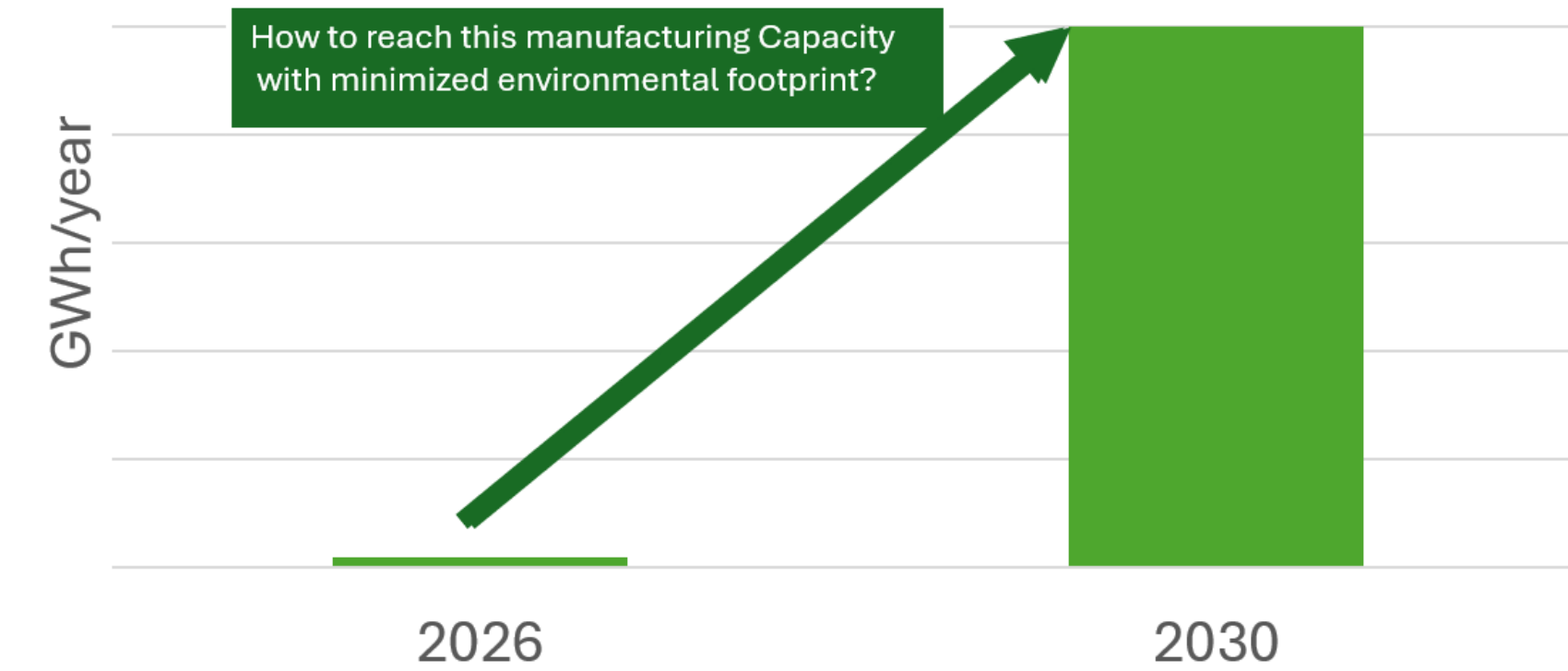


Best Practices for Manufacturing Passenger EV Batteries in the UK (NMC-LIB)

Merna Nomier, Alejandro Arellano, Nedunchezhian Swaminathan-Engineering Department, University of Cambridge

