Automotive industry demand forecast

Q4 2021 Update

Insights by Technology Trends, APC UK
March 2022

ADVANCED PROPULSION CENTRE UK

Accelerating Progress

Introducing the APC quarterly demand forecast

The data in these demand graphs is based on APC insight from our close relationship with OEMs for xEV production, APC Automotive Council PEMD traction specifications coupled with published data from IHS, FEV & BNEF powertrain splits used to guide 2030 demand forecast.

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

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

Key headlines in this report

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Global automotive battery demand is expected to be 16x higher in 2030 than it was in 2020 which will have a huge impact on critical material demand	11
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A third of world demand for batteries in 2030 is likely to come from Europe	13 and 22
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South Korean cathode active material suppliers strengthen the European battery supply chain while Johnson Matthey bows out

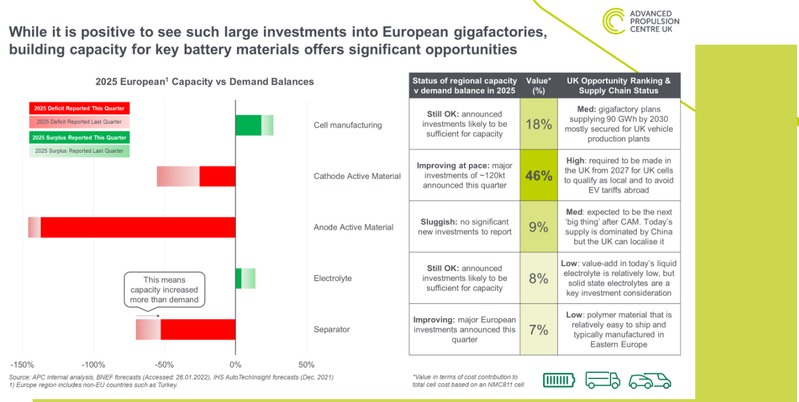
In the race to meet tailpipe CO_2 targets in Europe, car manufacturers are increasingly rolling out fully-electrified products. This means larger batteries and therefore poses additional demand on the supply chain to meet this. Gigafactory announcements throughout Europe and the UK are well reported. Our analysis shows that assuming all of these gigafactories are built in the timescale and capacity suggested, Europe might be self-sufficient for battery production around 2025.

A far less reported area is the potential deficit of the high value-add material that make up batteries. Our analysis shows that real pinch points might occur around anode, cathode, separators and foils in Europe by 2025, with anode active materials largely imported from Asia. But the regional market is localising rather quickly with most of these materials being in less deficit compared to last quarter.

Looking at Cathode Active Materials (CAM), which makes up around 40-50% of the bought in materials for cells, the picture has improved markedly. We suspect that a combination of factors has led the vehicle and battery cell manufacturers to focus on this material. These include a general desire to localise supply chains, but specifically logistics cost and value in transit of expensive high nickel cathode active chemistries that are favoured currently in Europe. The Brexit deal (also known as the Trade and Cooperation Agreement) might have been a deciding factor. It singles out the localisation of CAM manufacturing as a way to ensure the battery qualifies as originating locally to ensure that a car traded between the EU and UK does NOT attract a 10% tariff (see next slide for more details). At the same time, Johnson Matthey, widely seen as a key European CAM player, announced a withdrawal from this part of the battery value chain.

Regardless of the reasons, we have seen South Korean CAM players Posco and EcoPro announcing very large investments in Europe to supply South Korean headquartered cell manufacturers such as Samsung, LG and SK. The announcements of 108kt and 70kt by EcoPro can Posco respectively is a significant step towards Europe being self-sufficient by 2027. Until that point, we believe that most OEMs can achieve the minimum local content thresholds of 40 & 45% now and from 2024 respectively. Meeting the 55% local content on a vehicle level and 65% local content on a cell level from 2027 onwards effectively means that local CAM, or most other materials, are required to be local. We do predict that there will still be a gap of at least 150kt of CAM materials (equivalent to around 100GWh or approx. 140,000 vehicles with 70kWh battery packs), which might pose a significant issue for those cell manufactures and OEMs who have not managed to localise enough of their supply chains.

The UK would be an ideal location for a CAM plant looking at its build-up in gigafactories (see announcements from Envisions AESC and Britishvolt) to the predicted 90GWh demand by 2030. This would help increase UK local content which is likely to prove very advantageous for UK manufactured vehicles exported to overseas territories with whom the UK has secured trade deals. Longer term, such a plant would also be key to close the loop on recycled battery materials as highlighted in a previous insight piece.



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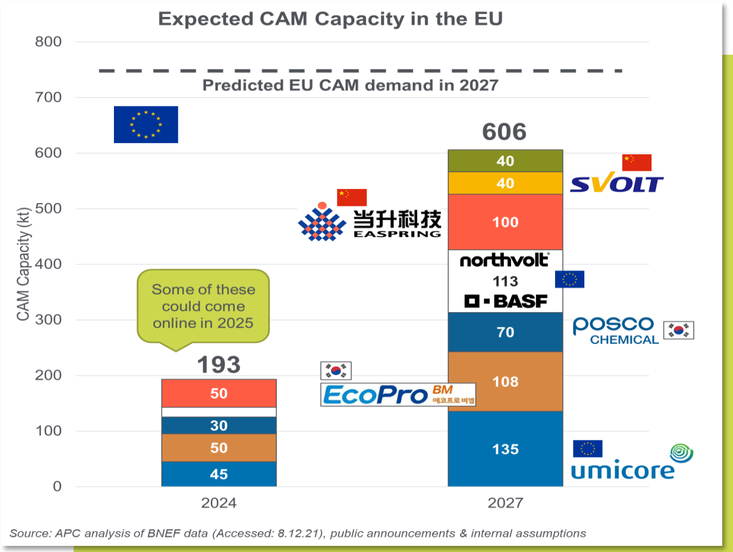

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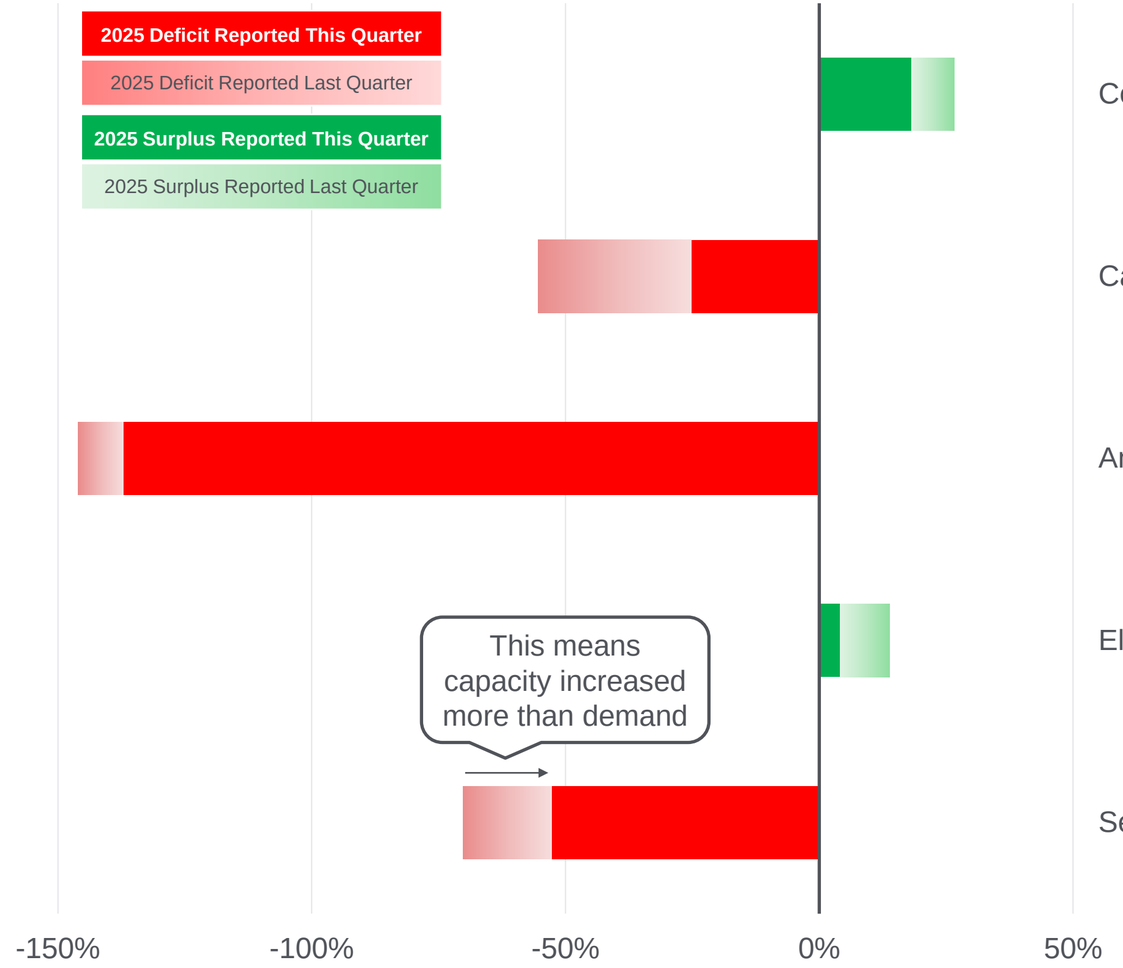
While it is positive to see such large investments into European gigafactories, building capacity for key battery materials offers significant opportunities

2025 European[1] Capacity vs Demand Balances



Status of regional capacity v demand balance in 2025	Value* (%)	UK Opportunity Ranking & Supply Chain Status
Still OK: announced investments likely to be sufficient for capacity	18%	**Med:** gigafactory plans supplying 90 GWh by 2030 mostly secured for UK vehicle production plants
Improving at pace: major investments of ~120kt announced this quarter	**46%**	**High**: required to be made in the UK from 2027 for UK cells to qualify as local and to avoid EV tariffs abroad
Sluggish: no significant new investments to report	9%	**Med**: expected to be the next 'big thing' after CAM. Today's supply is dominated by China but the UK can localise it
On track: announced investments likely to be sufficient for capacity	8%	**Low**: value in today's liquid electrolyte is relatively low, but solid state electrolytes are a key investment consideration
Improving: major European investments announced this quarter	7%	**Low**: polymer material that is relatively easy to ship and typically manufactured in Eastern Europe

Source: APC internal analysis, BNEF forecasts (Accessed: 26.01.2022), IHS AutoTechInsight forecasts (Dec, 2021)
1) Europe region includes non-EU countries such as Turkey.

