Paper no: AC1012/02: Technology Council Report to the Automotive Council

Members' brief:

- The NAIGT process delivered the Technology Road map as a key product which has built a wide consensus and is influencing other industries.

- Many members of the Automotive Council may not have engaged closely with it to date and therefore Jerry will provide an opportunity to discuss.

- The NAIGT Technology Working Group has continued informally to engage in the last 6 months, including consideration of TSB-funded work on UK strengths and weaknesses. This has had wide informal circulation and is proving influential.

- Members will be asked to **AGREE** the actions that appear in paragraphs 6, 6.1, 6.2 and 6.3.

- Members will also want to **REFLECT** on how the TSB analysis reflects their assessment of UK strengths and weaknesses and how it can be used to promote inward investment into the UK supply chain.

Automotive Council Secretariat

1. Automotive Technology Council

1. 1 The automotive Technology Council aims to:

- Identify opportunities to provide a more compelling investment proposition for automotive R&D in the UK versus other countries
- Agree on the technology roadmaps for low carbon vehicles and fuels, and exploit opportunities to promote the UK as a strong candidate to develop these technologies
- Develop a stronger supply base through joint research on focused areas driven by a common agenda and by brokering collaboration opportunities

2. Low Carbon Vehicle Product Road Map

2.1 OEMs share a common product technology roadmap and recognise the same technical and commercial barriers. Individual manufacturers will implement technologies which best address their own brand values and market sectors.

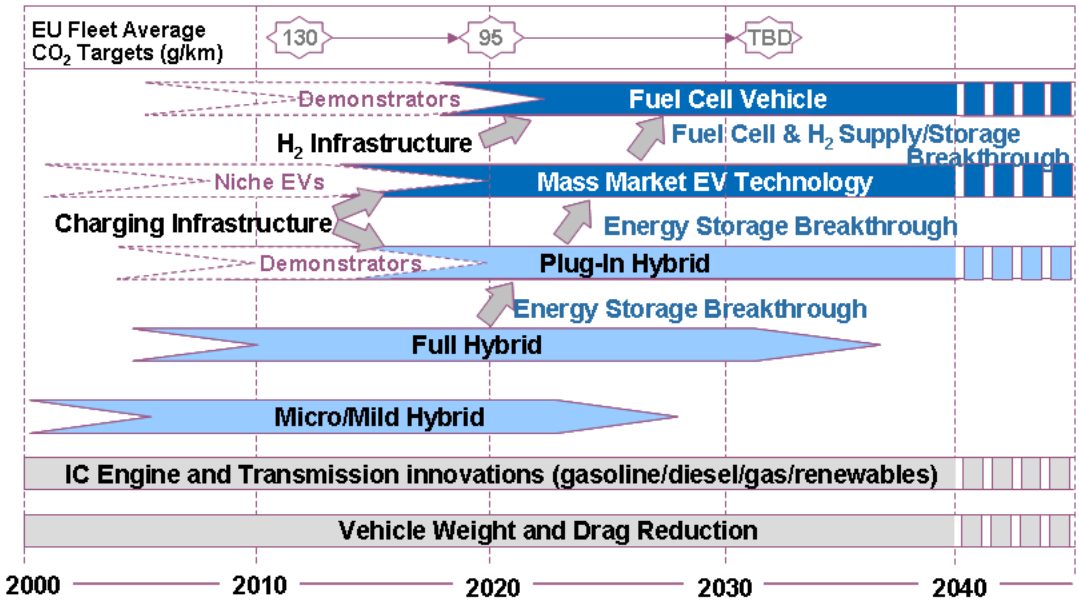
2.2 In the near to medium term, improvement of conventional Powertrain and transmissions can have a significant impact on fleet average CO2 by providing moderate benefits for a large proportion of the fleet. We expect that the battery range and cost issues, together with the infrastructure implications, will mean that pure electric car growth will increase to between 1m and 3m cars globally by 2020.

2.3 This means that over 90% of all the CO2 the industry will save in the next ten years will come from IC Powertrain and vehicle technologies, where the UK has a large installed base.

2.4 Introduction of increasing levels of hybridisation / electrification is highly dependent on the availability of battery, motor and power electronics technology with high power density, high energy density, and low cost and the economic acceptability of this solution in the marketplace

2.5 Widespread uptake of electric vehicle technology is critically dependent on availability of batteries with low cost and high energy density, along with the availability of infrastructure to deliver clean electricity to point of use.

