Automotive Council & the Electrification Transformation

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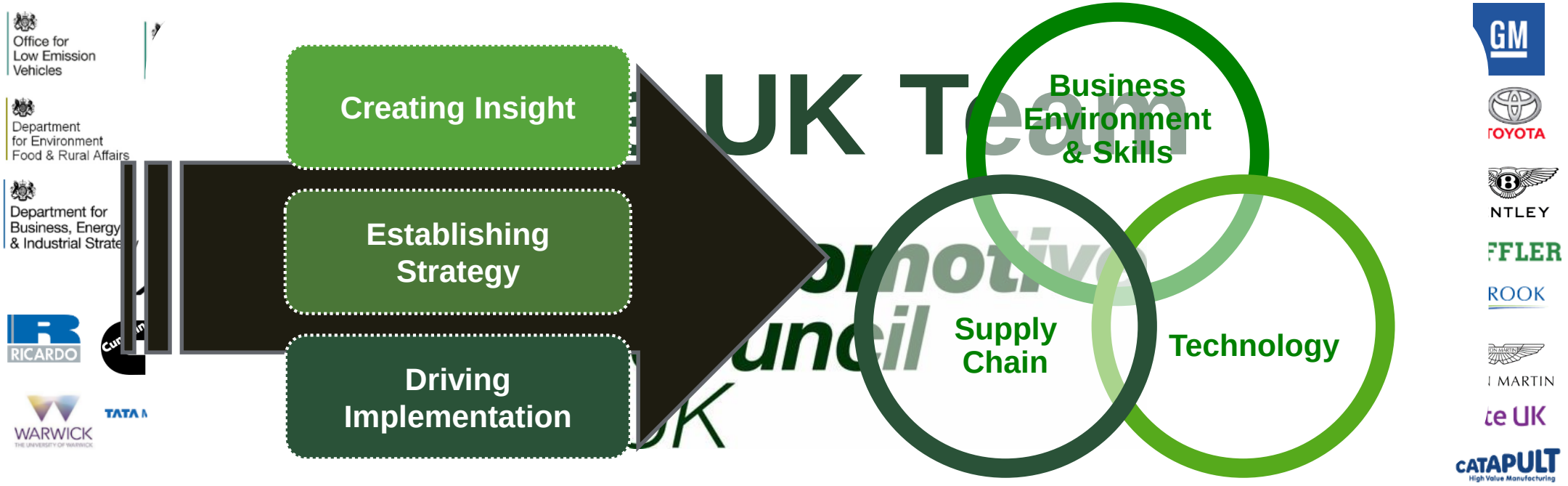
www.automotivecouncil.co.uk

UK Automotive Council: Structure & Approach

- The Automotive Council was formed in 2009
- To strengthen and promote sustainable growth of the automotive sector in the UK through enhanced dialogue and co-operation between UK government and the automotive industry
- Membership is made up of senior figures from across industry, government, trade association and trade unions
- Through the Council, industry works in partnership with government to support innovation, create the right business environment and to ensure that the UK remains an open economy



A continuous value creation cycle involving all facets of the Automotive Council

Advanced Propulsion Centre & Mapping the road ahead

- **The Advanced Propulsion Centre:**
  - £1b investment by Industry & Government to commercialise future low carbon propulsion technologies
- **The Automotive Council's roadmaps:**
  - visualize the evolving automotive landscape
  - communicate a shared view of the future.
- **Latest APC roadmaps Signpost**
  - short, medium and long term challenges in R&D
  - where investment is required
  - potential collaborative opportunities

Electrification Acceleration

- Stephenson Challenge

  ISCF Bid - £96m (+£125m loans)

  Manufacture of £5b worth of e-Drives By 2025

'Towards 2040: A Guide to Automotive Propulsion Technologies' **Launched, July 18**

Faraday challenge addresses well defined targets via three defined initiatives

The Faraday Challenge: an investment of £246 million over 4 years

Cost
Now $130/kWh (cell) $280/kWh (pack)
2035 $50/kWh (cell) $100/kWh (pack)

Energy Density
Now 700Wh/l, 250Wh/kg (cell)
2035 1400Wh/l, 500Wh/kg (cell)

Power Density
Now 3 kW/kg (pack)
2035 12 kW/kg (pack)

Safety
2035 eliminate thermal runaway at pack level to reduce pack complexity

1st Life
Now 8 years (pack)
2035 15 years (pack) Including rapid charge

Temperature
Now -20° to +60°C (cell)
2035 -40° to +80°C (cell)