**Value in terms of cost contribution to total cell cost based on an NMC811 cell*

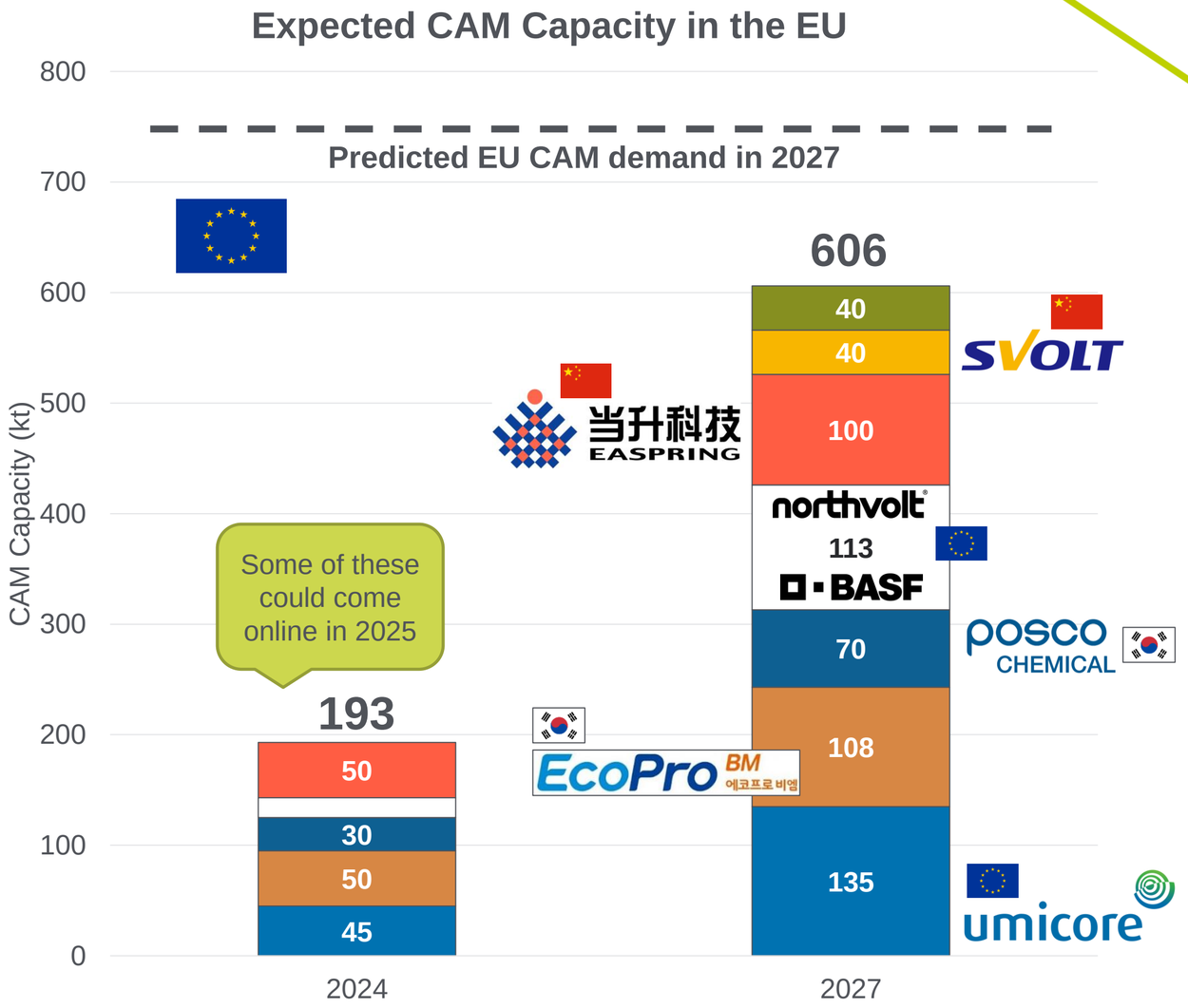
European battery demand is still increasing and could reach 900 GWh by 2030. 3 large CAM players have recently committed to produce 200kt locally

1. Ramp-up in cell manufacturing across Europe is justified and with de-risked capacity it could be on par with 900 GWh demand

2. EU CAM demand in 2027 looking **increasingly likely to be met by suppliers based in EU countries**.

   - 535 GWh in 2027 would mean about **750kt of cathode active material** would have to be made in the EU assuming all OEMs and cell manufacturers look to comply with EU – UK rules of origin for EVs. Latest pipeline estimates and announcements suggest European CAM capacity in 2027 will likely exceed **600kt** with more announcements expected in 2022**.**

3. Meeting **2027 rules of origin** for local battery cells and tariff-free EV trade between the UK and EU could be feasible for most EU-based OEMs



Source: APC analysis of BNEF data (Accessed: 8.12.21), public announcements & internal assumptions

Rules of Origin for batteries and electrified vehicles provide a six-year phase in period, driving localisation of the battery supply chain

	1st January 2021 – 31st December 2023	1st January 2024 – 31st December 2026	1st January 2027 onwards
Electric battery cells	70% maximum non-originating material allowance Or Change in tariff heading	50% maximum non-originating material allowance Or Change in tariff heading except from non-originating active cathode materials	35% maximum non-originating material allowance Or Change in tariff heading except from non-originating active cathode materials
Electric battery packs	70% maximum non-originating material allowance Or Change in tariff sub-heading Or Assembly from non-originating cells or battery modules	40% maximum non-originating material allowance Or Change in tariff heading except from non-originating active cathode materials	30% maximum non-originating material allowance Or Change in tariff heading except from non-originating active cathode materials
Electric vehicles (HEVs, PHEVs, BEVs)	60% maximum non-originating material allowance	55% maximum non-originating material allowance	45% maximum non-originating material allowance + originating battery for P HEVs and BEVs

In effect this means that by 2027:

- The battery pack and cells need to be produced locally

AND

- Cathode active material needs to be manufactured locally

OR

- Most other battery materials must be made locally

Otherwise

The car will attract 10% tariff when shipped from EU27 to UK or vice versa

Source: Department of Business, Energy and Industrial Strategy

Demand for electrified components

Q4 2021 forecast

Insights by Technology Trends, APC UK
March 2022

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The following section includes demand for electrified components from light duty vehicles (LDV) only, which are cars and vans

What does a GWh of battery demand mean? Why do battery electric vehicles (BEVs) account for most of battery demand?

1 GWh of Battery Demand is equivalent to:

1,000,000 kWh

25,000
Nissan Leafs

OR

17,000
Tesla Model 3s

Relative battery sizes based on type of car (representative)

BEV Battery

PHEV Battery

Other xEV Battery

The battery in a BEV like the Tesla Model 3 is **4x larger** than a usual plug-in hybrid (PHEV) battery and **30x larger** than other hybrids. Therefore **BEV production takes the lion share of GWh demand** (as seen in the following demand forecasts)

We calculate the GWh Battery Demand number by multiplying the number of vehicles x size of the battery on-board (in kWh), and then we divide it by 1,000,000 to convert it back to GWh

Image source: evisionevs.co.uk

Forecasts for LDV production by powertrain: zero-emission vehicles (ZEVs) expected to dominate European and UK production by the end of the decade

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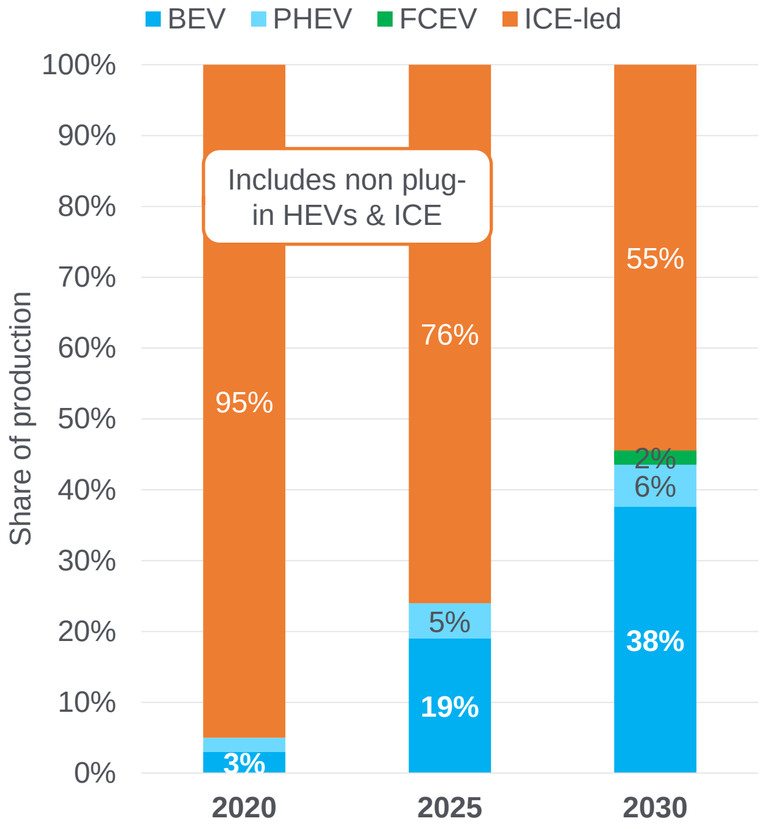
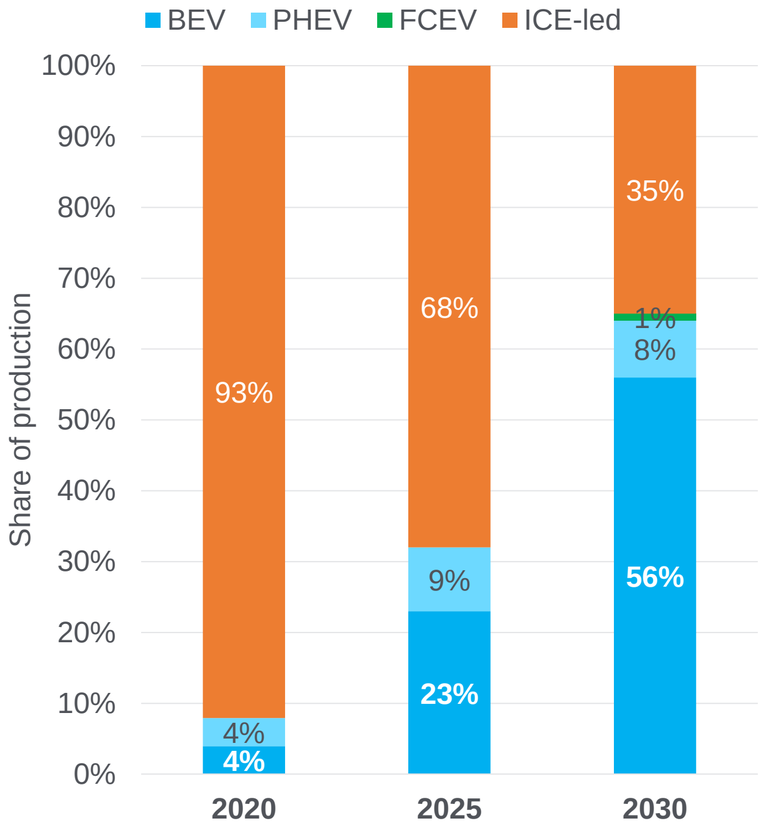
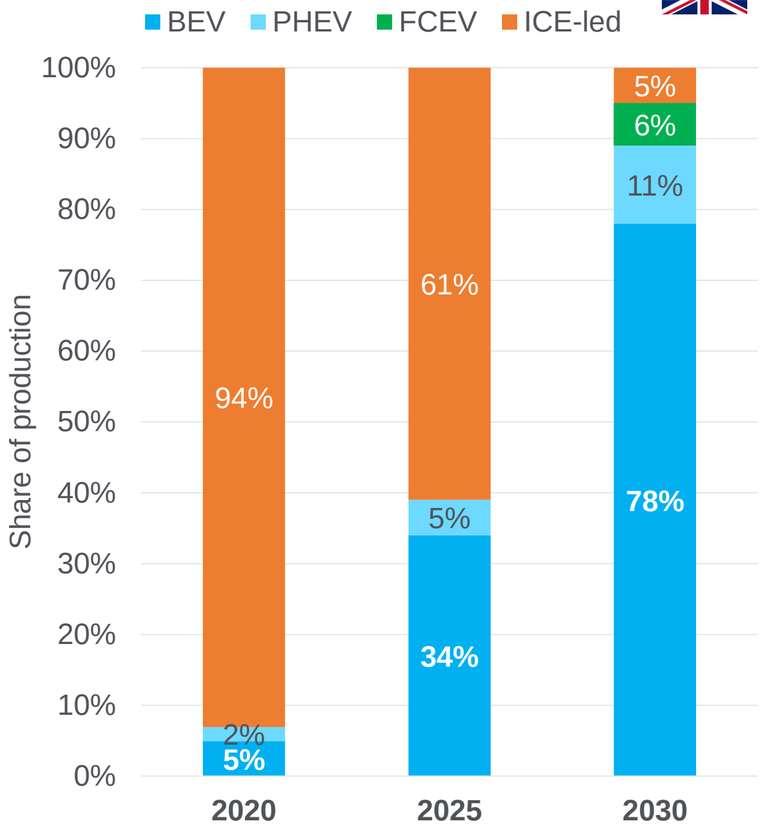
World LDV Production by Powertrain (Passenger Cars & Vans)



