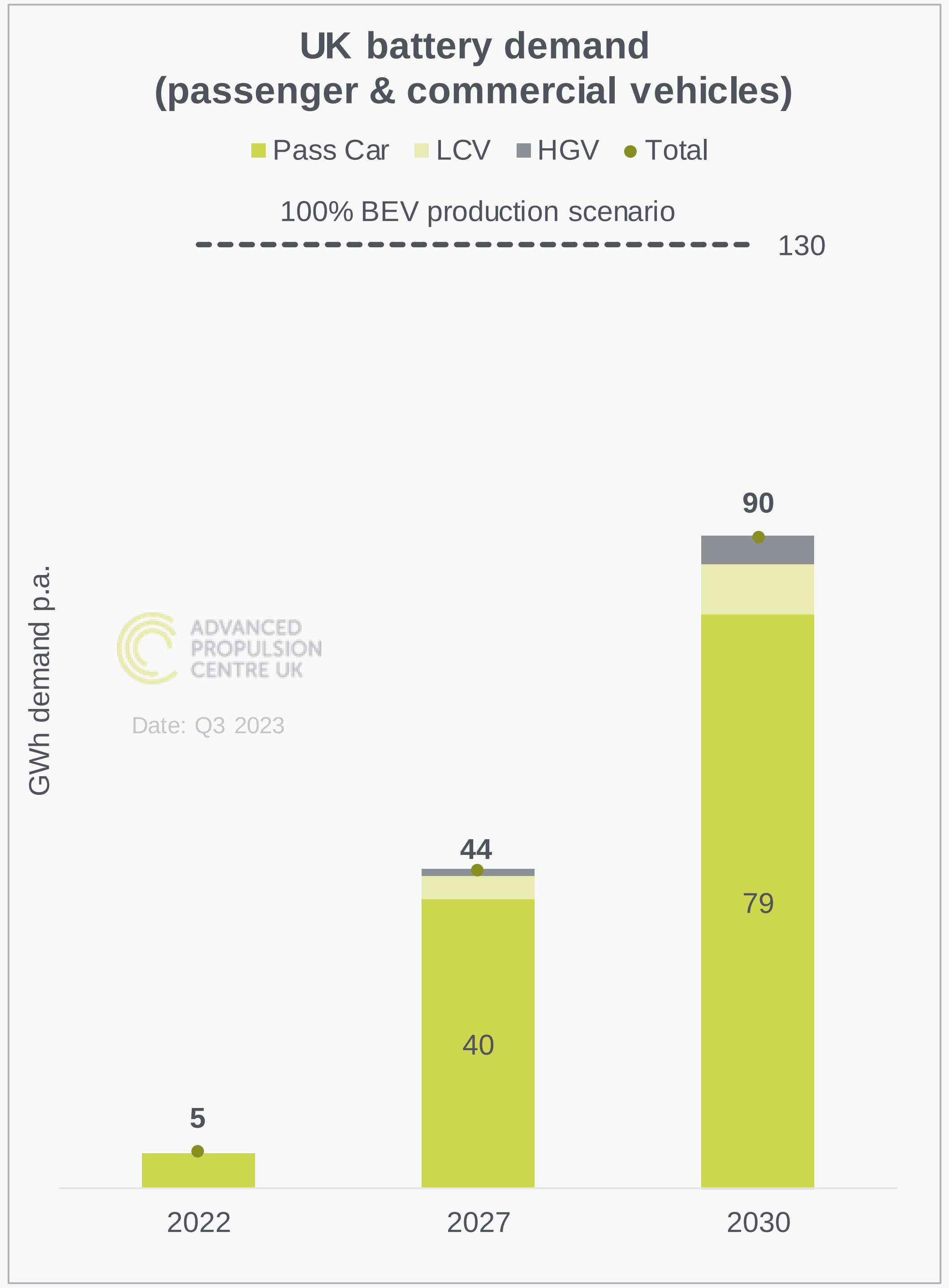
Source: APC Demand Databases using S&P Global AutoTechInsight (Oct 2023), Rho Motion data (2023), BNEF (2023), LMC (2023)
Note: LCV = Light Commercial Vehicles < 3.5t, buses not included. *European forecast includes non-EU countries such as Turkey

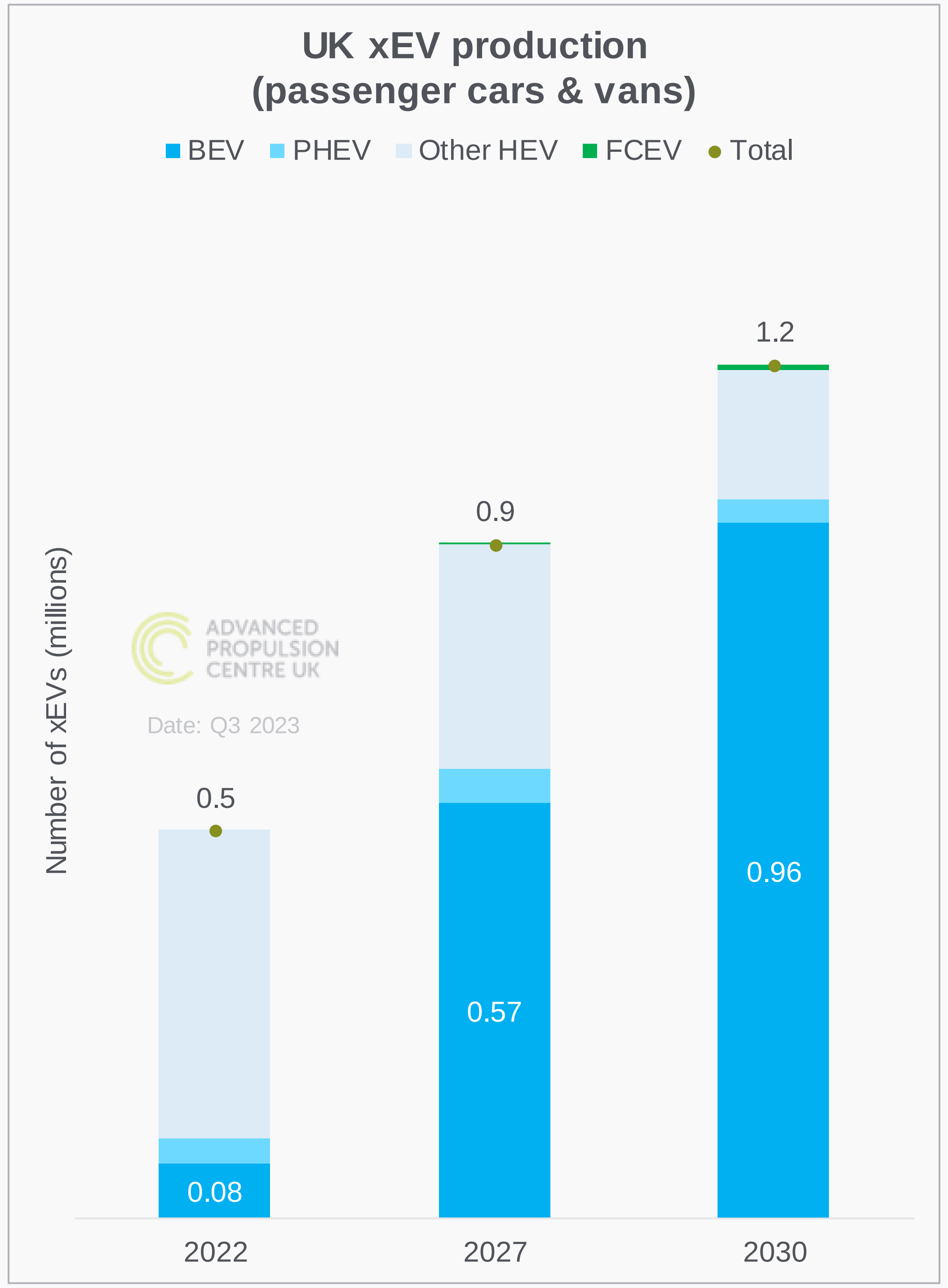
UK xEV production

Passenger cars and vans

Q3 2023 notes

- BEV production expected to be more than 40% of output in 2027 when new rules of origin come into force.
- ZEV mandate and individual OEM strategies, alongside important. investment decisions brings confidence in a high number of BEVs in 2027.





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

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Q3 2023 – Trends insight

Different battery chemistries have different supply chains

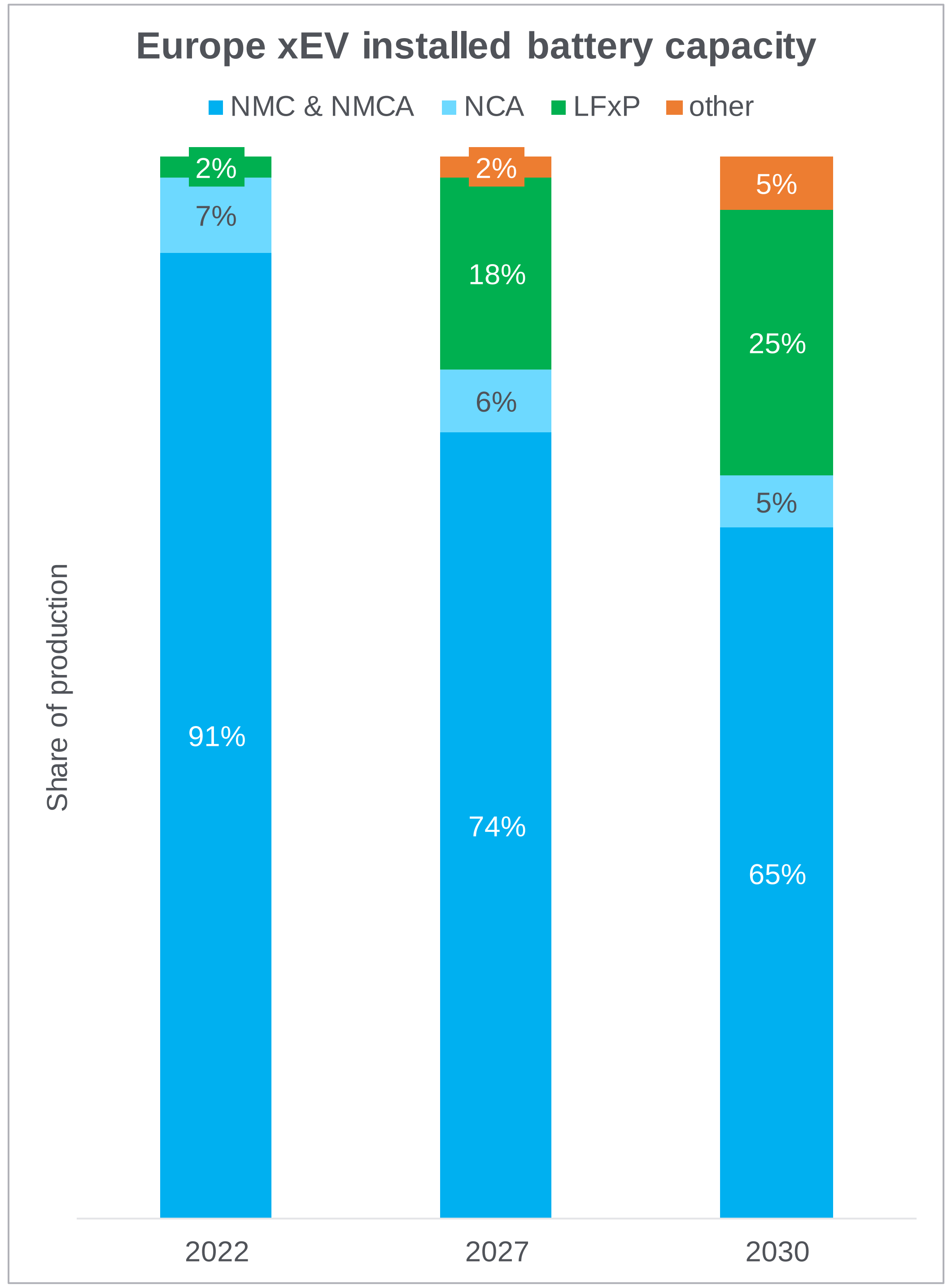
Nickel Manganese Cobalt (NMC)- and Lithium Ferrophosphate (LFP)-based chemistries are expected to be the two most popular cathode chemistries for the coming decade.

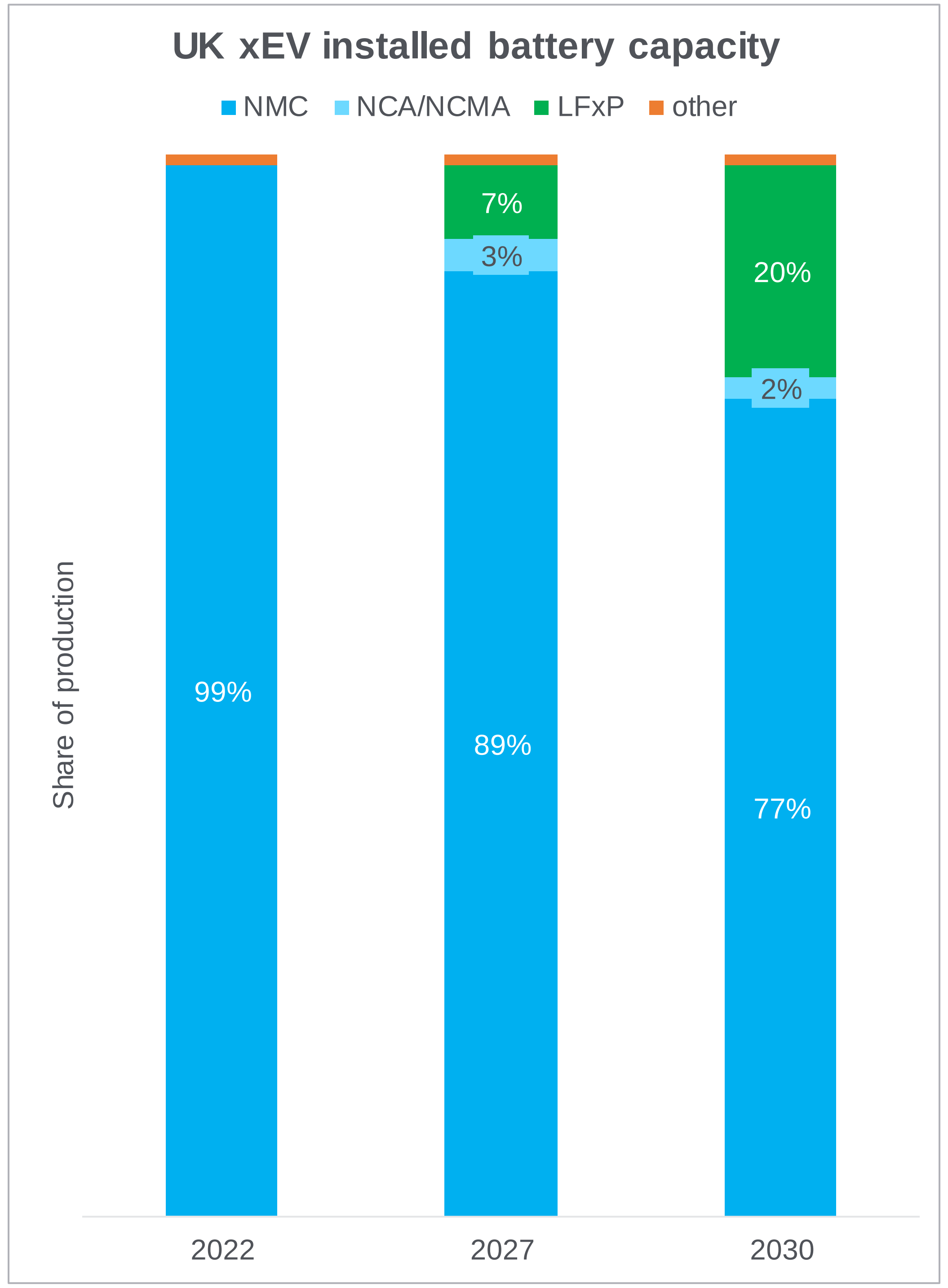
NMC comprises lithium, nickel, manganese and cobalt. Aluminium can be added to improve cycle life.

LFP comprises lithium and iron phosphate, while manganese can be added to improve energy density.

NMC or nickel-rich chemistries offer the highest energy capacities but are subject to high and volatile costs for nickel and cobalt. LFP offers a lower cost alternative that can still achieve good performance for a large segment of the automotive market (see our Automotive battery value chains report, November 2023, for details).

Both are lithium-ion chemistries and require a source of lithium.





LFP demand revised down since Q2 2023 due to perceived pace of LFP supply chain development in Europe. Decreased by 5% in 2030 for both UK and Europe and decreased by 2% in 2027 for Europe and 5% in 2027 for UK.

Source: RhoMotion, Wood Mackezie, BloombergNEF, APC analysis

Lithium salt differences between NMC(A) and LFP(A)

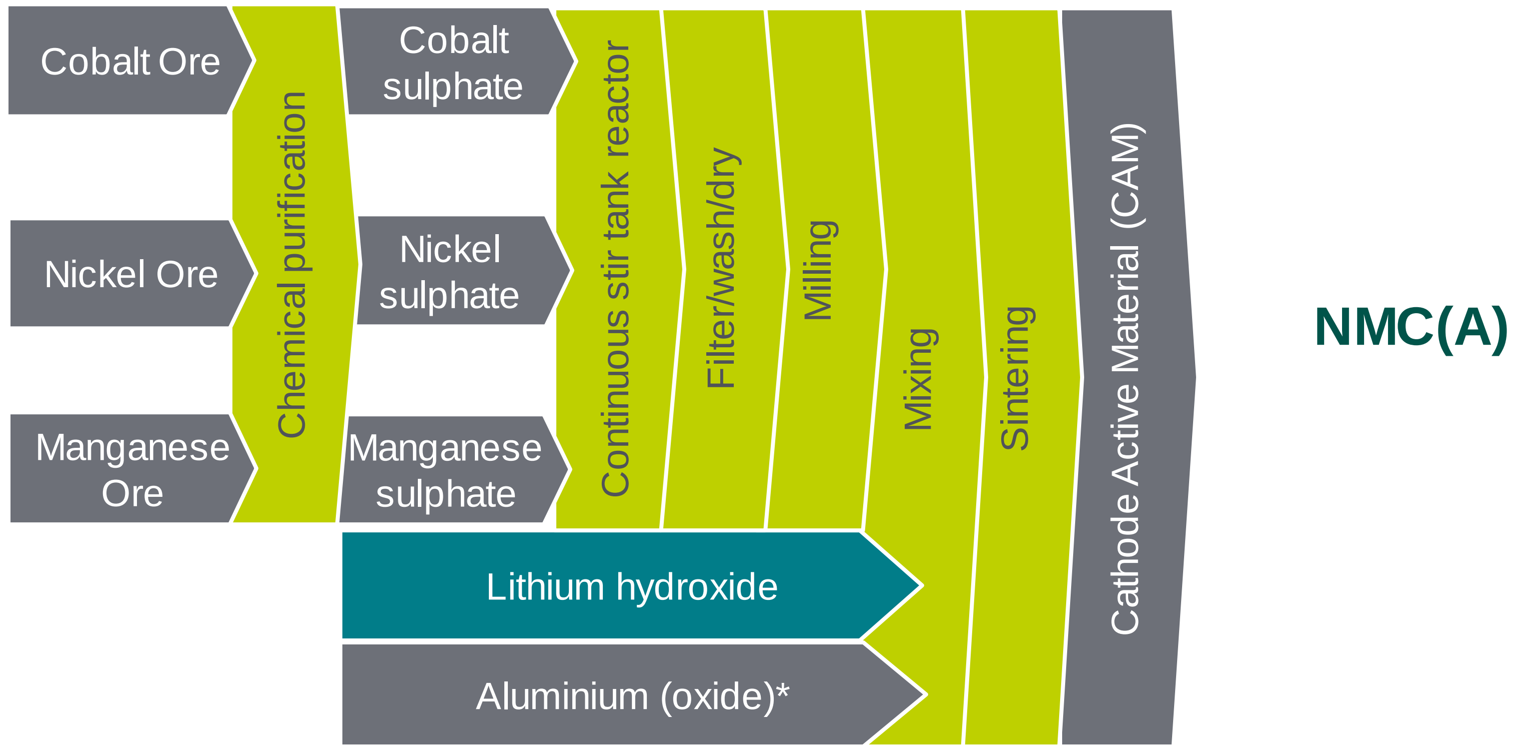
The graphic on the right shows the different input materials and process to make cathode active material (CAM) for NMC(A) and LF(M)P lithium-ion batteries.