Predictability
2035 full predictive models for performance and aging of battery

Recyclability
Now 10-50% (pack)
2035 95% (pack)

Faraday Institution
Countering Degradation
Solid State Batteries
Multi-Scale Modelling
Developing A Circular Economy

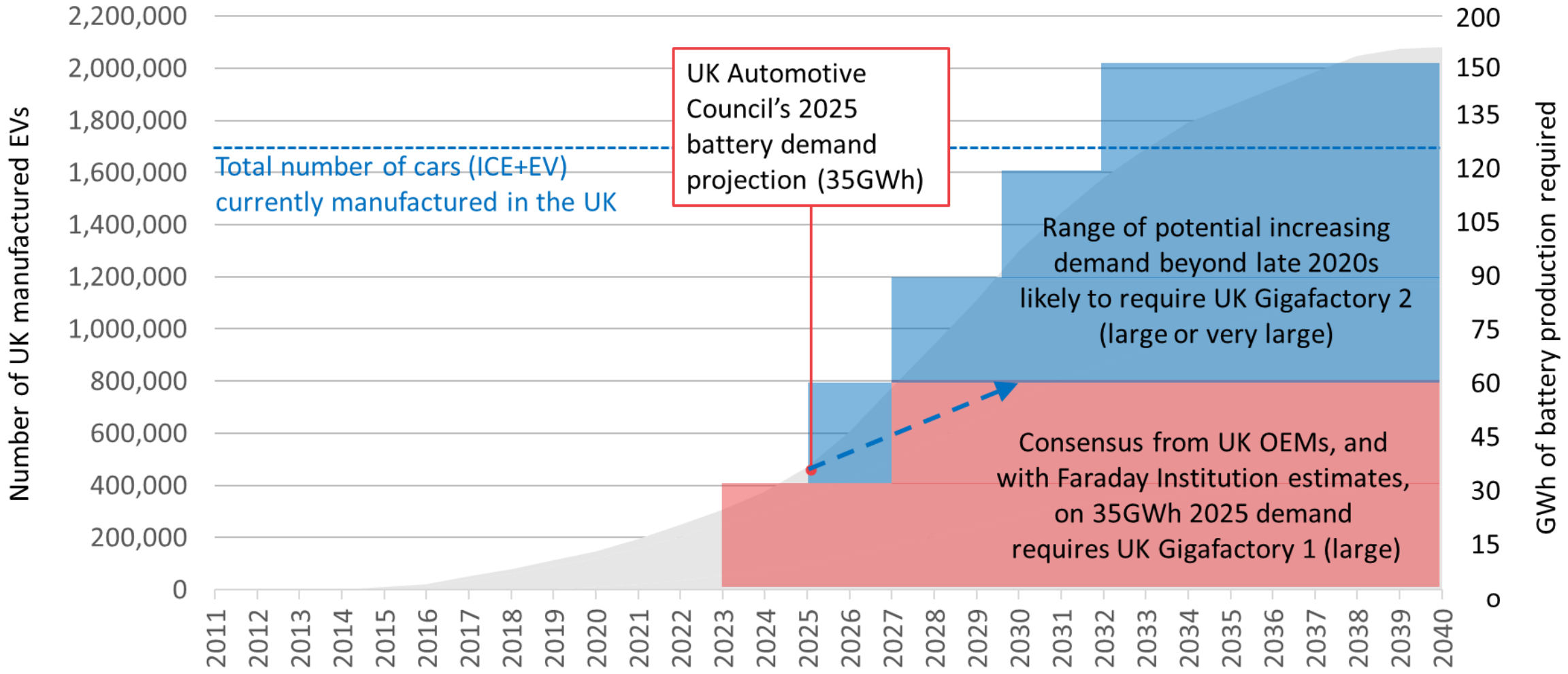
Feasibility Studies
Technology Challenges
Business Models