Europe* LDV Production by Powertrain (Passenger Cars & Vans)



UK LDV Production by Powertrain (Passenger Cars & Vans)



In 2021 we saw pivotal announcements from global OEMs regarding their electrification strategies. Massive investments in BEV platforms means OEMs are accelerating their ZEV strategies and more BEV models are expected to be launched throughout this decade, replacing the transitionary plans for production of non-plug-in hybrids and ICE vehicles.

Source: APC Demand Databases using IHS AutoTechInsight (Dec, 2021), FEV data (April, 2021) & BNEF forecasts (2021)
*Note: Passenger cars & Light Commercial Vehicles < 3.5t only, *Europe region includes non-EU countries such as Turkey*

Forecasts for light duty xEV production: strong outlook for Europe & UK with BEV production in 2030 forecast to almost triple 2025 levels

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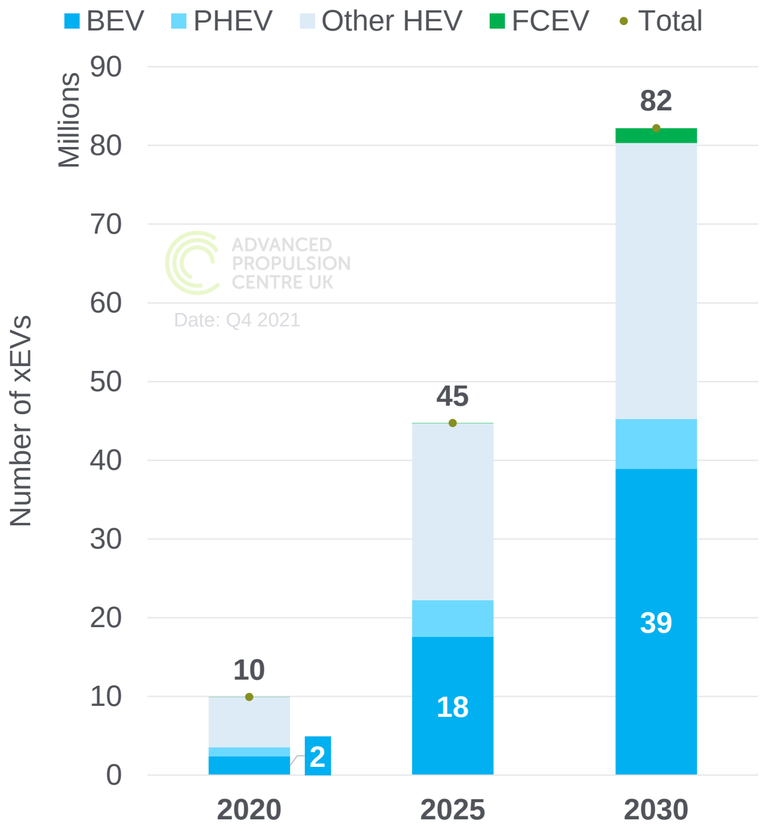
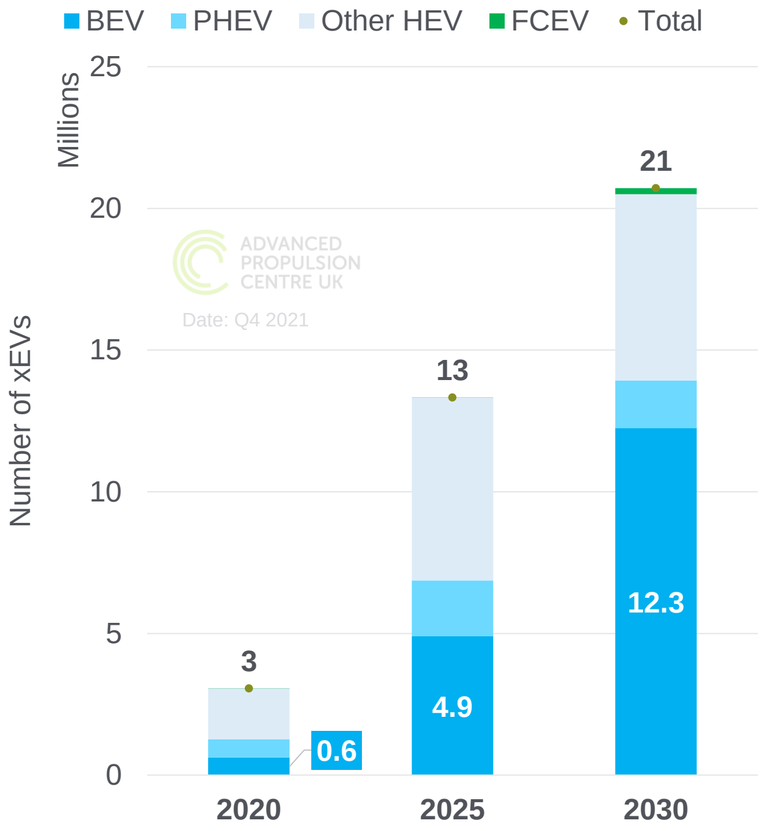
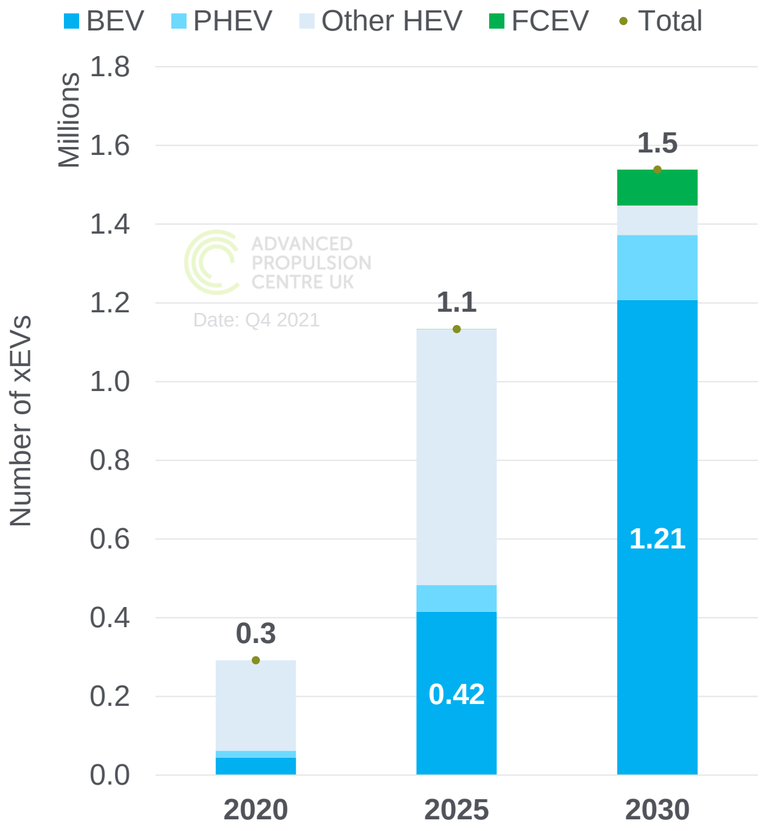
World xEV Production (Passenger Cars & Vans)



Europe* xEV Production (Passenger Cars & Vans)



UK xEV Production (Passenger Cars & Vans)



The number of electrified vehicles produced globally is expected to rise exponentially out to 2030 with China and Europe expected to lead the charge. US xEV production is also expected to grow significantly based on recent policy and investments. Growth in European and UK BEV production is a key indicator of the battery demand curve we can expect this decade.

Source: APC Demand Databases using IHS AutoTechInsight (Dec, 2021), FEV data (April, 2021) & BNEF forecasts (2021)
*Note: Passenger cars & Light Commercial Vehicles < 3.5t only, *Europe region includes non-EU countries such as Turkey*

World battery demand for LDVs to exceed 2,600 GWh by 2030, 16x higher than demand in 2020. Europe to account for one third of this demand