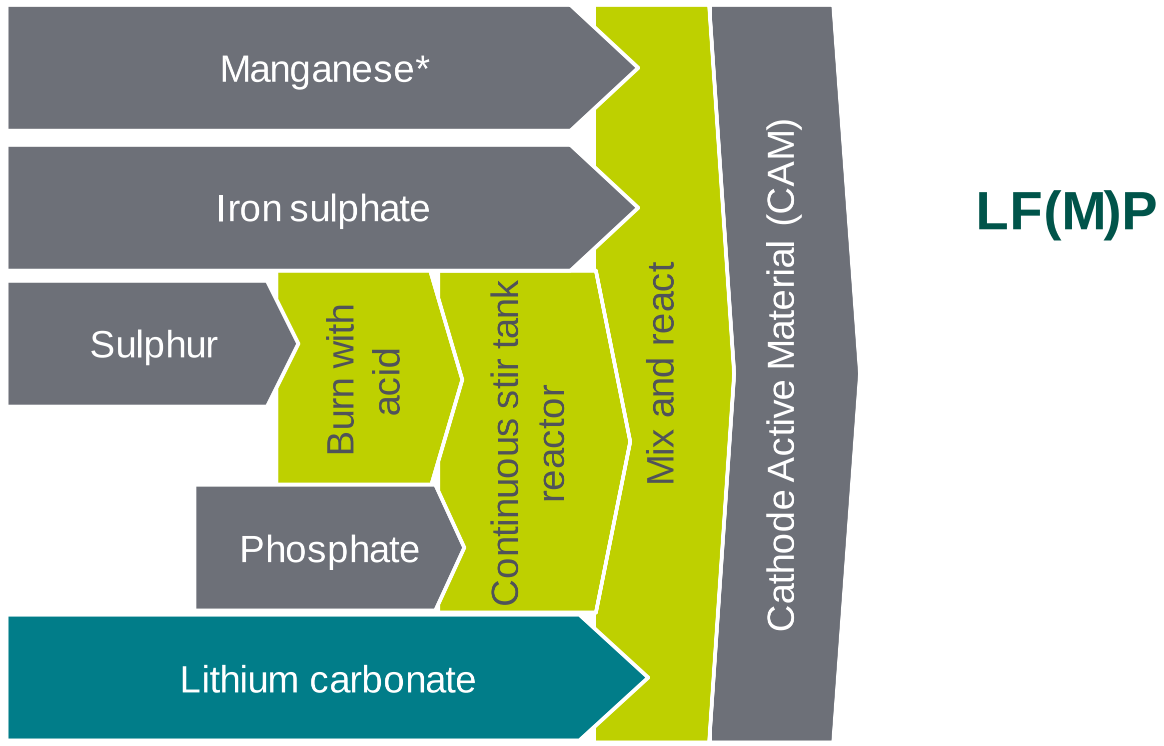
Highlighted is the preferred lithium input. Lithium hydroxide is preferred for nickel rich chemistries, like NMC 811, and lithium carbonate is preferred for LFP chemistries.

Lithium carbonate is typically cheaper than lithium hydroxide and there is more variance in purity from lithium hydroxide sources.

However, lithium hydroxide has been shown to provide an increase to cycle life and is known to be easier to mix in NMC precursor material. Typically, LFP batteries can achieve higher cycle life than NMC and can take advantage of the cost benefits of lithium carbonate.

The main reason to use lithium hydroxide for nickel rich, NMC-like, chemistries is the melting point of the salts. Lithium hydroxide has a lower melting point, 471°C compared to 720°C for lithium carbonate. Nickel-rich chemistries require a lower sintering temperature, as low as 740°C for NMC955, making lithium hydroxide the preferred option.



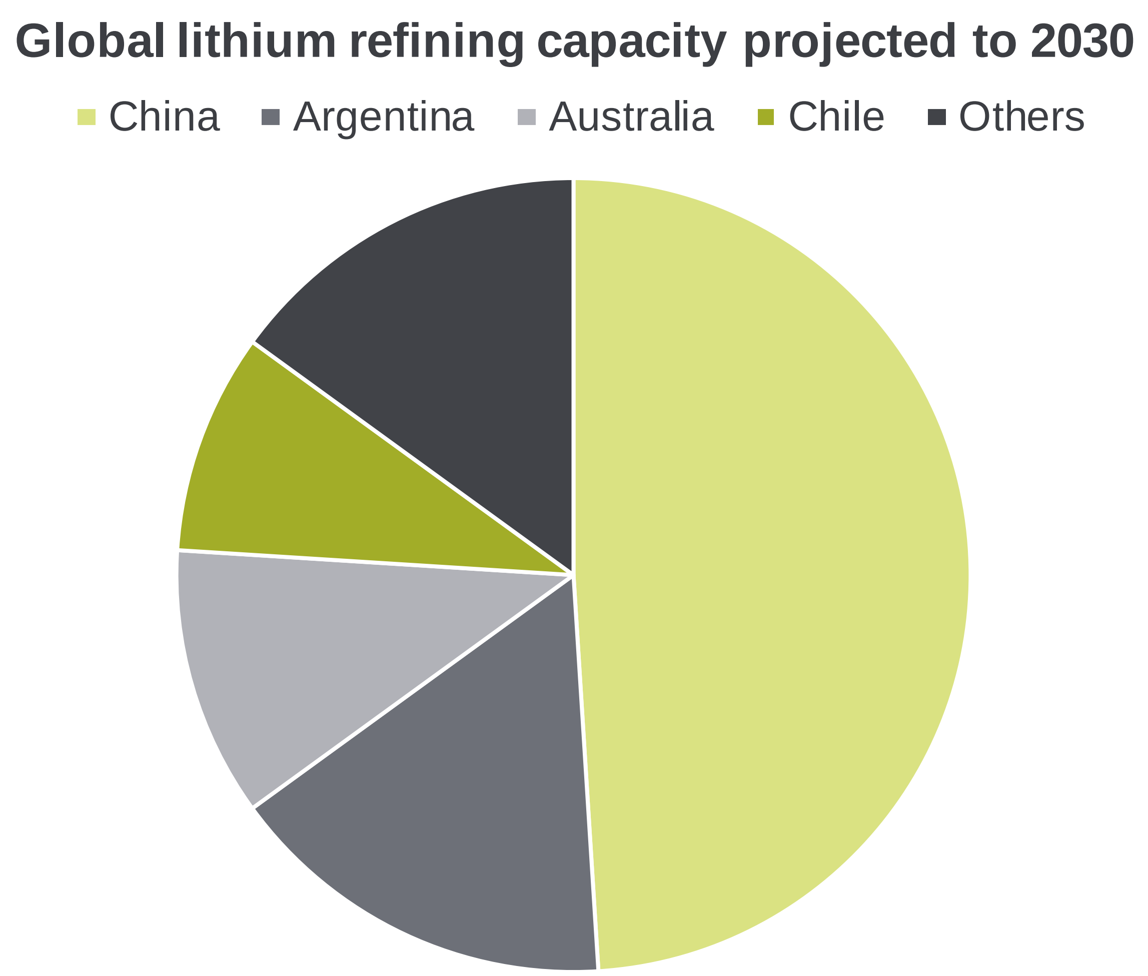


*optional additives

The lithium salt supply chain

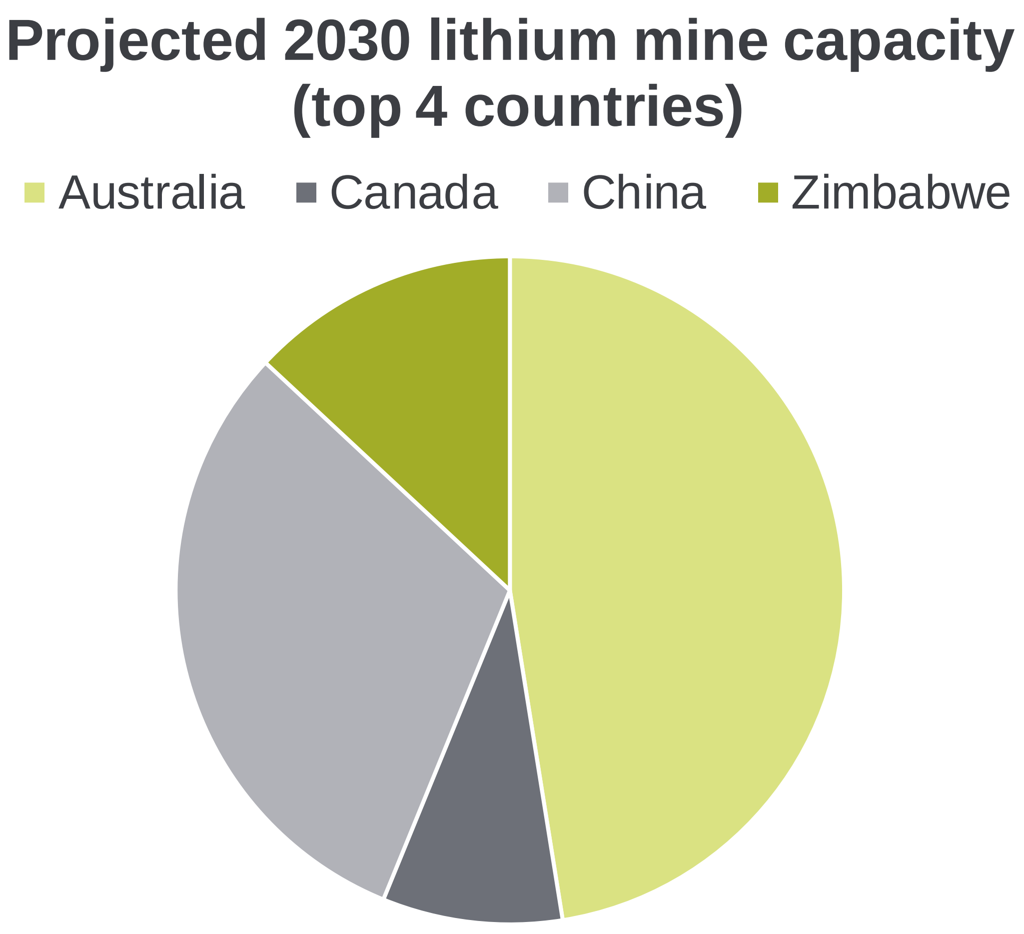
Lithium salts can be obtained through two primary methods: mining hard rock, such as spodumene, and extracting from subterranean brine sources.

Once extracted, lithium requires refining. China currently dominates global lithium refining capacity.



Source: APC analysis based on IEA, USGS, BGS, Wood Mackenzie and Benchmark Mineral Intelligence

Hard rock lithium mining

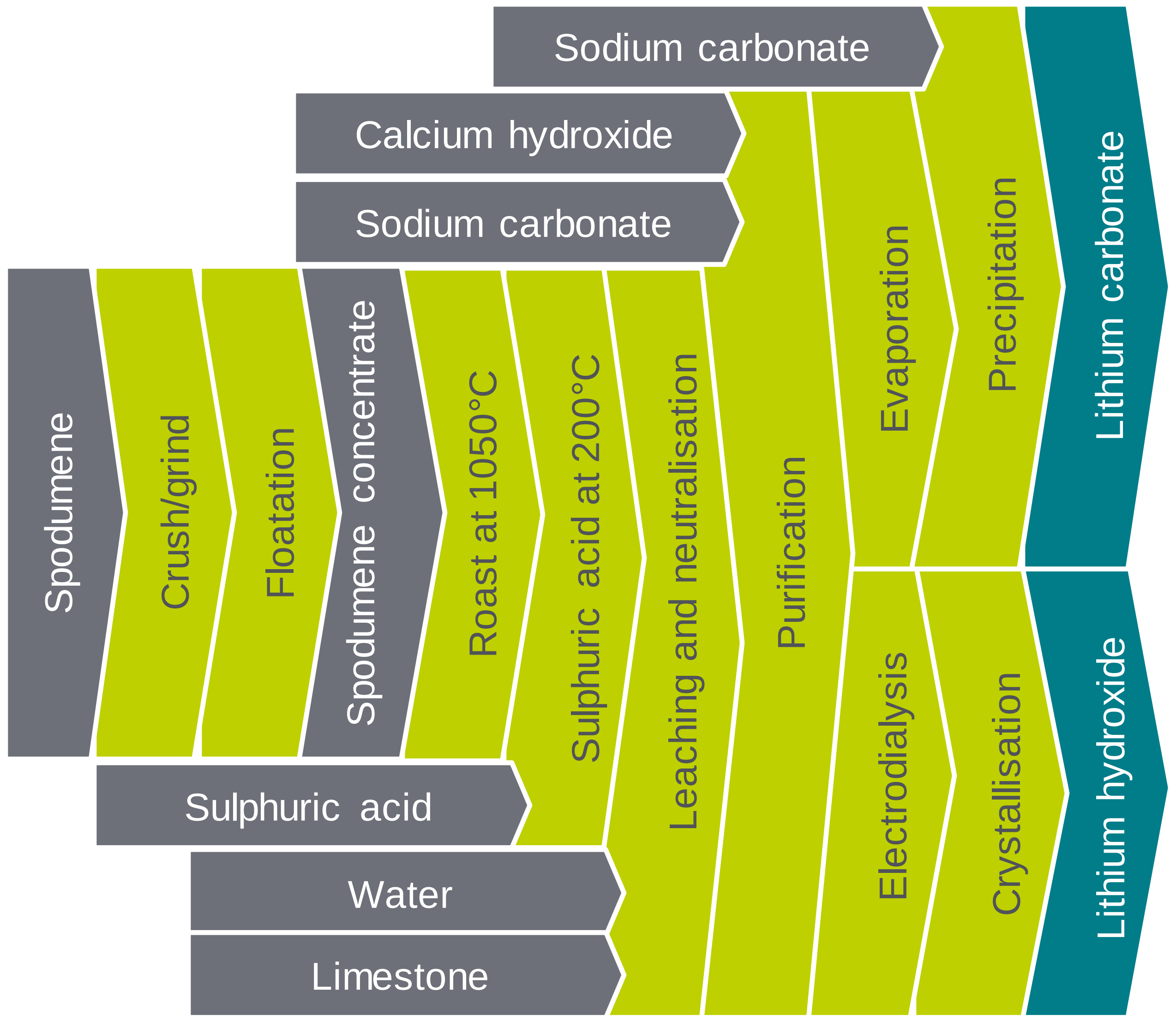


At present, Australia mines the most lithium. However, China has been developing domestic mines and investing around $6 billion in lithium assets around the world, including in Australia. Investment in the USA could see the USA challenge Canada for the fourth spot by 2030.

China has almost half the world's processing capacity, which it is unable to fill from domestic supply alone. China is investing in global assets to fill this gap.

Hard rock mining involves the extraction of lithium from lithium containing mineral ores. Spodumene is the main source of lithium from mineral ores as it has the highest theoretical lithium content. Lepidolite is another important ore, with slightly lower lithium content than spodumene.

There are a few ways to produce lithium carbonate and lithium hydroxide from spodumene or lepidolite. The most common method of producing lithium carbonate involves the use of sulphuric acid.



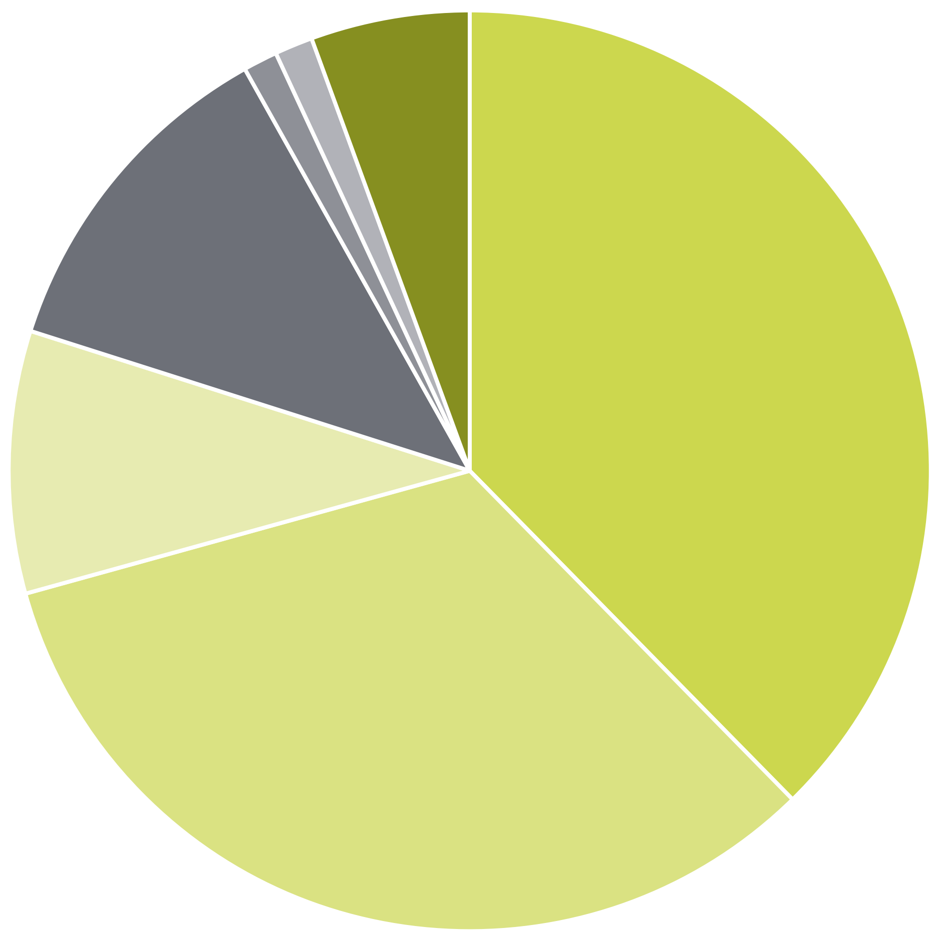
Sources: APC analysis based on IEA, USGS, BGS, Wood Mackenzie and Benchmark Mineral Intelligence

Gao, T. ming, Fan, N., Chen, W., & Dai, T. (2023). Lithium extraction from hard rock lithium ores (spodumene, lepidolite, zinnwaldite, petalite): Technology, resources, environment and cost. China Geology, 6(1), 137–153. https://doi.org/10.31035/CG2022088

Tadesse, B., Makuei, F., Albijanic, B., & Dyer, L. (2019). The beneficiation of lithium minerals from hard rock ores: A review. Minerals Engineering, 131, 170–184. https://doi.org/10.1016/J.MINENG.2018.11.023

Subterranean lithium extraction

Global extraction of lithium from subterranean sources projected to 2030



Argentina and Chile account for 70% of the world's subterranean lithium extraction, primarily from brine sources.

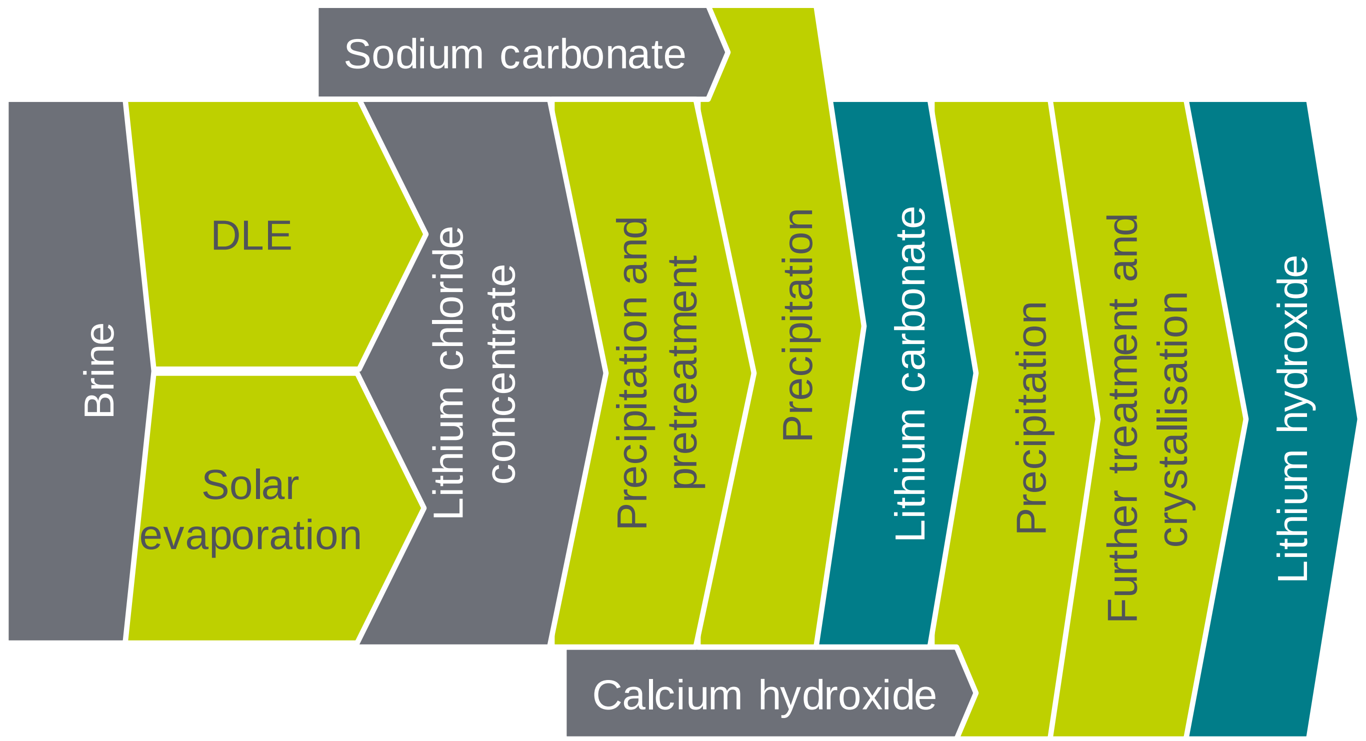
Europe and the UK are investing in domestic extraction, in particular direct lithium extraction.

Direct lithium extraction can reduce the carbon footprint of lithium extraction and significantly reduce water usage as the water is reserved and reintroduced to the source.

Subterranean sources include underground continental brine reservoirs and geothermal sources. Lithium extraction can be done via evaporation or direct lithium extraction methods.

Evaporation: brine is pumped into large, shallow, open-air reservoirs. Over a long period of time the water evaporates from natural wind and solar heat. Lithium chloride crystallizes out as saturation is reached. This process can take over a year, depending on the size of the reservoir. This lithium salt needs further processing to produce lithium carbonate or lithium hydroxide.

Direct Lithium Extraction (DLE): there are several types of DLE methods at varying levels of commercial maturity. This is an area of innovation with the potential to open up new sources of lithium and reduce the environmental impact of current sources.



Source: APC analysis based on BGS, Wood Mackenzie and Benchmark Mineral Intelligence

Direct Lithium Extraction (DLE)

Direct Lithium Extraction involves the selective extraction of lithium ions from a lithium solution. This avoids evaporation used in the evaporation method and preserves the water, which can then be injected back into the extraction site.

