Economics update

November Conference

Stephen Gifford, Head of Economics
November 2019
1. Global battery market
2. Key factors influencing EV take-up
3. Capturing the EV economic benefits for the UK
4. Non-EV markets
THE GLOBAL BATTERY MARKET IS GROWING FAST

- Global demand is growing faster than forecasters can forecast!
- Around 85% of demand in 2030 is from the EV market
- Energy storage and electronic devices make up the rest of the market

Source: Avicenne Energy
REGULATION: THE EV MARKET IS TRANSITIONING FROM A INCENTIVE-BASED MARKET TO ONE DRIVEN BY REGULATION

- New EV models will start to flood the market from 2020/21
- Production cycle times mean the likely auto market for 2020-2025 is already well known
- Design decisions are being made now on the technology for the 2030s market

Average CO2 emission level for new passenger cars in the EU

Source: EU / International Council of Clean Transport
COST: EV PURCHASE PRICE WILL REACH A TIPPING POINT IN THE EARLY 2020S

• EVs expected to reach parity in the next few years (between 2022-2024 depending on source)

• Total cost of ownership for average model already cheaper for EVs

Source: BNEF EVO2019

EU pre-tax retail price for medium ICE and BEV
Insufficient range is a key barrier but has declined from 55% to 48% in the past year.

EV owners want improved charging times.

Non-EV owners are concerned about:

1. Purchase price (83%)
2. Charging network (80%)
3. Lack of rapid charging on motorways (79%)

Source: 1 AA Populus Driver Poll 2018

Source: Baringa – Is the UK ready for Electric Cars
EV demand will support 8 Gigafactories in 2040

UK manufacturing capacity of 60-200 GWh in 2040

UK industry of 246,000 employees in 2040
COMPETITIVENESS: UK CELL MANUFACTURING CAN COMPETE WITH EUROPE AND EVEN WITH CHINA UNDER THE RIGHT CONDITIONS

- Compared the potential costs of lithium battery cells manufactured in the UK with China & Germany
- The UK has a slight advantage over Germany, but China outperforms both
- State subsidies and a working concentrated supply chain favours China
- But with government support the UK could compete with China

### Costs of cells delivered to the UK by country of manufacture ($/kWh)

- **UK**
  - Tariffs
  - Transport to the UK
  - Profit
  - Warranty
  - R&D

- **Germany**
  - Tariffs
  - Transport to the UK
  - Profit
  - Warranty
  - R&D

- **China**
  - Tariffs
  - Transport to the UK
  - Profit
  - Warranty
  - R&D

- Hardware
- Electrolyte
- Separator
- Anode
- Cathode

3. Capturing the EV economic benefits for the UK
SKILLS: EXTENSIVE TRAINING AND SKILLS DEVELOPMENT REQUIRED

3. Capturing the EV economic benefits for the UK

- 75% of the workforce for a Gigafactory and its supply chain will need experienced level 2 & 3 technicians in advanced manufacturing.

- Fire, police, ambulance, and service personnel will also need new skills to handle EV accidents and repair.

<table>
<thead>
<tr>
<th>Job examples</th>
<th>ICE value chain</th>
<th>EV value chain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine calibration engineer</td>
<td>Retraining required</td>
<td></td>
</tr>
<tr>
<td>Fuel system engineer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Embedded design engineer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Circuit engineer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Systems engineer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EDU component engineer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test engineer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power electronics engineer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Battery research engineer</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- 75% of the workforce for a Gigafactory and its supply chain will need experienced level 2 & 3 technicians in advanced manufacturing.

- Fire, police, ambulance, and service personnel will also need new skills to handle EV accidents and repair.

Jobs impacted by uptake of EVs:

- Vehicle technicians, mechanics, electricians
- Police services
- Ambulance services
- Fire services
- Retail sale of automotive fuel
**Develop and embed the next generation of cutting-edge automotive technologies**

- £1 billion fund announced
- Investment in the manufacturing of batteries (cells, modules and packs)
- Research and development into new, advanced EV technologies
- Investment in electric motors, power electronics and hydrogen fuel cells
- Builds on the £1 billion Advanced Propulsion Centre and £274 million Faraday Battery Challenge

---

**Electric Revolution & construction of three battery plants**

- £2 billion announced for Gigafactories
- £500 million into four metal reprocessing plants to reprocess cobalt and rare earth minerals
- £500 million for research and development in electric, connected and autonomous car technology

---

Conservative Party/Government Press release (15 October 2019)

Labour Party Press release (24 September 2019)

---

**3. Capturing the EV economic benefits for the UK**
WHERE SHOULD WE FOCUS NEXT?

Share of transport greenhouse gases in the EU

- Road transport accounts for 72% of greenhouse gas emissions from transport
- Transport is the sector with the largest emissions (27% of greenhouse gas emissions)

Source: European Environment Agency
FALLING COSTS OF ENERGY STORAGE ARE LEADING TO INCREASED UPTAKE IN DEVELOPING COUNTRIES

• Opportunity to provide cheap, clean and reliable electricity in developing countries: Market of 720 GW

• Diesel generator replacement market is particularly substantive market

Source: Vivid Economics
Discussion points

- Take-up of EVs in the UK
- Government intervention in the UK EV & battery industry
- Opportunities the Faraday Institution’s research should focus on
Thank you