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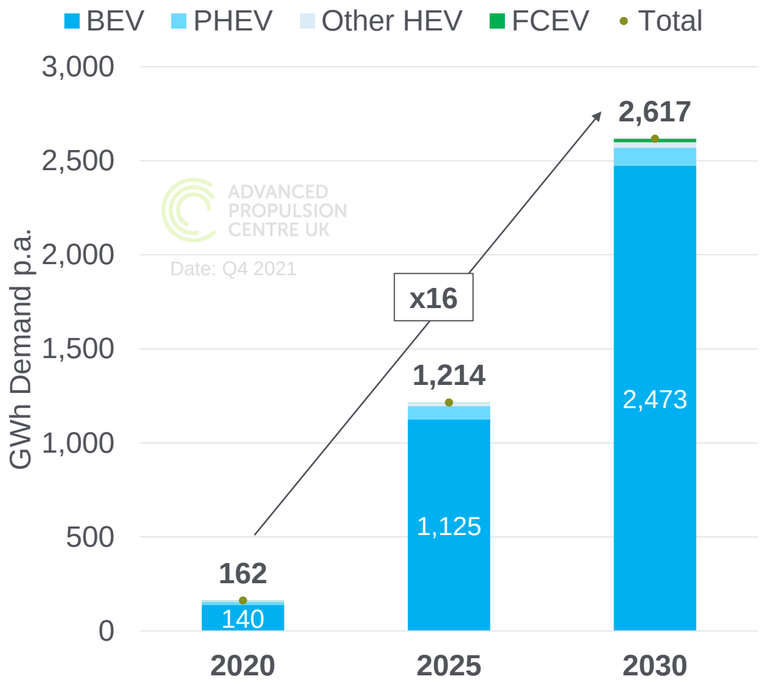
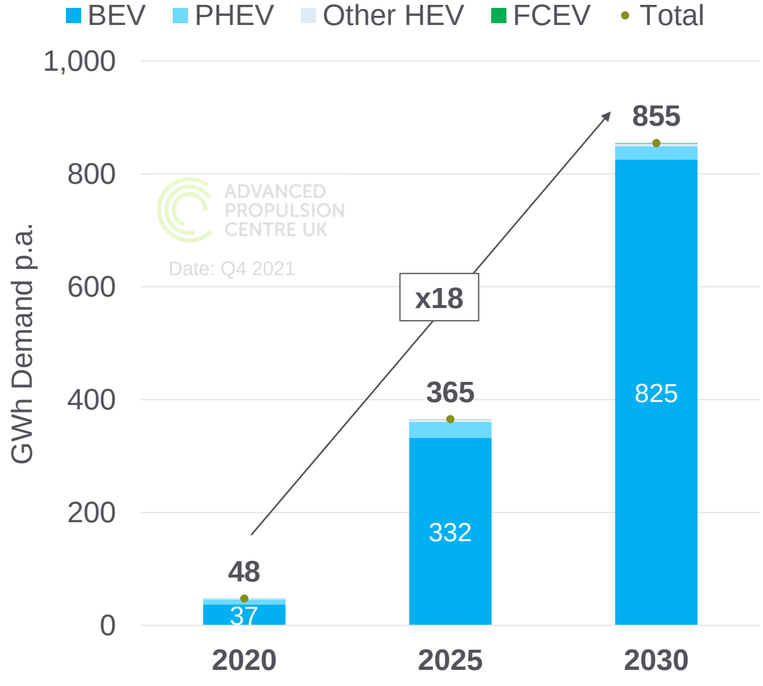
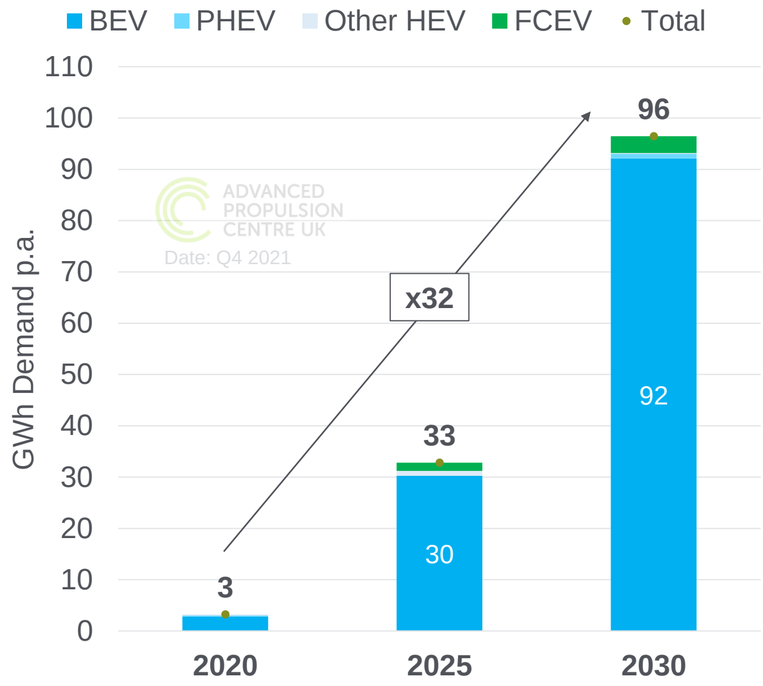
World Battery Demand (Passenger Cars & Vans)



Europe* Battery Demand (Passenger Cars & Vans)



UK Battery Demand (Passenger Cars & Vans)



- World battery demand for light duty xEVs is forecast to exceed **2,600 GWh by 2030**
- This is mainly driven by **China & Europe**, which together account for **~75%** of projected demand

- European demand from xEV production is forecast to account for **a third** of world battery demand in **2030**
- **Europe expected to rank 2nd** behind China but ahead of North America

- UK battery demand forecast to account for **11%** of European battery demand in **2030**
- Forecast powertrain share for BEVs will more than double from 2025 to 2030, reaching **78% of LDV production** by the end of the decade

Source: APC Demand Databases using IHS AutoTechInsight (Dec, 2021), FEV data (April, 2021) & BNEF forecasts (2021)
*Note: Passenger cars & Light Commercial Vehicles < 3.5t only, *Europe region includes non-EU countries such as Turkey*

European Cathode Active Material (CAM) demand for LDVs expected to surpass 500kt by 2025, almost 10x higher than demand in 2020

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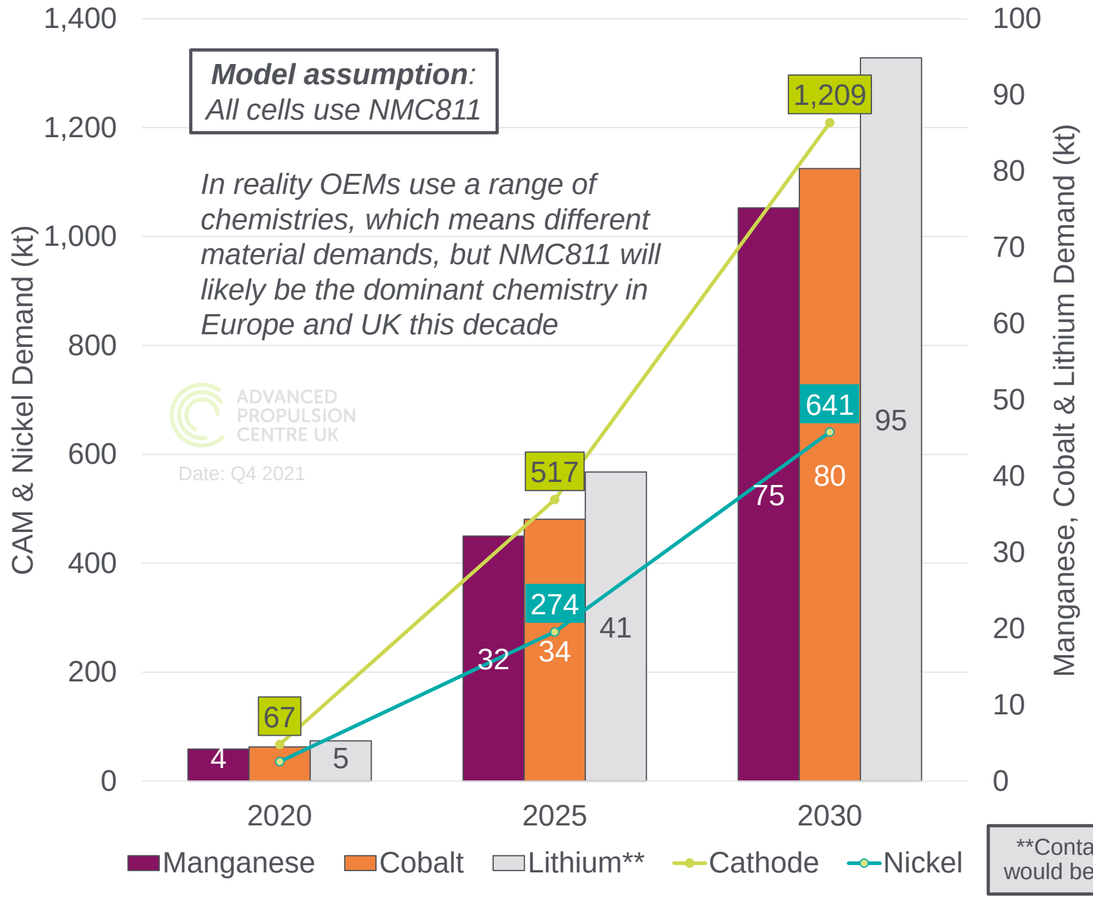
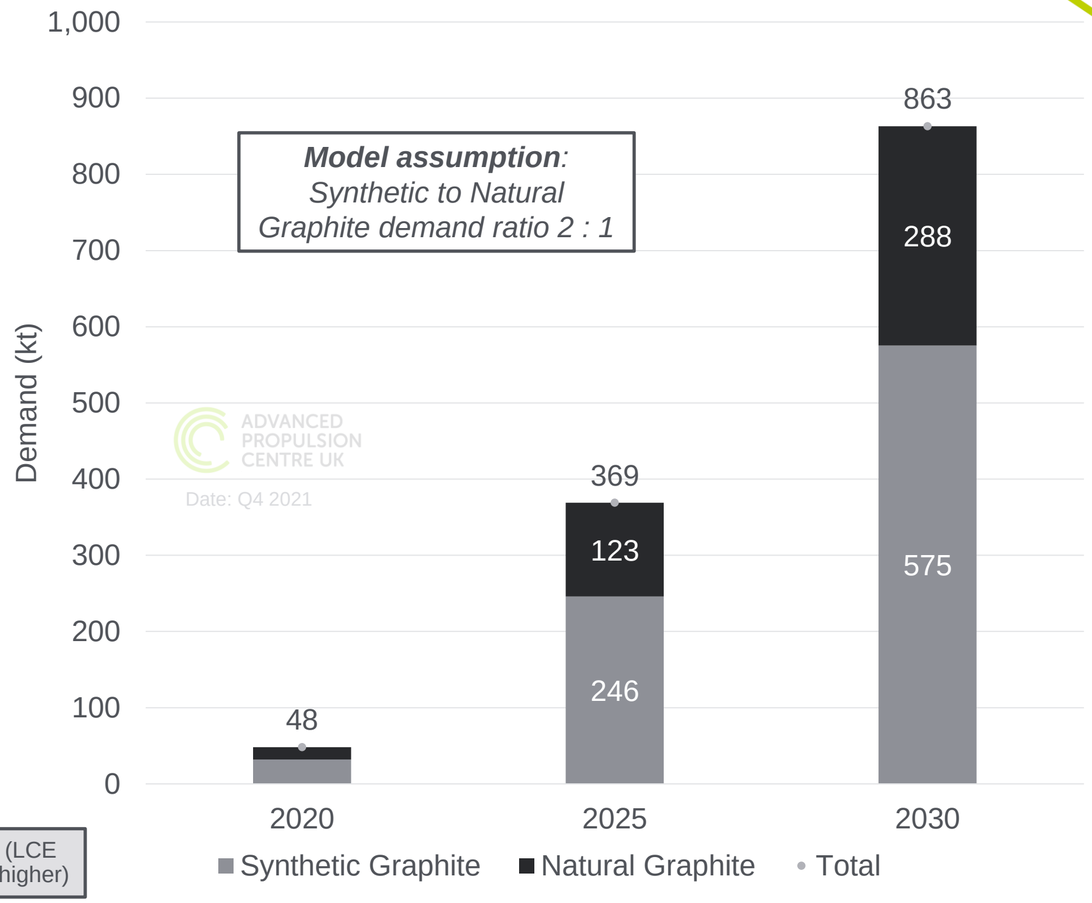
Europe* Cathode Material Demand



**Contained metal (LCE would be 5.3 times higher)

Europe* Anode Material Demand



With exponential growth in battery demand, thousands of metric tonnes of raw and processed materials will be needed to go into these batteries. **Onshoring supply** of cathode active materials will be critical for European OEMs that want to avoid trade tariffs and reduce reliance on imports from countries such as China and South Korea.