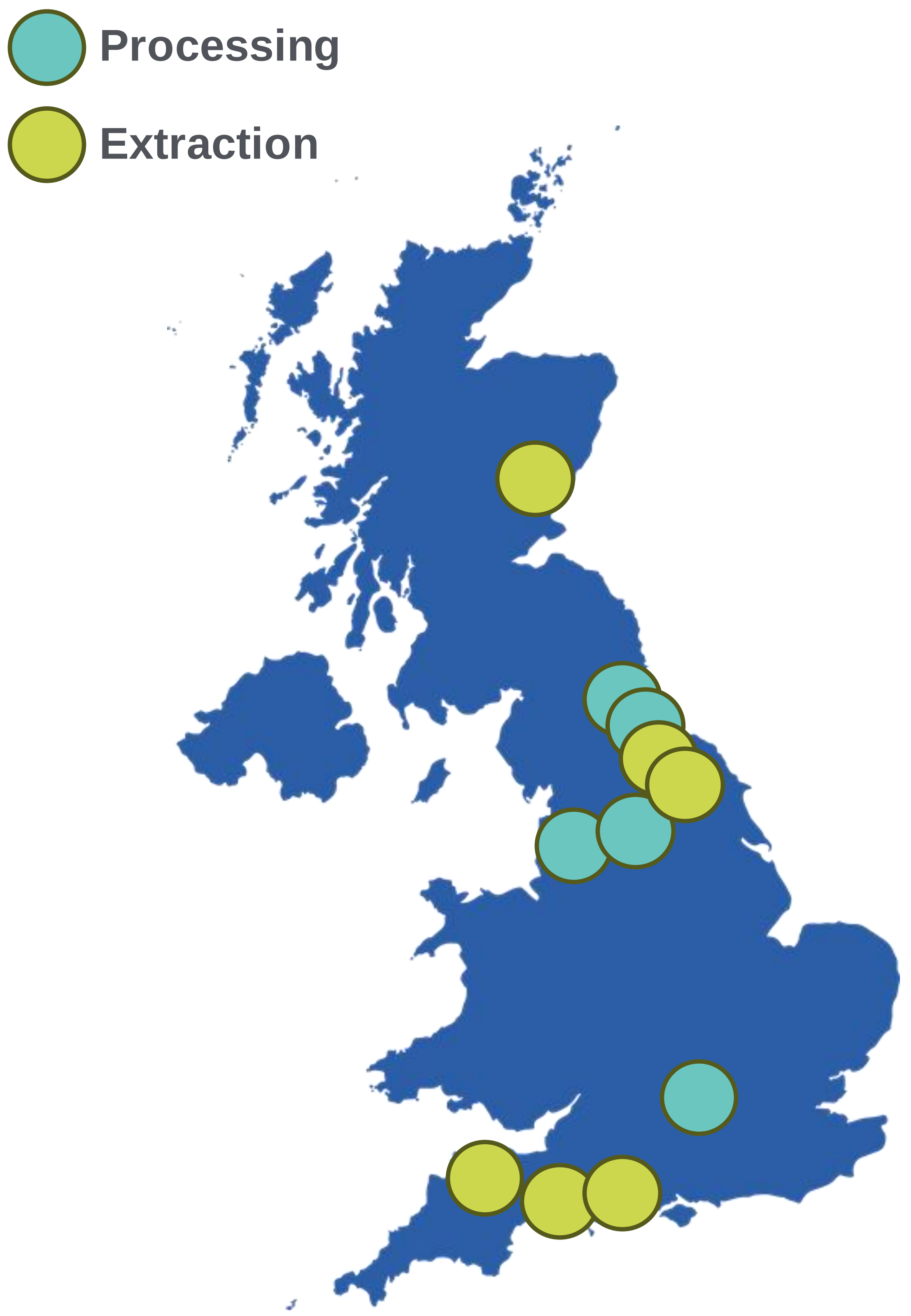
Many sites suitable for DLE are also geothermal sites, which means clean geothermal energy can be produced to supplement the energy needs of extraction and processing, in some cases providing surplus energy.

By targeting the lithium ions directly, DLE can very efficiently produce high-purity lithium compounds which can reduce both the environmental footprint of lithium extraction and the cost.

There are multiple techniques in various stages of development which include, but are not limited to, sieve adsorption, solvent extraction, and electrochemical separation. Within these broad categories are several variations.

Method	Description
Sieve adsorption	Sieve adsorbents are inorganic materials with specific physical and electrochemical structures. The sieve extracts lithium ions via physisorption driven by electrostatic interaction with the surface and chemical adsorption via ion exchange. Acid is used to extract lithium from the sieve once adsorbed and this acid creates both a waste product and wear or loss of the sieve.
Solvent extraction	Solvent extraction exploits relative solubilities of compounds in the aqueous brine and a solvent mixture. The solvent mixture is blended with the brine to extract the water leaving lithium compounds and other metals in the solvent mixture. The lithium ions are then ‘stripped’ from the solvent. This process can work with very low lithium concentrations however the solvents required are considered hazardous waste.
Electrochemical separation	Electrochemical separation can be broadly split into charge transfer processes and electro-sorption or intercalation processes. Charge transfer processes involve the transfer of lithium ions across a membrane under an applied electric field. Electro-sorption processes involve the adsorption of lithium ions on the surface of electrodes under an applied electric potential.

Growing innovation in UK lithium extraction



Company	Source	Forecast 2030 LCE supply (kt)
Imerys British Lithium	Granite hard rock	21
Cornish Lithium	Geothermal brine DLE and granite hard rock	3.5
Geothermal Engineering Limited	Geothermal brine DLE	12
Northern Lithium	Geothermal brine DLE	10*
Weardale Lithium	Geothermal brine DLE	10

The UK has both hard rock and geothermal brine sources of lithium. Extraction projects from geothermal brines can be completed in the time scale of 2-5 years, while hard rock projects can take 5-15 years. The current forecast for UK domestic supply is 56.5 kt LCE in 2030 compared to a demand of 64 kt LCE to satisfy 90 GWh of domestic battery production in 2030. There is time for new projects to come online, and for faster scale-up, with appropriate support. These projects are capital intensive in the exploration phase, requiring access to a skilled workforce, and can be slowed down by mineral access rights and permitting timelines.

The theoretical lithium content of granite hard rock is half that of spodumene. However, companies in the UK are innovating new processes to achieve higher recovery rates, and therefore a competitive product, compared to spodumene.

The UK also has academic organisations and companies pioneering new direct lithium extraction technologies, such as Watercycle Technologies (Manchester) and Evove (Daresbury).

The UK also has lithium processing projects. Green Lithium and Tees Valley Lithium, for example, could provide onward processing of concentrate products, achieving a combined processing capacity of over 100 kt in 2030.

*2027 forecast

Mineral rights

The separation of mineral ownership from landownership is common, particularly in England and Wales. Whilst a land title may indicate separation of ownership the transfer of ownership, and certainly any subsequent transfers, may not be recorded. This means is not always clear and obvious who owns mineral rights which creates an added financial and time burden in due diligence.

Even upon completion of due diligence it is possible a rights owner will come forward to claim ownership and halt a project.

The Mines Act (1966) goes someway to rectifying this by providing a means to navigate uncertainty of ownership and unreasonable refusal to grant rights, specifically for nationally significant minerals. However, this is a complex and costly two-step process which is rarely used. For more information see, the ‘Review of Mineral Rights’ commissioned by CMIC

With the right legal advice this is not an intractable problem, but such legal advice is an additional cost which could be reduced with a simplified process.

Planning and permitting

Assuming mineral rights can be acquired a further challenge exists in obtaining the relevant planning and permitting permissions. The primary issue being lead time for decisions.

Whilst a geothermal mine can theoretically be operational in a couple of years it is quoted that an application to the environment agency can take two years to be assigned to a permitting officer. The permission from the environmental agency is just one of the permissions required.

Planning permission is a local authority issue. Local authorities can also have capacity issues in dealing with planning requests. Local authorities may face challenges weighing national interest against local interest that a centralised system can avoid.

In combination there is uncertainty and risk over timelines for planning permission and relevant permits which can be detrimental to attracting investment and increases project costs through delays. This is not unique to the UK, the EU has sought to reduce timelines by creating centralised authorities in each member nation with assumed permitting depending on the type of project and waiting time. In Canada the regulatory framework is being reviewed and the Critical Minerals Centre of Excellence (CMCE) is tasked with assisting project developers with regulatory processes. The UK government has committed to strengthen the capacity of the UK planning system introducing a new premium planning service and planning reforms.

Availability of skilled workforce

Like many countries the UK is experiencing a growing skills gap around mining engineering and metallurgy, as highlighted in 'The talent gap: critical skills for critical materials' produced by IOM3. Primarily this appears to be driven by perceptions and awareness of the mining industry.

Lithium extraction requires highly technical skills for example in the understanding of geophysics and engineering required in exploration and in the innovative processes being developed. This requires a number of experienced materials scientists, metallurgists, geologists and process chemists to name a few.

In the UK the CMIC is playing a key role in a program of public engagement as part of the UK's critical mineral strategy.

Relative environmental impact

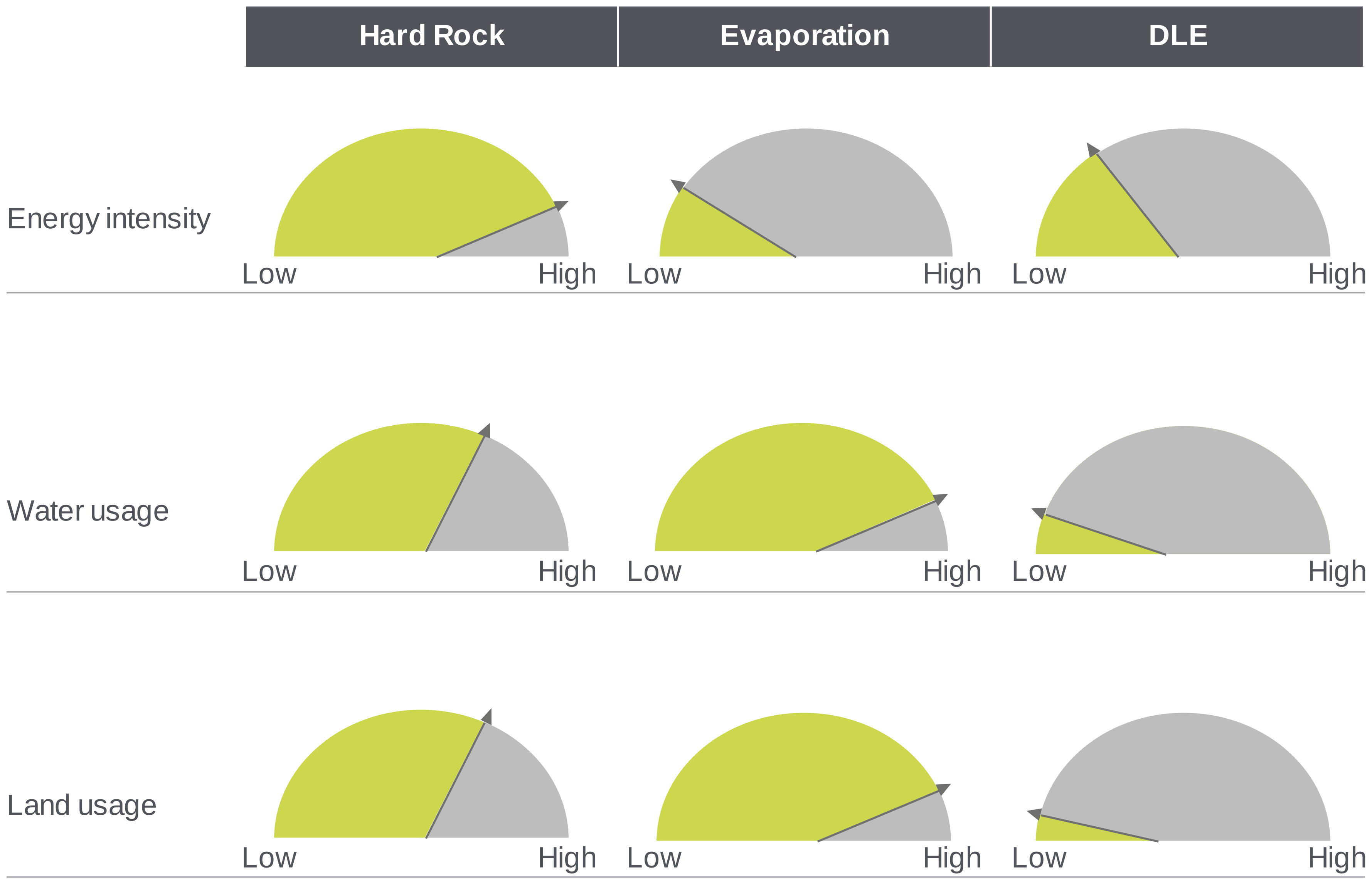
Lithium extraction from hard rock sources generally has a higher carbon intensity than brine evaporation. The acid roasting steps used to extract lithium products from spodumene are particularly energy intensive. This results in carbon intensity two to seven times higher for traditional hard rock sources.

The regional grid mix has a significant impact on the carbon intensity of lithium extraction.

Both hard rock mining and brine evaporation use significant quantities of water, with hard rock extraction requiring acid or alkali in the required processing steps. Water usage varies significantly, with some estimates suggesting evaporation uses 10 times more water, and others measuring only direct water usage suggesting hard rock mining uses twice as much water as evaporation.

Direct lithium extraction can use very little land, water can be replaced after extracting the lithium and in many cases geothermal energy can be used produced alongside the brine extraction.

This is where innovation in direct lithium extraction techniques is so important. New techniques being developed in the UK are reducing overall environmental impact by reducing carbon intensity, water usage, chemical usage, and enabling new sources of lithium to be exploited.

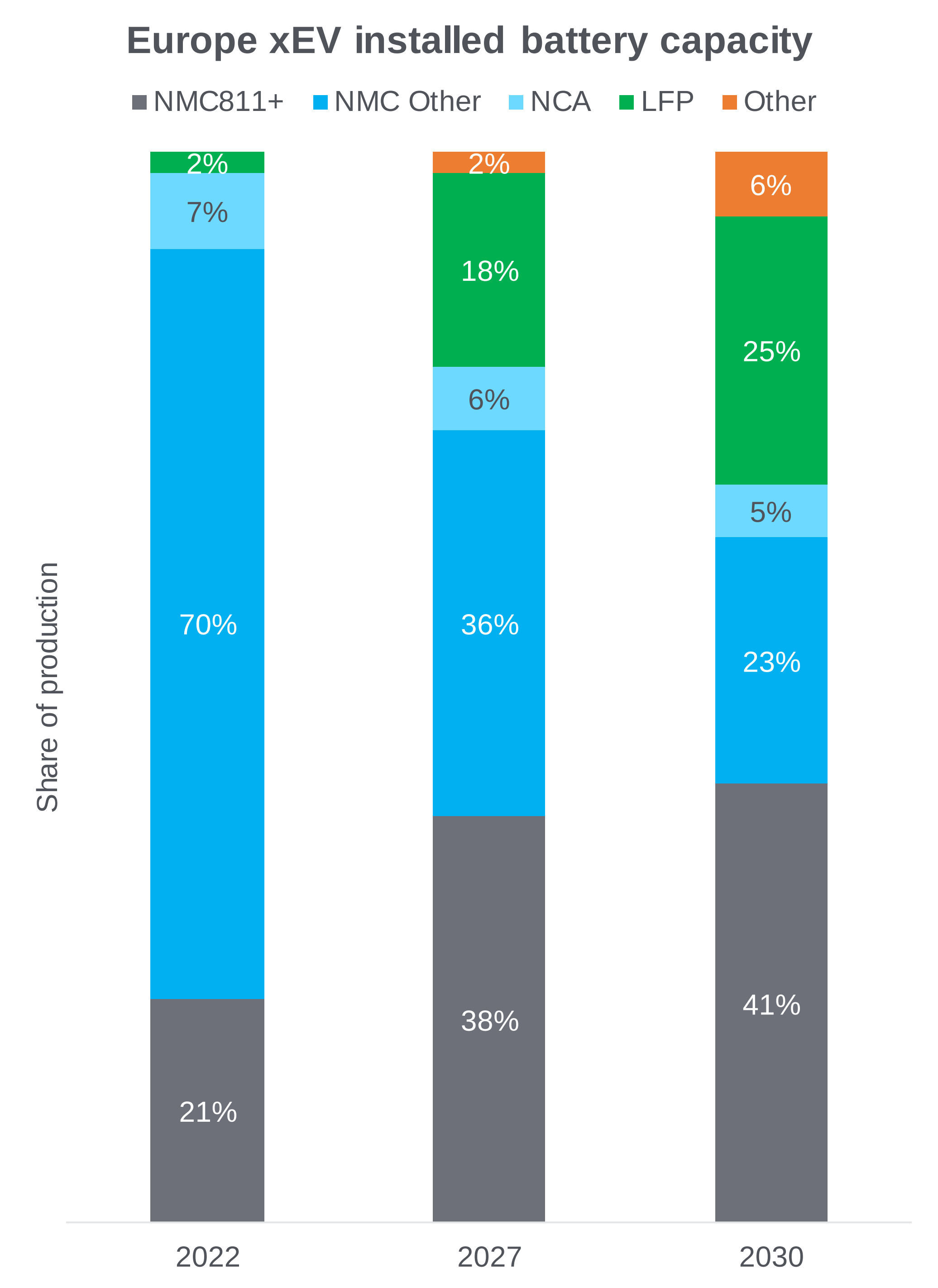


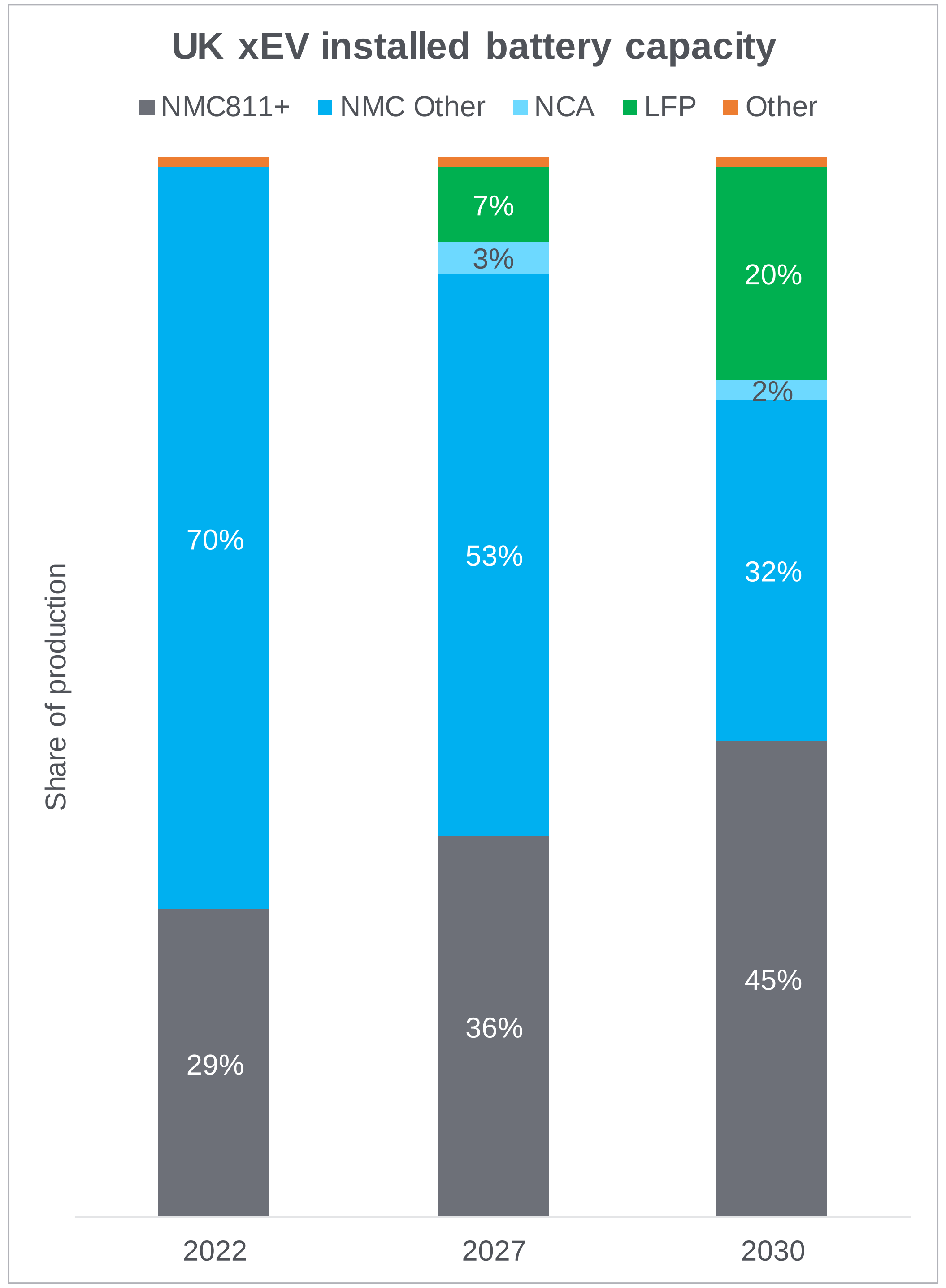
*Carbon intensity of local electricity varies between European nations and not all European nations will provide as low a carbon intensity offering as the UK.
Source: APC analysis based on Wood Mackenzie, Benchmark Mineral Intelligence, Gao, T. ming, Fan, N., Chen, W., & Dai, T. (2023). Lithium extraction from hard rock lithium ores (spodumene, lepidolite, zinnwaldite, petalite): Technology, resources, environment and cost. China Geology, 6(1), 137–153 and Vera, M.L., Torres, W.R., Galli, C.I. et al. Environmental impact of direct lithium extraction from brines. Nat Rev Earth Environ **4**, 149–165 (2023).

