Session 2b : Storage for Future Mobility
The Transport - Energy Nexus: Challenges and Opportunities

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The CSA: My Objectives

- Provide leadership on developing technology and innovation
- Improve the strategy for science and innovation research and future proof decision making in the DfT
- Position DfT as a leader in science across Whitehall and maximise value of the SAC
- Develop stronger links between science and internal stakeholders and provide strategic science input and evidence into analysis work programmes
- Identify and deliver on a number of high priority scientific issues including:
  - air quality, vehicle emissions and decarbonisation;
  - intelligent infrastructure and smart condition monitoring;
  - older people mobility and accessibility;
  - big data/smart Cities and MaaS;
  - railway signalling/digital railways;
  - drones and future flight;
  - spaceflight;
  - engineering skills; and
  - cooperative and autonomous vehicle
- Support Industrial Strategy and Sector Deals
- Future-proof DfT investment decisions through science
What is driving the agenda?

- Innovation based companies will be attracted to UK cities that will use their technology and skills.
- BIS calculates that the Smart Transport market will be worth $100 million by 2018.

- Technology is influencing all aspects of city life and offers new ways to plan and manage transport according to peoples needs.

- Behaviour shifts have led to new travel options, such as working from home or the using the sharing economy. Mobility for older and impaired traveller.

- Resilience can be improved through technology to anticipate and quickly react to extreme weather events that can cripple transport.

- Transport has a significant impact on poor air quality, technology can reduce this.
- Alleviate pressure on existing infrastructure and services and reduce congestion.

- Increasing urbanisation puts more pressure on transport and new solutions are needed.
- Benefits to travellers can be achieved without large scale infrastructure building.
Some of our challenges

- **Decarbonising transport** on roads, rail, in the air and at sea. By 2050. This will be laid out in the [Road to Zero Strategy](#) due this Spring.

- **£400Bn billion of transport investment** over the next decade, about 25% of which is publicly funded. Transport is 30% of HMG capital spend. **Immense opportunity to deploy new ideas and technologies at scale if we get it right.**

- **External challenges to society** – climate change adaptation, air quality, technological acceleration in transport related topics like AI, robot cars, flying cars, hyperloop, aging, new approaches of the young, productivity, business models etc.

- **Industrial Strategy** goals for the UK to play a leading role in creating and exploiting the new technologies in order to solve the external challenges and lead the World industrially.

- **Delivering the Grand Challenge on Future of Mobility** and ensuring transport is a key theme of the other three Grand Challenges:
  - Ageing Society
  - Clean Growth
  - AI and data

- **Productivity challenge** in our supply chain due to skills, practices, methods, and little built-in research and innovation to drive efficiency and excellence.
Clean Growth Plan

- The primary focus of reducing carbon from road transport was outlined in the **Clean Growth Plan** in October 2017. This primarily looked at road as it is the largest CO₂ emitter that needs to be reduced to meet CB4 and CB5. It also provided funding to reduce the CO₂ from domestic shipping and aviation.

- Key ambition in the Plan include:
  - **To meet the 2050 CO₂ target, all cars and vans will be ULEV by 2050**, with only ULEV cars and vans will be available for sale from 2040
  - **Emissions from heavy goods vehicles (HGVs) will also need to reduce significantly** to make a meaningful contribution towards meeting the UK’s overall 2050 target
  - **Walking and cycling will be made easier for many shorter journeys.** By 2040, we want cycling and walking to be the natural choices for shorter journeys, or as part of a longer journey.
The Road to Zero Strategy will:

- Set out how Government will support the transition to zero emission vehicles;
- Ensure the UK is well placed to capitalise on new economic opportunities and drive down emissions from conventional vehicles.
- Consider GHG and air quality in parallel for the first time;
- Bring together a range of policy initiatives into a single strategy that provided certainty to consumers and industry about Government’s position and priorities.