Source: APC Demand Databases using IHS AutoTechInsight (Dec, 2021), FEV data (April, 2021) & BNEF forecasts (2021)
*Note: Passenger cars & Light Commercial Vehicles < 3.5t only, *Europe region includes non-EU countries such as Turkey*

UK Cathode Active Material (CAM) demand for LDVs expected to surpass 130kt by 2030. Big opportunity to localise at least 3 CAM plants in the UK

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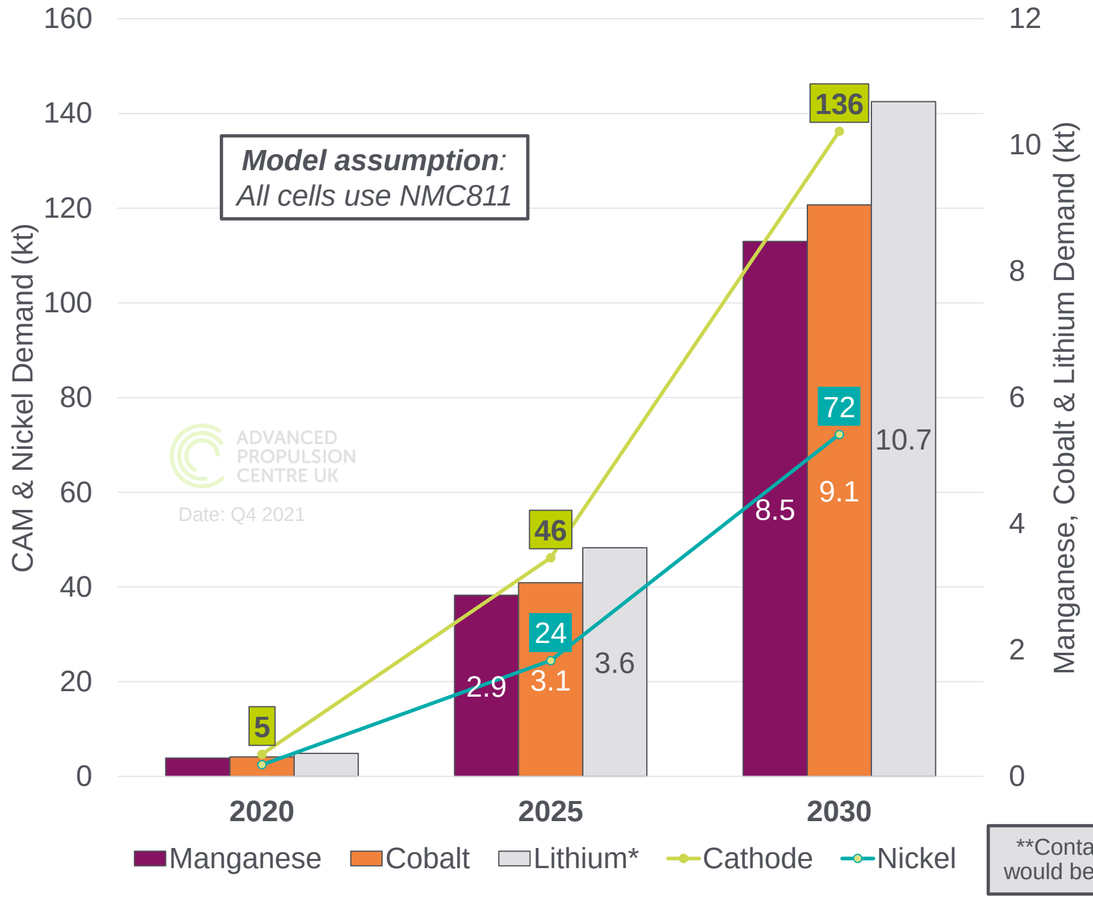
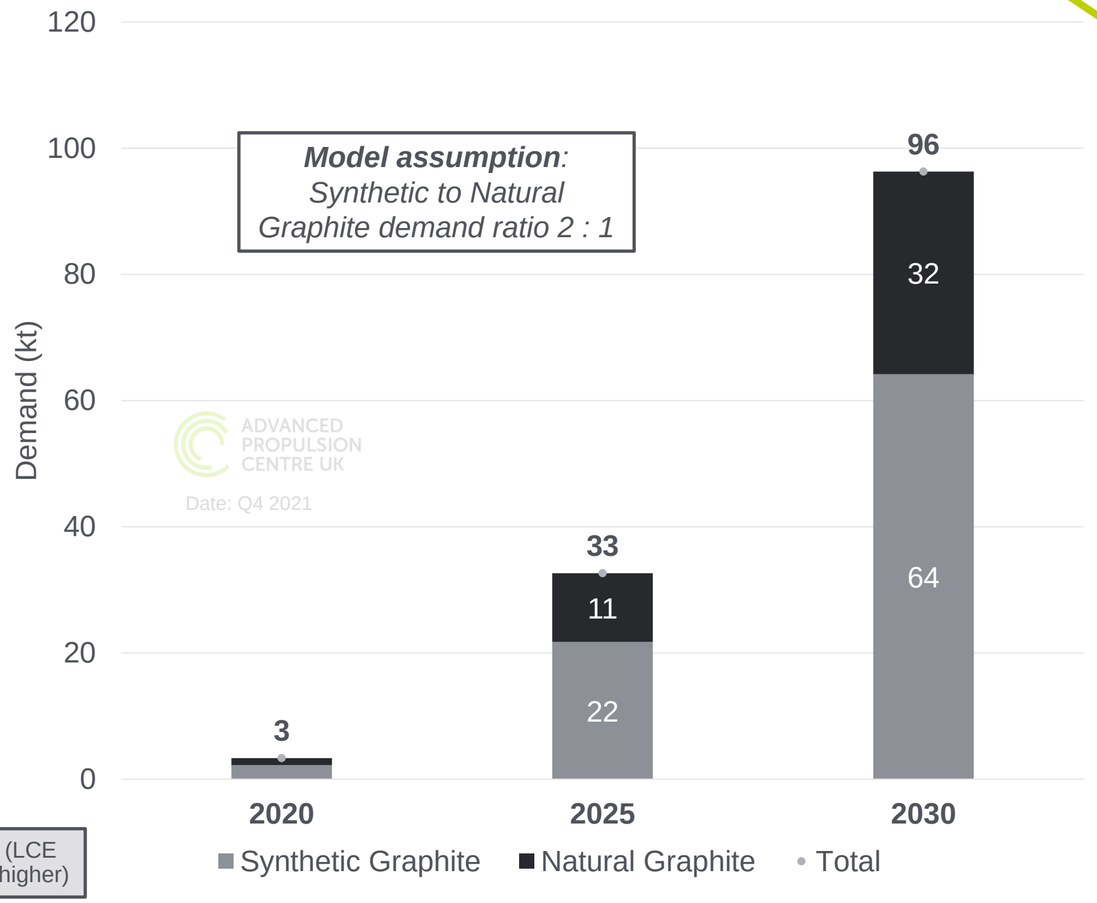
UK Cathode Material Demand



**Contained metal (LCE would be 5.3 times higher)

UK Anode Material Demand



While significant CAM investments have already been announced and realised in the EU, the UK currently relies on imported high-value materials such as CAM from the Far East. However, this is not sustainable for the UK following the agreed EV trade rules of origin with the EU. **CAM must be made in the UK** if OEMs are to remain competitive in the long-term.

Source: APC Demand Databases using IHS AutoTechInsight (Dec, 2021), FEV data (April, 2021) & BNEF forecasts (2021)
Note: Passenger cars & Light Commercial Vehicles < 3.5t only

European demand for battery foils expected to reach 280kt by 2025
The incentive to localise supply of electrolyte & separators will also strengthen