Research & Development
Materials & Manufacturing
Diversified Products & Services

National Battery Manufacturing Development Facility

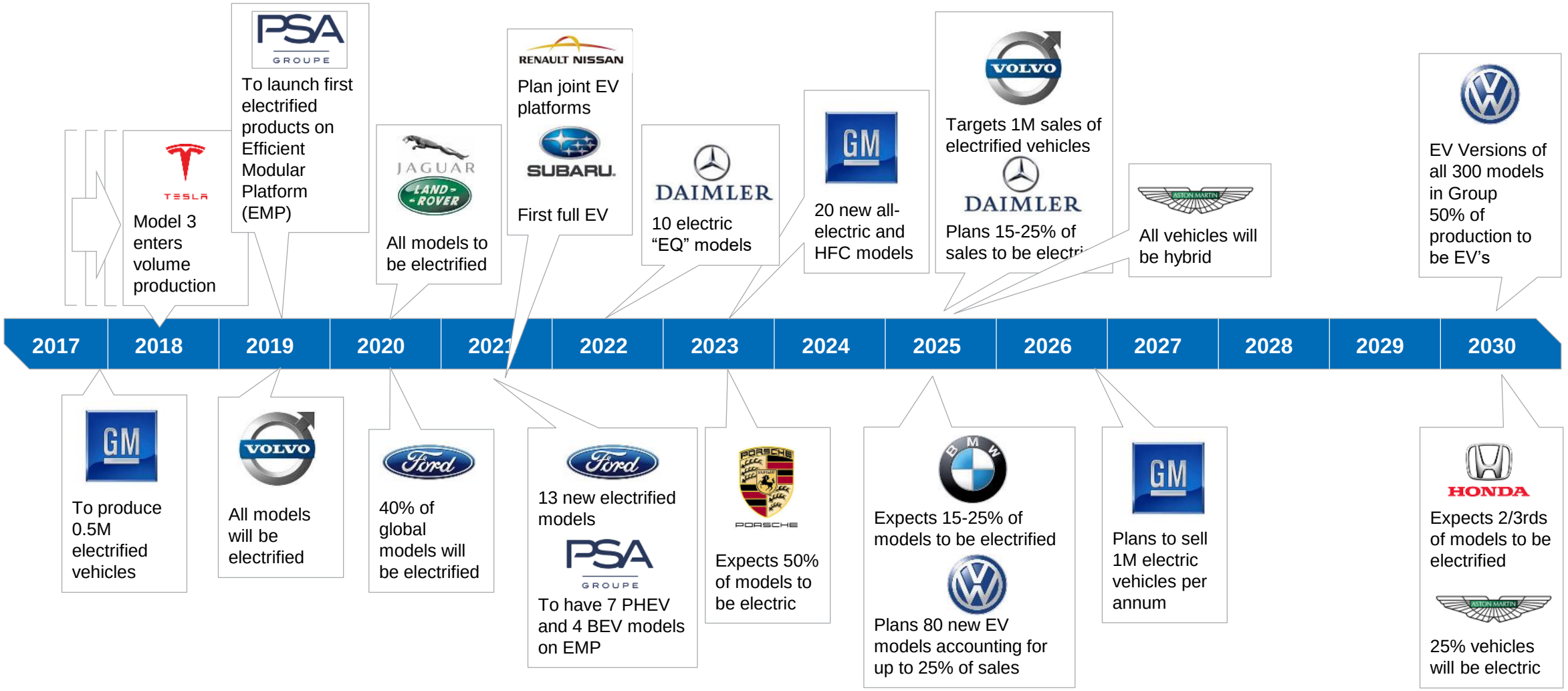
Leading proposition for battery technology Research, Development & Scale-up