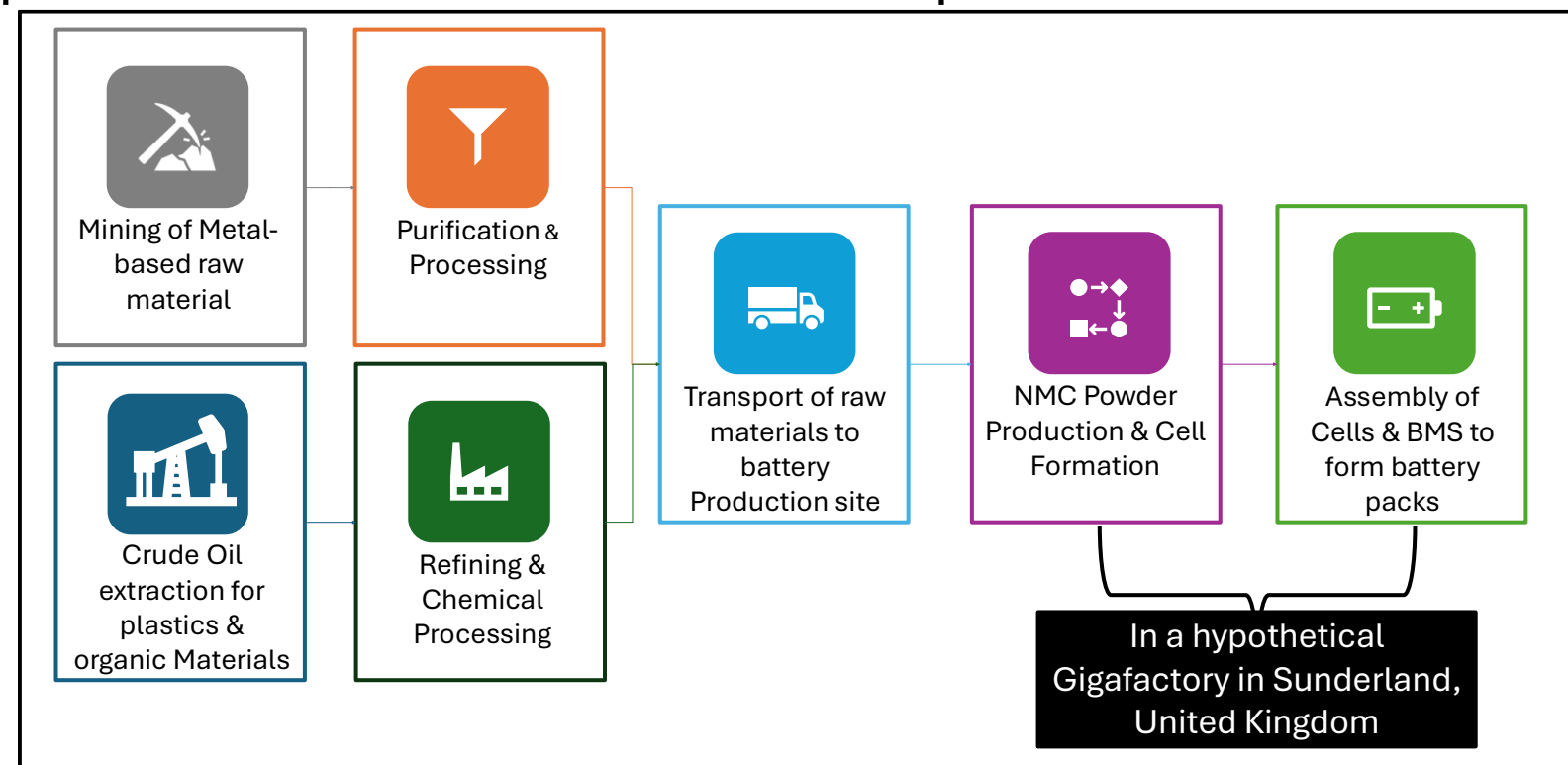
MOTIVES & GOALS

UK current manufacturing capacity is under 2 GWh capacity & needs to scale up to 100 GWh annually by 2030, to ensure energy sovereignty, reduce vulnerability to supply chain disruption and protect automotive industry within the UK. [1]