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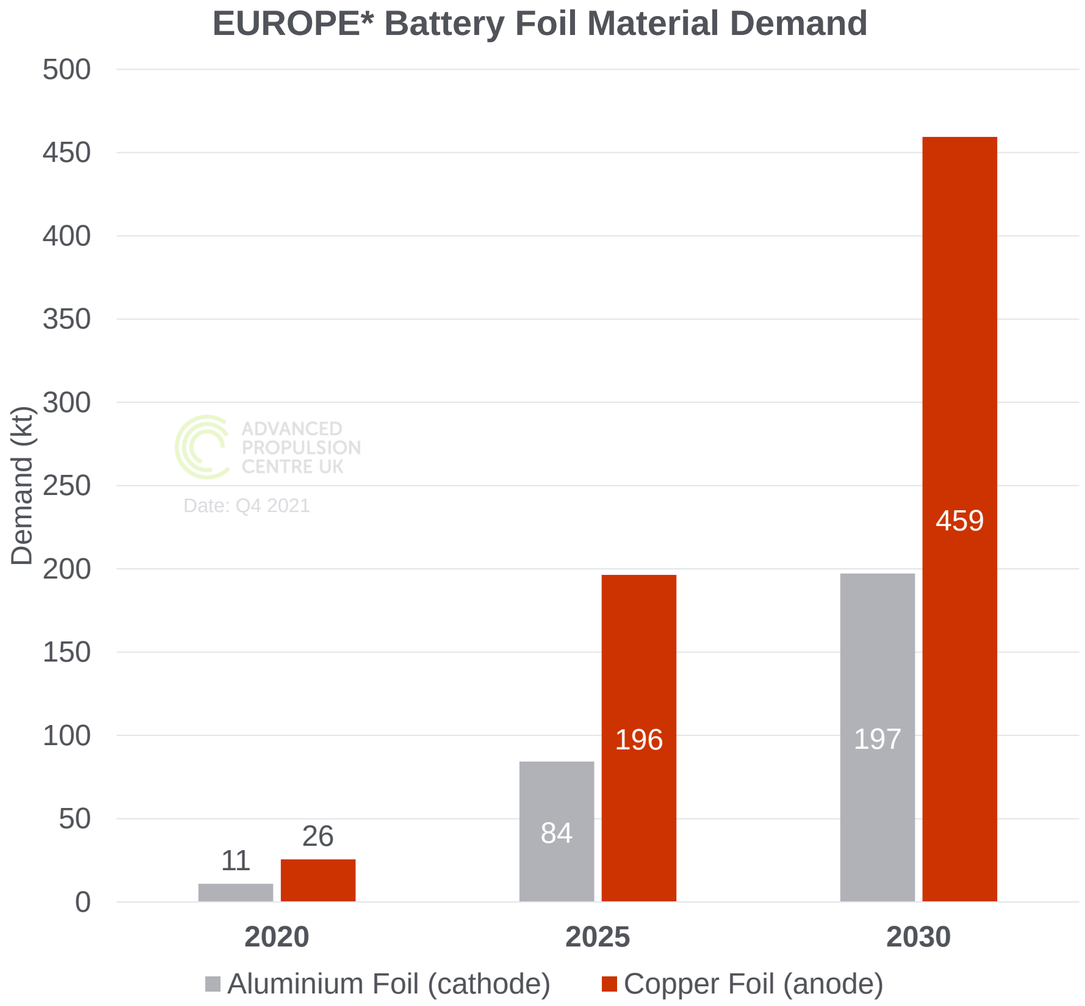
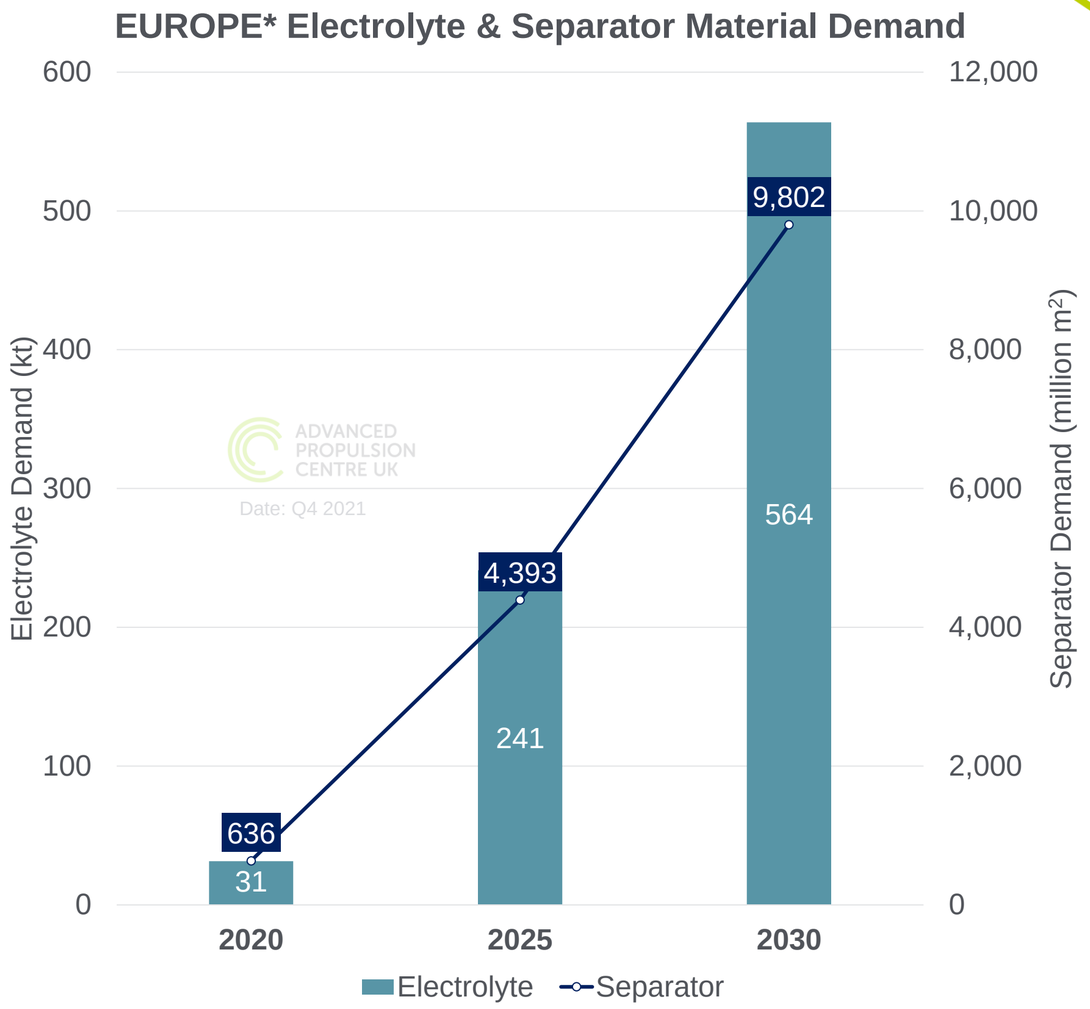
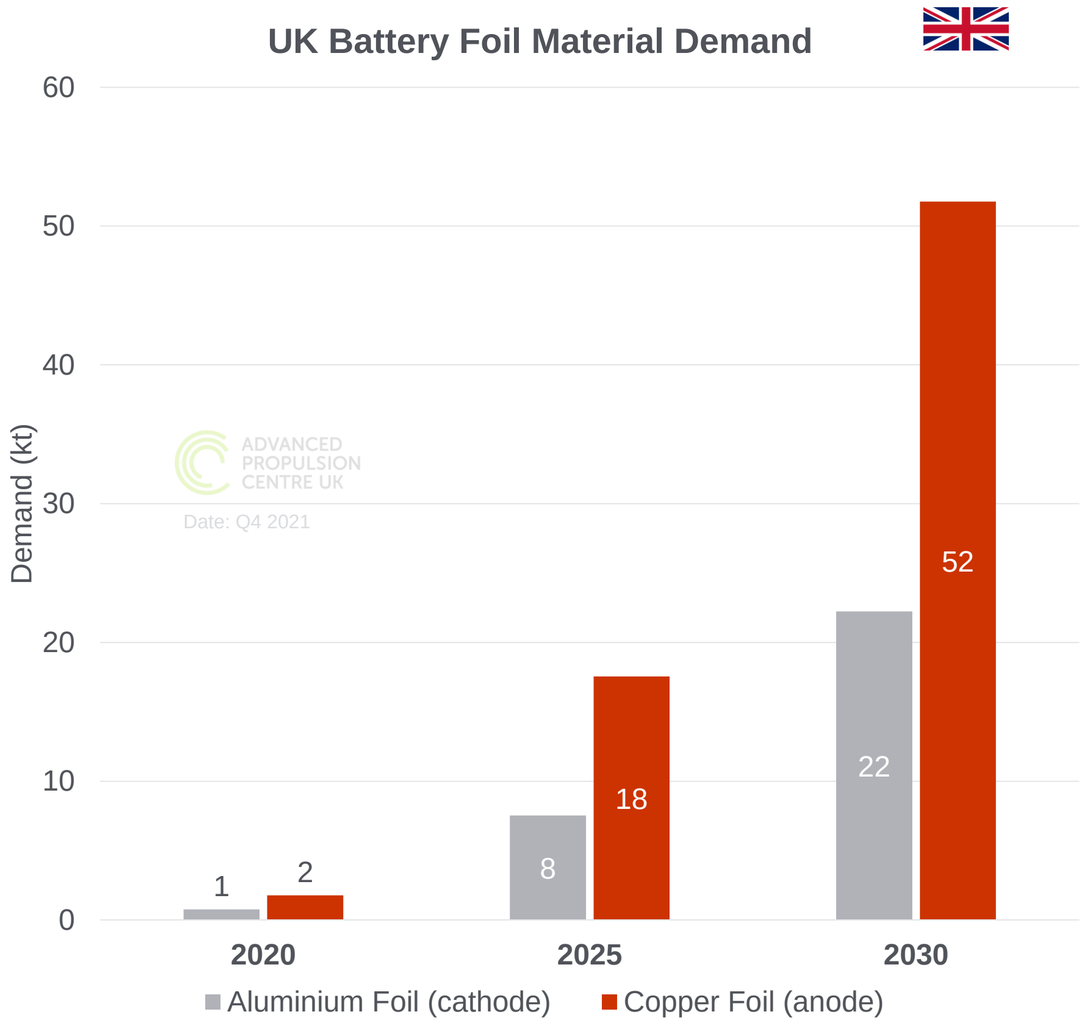
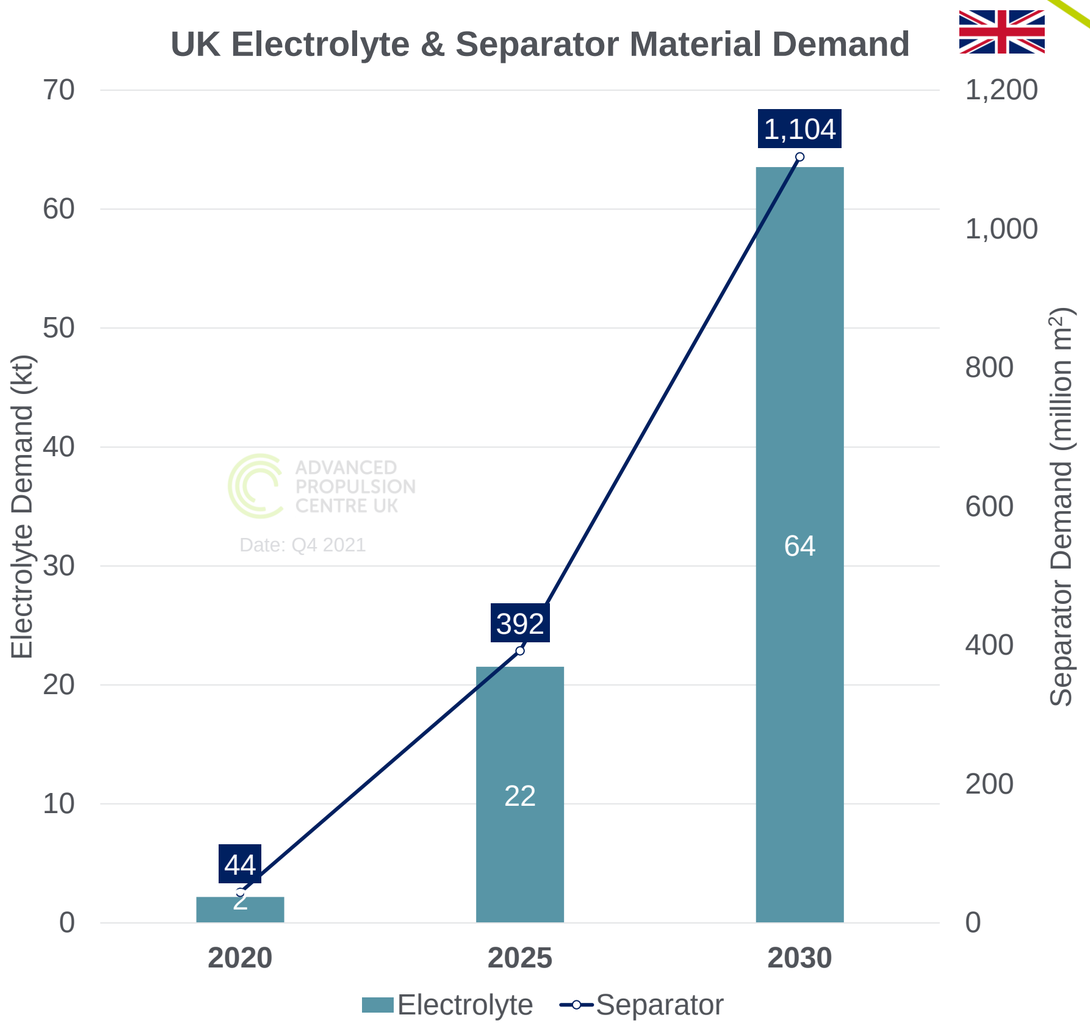