A rapidly growing UK market for batteries & rapid technological change



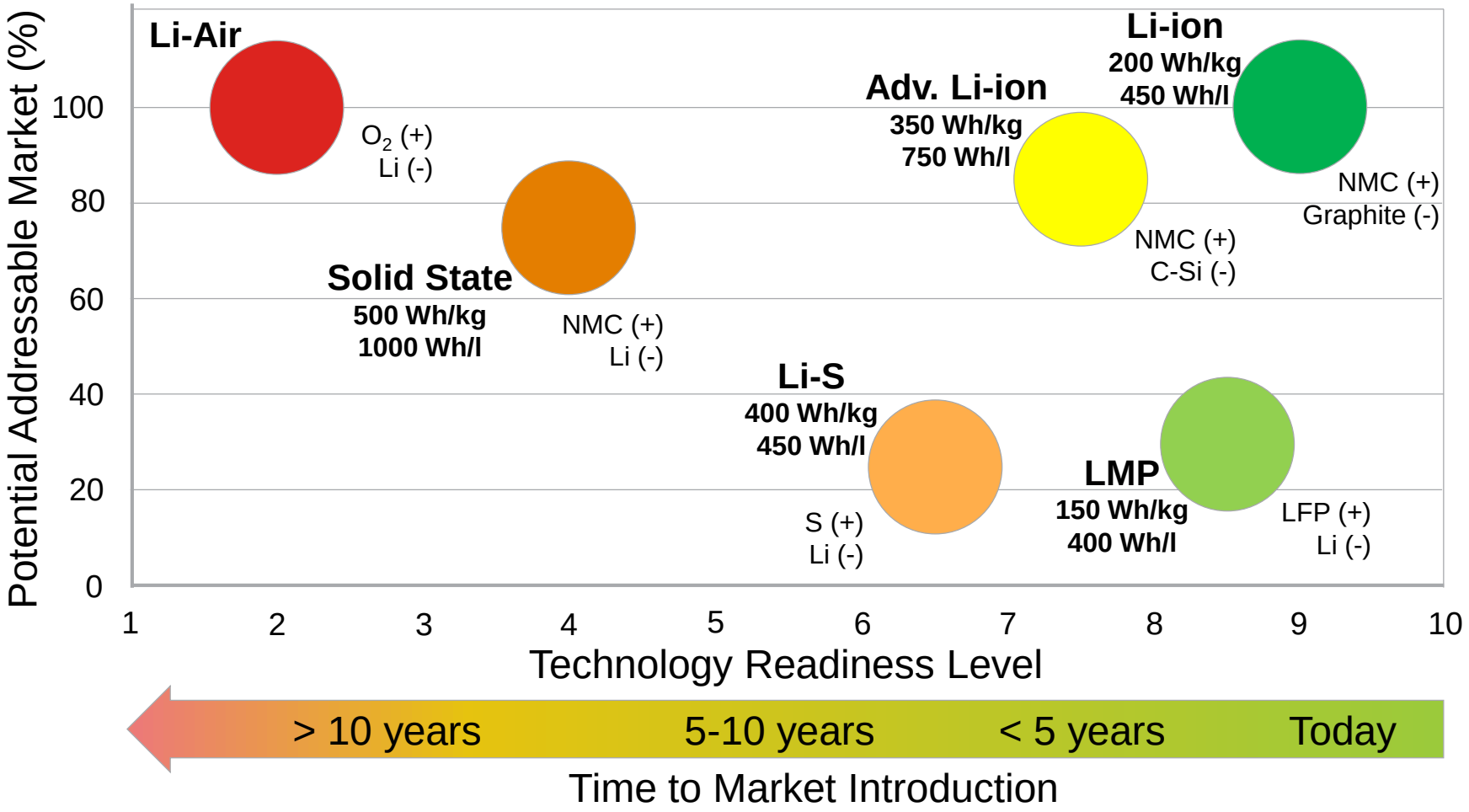
NB: Battery Giga-factory ~ $4-5b capex investment each – 6-7 needed in Europe by 2030

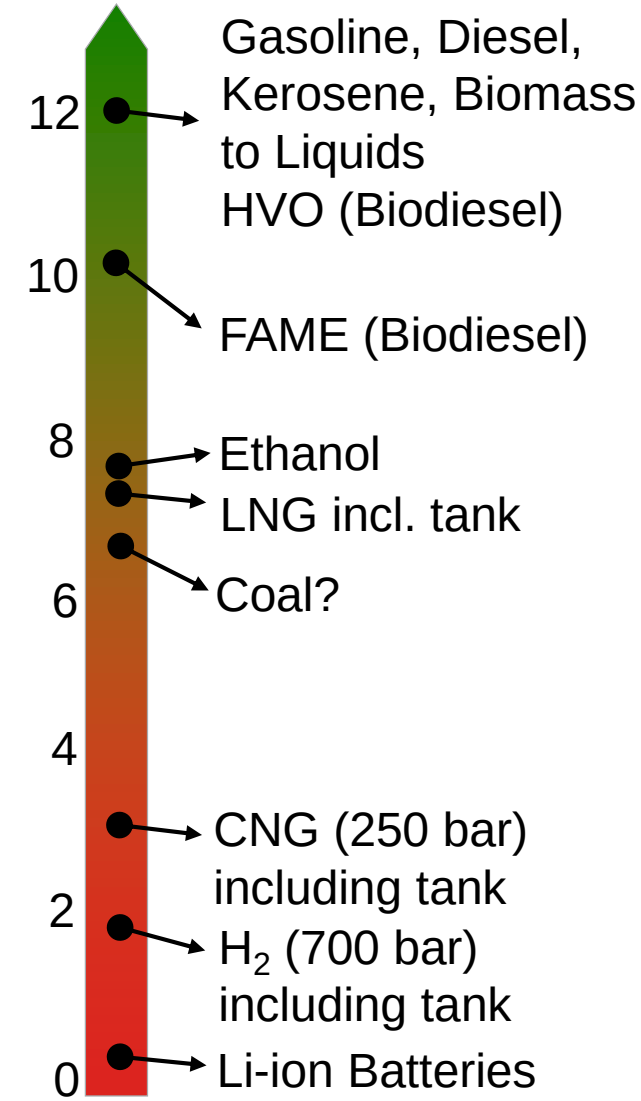
Environmental challenges/policies have accelerated Vehicle OEM commitments to introduce more electrified vehicles & larger batteries