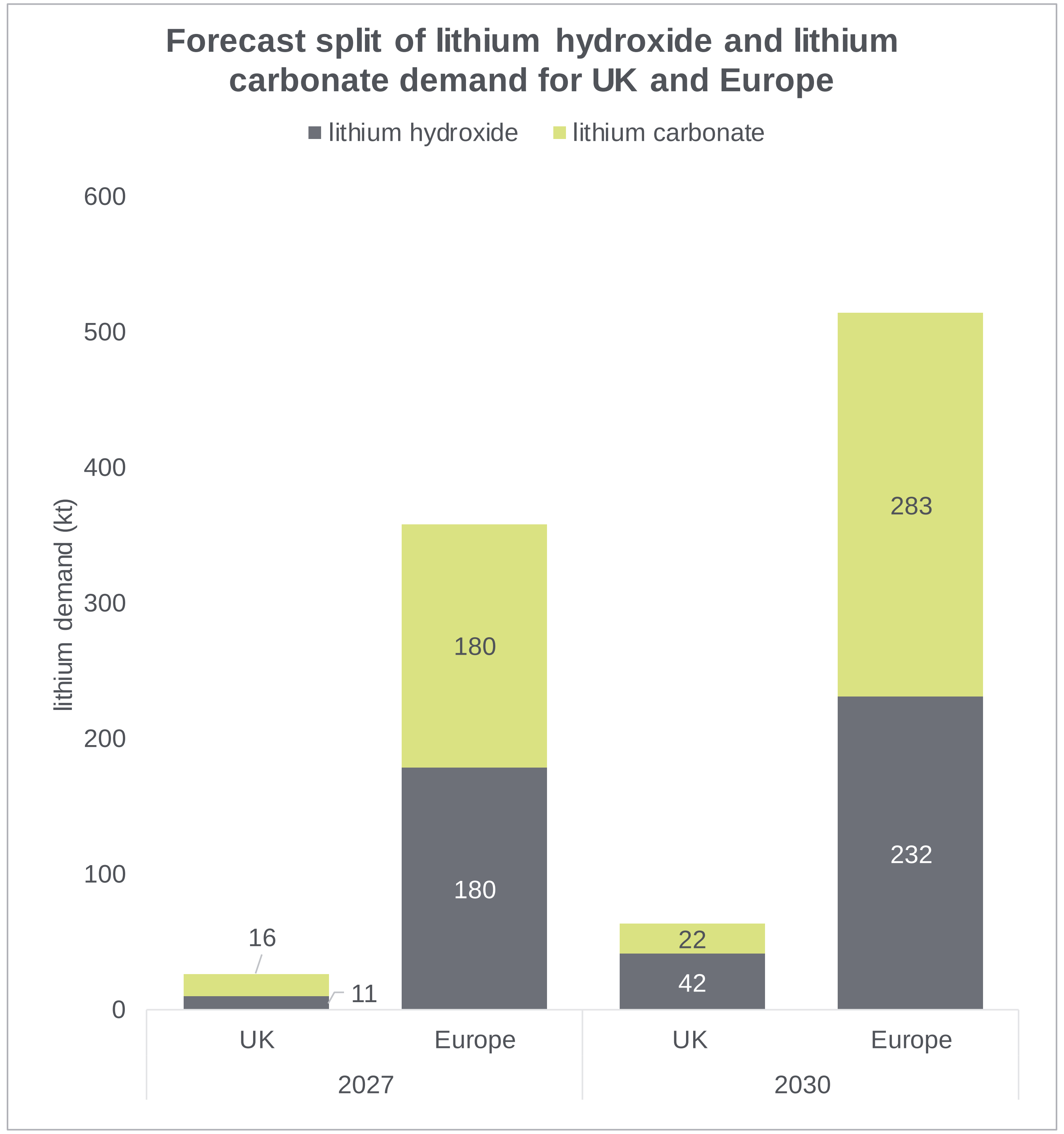
Lithium demand split based on vehicle demand

Assumptions:

- Lithium demand split based on forecast installed battery capacity for UK and Europe vehicle production
- NMC 811 and higher will predominately use lithium hydroxide
- Other chemistries, including lower nickel content NMC, are more likely to use cheaper lithium carbonate



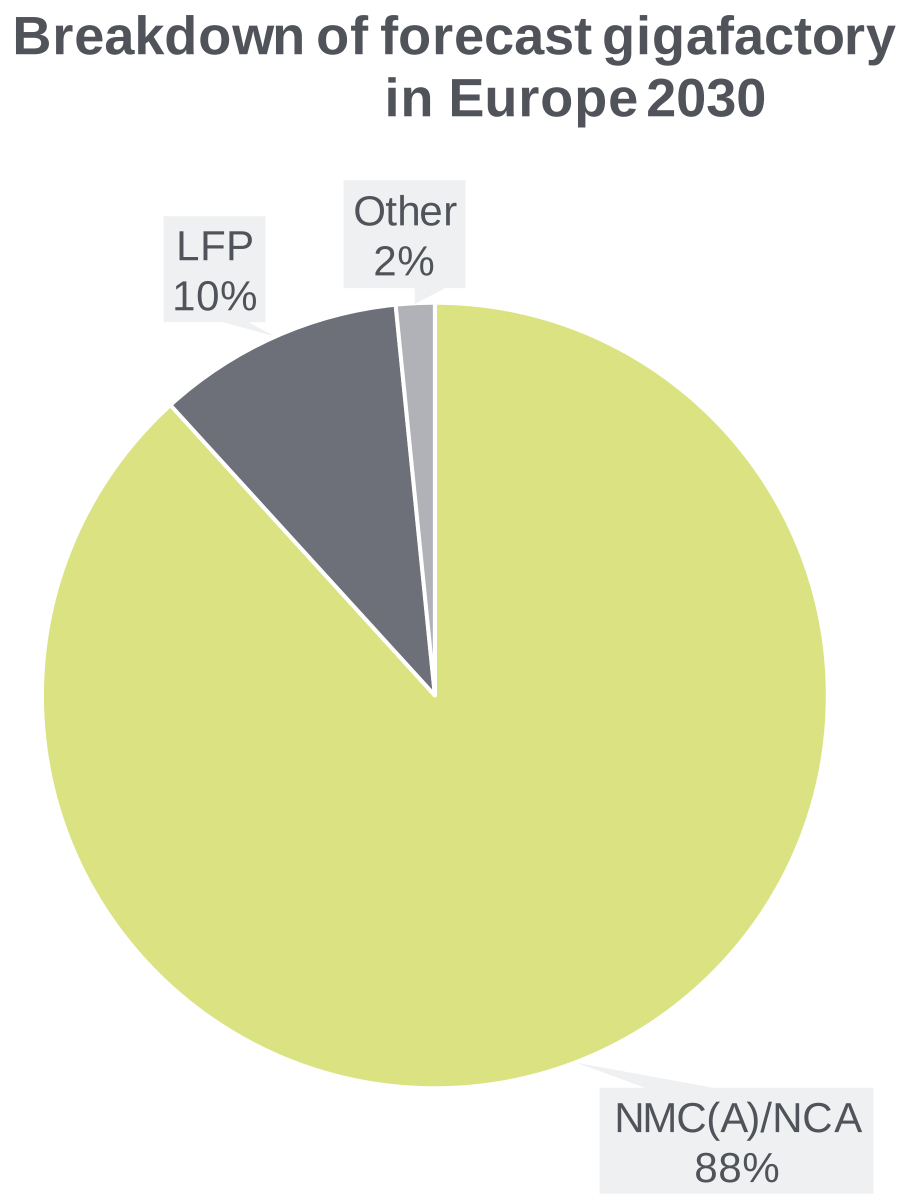




*European forecast includes non-EU countries such as Turkey.

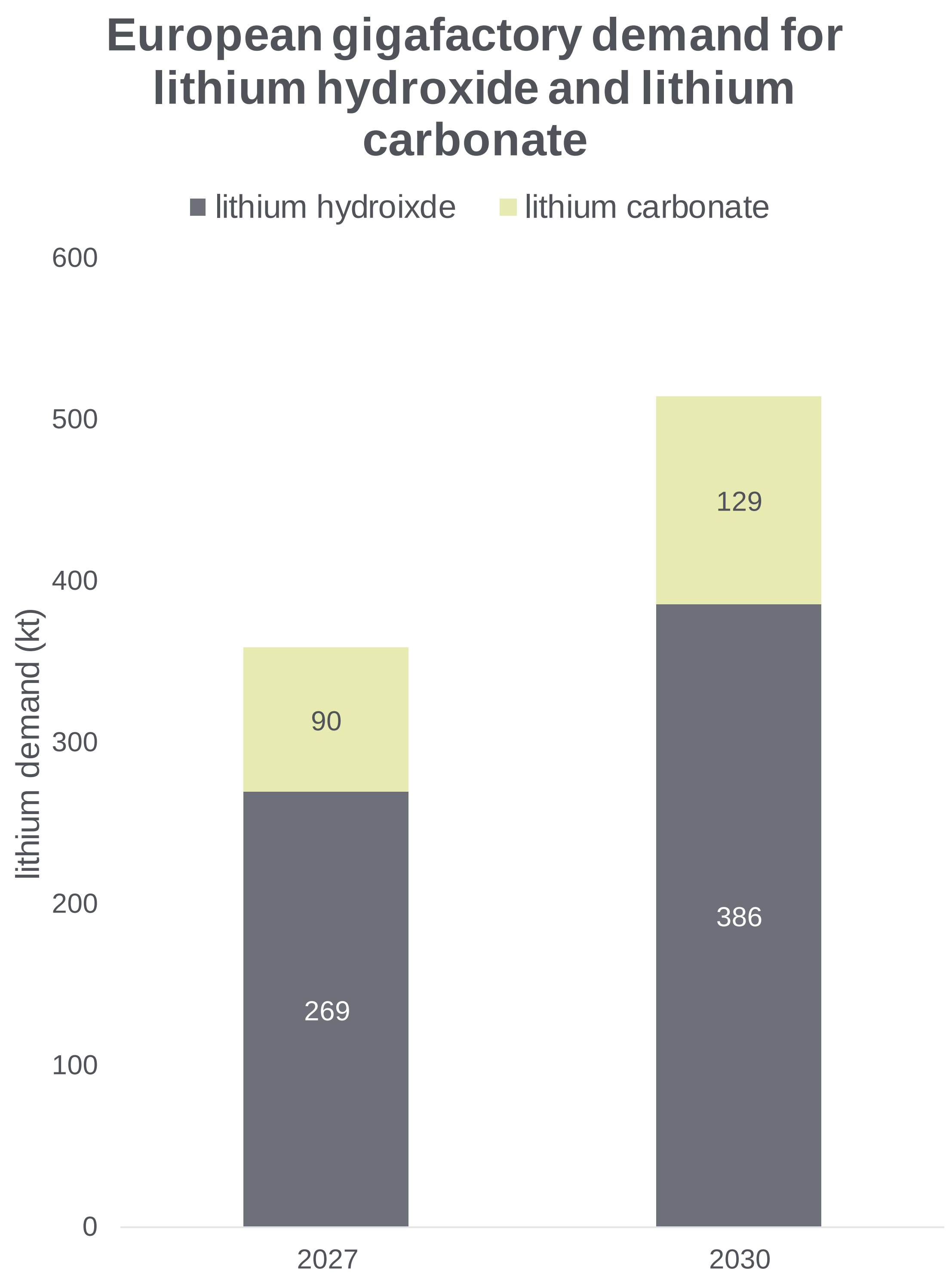
Source: RhoMotion, Wood Mackezie, BloombergNEF, APC analysis

Lithium forecast based on European gigafactory demand



While the automotive industry in Europe may be moving to 30% LFP battery chemistry in vehicles by 2030, the gigafactory scale-up is lagging behind this demand.

This results in a different demand profile for raw material being produced or processed in Europe to meet this demand.



*European forecast includes non-EU countries such as Turkey.

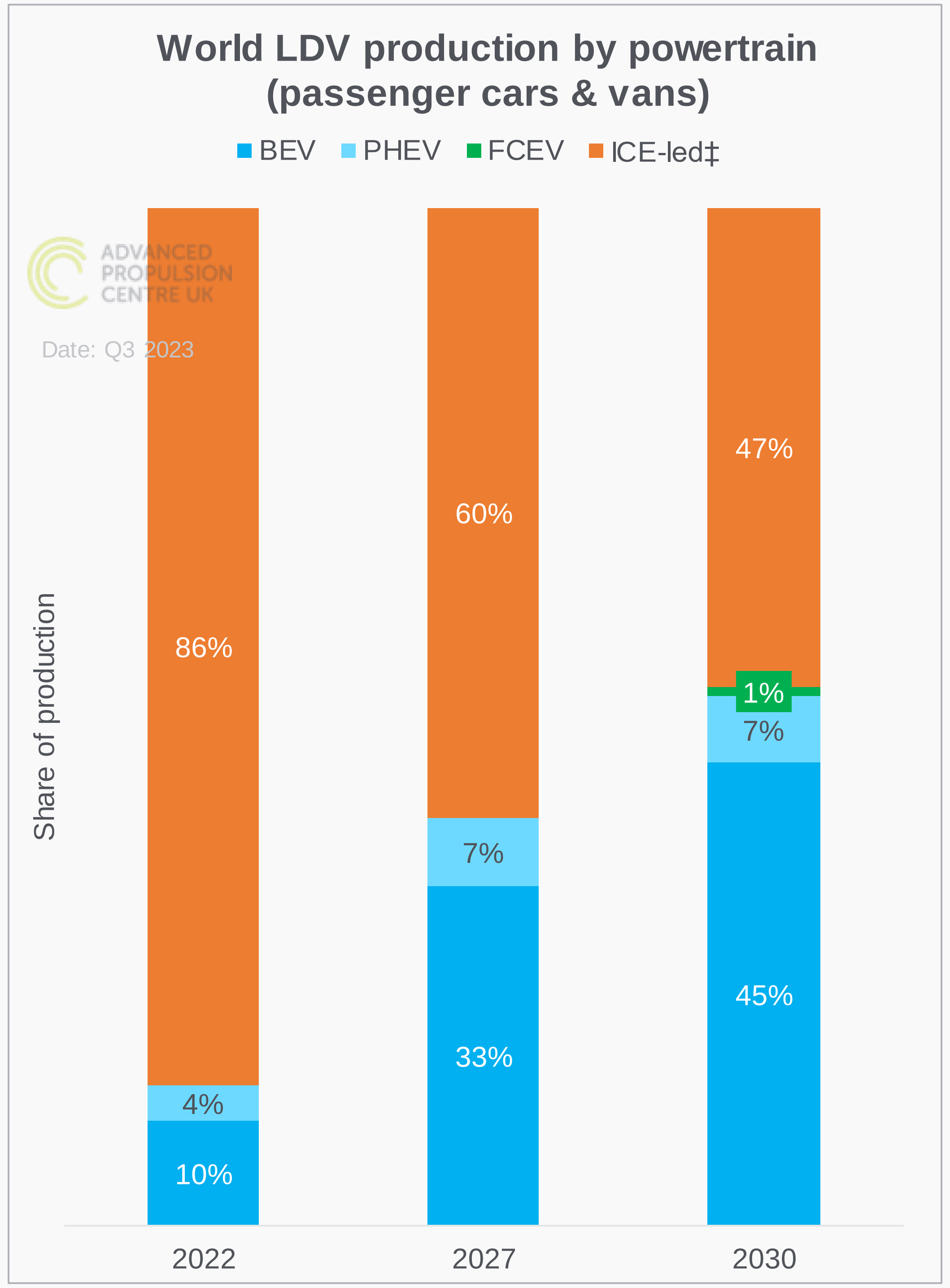
Source: RhoMotion, Wood Mackezie, BloombergNEF, APC analysis

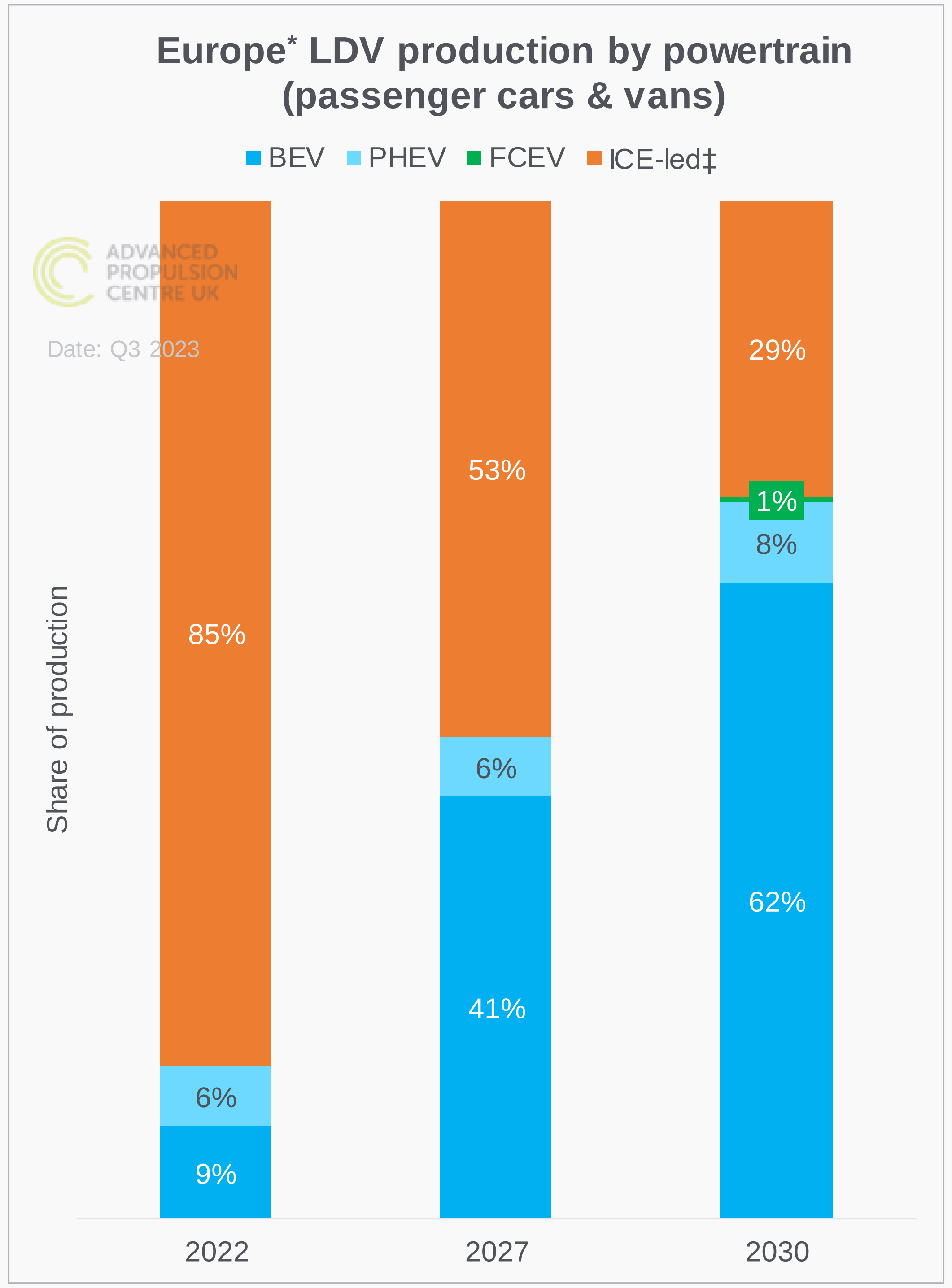
Q2 2023 – Electrified components data

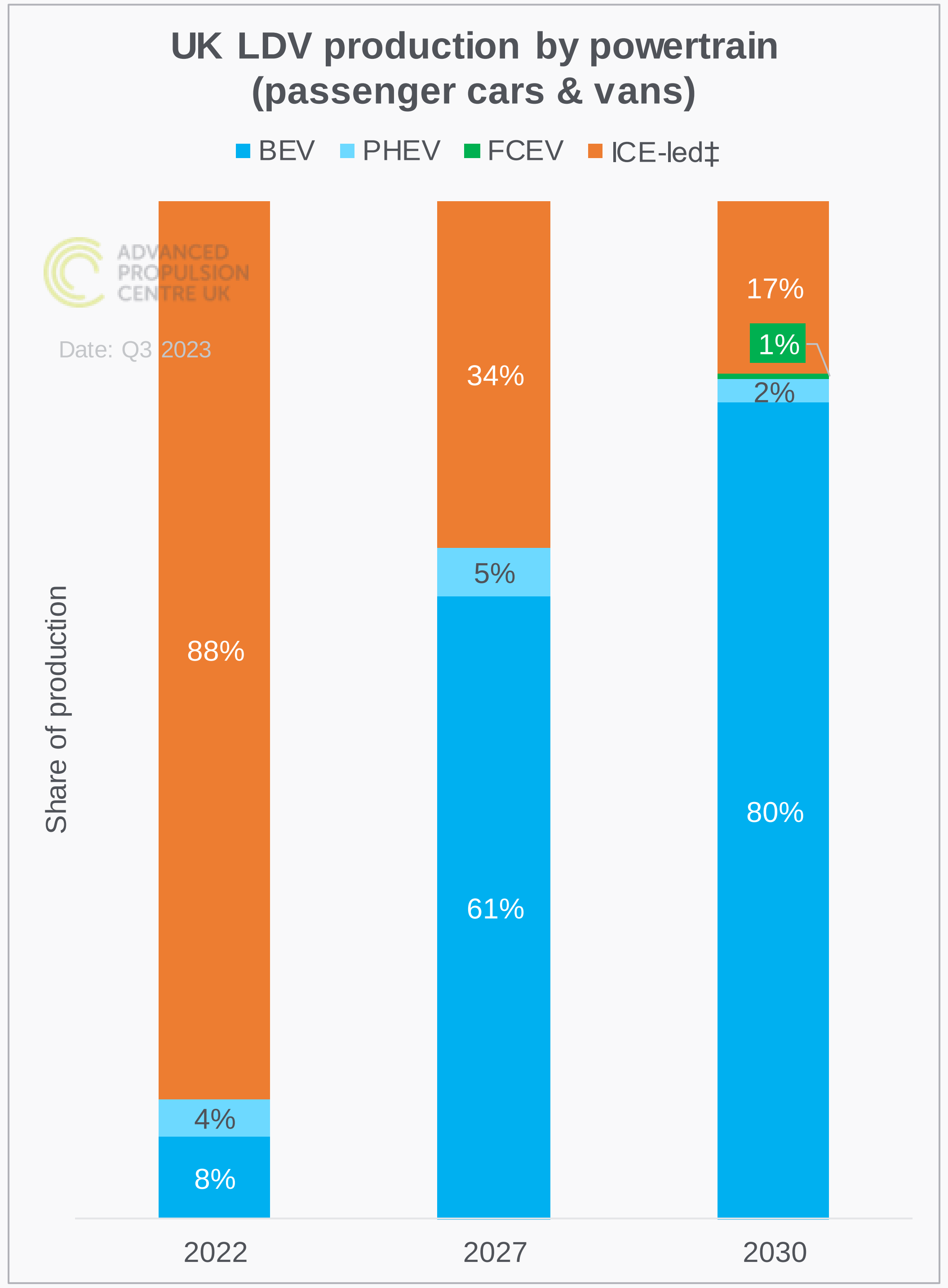
Forecasts for LDV production by powertrain

Q3 2023 notes

- World production of ICE is decreasing but quarterly numbers are still fluctuating between larger or smaller than BEV share.
- The forecast for BEVs in Europe continues to grow but there is still some way to go to pass 2/3 of total production.
- UK forecast to far exceed European and global percentage splits.