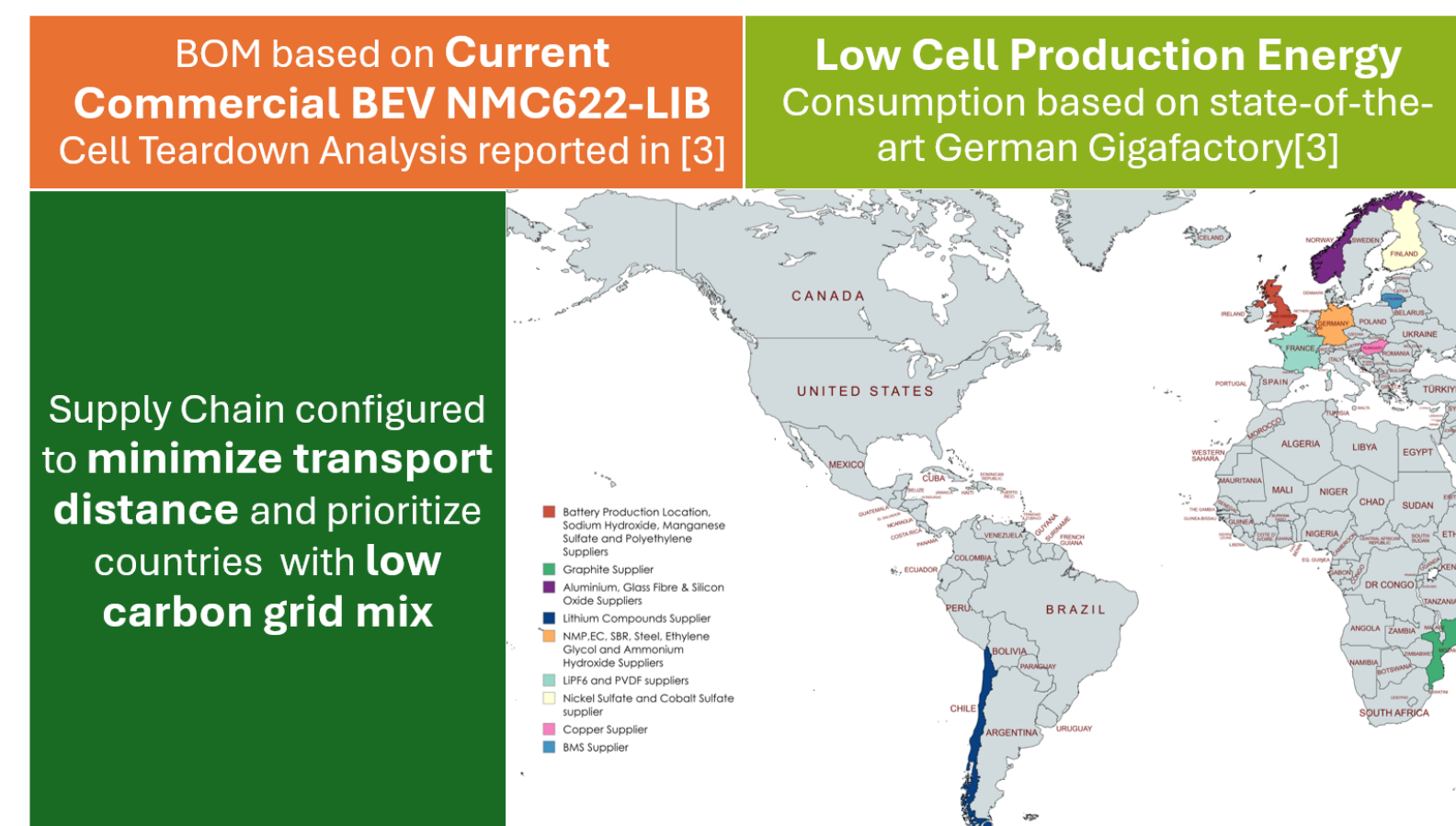


METHOD

Best practice is identified through conducting a cave to case life cycle assessment (LCA) for Nickel Manganese Cobalt (622) Lithium Ion Battery, utilizing GREET2024 database. [2] The LCA metrics are global warming potential (GWP) and air pollutants emissions. The LCA scope is:



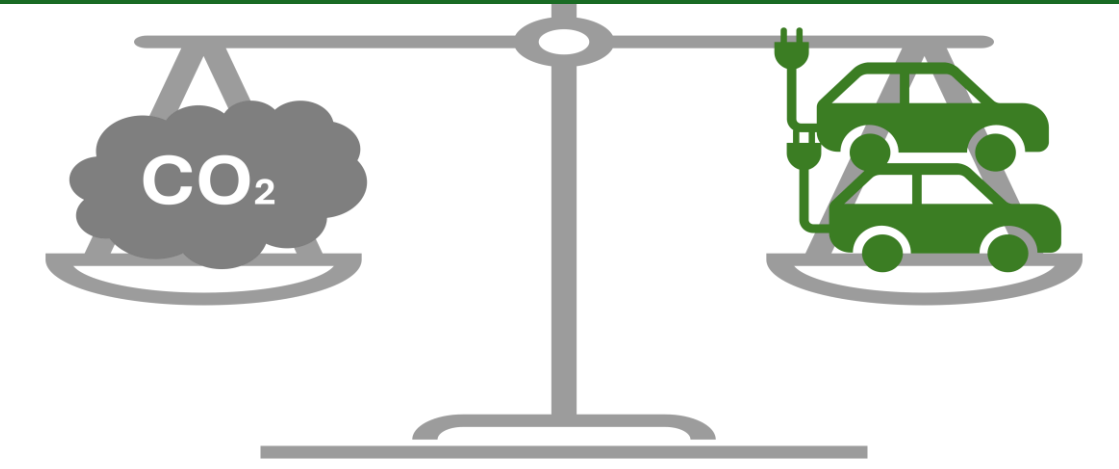
To create the life cycle inventory for this scope:



LCA OVERALL RESULTS

LCIA Metrics	1 Kg	1 KWh	54 KWh
CO (g)	10.3	62.87	3395
NOx (g)	12.33	75.24	4063
PM10 (g)	3.87	23.62	1276
SOx (g)	85.67	522.73	28227