HFC = hydrogen fuel cell

Battery chemistries will continue to evolve but major steps forward at least a decade away for the volume market





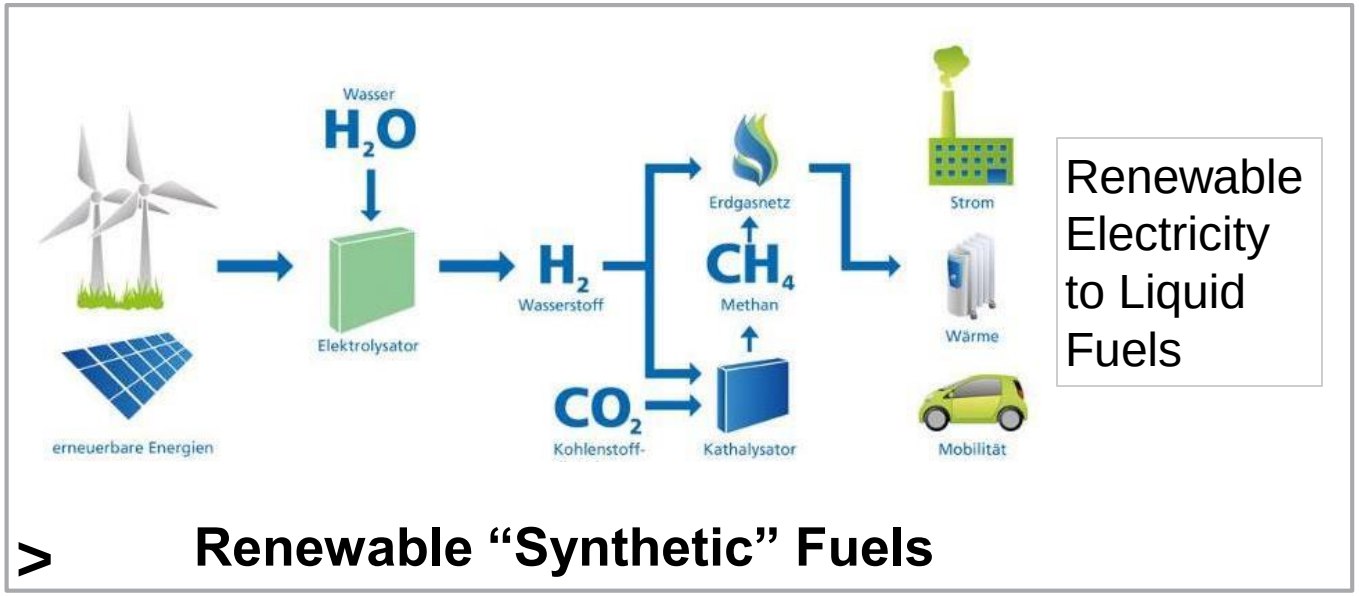
NMC = Nickel Manganese Cobalt
LMP = Lithium Metal Polymer
LMO = Lithium Manganese Oxide

LFP = Lithium Iron Phosphate
Li-S = Lithium Sulphur
NCA = Lithium Nickel Cobalt Aluminium Oxide