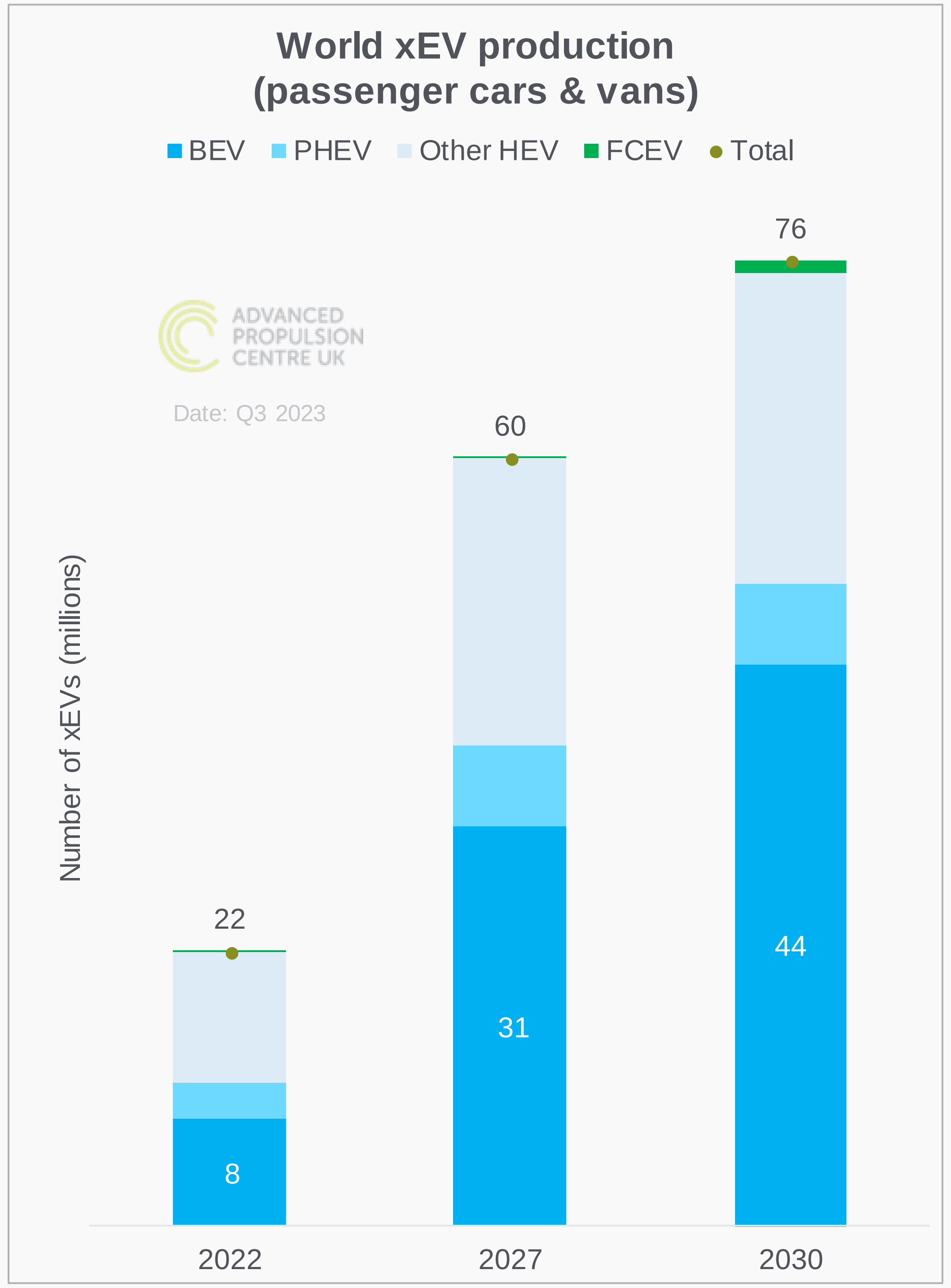


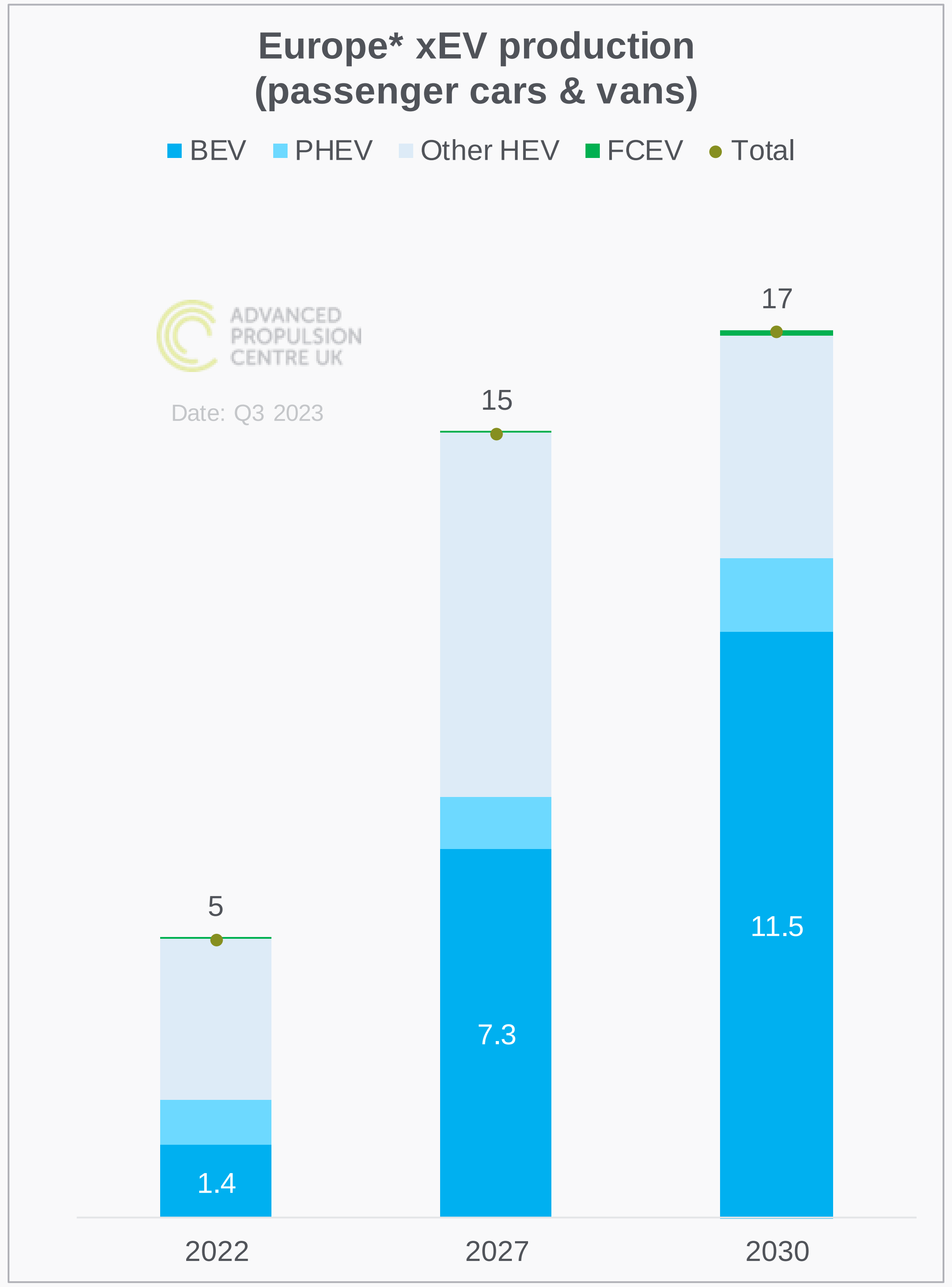
Source: APC Demand Databases using S&P Global AutoTechInsight (Oct 2023), BNEF forecasts (2023)
Note: Passenger cars & Light Commercial Vehicles < 3.5t only, *European forecast includes non-EU countries such as Turkey, ‡Includes non-plug-in HEVs & ICE

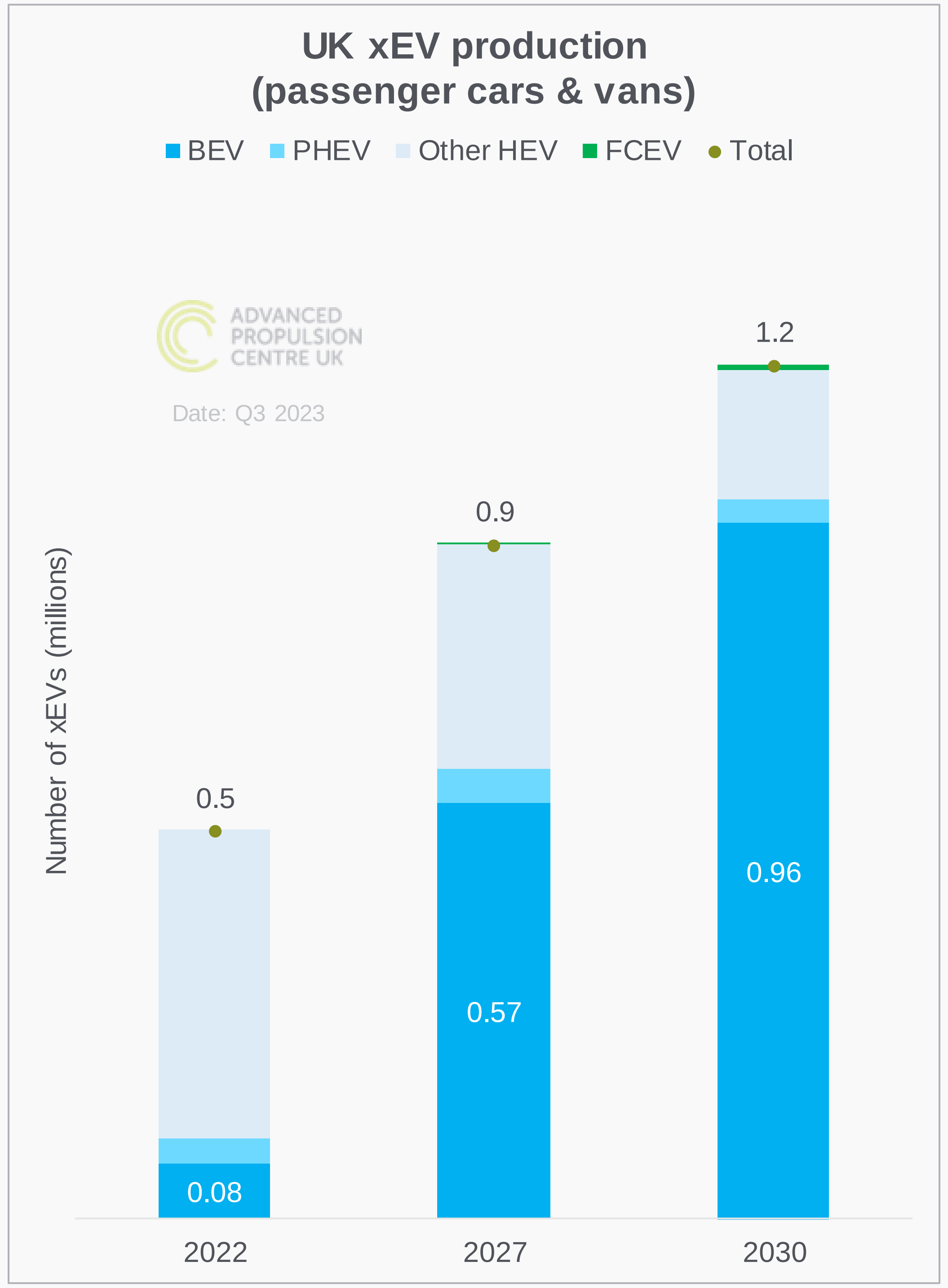
Forecasts for light duty xEV production

Q3 2023 notes

- Total Global World production did slightly decrease in Q3 by 660,000 units, equal to 0.86% in 2030.
- Total European production grew in Q3 by 1.7% in 2030.





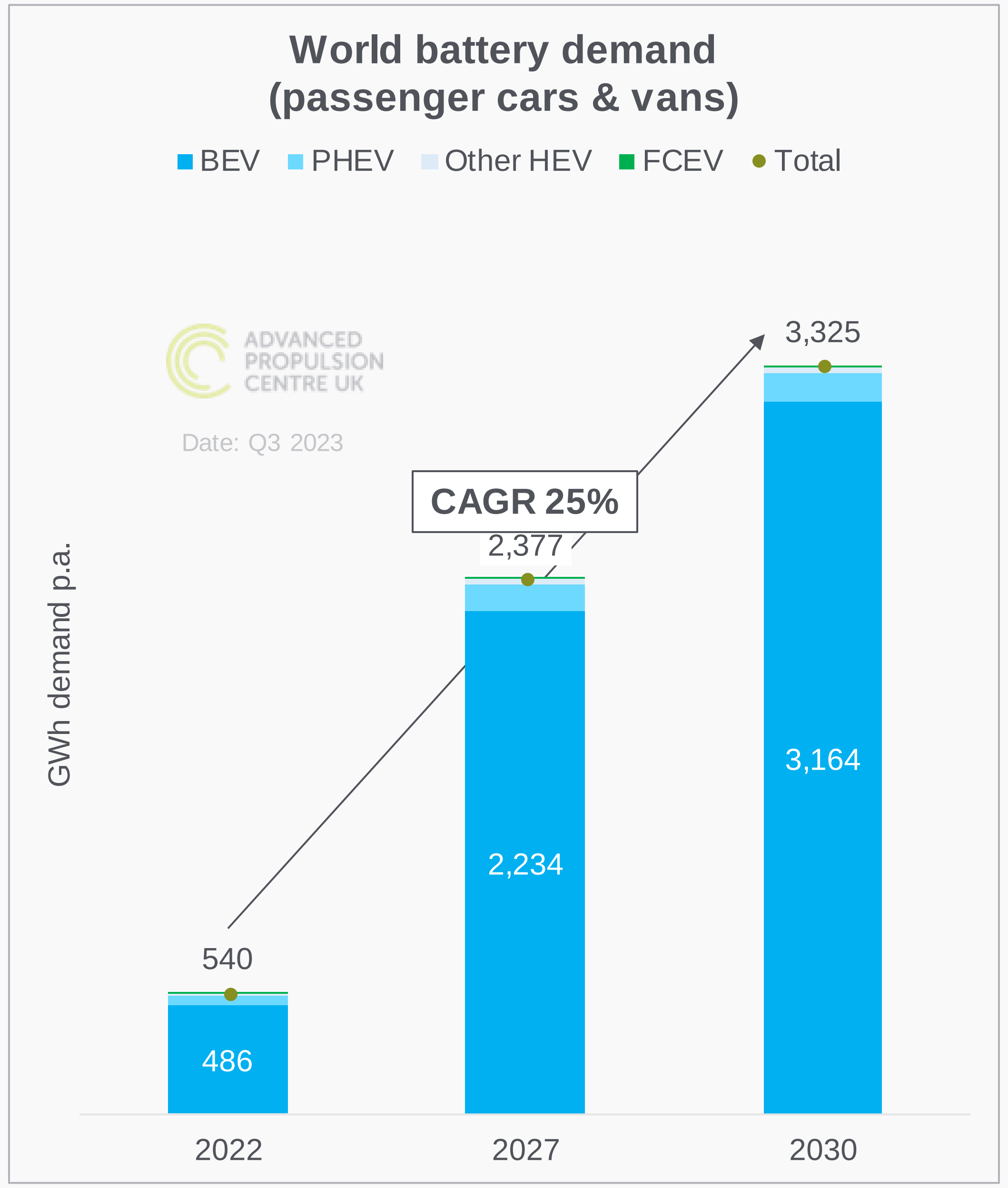


Source: APC Demand Databases using S&P Global AutoTechInsight (Oct 2023), BNEF forecasts (2023)
Note: Passenger cars & Light Commercial Vehicles < 3.5t only, *European forecast includes non-EU countries such as Turkey