Strategic priorities are to:

- Drive up uptake of zero emission vehicles;
- Ensure the right infrastructure is in place;
- Prepare for the impact on the energy system;
- Position the UK as the best place in the world to develop and manufacture these vehicles;
- Reduce the carbon and air quality impact of conventional vehicles;
- Develop zero emission solutions for heavier vehicles.
Emerging technologies that we are watching

- Smart infrastructure and construction
- Hybrid and electric aviation
- Hyperloop

Ambition to work much more closely with academic researchers, from individuals up to project and programme scale.

Skills – UK needs 20,000 more new engineers annually. Transport doesn’t even appear in the planned CDTs call.

Missing transport focus in existing RCUK investments – transport treated as a “client” of other research, rather than a worthy topic of work.
There is a clear causal effect of choice of energy vector and emissions of CO₂ and pollutants that affect health, such as NO₂ and PM₁₀ and PM₂.₅. It is essential that both sectors better understand their impact on the other.

In Government, energy is the domain of BEIS, and transport obviously the domain of DfT. OLEV bridges both Departments to lead on low carbon vehicles strategy.

In research funding, transport isn’t even a theme.
ULEVs

- Effectiveness of policies supporting ULEV technologies;
- Regulatory test cycles especially heavy duty vehicles.
- **EV charging infrastructure**, and the effectiveness of current policies.
- **Battery technologies** performance and degradation, with the Faraday Battery Challenge.
- **Hydrogen demonstrations** to explore opportunities to scale up to commercial level, and the **nexus with heat**.
- The needs and attitudes of EV business and personal buyers, barriers to EV purchase decisions, the second-hand ULEV market;
- Integration of vehicles and supporting infrastructure with the energy base.
- LCA of current & future production vehicles
- Emission from different freight technologies.

- Real world charging and driving behaviour of users of ULEVs during use.
- Price & range competitiveness of ULEVs now and in the future.
- **Tools to better forecast ULEV uptake under a range of different scenarios and policies.**
Total Government investment in ULEV is now nearly £1.5 billion until 2020/21

<table>
<thead>
<tr>
<th>Infrastructure Investment Fund (£££m)</th>
<th>~£1.5 billion 2015/16-2020/21 PROGRAMME</th>
<th>Research &amp; Development (£££m)</th>
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<tbody>
<tr>
<td>Plug-in Car Grants (£££m)</td>
<td>Domestic Chargepoint Grants (££m)</td>
<td>Go Ultra Low campaign (£m)</td>
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<td>Plug-in Van and Truck Grants (££m)</td>
<td>Other Infrastructure Grants (£££m)</td>
<td>Go Ultra Low Cities (££m)</td>
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<td>Plug-in Motorcycle Grants (£m)</td>
<td>Highways England Rapids (££m)</td>
<td>Zero and Low Emission Buses (£££m)</td>
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<td>Hydrogen Fuel Cell EV Grants (£m)</td>
<td>Hydrogen Refuelling Stations (££m)</td>
<td>Public Sector Fleet support (£m)</td>
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- **2020**: 3-7% new cars ULEVs
- **2040**: 100% new cars and vans ZEVs
- **2050**: Almost all cars and vans ZEVs

**Advanced Propulsion Centre (BEIS)**
- £500m

**Fiscal Incentives (HMT)**
- £100m

**Plug-in Car Grants (£££m)**

**Go Ultra Low campaign (£m)**

**Go Ultra Low Cities (££m)**

**Zero and Low Emission Buses (£££m)**

**London (££m)**

**Research & Development (£££m)**

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**Infrastructure Investment Fund (£££m)**
Low Carbon Fuels

- Evidence gaps in our transport decarbonisation strategy, ranging from availability of waste feedstock to efficiency of technologies to make sustainable aviation fuels.
- The UK biofuel landscape, including main players, skills, innovations and technologies that characterise the supply chain, and the wider biofuel contributions to the economy.
- Potential of the biofuel supply chain to attract inward investment and deliver exports.
- **Much of this will be in collaboration with the Supergen bioenergy hub.**