Source: EMIRI

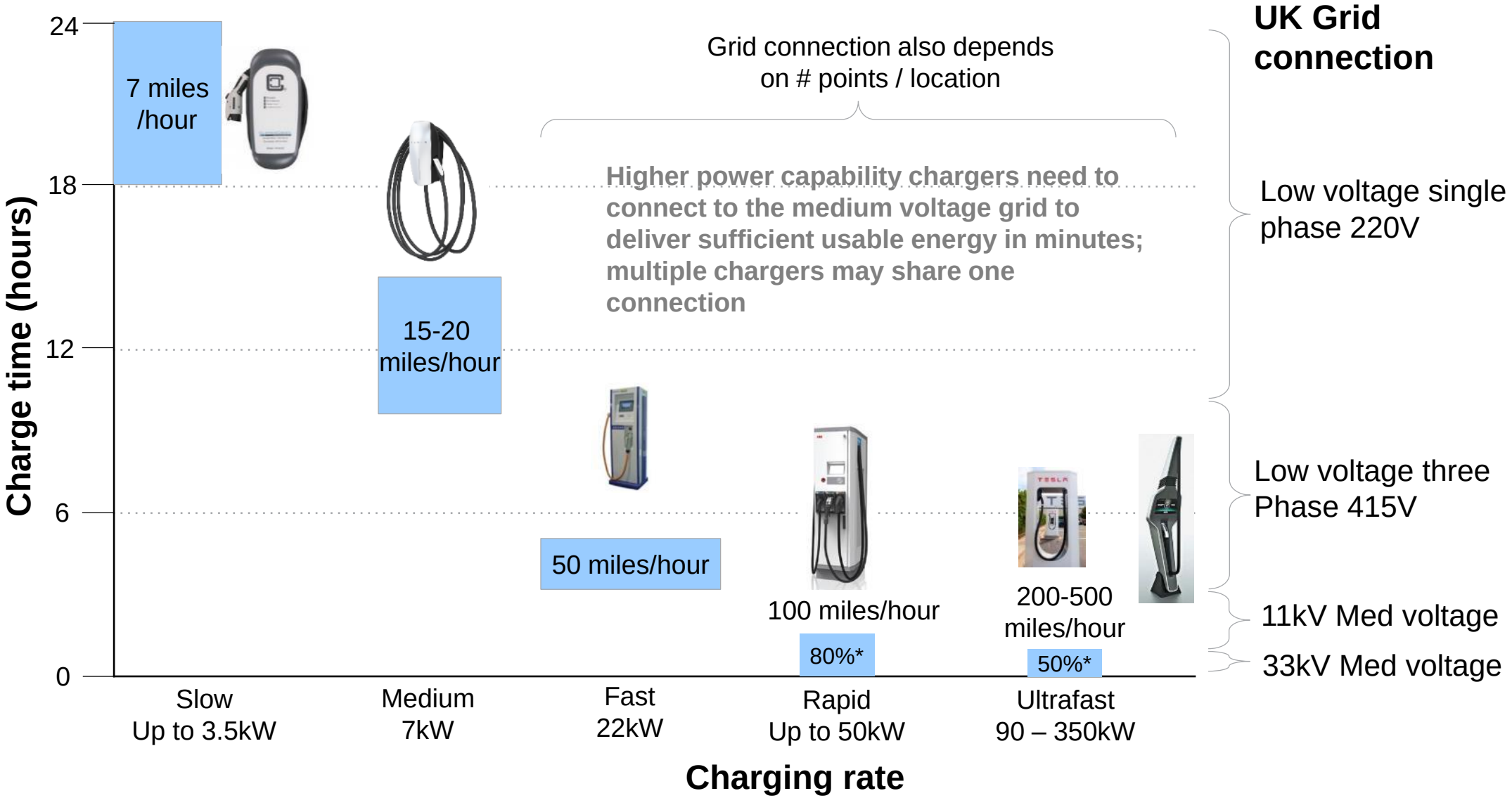
Ultra Low or Zero carbon HD trucks – probably a choice between H_2 Fuel cells with renewable hydrogen or Bio-Waste/Power to Liquid Fuels

H_2 Fuel Cell Trucks – Toyota/Nikola Motors < >



Renewable "Synthetic" Fuels

Grid voltage levels and charging times for 250+ mile range 85 kW.hr battery – to charge at >15 miles/hour need three phase supply