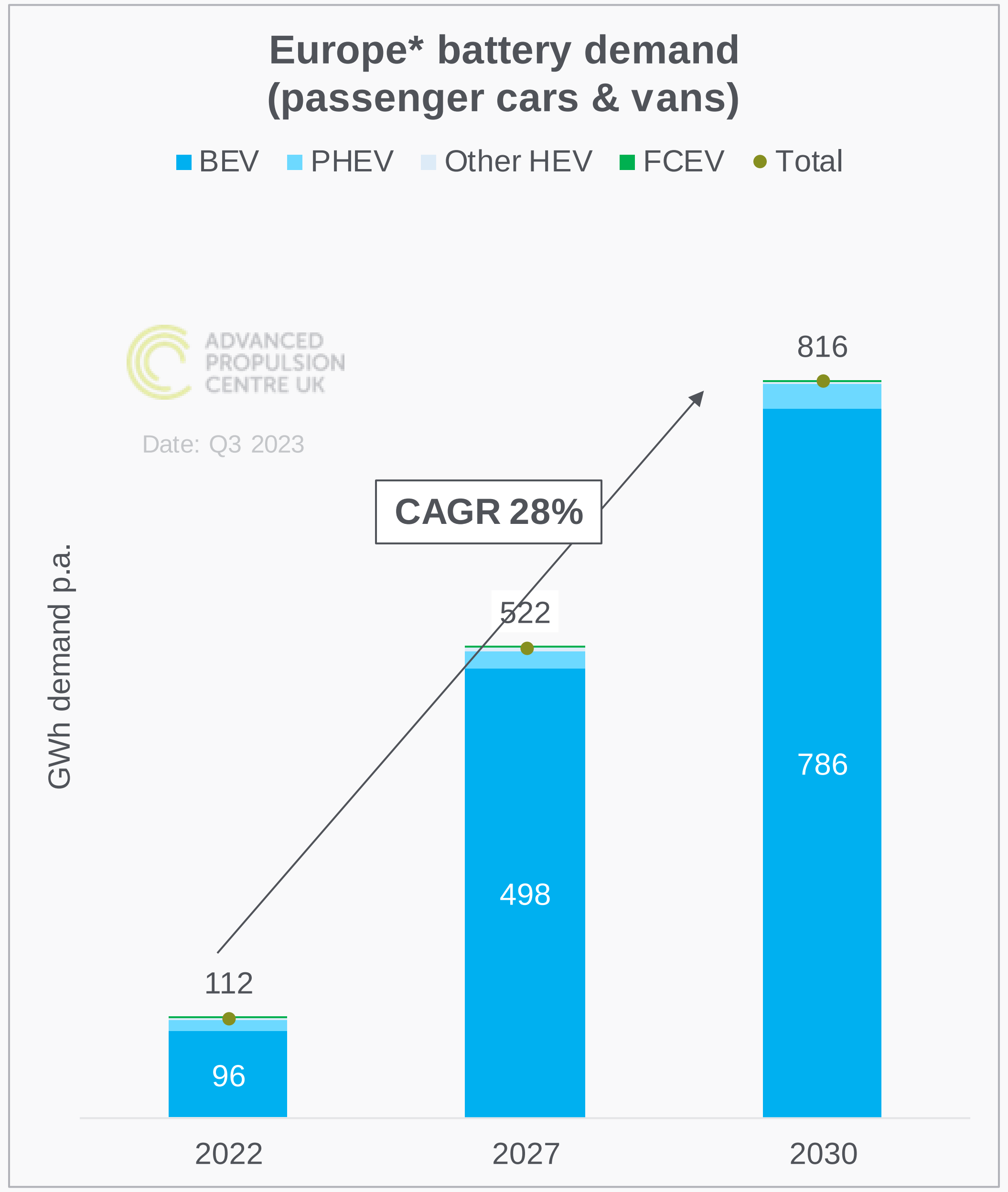
World battery demand for LDVs

Q3 2023 notes

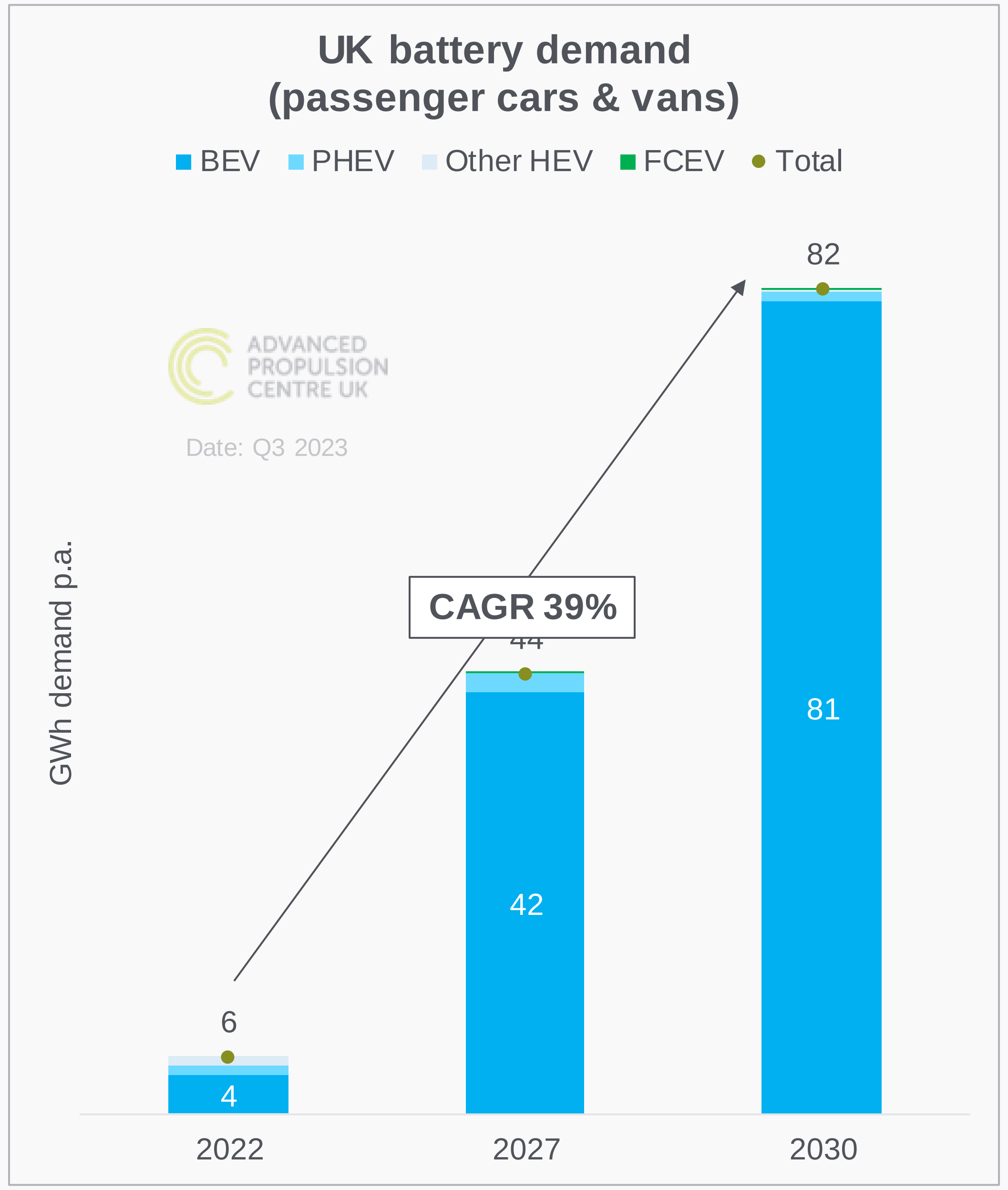
- World battery demand remains similar to APC's Q2 demand forecast with only a marginal decrease in 2030.
- The European battery demand unchanged in 2030 since Q2.
- Relative to APC's Q2 2023 demand forecast, UK BEV demand increased significantly in 2027.



- Relative to APC's Q2 2023 demand forecast demand remains very similar with a small increase



- European battery demand to account for 24% of global battery demand by 2030
- Relative to APC's Q2 2023 demand forecast the forecast remains relatively unchanged



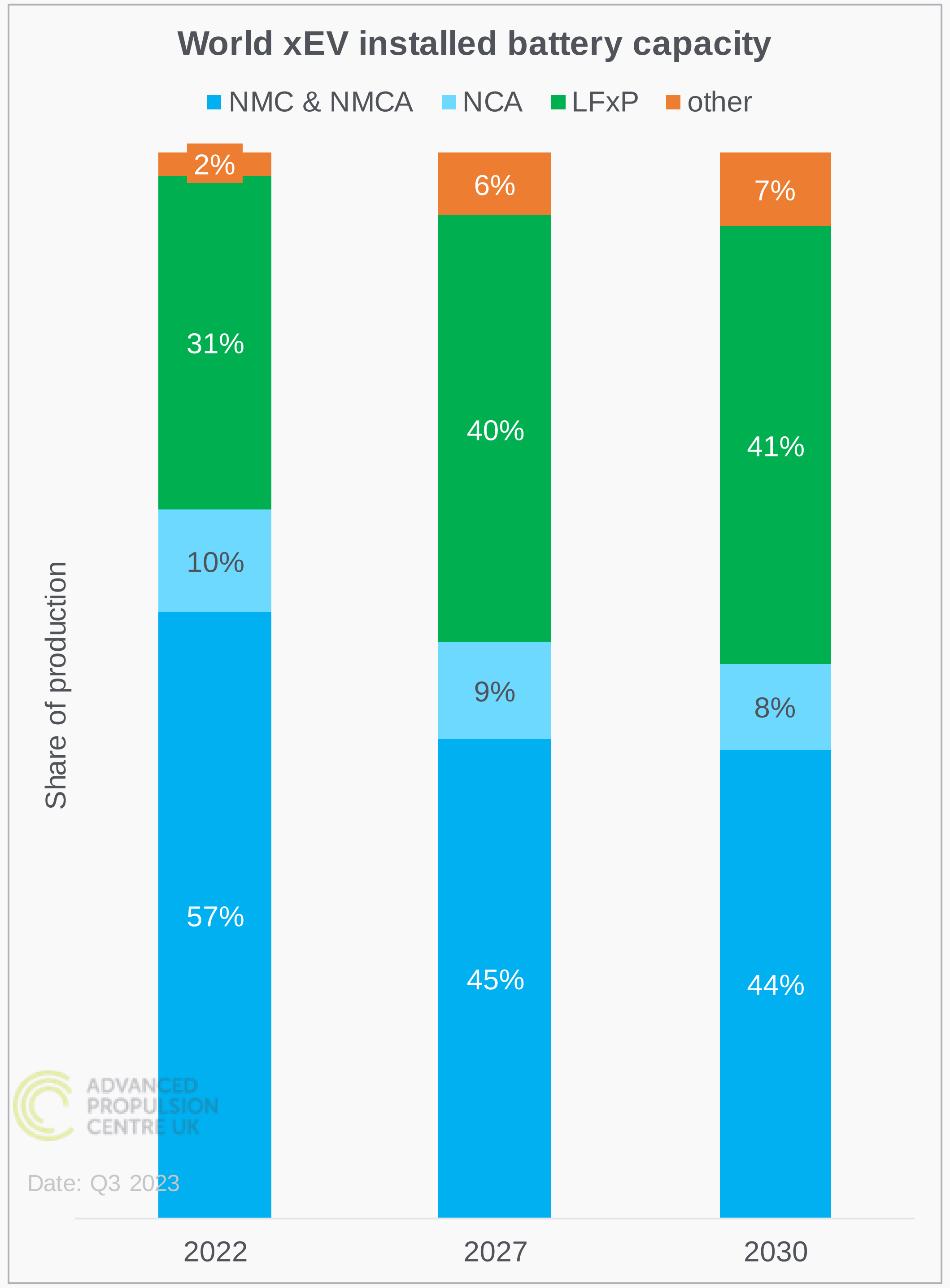
- UK battery demand forecast to account for 10% of European battery demand in 2030
- Relative to APC's Q2 2023 demand forecast, BEV demand increased significantly in 2027

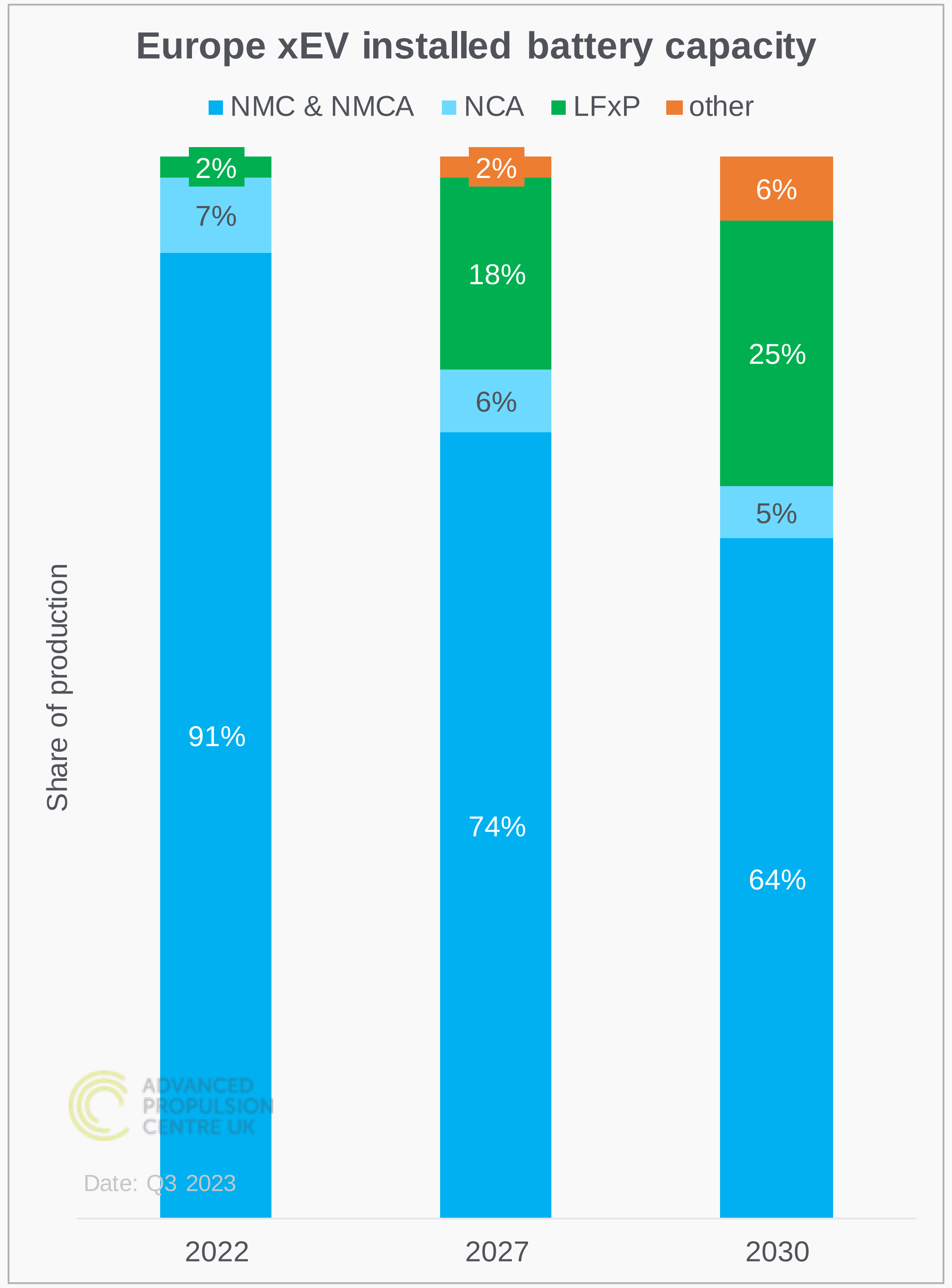
Source: APC Demand Databases using S&P Global AutoTechInsight (Jul 2023), BNEF forecasts (2023)
Note: Passenger cars & Light Commercial Vehicles < 3.5t only, *European forecast includes non-EU countries such as Turkey

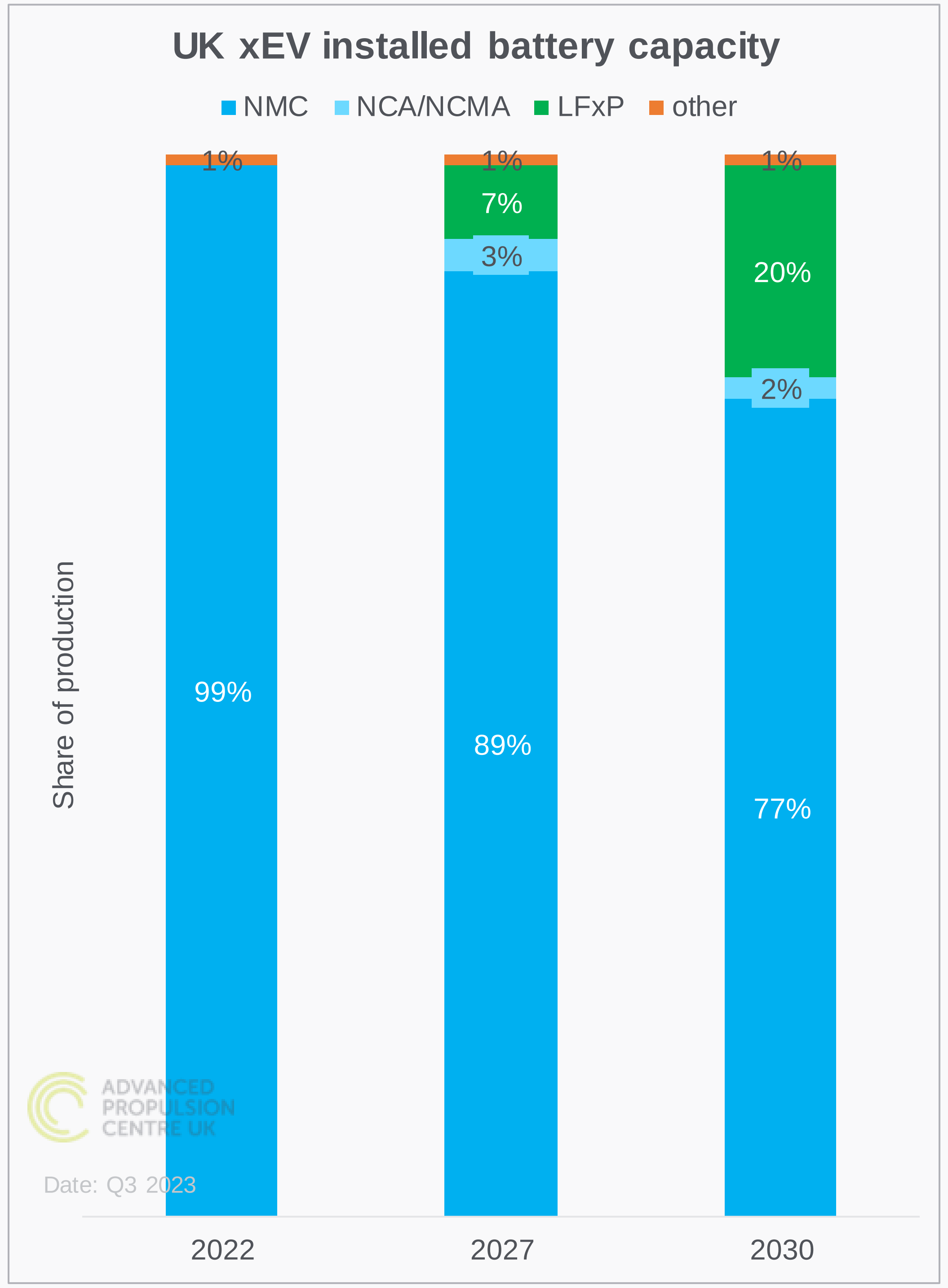
Forecasts for automotive battery production by chemistry

Q3 2023 notes

- LFxP demand forecast has been reduced for UK and Europe. This is driven by slow investment in the LFP supply chain in the region.
- Demand signals from OEMs remain high with more OEMs indicating a desire to use LFxP however the supply chain investment is lagging behind demand and is likely to hinder uptake.





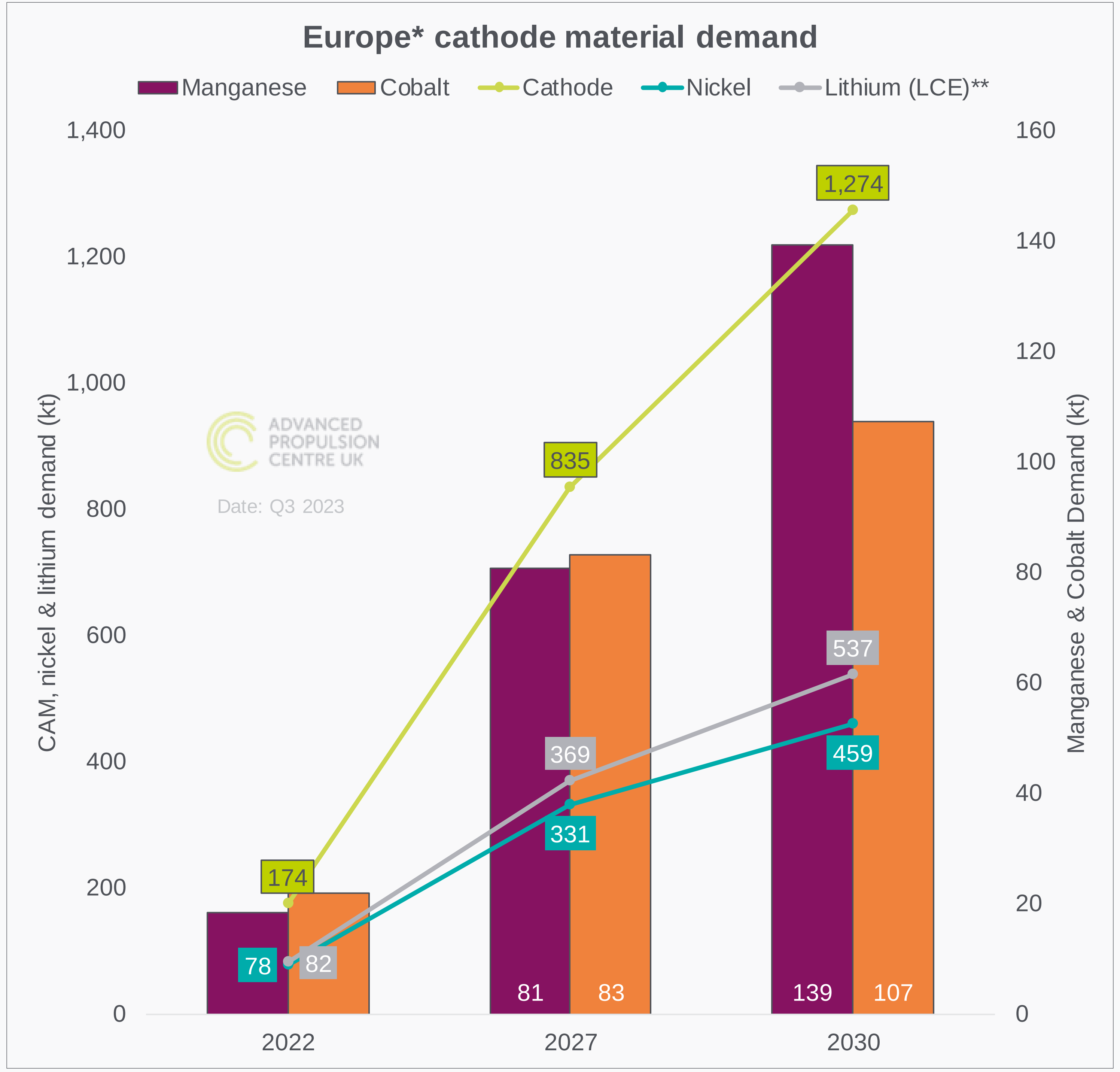


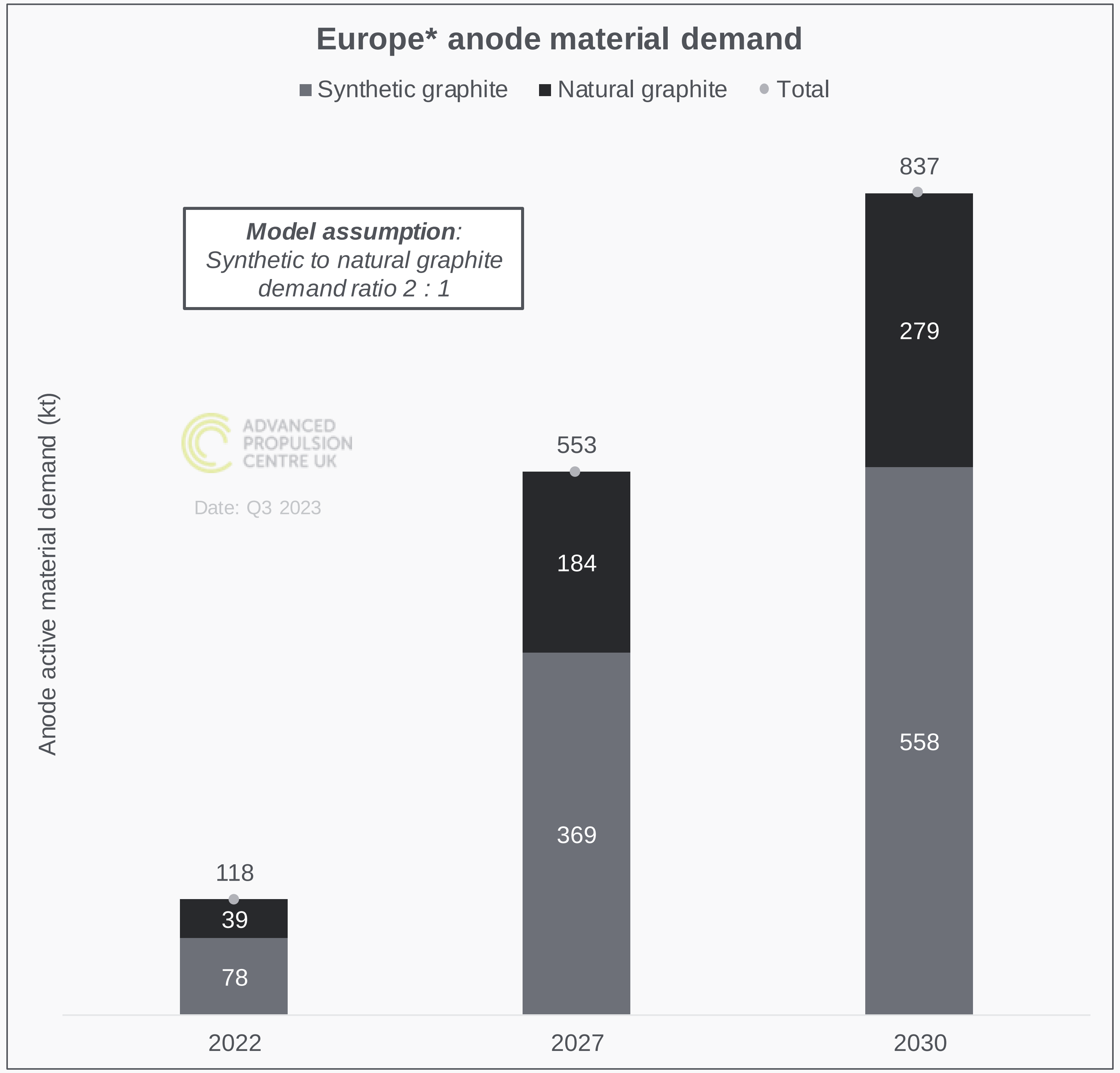
Source: APC Demand Databases using S&P Global AutoTechInsight (Oct 2023), BNEF forecasts (2023)
Note: Passenger cars & Light Commercial Vehicles < 3.5t only, *European forecast includes non-EU countries such as Turkey, ‡Includes non-plug-in HEVs & ICE

European Cathode Active Material (CAM) demand

Q3 2023 notes

- Due to the change in battery material loading for each chemistry and estimates of production waste, the forecast for materials has changed compared to Q2 demand report.
- European anode material increased slightly in Q3.