Source: APC Demand Databases using IHS AutoTechInsight (Dec, 2021), FEV data (April, 2021) & BNEF forecasts (2021)
*Note: Passenger cars & Light Commercial Vehicles < 3.5t only, *Europe region includes non-EU countries such as Turkey*

UK demand for battery foils, electrolyte and separator material will only go up from here, and offers significant opportunities to localise supply





Source: APC Demand Databases using IHS AutoTechInsight (Dec, 2021), FEV data (April, 2021) & BNEF forecasts (2021)
Note: Passenger cars & Light Commercial Vehicles < 3.5t only

APC's latest forecast suggest that European demand for traction electric motors in light duty vehicles could be 10x higher in 2030 relative to 2020

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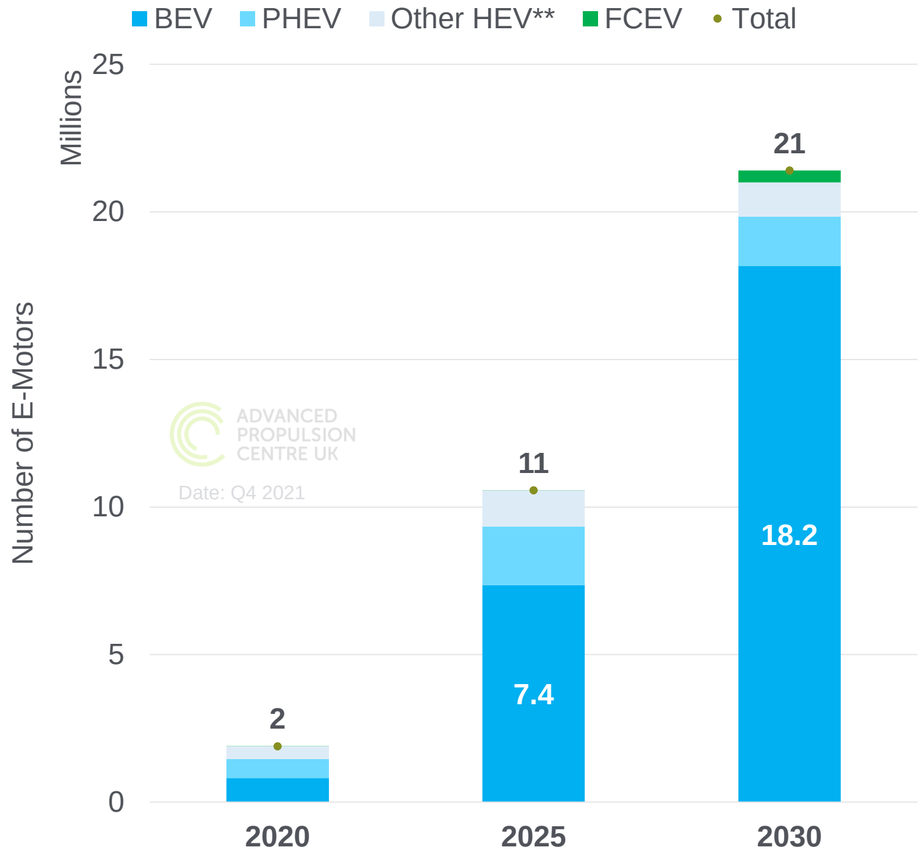
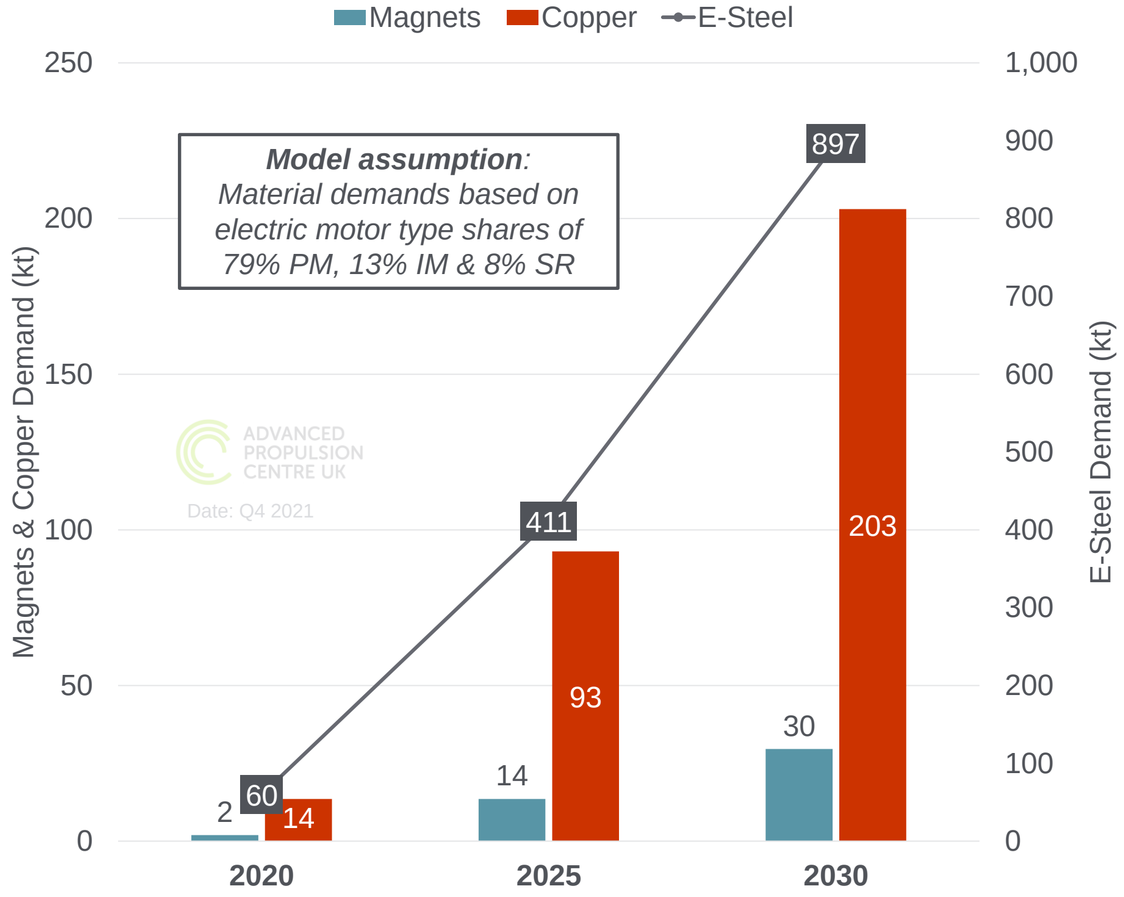
Europe* Traction E-Motor Demand (Passenger Cars & Vans)



EUROPE* Traction E-Motor Material Demand



With permanent magnet motors expected to take most of the market, there are important opportunities for Europe to invest in regional supply of rare earth magnets (NdFeB) potentially through recycling from electric motors. China currently controls 90% of the rare earth element magnet market.

Source: APC Demand Databases using IHS AutoTechInsight (Dec, 2021), FEV data (April, 2021) & BNEF forecasts (2021)
*Note: Passenger cars & Light Commercial Vehicles < 3.5t only, *Europe region includes non-EU countries such as Turkey, **Excluding mild hybrid electric motors*

UK demand for traction electric motors expected to exceed 2 million units by 2030, an opportunity to transition the UK's ICE manufacturing plants

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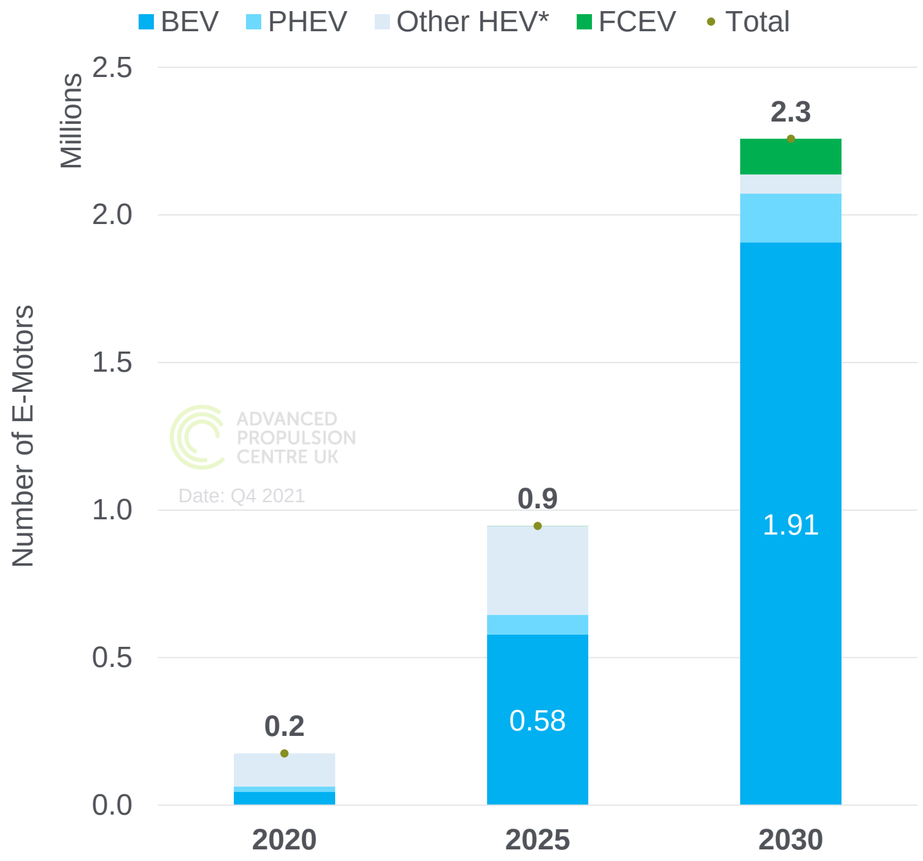
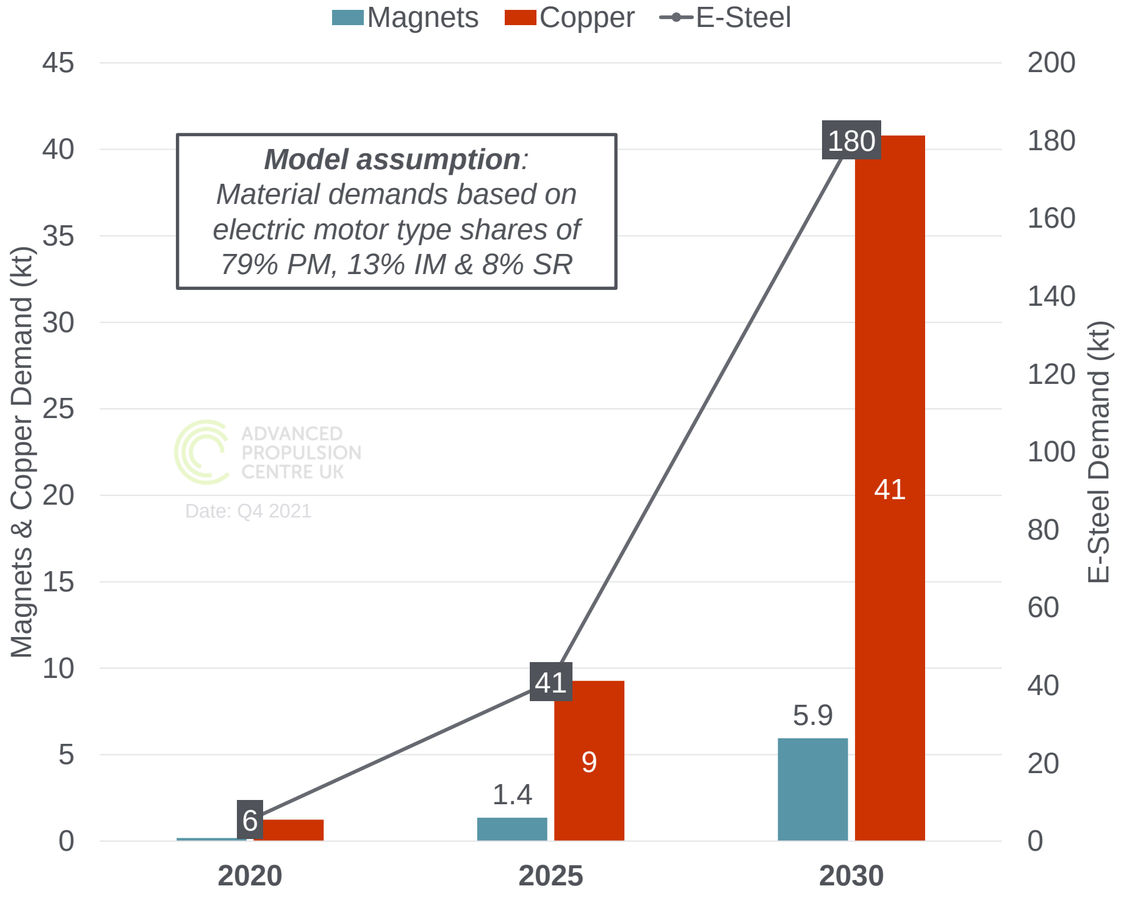
UK Traction E-Motor Demand (Passenger Cars & Vans)