GWP (kgCO2eq)	9.71	59.27	3200

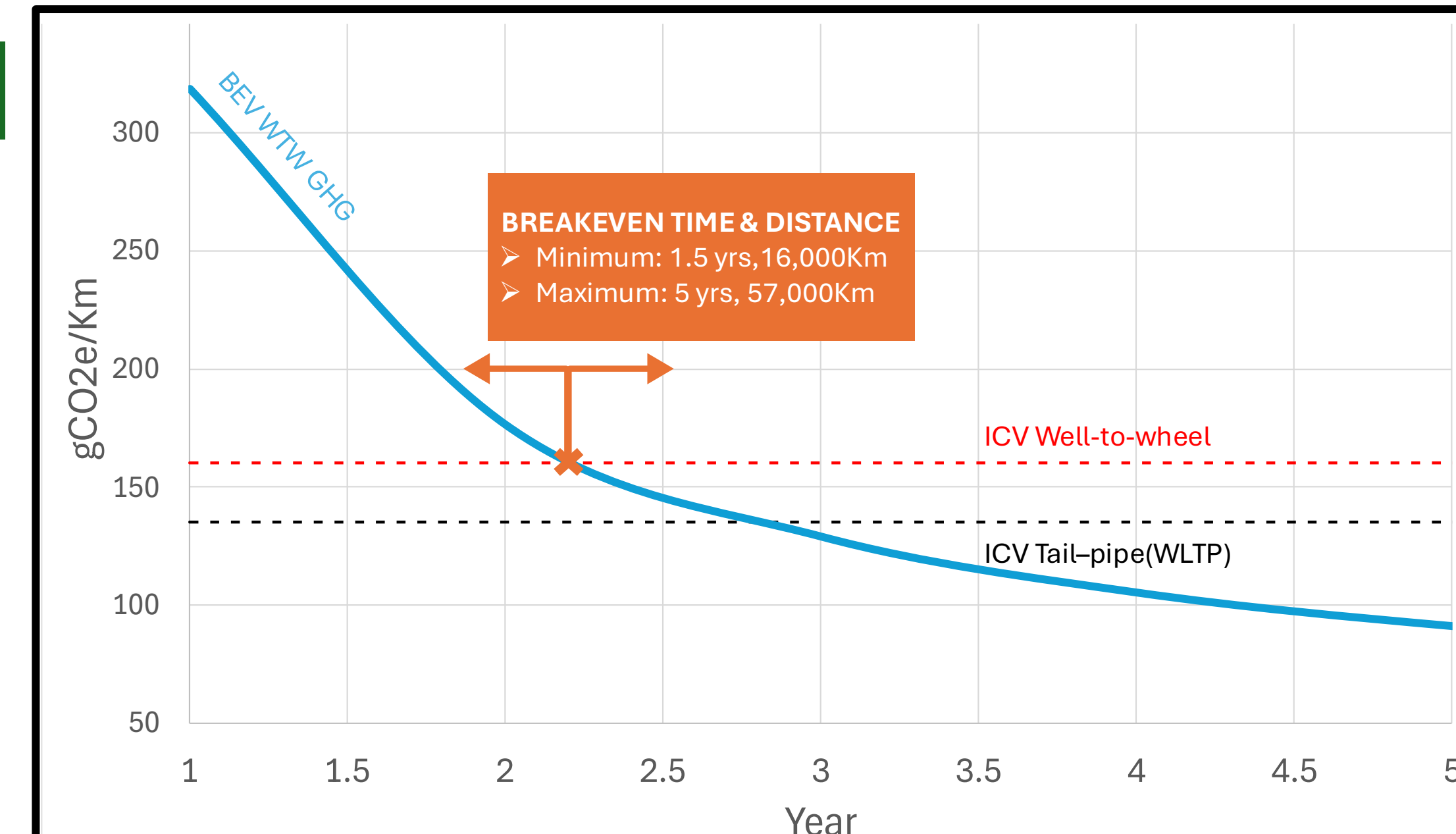
Producing a battery for an average electric hatchback emits greenhouse gases weighing twice as much as the whole car, highlighting the high GWP of battery manufacturing.