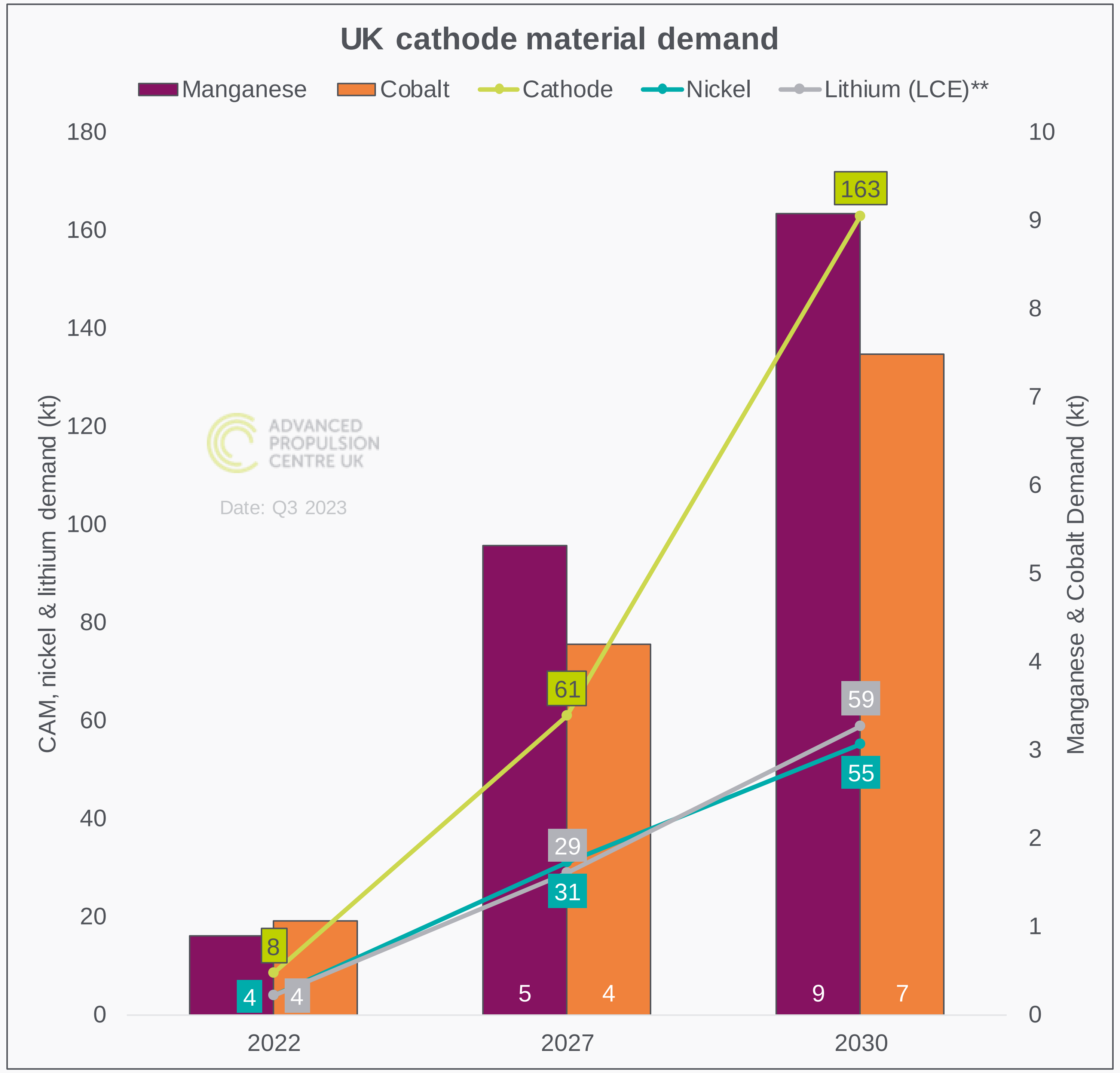


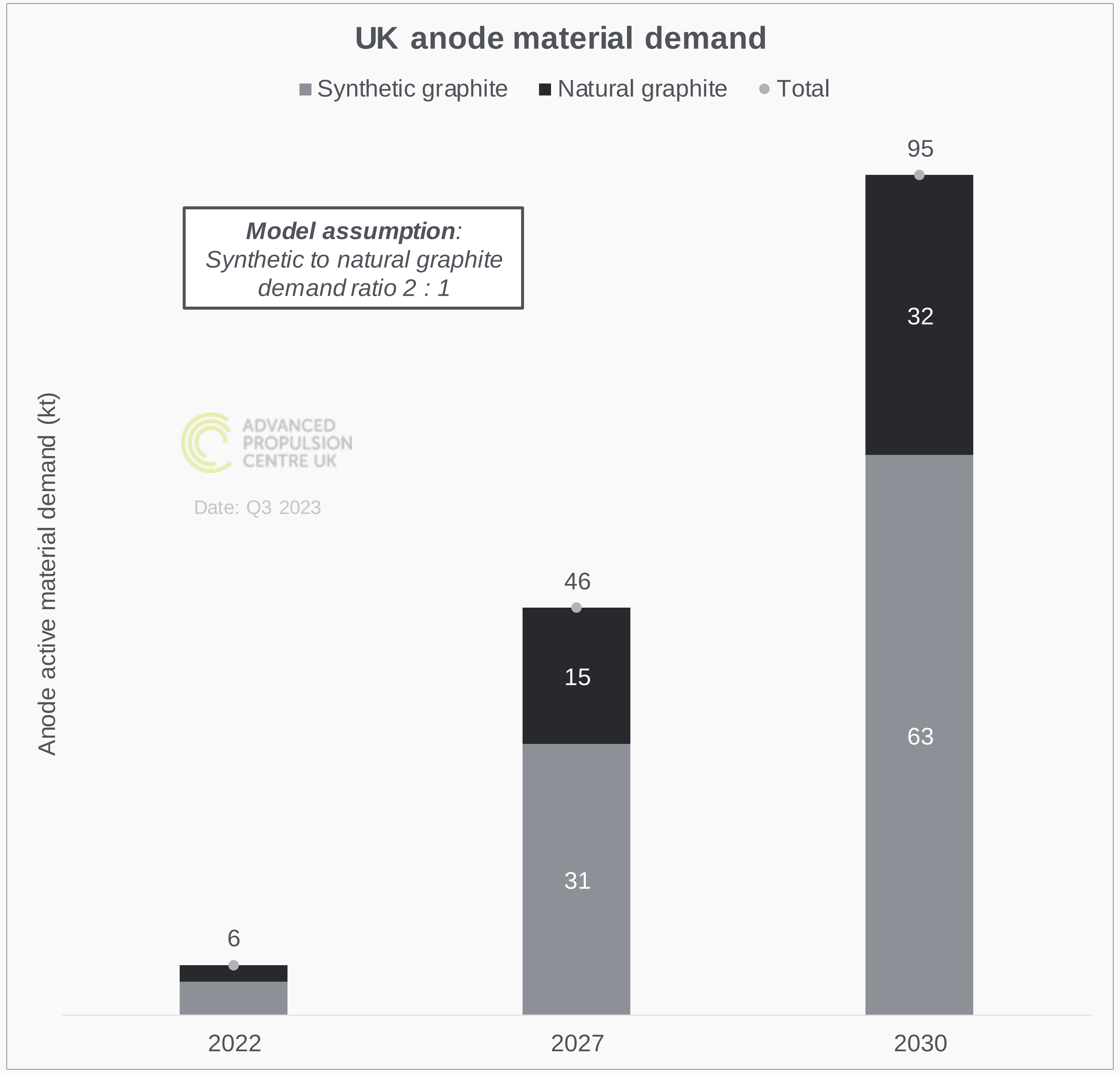
Source: APC Demand Databases using S&P Global AutoTechInsight (Oct 2023), Rho Motion data (2023), BNEF forecasts (2023)
Note: Passenger cars & Light Commercial Vehicles < 3.5t only, *European forecast includes non-EU countries such as Turkey, **Contained Li metal would be 5.3x lower

UK Cathode Active Material (CAM) demand

Q3 2023 notes

- Increases in material demand seen for 2027
- Adjustments of material weighting and production waste in chemistries impacts demand forecast



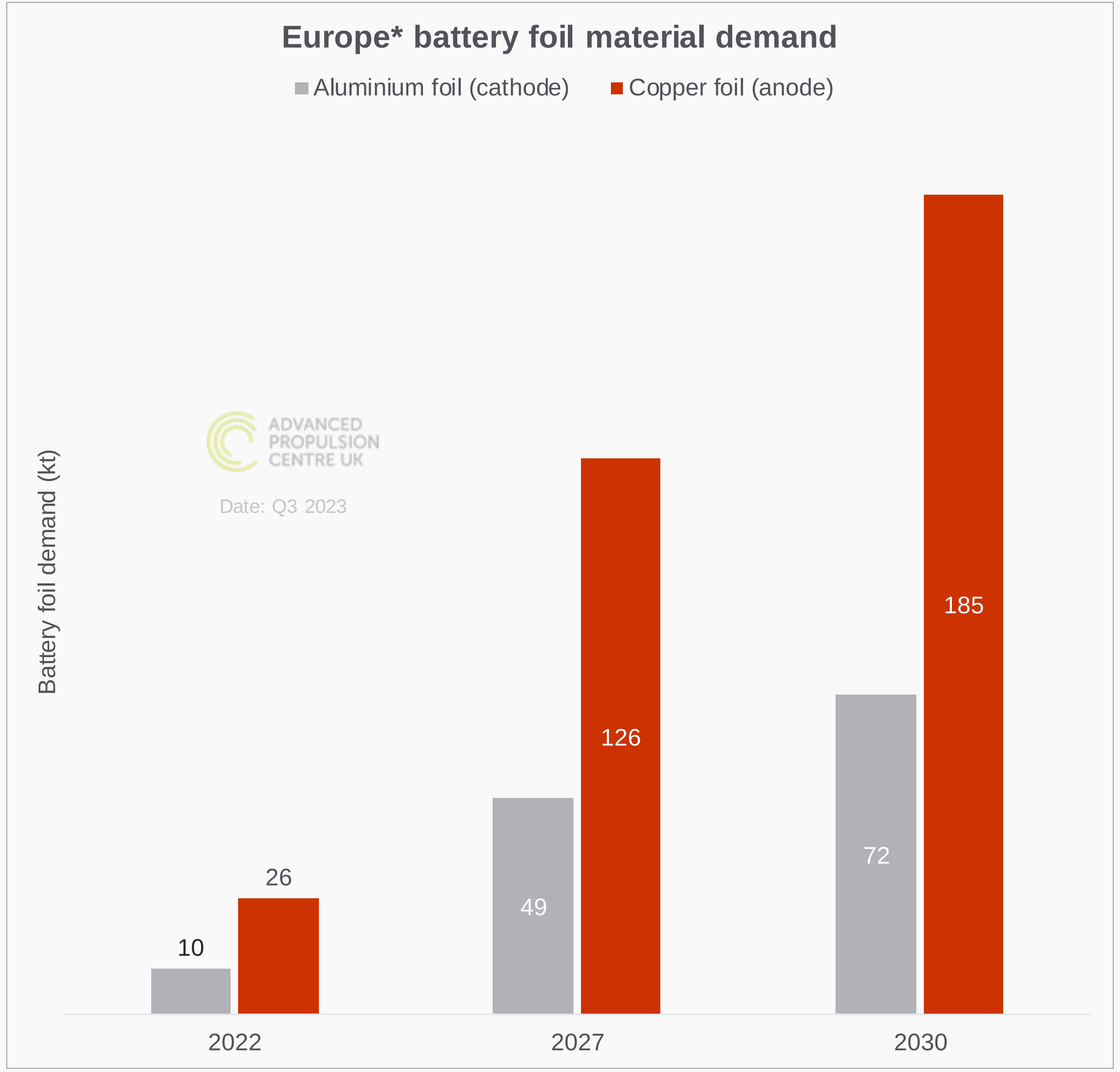


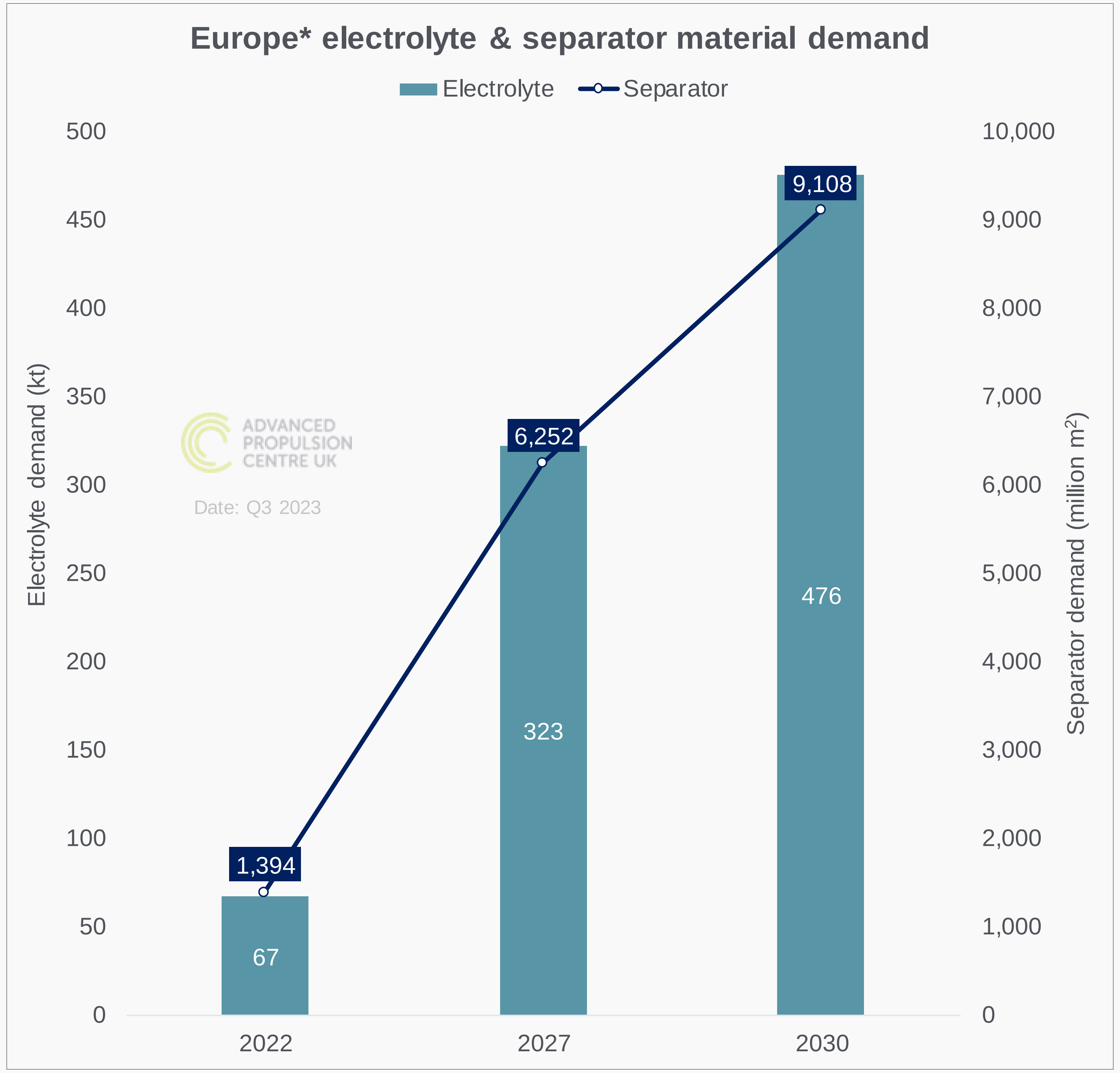
Source: APC Demand Databases using S&P Global AutoTechInsight (Oct 2023), Rho Motion data (2023)
Note: Passenger cars & Light Commercial Vehicles < 3.5t only, **Contained Li metal would be 5.3x lower

European demand for battery foils, electrolyte and separator material

Q3 2023 notes

- Marginal increase in battery foil material demand in Q3
- Small increase in separators and electrolyte in Q3