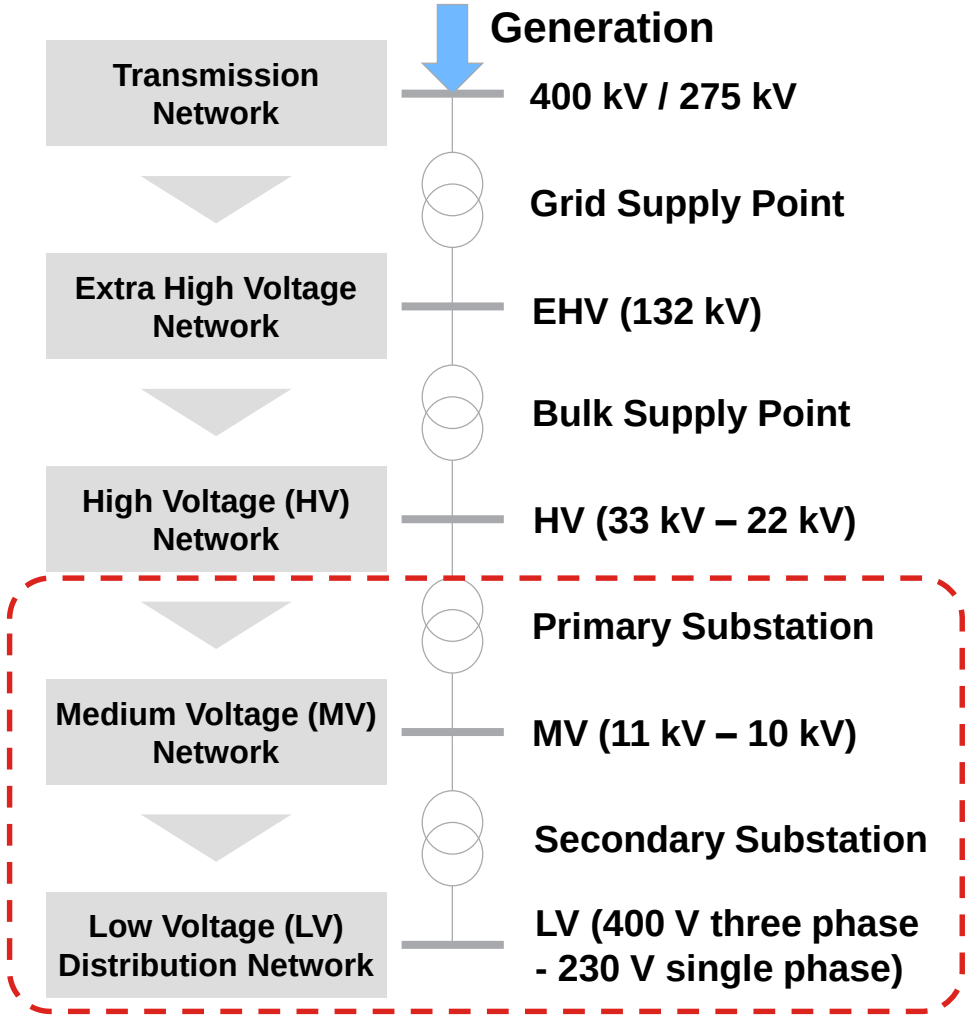


Will Wireless Charging Disrupt this System?

rce: Ricardo analysis

* = charge level within charging time from low State of Charge

Network reinforcement required beyond 15-20% EV penetration to deliver adequate EV re-charge power will be significant*



Significant Re-enforcement Required

- Capital costs for re-enforcing EU EV charging infrastructure & charge facilities for predominantly EV passenger cars & van parc:
  - **€630 billion assuming primarily "home" charging**
  - **€830 billion assuming "grazing" frequent top-up**
- Based on "Smart" network with charge periods selected to minimise local network loads

Only a small part of total road transport costs including vehicles and energy but who pays for this?

Ref: Impact Analysis of Mass EV Adoption – Ricardo Defossilizing the transportation sector - FVV

Source: The Energy Technologies Institute & *Household Electricity Survey - A study of domestic electrical product usage Intertek Report R66141

Auto Industry concerned that Infrastructure will limit market penetration – Supply/Network operators assume a more demand led approach

Automotive Industry Challenge:

- To achieve EV market uptake, need **larger batteries/longer range** and improved **charging** availability
- **Need to invest** in more charging infrastructure to **encourage EV purchase**

Need economies of scale to be commercially viable

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Electricity Supply Challenge:

- **Investment** in networks and charging facilities responsive and **based on demand**
- Local network issues will be resolved by **demand control** and **strategic positioning** of recharge facilities

No significant impact from EV take-up by 2030

Source: Ricardo Analysis, UK OLEV, Role of the power sector for Electromobility - Iberdrola