UNIVERSITY OF Southampton

The role, value and needs of Energy Storage to Net-Zero 2050 - Transport

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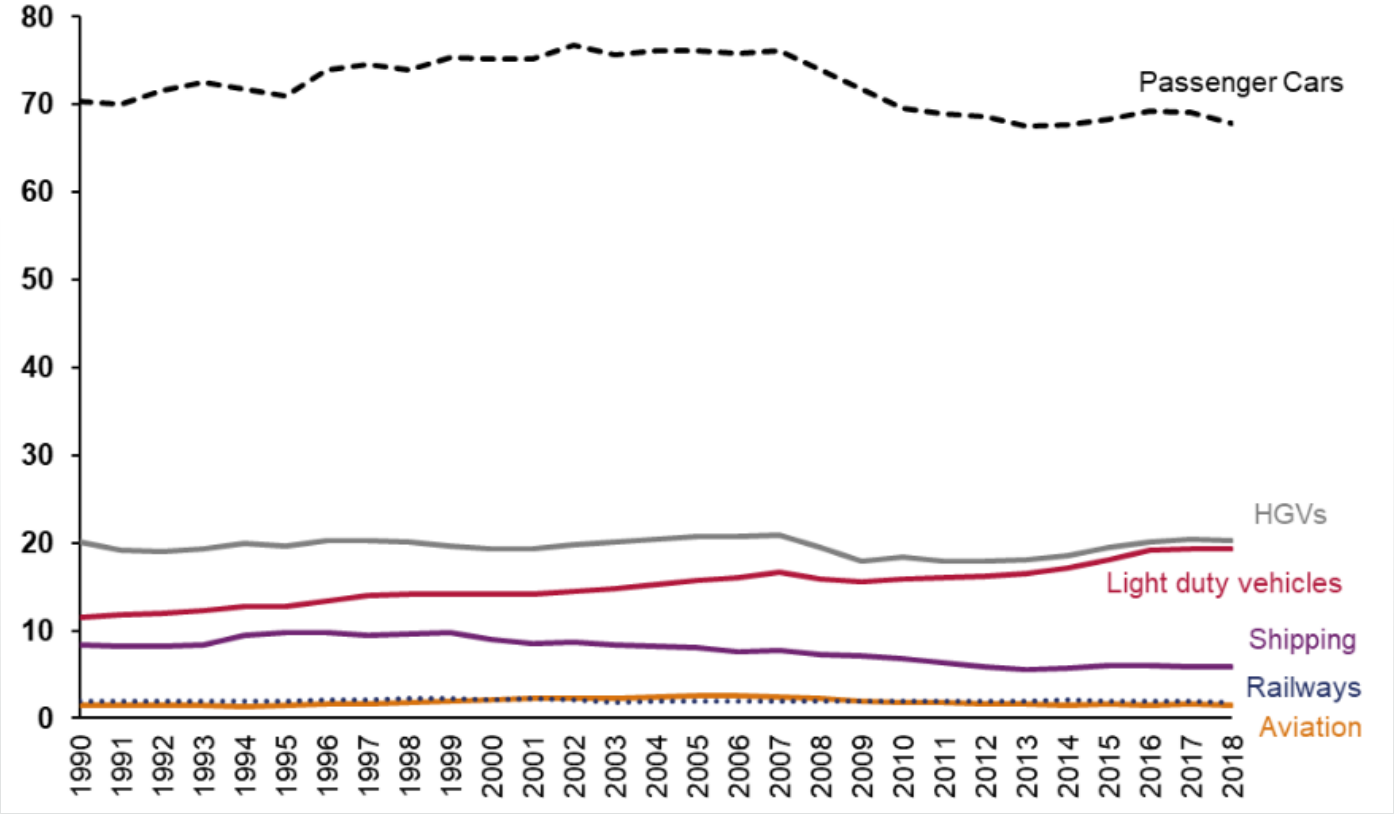
1st Sept 2021

Context – legislation

- UK will end the sale of new petrol and diesel cars by 2030
  - Consulting on a date for phasing out the sale of new diesel HGVs
- Rail – aiming to remove diesel only trains by 2040
- Maritime – IMO target of 50% GHG reduction by 2050
- Aviation – introducing sustainable aviation fuel (SAF) and exploring 'FlyZero'

Context – CO_2 Emissions by transport category

Figure 3.2: Estimated emissions of carbon dioxide ($MtCO_2e$) by transport category, UK, 1990 to 2018