INTERPRETING LCA RESULTS & KEY TAKEOUTS

1) BREAKEVEN POINT & SENSITIVITY ANALYSIS

To evaluate the effectiveness of BEV in decarbonizing road transport, a GHG breakeven analysis comparing BEVs with ICVs is conducted. To determine the operational timeframe required for a BEV to offset its battery manufacturing emissions, 48 distinct scenarios were established by adjusting 6 key parameters.



Parameter	State at Minimum BED	State at Maximum BED
1) Supply Chain	Europe-based	China-based
2) Car charging Electricity	Decarbonized Grid	UK 2023 Grid Mix
3) Cell Production Energy	Natural gas & Electricity	Fully Electrified
4) Battery Chemistry	NMC900	NMC622
5) Lithium Source	Brine Li2CO3	Spodumene Ore LiOH
6) Car Size	Small (Vauxhall Astra)	Big (Peugeot E3008)

2) IMPACT OF UK-WIDE SHIFT TO BEV

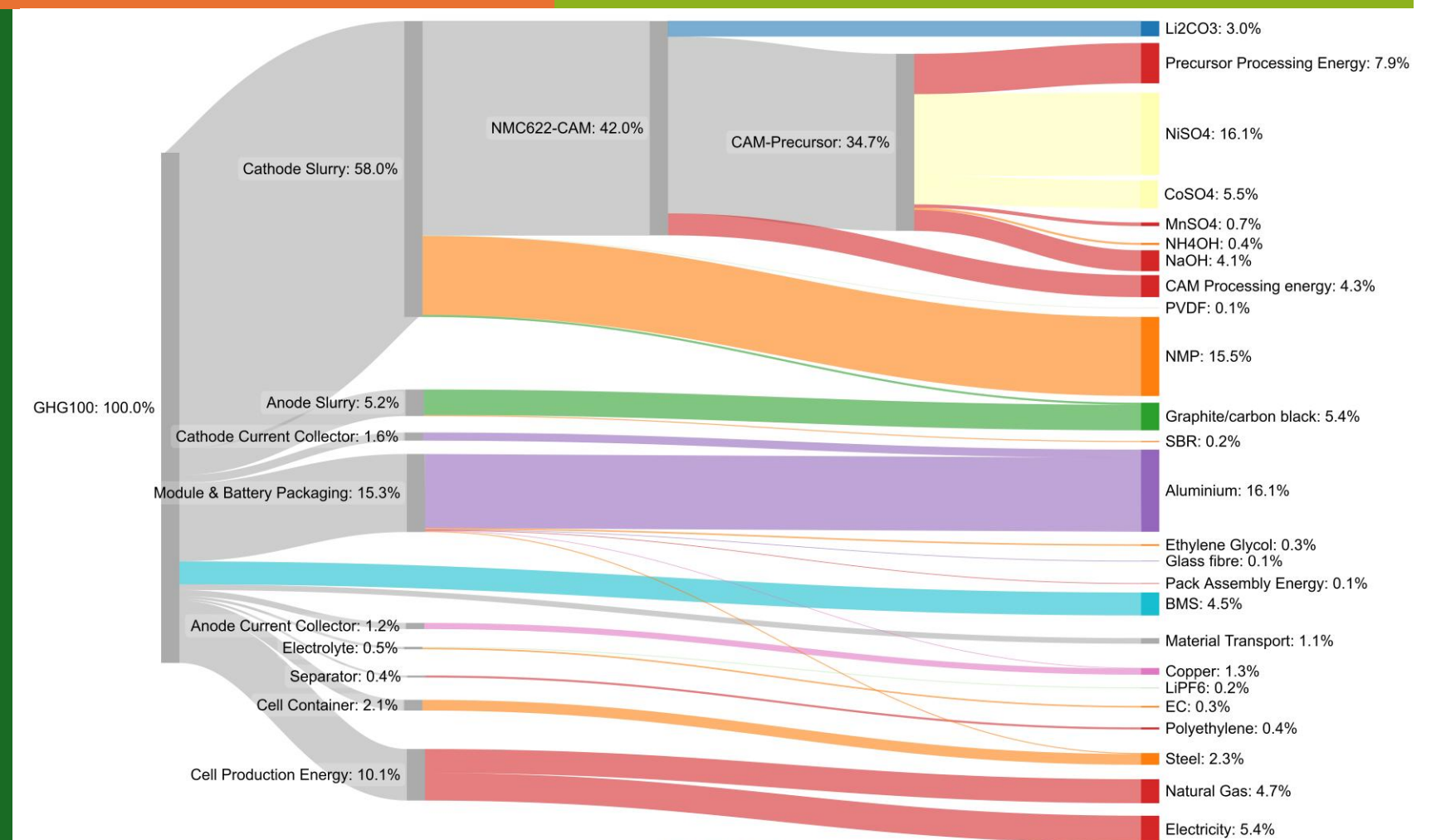


3) ENVIRONMENTAL HOTSPOTS

Battery production energy contributes <30% in each impact. Battery grade materials extraction & processing accounts for >70%.

Material transport has negligible contribution around 1%. (Impacts are colour coded according to country.)

Materials & energy of battery packing & BMS account for <25% across all categories. The cell level production energy & materials dominate all impacts.



