BATTERIES FOR ELECTRIC CARS

A CASE STUDY IN INDUSTRIAL STRATEGY

Geoffrey Owen
Policy Exchange
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INDUSTRIAL STRATEGY CHALLENGE FUND – SIX TARGETS

• Health care and medicine
• Robotics and artificial intelligence
• Batteries for clean and flexible energy storage
• Self-driving vehicles
• Manufacturing and materials of the future
• Satellites and space technology
WHY BATTERIES?

1. Accelerate shift to electric cars as part of drive to reduce CO2 emissions
2. Belief that UK’s academic strength in electrochemistry could help UK-based firms win a larger share of world market
3. Concern that without a viable battery supply chain in the UK car makers might make their electric cars elsewhere
PRINCIPAL ELECTRIC CAR TYPES

Hybrid electric vehicle (HEV) – powered by petrol or diesel and battery

Plug-in hybrid electric vehicle (PHEV) – battery recharged via external charging outlet

Battery electric vehicle (BEV or EV) – powered entirely by battery
### SALES OF ELECTRIC CARS IN 2017

<table>
<thead>
<tr>
<th>Country</th>
<th>Total sales</th>
</tr>
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<tbody>
<tr>
<td>China</td>
<td>1,245,900</td>
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<tr>
<td>US</td>
<td>943,700</td>
</tr>
<tr>
<td>Japan</td>
<td>207,200</td>
</tr>
<tr>
<td>France</td>
<td>149,800</td>
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<tr>
<td>UK</td>
<td>137,300</td>
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<tr>
<td>Germany</td>
<td>121,500</td>
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EVOLUTION OF BATTERY TECHNOLOGY

• LEAD ACID
• NICKEL IRON
• NICKEL CADMIUM
• NICKEL-METAL-HYDRIDE (OVSHINSKY/GM)
• LITHIUM-COBALT-OXIDE (GOODENOUGH/SONY)
• ?SOLID STATE BATTERY
• ?LITHIUM-AIR
TOP LITHIUM-ION BATTERY SUPPLIERS

• Panasonic (Japan)
• Samsung SDI (Korea)
• LG Chem (Korea)
• SK Innovation (Korea)
• CATL (China)
• BYD (China)
LITHIUM-ION BATTERY SUPPLY CHAIN FOR VEHICLES

Mining and processing of raw materials – lithium, cobalt, nickel etc
Development and production of materials for anode, cathode, electrolyte
Manufacture of cells
Design and production of battery packs
Production of cars and trucks
Battery recycling
TOP-SELLING ELECTRIC CARS IN US (Jan-August 2018)

- Tesla Model 3                  55,882
- Toyota Prius Prime             18,310
- Tesla Model S                  14,649
- Tesla Model X                  13,600
- Chevrolet Volt                 11,114
- Chevrolet Bolt                 10,258
TOP-SELLING ELECTRIC CARS IN EU (Jan-June 2018)

- Nissan Leaf 18,080
- Renault Zoe 17,394
- BMW i3 11,348
- Mitsubishi Outlander 9,771
- VW e-Golf 9,820
- Tesla Model S 7,700
EUROPEAN BATTERY CONSORTIA

• SAFT (FRANCE)

• TERRA-E (GERMANY)

• NORTHVOLT (SWEDEN)
RATIONALE FOR FARADAY PROGRAMME

• “A well-coordinated national research programme would send a strong signal to the automotive industry that the UK government is serious about getting ahead of the game in battery R & D and has an industry-focused strategic vision”

• The research community will need to work together “as a synergistic strategic collective rather than a large number of small uncoordinated groups” – Sir Mark Walport, March 3, 2017
THE £246m SUPPORT PROGRAMME

• £78m for research – Faraday Institution

• £88m for innovation – Innovate UK

• £80m for scale-up – Warwick prototyping and pilot production facility (UK Battery Industrialisation Centre)
QUESTIONS

• Given the expected growth in electric car sales, why does government need to support the battery sector?
• The battery supply chain is global – does the UK need to be represented in all phases?
• How much will the absence of cell-making plants affect investment in the motor industry?
• Is the existing UK battery sector strong enough to be the basis for a world-leading industry?
• Is the government’s battery programme a good model for other industries/technologies?