Energy Storage Market

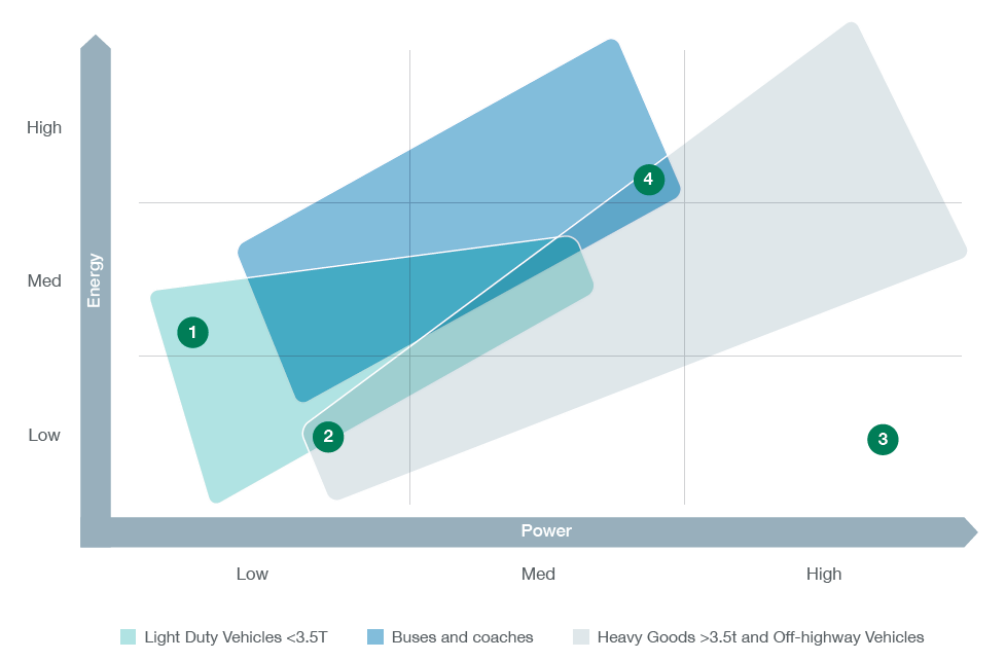
- Global battery demand expected to increase by 14 fold by 2030 (WEF, 2019)
- Global battery market estimated at $150bn by 2030 (Avicenne, 2020)
  - Global fuel cell market forecast to hit $9bn by 2030 (Global Market Insights, 2021)
- The market for EV batteries is already ten times greater than for grid-scale batteries (IEA, 2020)

Energy Storage – Performance Requirements

- See Advanced Propulsion Centre (APC) – automotive roadmaps (batteries and fuel cells)

Energy-power spectrum across applications

Propulsion systems are tailored to specific power and energy demands, based on their use case and duty cycle. The graph below presents an outline of principle mass-market products.



https://www.apcuk.co.uk/technology-roadmaps/

Role of Energy Storage in Transport … not just cars!

Yacht

Fuel Cell Powered Electric Airplane

Lawn Mower

Scooter

Submarine!

Segway

Lithium-ion Battery Waste

- Increasing concern over the anticipated volumes, and processing challenges, of ‘end-of-life’ Li-ion batteries

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Millions of electric car batteries will retire in the next decade. What happens to them?
The quest to prevent batteries - rich in raw materials such as cobalt, lithium and nickel - ending up as a mountain of waste
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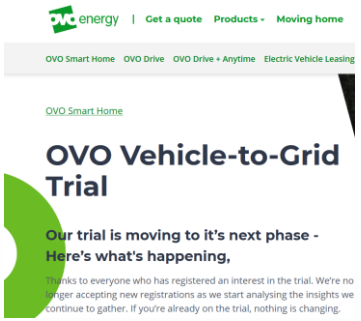
About this content
XiaoZhi Lim
Fri 20 Aug 2021 13.00 BST

Increased Regulation is being developed…

- Dec 2020 the EU proposed updated battery regulations:
  - target rates of 70% for battery collection;
  - recovery rates of 95% for cobalt, copper, lead and nickel and 70% for lithium;
  - mandatory minimum levels of recycled content in new batteries by 2030

Vehicle-to-Grid (V2G) – linking Transport to Grid…

- Aggregated EV batteries can offer substantial bidirectional energy storage;
  - Trials under way e.g. OVO Energy
  - Bus2Grid trial with SSE
- Battery technology neutral



New Battery Technology – Solid-State Battery

- Example: Solbat project – funded by Faraday Institution, actively developing SSB

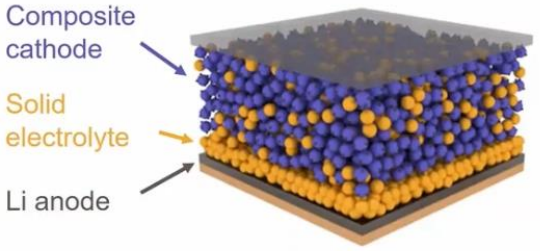
THE FARADAY INSTITUTION

POWERING BRITAIN'S BATTERY REVOLUTION

SOLID STATE BATTERIES - INTRODUCTION

Advantages:
- Safety
- Power density ($t_+ = 1$)
- Enable Li anode
- Longer life

Disadvantages:
- Unproven
- Cost
- Manufacturability
- Electrochemo-mechanics



Energy Density	Current Li-ion	Projected SSBs
Gravimetric (Wh/kg)	250	400
Volumetric (Wh/L)	700	1200

Conclusions

- There remains a technology race – in battery materials as well as battery vs fuel cell
- Significant growth and global Government support and subsidy will deliver change
- Waste and processing challenge clearly recognised
- V2G enables linkage between transport and grid sectors