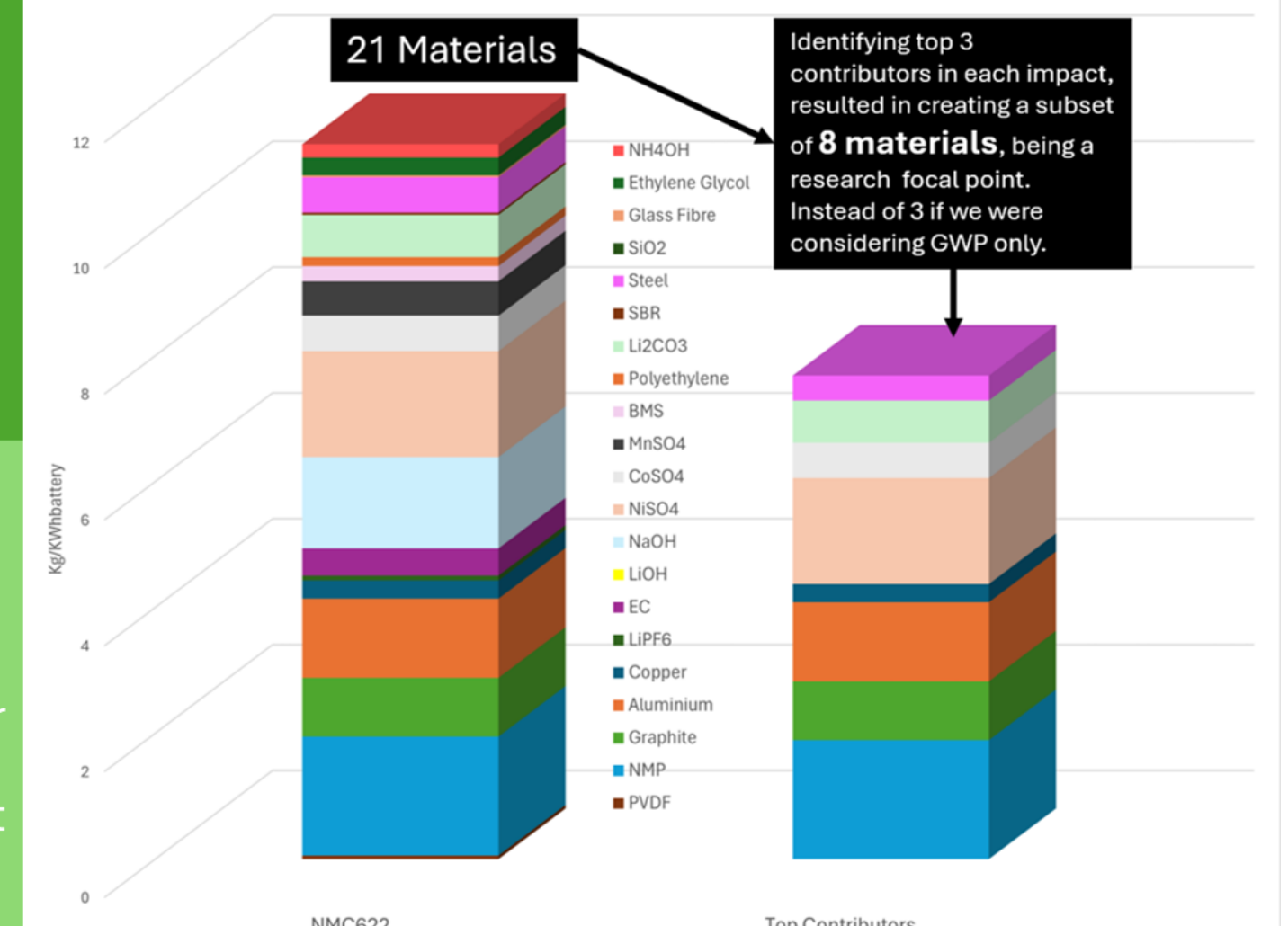
NISO4, CoSO4 & Copper should be sourced from countries with strict air pollutants regulation, as environmental impact & production practices varies significantly. [5]

NMP not part of final product. However, have great footprint, necessitating its on-site recovery and reuse. [3]

Aluminium is a top contributor, increasing recycled content has considerable impact on battery total footprint. [6]

Graphite is very sensitive to electricity mix of source country. GWP per Kg in Mozambique is 1/3 of that in China, for same process pathway.

Lithium used for cathode active material synthesis can be in the form of lithium carbonate or hydroxide. It can be sourced from brine or spodumene ore. Li2CO3 sourced from brine has least impact. [7]



References:

- [1] House of Commons Business and Trade Committee. First Report-Batteries for electric vehicle manufacturing. en. Nov. 2023. url: <https://committees.parliament.uk/work/7204/batteries-for-electric-vehicle-manufacturing/publications/> (visited on 08/08/2025).
- [2] Argonne National Laboratory. GREET model: The Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation Model. 2024. url: <https://greet.anl.gov/> (visited on 08/09/2025).
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