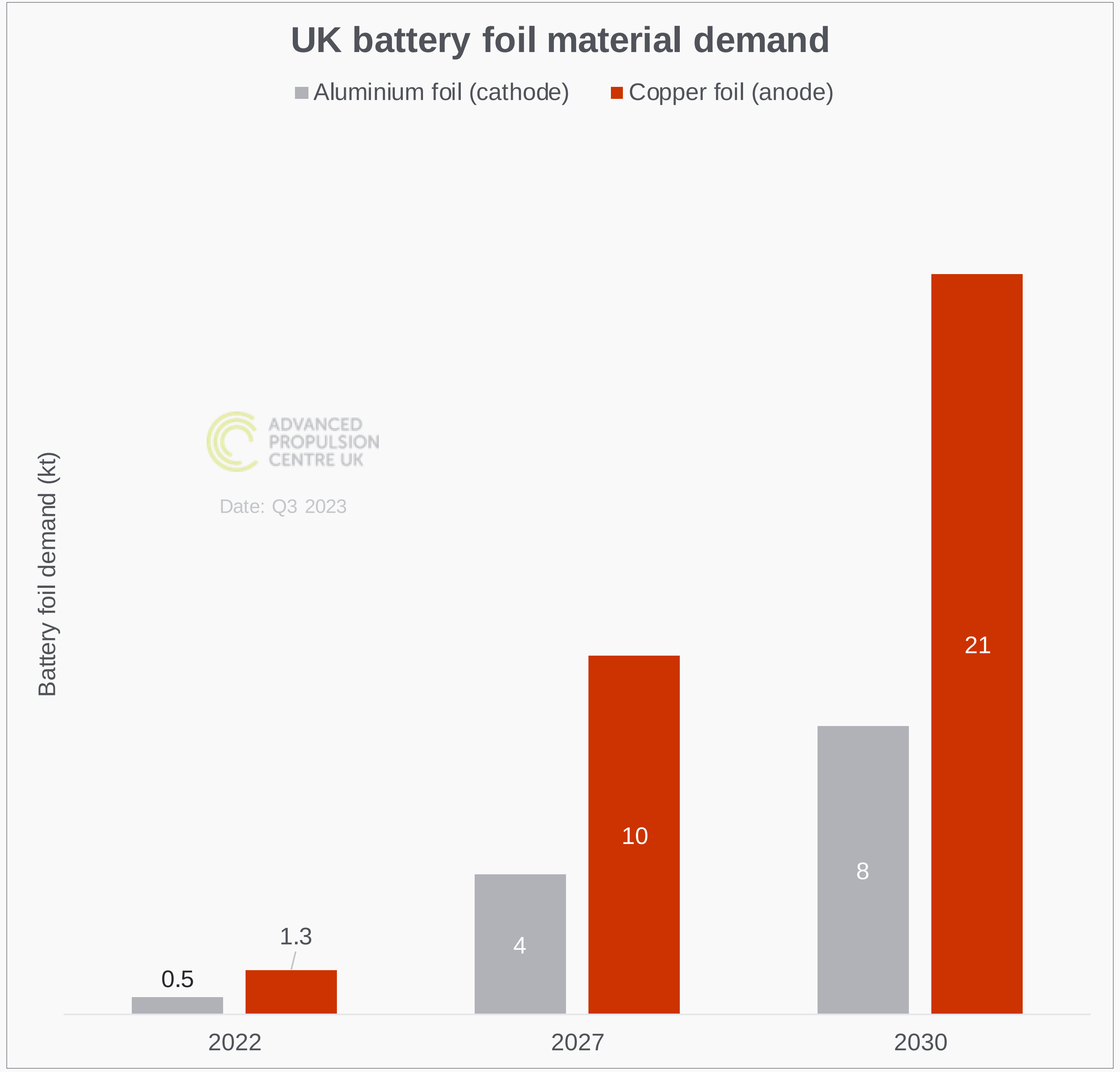


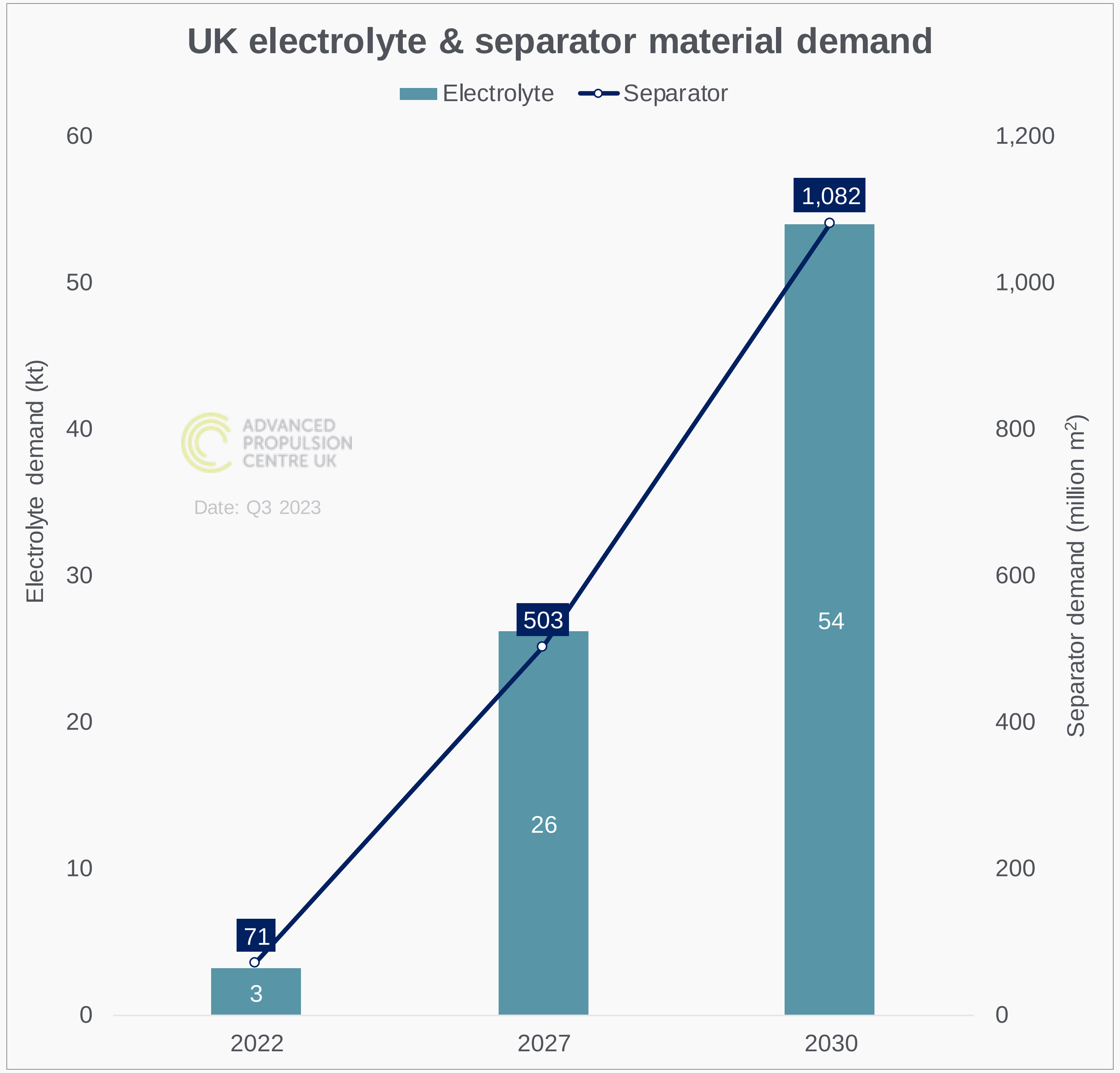
Source: APC Demand Databases using S&P Global AutoTechInsight (Oct 2023), Rho Motion data (2023), BNEF forecasts (2023)
Note: Passenger cars & Light Commercial Vehicles < 3.5t only, *European forecast includes non-EU countries such as Turkey

UK demand for battery foils, electrolyte and separator material

Q3 2023 notes

- Increase in demand for foils in 2027 due to increased battery demand.
- Small decrease in 2030 due to review of material needed per GWh.



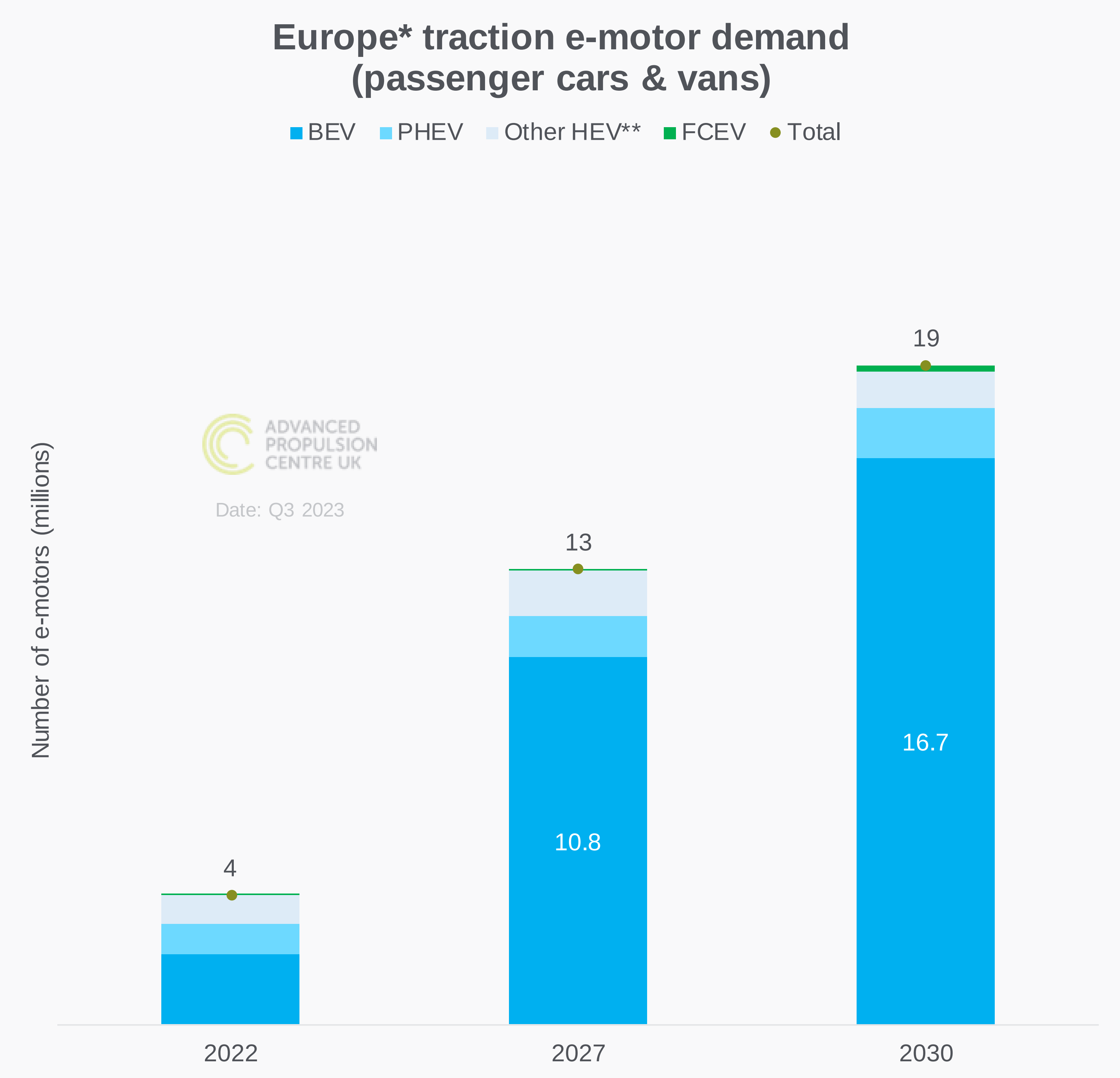


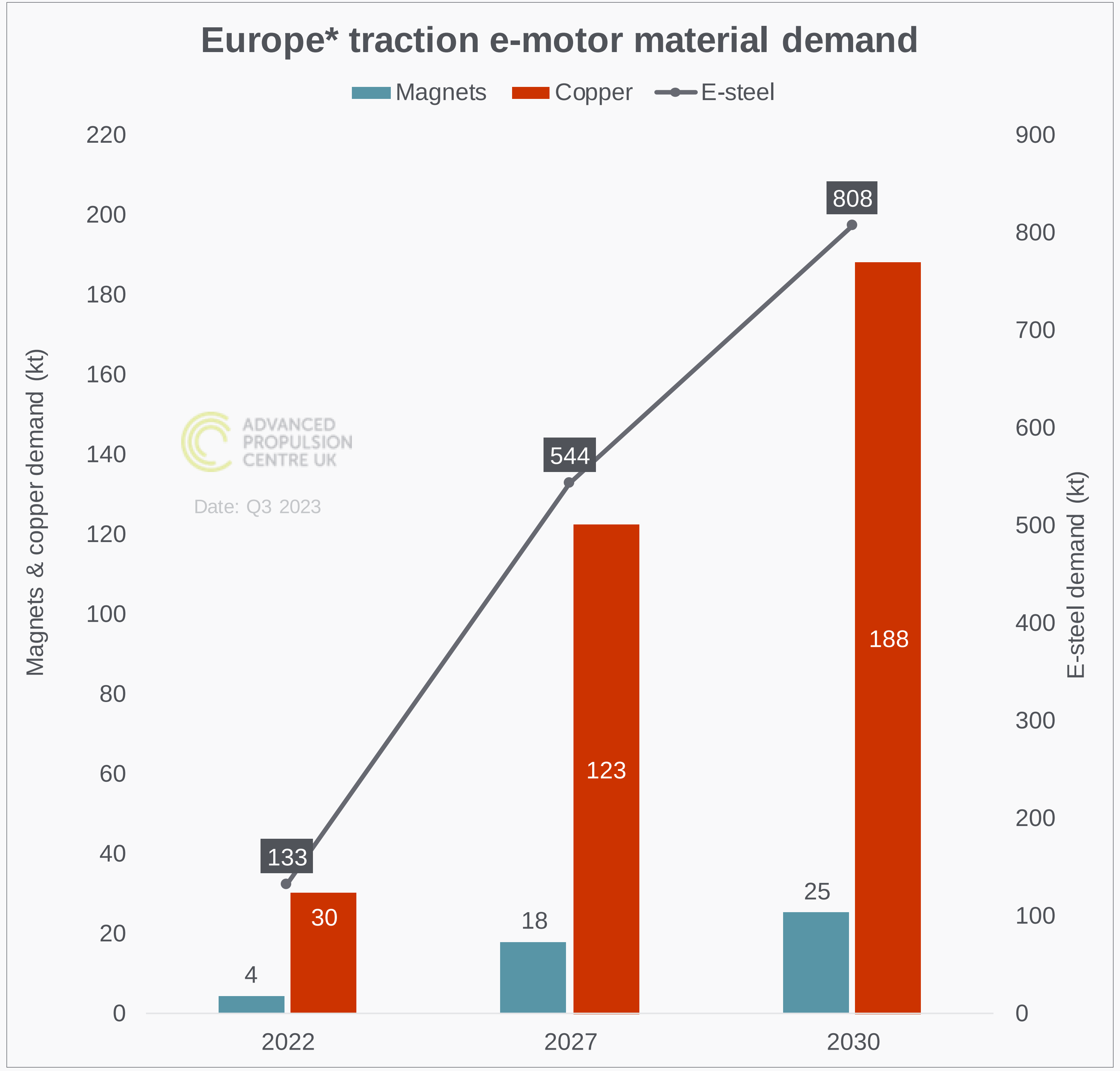
Source: APC Demand Databases using S&P Global AutoTechInsight (Oct 2023), Rho Motion data (2023)
Note: Passenger cars & Light Commercial Vehicles < 3.5t only

European demand for traction electric motors

Q3 2023 notes

- Small increase in forecast for battery electric vehicles in 2030 has a corresponding small increase in 2030 material demand



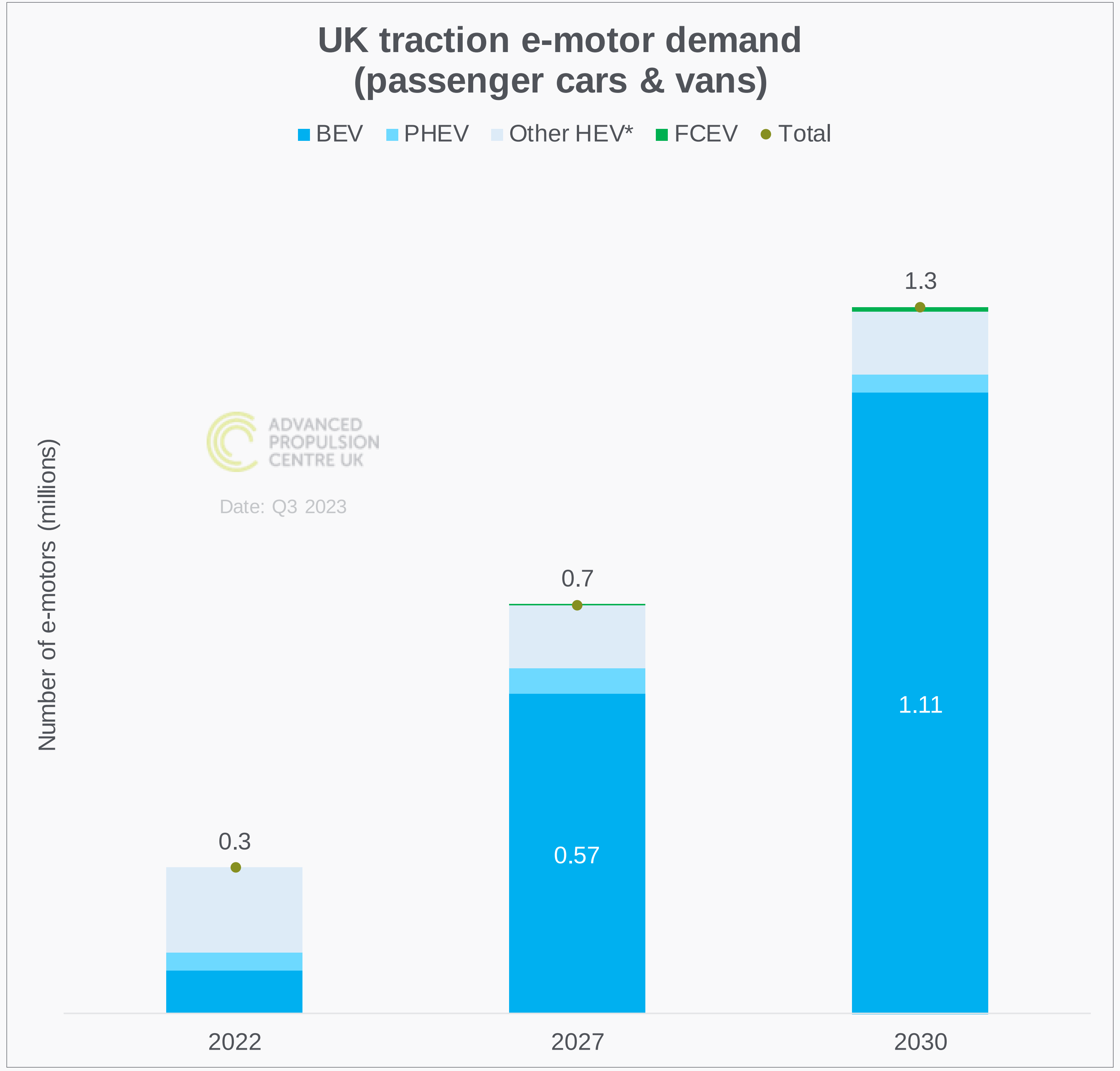


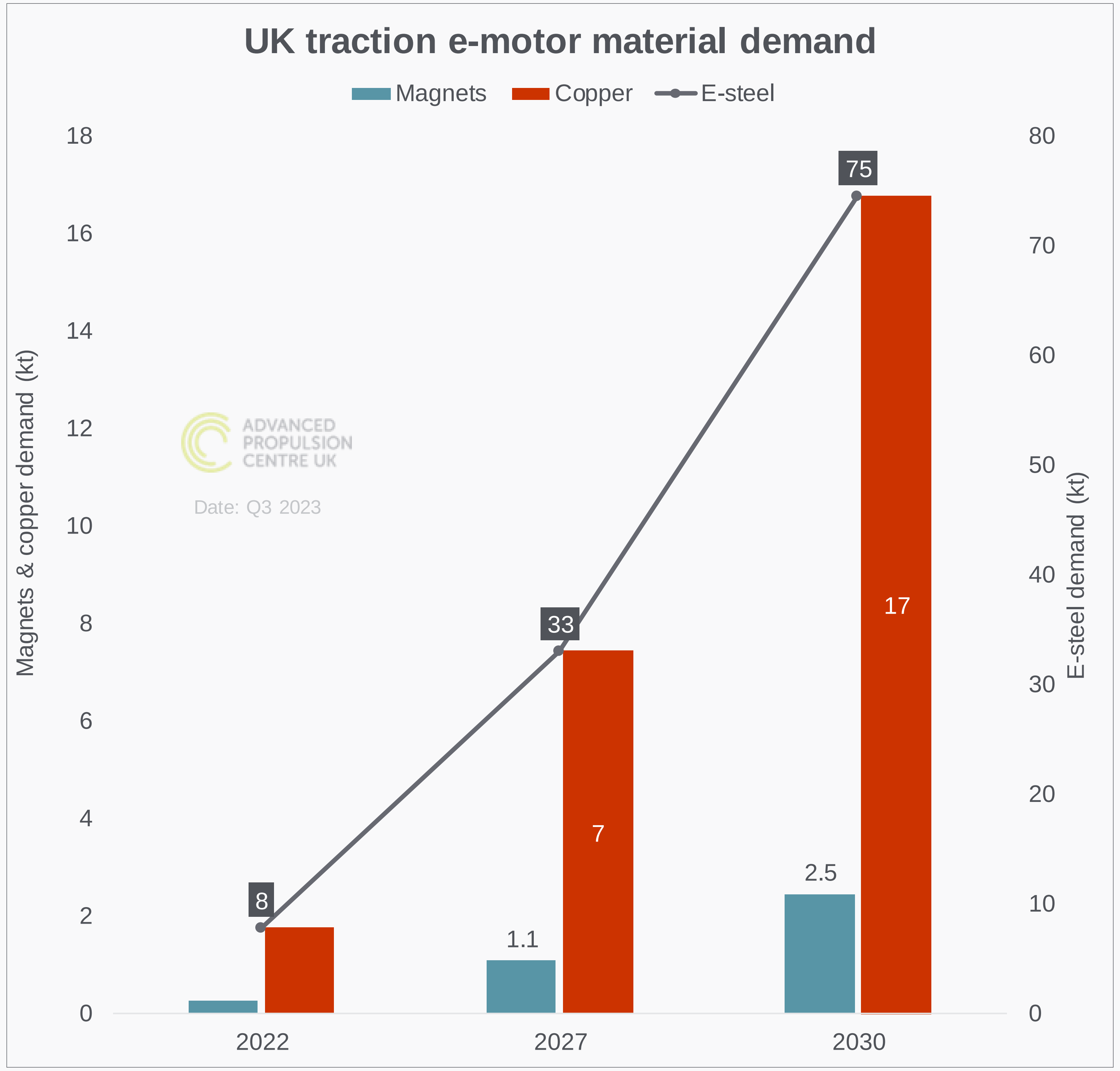
Source: APC Demand Databases using S&P Global AutoTechInsight (Oct 2023)
Note: Passenger cars & Light Commercial Vehicles < 3.5t only, *European forecast includes non-EU countries such as Turkey, **Excluding mild hybrid electric motors

UK demand for traction electric motors

Q3 2023 notes

- Relatively small changes in total motor demand, even in 2027, despite increase in BEV numbers, demonstrating that BEVs are replacing expected hybrids.





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

Glossary

ADVANCED PROPULSION CENTRE UK

APC	Advanced Propulsion Centre UK
BEV	Battery Electric Vehicle
CAM	Cathode Active Material
CMIC	Critical Minerals Intelligence Centre
DLE	Direct Lithium Extraction
FCEV	Fuel Cell Electric Vehicle
HGV	Heavy Good Vehicle
IRA	Inflation Reduction Act
LCE	Lithium Carbonate Equivalent
LCV	Light Commercial Vehicle
LFxP	Lithium iron phosphate (LFP) lithium-ion cathode which can include manganese (LFMP)
NCA	Nickel Cobalt and Aluminium lithium-ion cathode
NMC	Nickel Manganese Cobalt lithium-ion cathode
NMCA	Nickel Manganese Cobalt and Aluminium lithium-ion cathode
OEM	Original Equipment Manufacturer
Other-HEV	Non-plug-in hybrid vehicles including full and mild hybrids that combine and internal combustion engine and a battery to deliver power
Pass Car	Passenger car
PHEV	Plug-in hybrid electric vehicle combining an internal combustion engine and an electric powertrain
xEV	Electrified vehicle including BEV, PHEV, HEV, FCEV
ZEV	Zero Emission Vehicle

This Quarter 3 automotive 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

December 2023