UK Traction E-Motor Material Demand



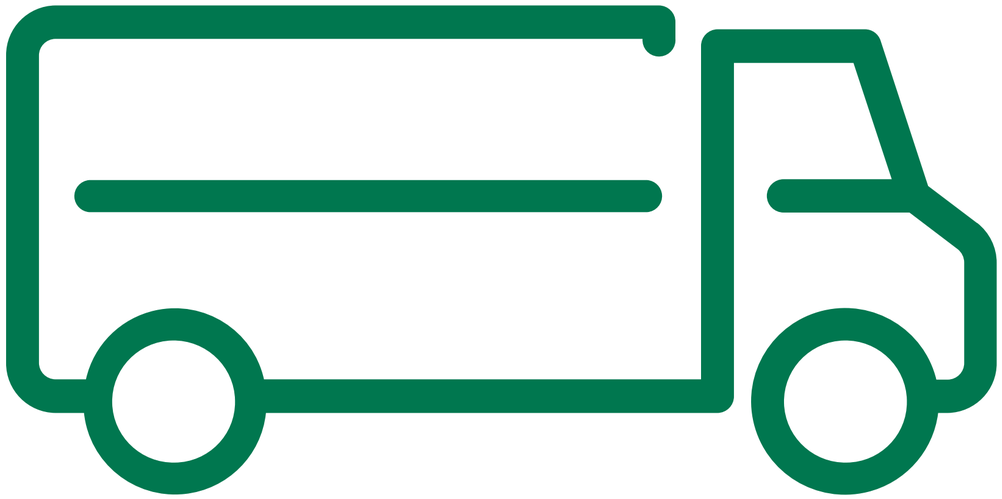
The UK has high potential in reaching self-sufficiency for electric motor supply, transitioning ICE plant assets to manufacture electric motors is a key opportunity within this ambition. In 2021 we saw the pivotal Ford investment in transitioning the Halewood ICE transmission plant to manufacture electric drive units.

Source: APC Demand Databases using IHS AutoTechInsight (Dec, 2021), FEV data (April, 2021) & BNEF forecasts (2021)
*Note: Passenger cars & Light Commercial Vehicles < 3.5t only, *Excluding mild hybrid electric motors*

Special insight

Will European capacity of battery components keep-up with demand?

The following section includes battery demand from both light duty vehicles (LDVs) & heavy goods vehicles (HGVs)



World battery demand forecast to exceed 2,800 GWh by 2030, more than double the forecast for 2025. Europe to account for ~1/3 of this demand.

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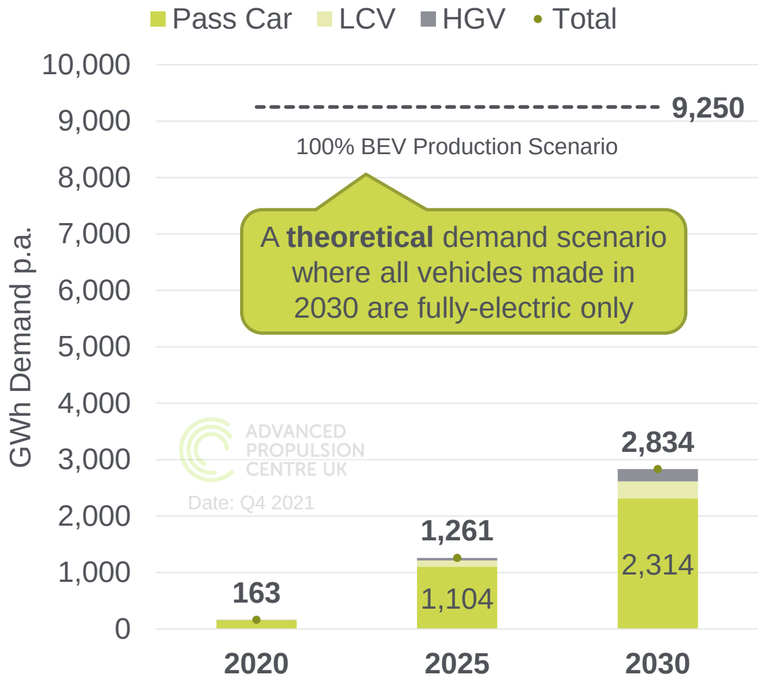
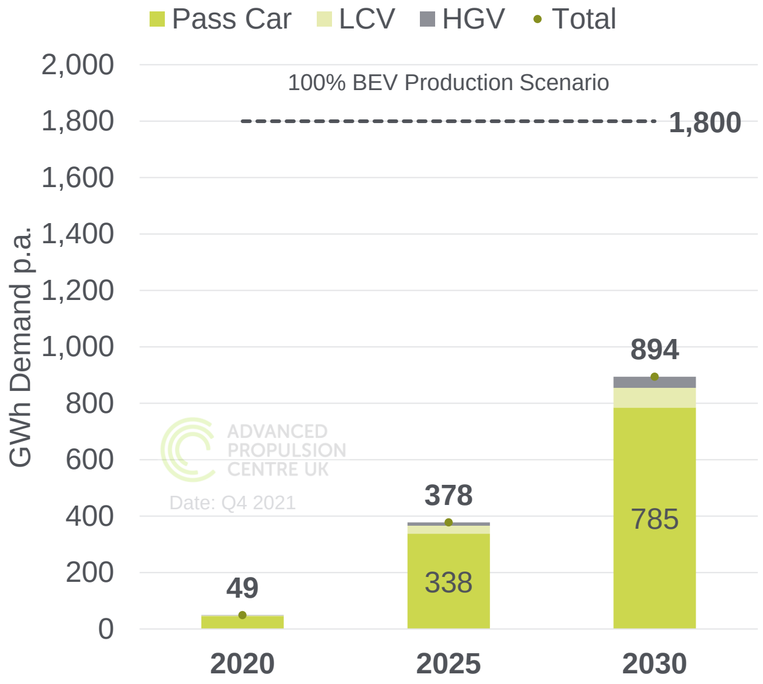
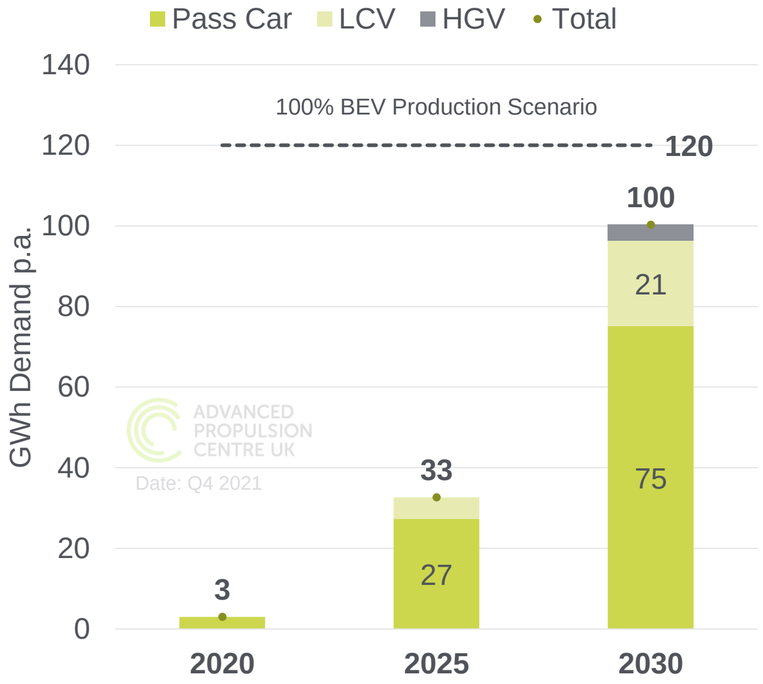
World Battery Demand (Passenger & Commercial Vehicles)



European* Battery Demand (Passenger & Commercial Vehicles)



UK Battery Demand (Passenger & Commercial Vehicles)



- World battery demand for pass car and commercial xEVs is forecast to reach **2,800 GWh by 2030**
- Theoretically, World battery demand would only be 30% of the way in reaching its **100% BEV ceiling by 2030**. There is a lot more room for BEV demand.

- European battery demand for is forecast to account for ~**1/3 of world demand in 2030**
- Theoretically, the European forecast could reach **50% of its 100% BEV ceiling in 2030**. There is a lot more room for BEV demand

- UK battery demand from xEV production is forecast to account for **~11% of European battery demand in 2030**
- Theoretically, the UK forecast would reach **80% of its 100% BEV ceiling in 2030**.

Source: APC Demand Databases using BNEF (2021) & IHS AutoTechInsight data (Dec, 2021)
*Note: LCV = Light Commercial Vehicles < 3.5t, Buses not included. *Europe region includes non-EU countries such as Turkey*