Connected & Autonomous Vehicles

- Developing evidence on the potential impacts of new mobility business models
- Understanding the wider impacts of connected and autonomous vehicles

Vehicle standards

- Environmental performance – understand the real world emissions of road vehicles. (ongoing)

Environment

- Vehicle emissions and retrofit technology, and extending the emissions analysis in the Transport Energy Model.
- Emissions of different HGV technologies
- Research to improve models of car, van, HGV fleet emissions, energy etc.
Five Pillars of future ITS/Intelligent Mobility

**Connected**
Moves as part of system...in time, multi-modal
DATA: The key to new network management – people and freight

**Automated**
FULLY automated – can move when empty
HIGHLY automated – needs a « driver »

**Electric**
Ideally electric or other future energy source

**Pricing**

**Shared**
Increased interest in shared fleets and use of “mobility as a service”
The key to place-making benefits

Source: WSP, ITS Montreal
Trends in automation

- Not limited to cars: new technologies such as last mile delivery pods, drones, moving in to areas of traditional transport such as trains, ships and agriculture.

- Changing consumer perceptions. Consumers are increasingly expecting information to be available readily and easily. The smart phone is the only thing some people need to consume transport.

- A move toward a sharing economy. Asset ownership (cars) could be diminishing. Ride sharing and car sharing could lead to a shift away from private car ownership.

- UK ambition to be a world leader with over £300m invested or committed.
Rail

- **Smart grid technologies** improve management of energy on the railway and enable more effective use of local generation and energy storage technologies.

- **Energy transferring infrastructure design** to optimise efficiency of construction and operation

- Real world emissions of existing rolling stock

- Shore supply

- Other potential types of low emission rolling stock such as diesel electric bi-modes, hybrid electric and battery power for trains.

- Decarbonisation of rail freight.

- Use of robotic and modular construction and new materials

- Smart infrastructure to better manage through condition based monitoring and maintenance
Much of the focus is on **improving design of planned elements to reduce energy use**, including reducing embedded carbon in construction materials and carbon emissions from construction works; and reduce energy requirements of the scheme and maximise the energy efficiency of operations.

Potential for innovation in track, system operation and HS2 rail vehicle designs, design of passenger flows, operations and road traffic to ensure efficiency and minimise CO$_2$; use of robotic construction and new materials to reduce CO$_2$ footprint of infrastructure build.

Transfer of horizontal innovation to rail from APC and ATI

Smart infrastructure to better manage through condition based monitoring and maintenance
Maritime

- How can UK become a global leader in zero emission vessel technology and services?
- Scaling up of clean shipping technologies including bunkering infrastructure, battery technologies, sustainable fuels, hydrogen, shore supply.
- Understanding the barriers to the growth of the zero-emission vessel sector.
- Better understanding, measurement and modelling of shipping emissions and CO₂.
- Opportunities for emission reduction from maritime vessel automation.
- Availability of future fuels availability
- Transfer of horizontal innovation to maritime from APC and ATI
Electric powertrains for aircraft and hybridisation.

Improvements in biofuels and other low carbon fuels

Ensuring the Faraday centre include batteries for aviation in the next phase of their work

Jet fuels from waste..

Place of fuel cells in aviation

Low carbon flying taxis

Hybrid engine design

Scaling up of innovation opportunities and supporting the Industrial Strategy
Key Take Aways
De-Silofication

- Energy as a whole system
- Transport as a system not just a set of loosely connected modes
- How is industry engaged?
- Coordination on CO₂ across modes and OGD’s
- Clear recurring themes:
  - Batteries (Faraday Institute)
  - Biofuels
  - Hydrogen
  - Lightweighting
  - Scaling up of innovation opportunities
  - Supporting the Industrial Strategy
  - Role of Automation