2.6 Adoption of fuel cell technology relies on overcoming significant technical hurdles in relation to fuel cell durability and cost reduction, hydrogen storage, sustainable hydrogen production and development of a hydrogen delivery infrastructure.



3. Low Carbon Research Development Roadmap

3.1 The research development roadmap identifies the technologies that are likely to be required in order to deliver the product roadmap.

Research Development Roadmap

	SHORT TERM 5 – 10 years from production	MEDIUM TERM 7 – 15 years from production	LONG TERM 10 – 20 years from production
	INDUSTRY		UNIVERSITIES
Propulsion	• IC engine optimisation • Boost systems for downsizing • Flexible valve/actuation for engines/transmissions • Low cost compact e-motors	• Higher efficiency IC engines • Capacitive boost systems • All electric actuation systems • Optimised range extender engine • Lower cost e-motor • Heat energy recovery (e.g. E-turbine)	• Super high efficiency motors (superconducting) • New IC engines with 70%+ thermal efficiency • Advanced heat energy recovery (e.g. thermoelectric) • Motor/Fuel Cell materials
Energy Storage	• Improved quality / durability 200+ Wh/kg & $800/kW.h cost battery systems • Low cost power electronics	• Next gen batteries 300+ Wh/kg and $500/kW.h cost • Flexible power elec. modules • Other forms of energy recovery (mechanical/chemical etc)	• 3rd gen batteries 400+ Wh/kg & $200/kW.h cost • New low cost solid state power conversion systems • Hydrogen storage technology
Vehicle Efficiency	• Lightweight structures and interiors • Low rolling resistance tyres / brakes	• New vehicle classes and configurations • Combination of function to reduce weight / cost • Minimised weight / losses	• Flexible re-configurable multi-utility vehicle concepts • 50% weight reduction from 2008 • Advanced aerodynamic concepts
System Control	• Information enabled control (Topology, V2V, V2I, traffic etc.) • Optimised vehicle energy mgmt. • Intelligent thermal management	• Advanced information enabled control • Intelligent P/T and HVAC mgmt.	• Autonomous P/T and vehicle control integrated with active safety
Energy + Fuel Supply	• Optimised 1st gen biofuels processes • New 2nd gen biofuel processes	• Intelligent energy / re-fuelling infrastructure (e.g. fast charge) • Industrial scale demonstration of new 2nd gen biofuel processes	• 3rd gen biofuel processes • 2nd gen industrial scale biofuel production infrastructure
Processes + Tools	• Process + delivery tool development and connectivity	• Auto-optimisation methods using virtual systems	• Artificial Intelligence to deliver complex multi-criteria system optimisation

3.2 The Product Roadmap and the Research Development Roadmap have already been used to inform recent TSB funding calls.

4. Assessment of UK Automotive R&D Priorities

4.1 Subsequent to the NAIGT report the Evidence Base for UK Capability and Potential was developed through a consultative process involving 51 different organisations. The extract included below lists the technologies that offer the UK a greater level of return on investment over time. These are based on the assessment of;

- Evidence of UK technology strengths and limitations gathered in consultation
- Qualitative evaluations of the required effort to meet the Product Roadmap and the potential for UK value capture

4.2 This is the foundation document to support strategic R&D decision making of the Automotive Technology Council.

Evidence Base of UK Capability and Potential

	Technology Category	UK capability			Research Area Focus (selected items of interest)			Qual. ease of delivery	Qual. benefit to UK	Indic-ative "ROI"
		S	M	L	Short	Medium	Long			
A	FIE	Y	G	G	High pressures, more flexibility, hybrid app's	Design for biofuels		→	↑	↗
	Engines for HEV/PHEV		G	G	Simple, light engines for niche app's	Optimised engines		↗	↗	↗
	Integrated engine design & development	G	G	G	Flexfuel engine optimisation	Extreme downsizing concepts		↗	↑	↑
B	Electric motors	G	G	G	Low cost, compact	Lower cost	Super high eff., new materials	→	→	↗
	Hydrogen fuel cells		Y	Y	Support to demonstrators	Efficiency, cost improvements	New MEA materials	↓	↗	→
	Power electronics	Y	G	G	Low cost	Flexible	High temp, new materials	→	→	↗
C	Adv trans fluids	G	G	G	Fluids for low friction	Nano technology		→	↗	↗
D	Battery pack int.	G	G	G	Thermal control, safety/crash protection			↑	→	↑
	Mechanical energy storage tech.	G	G	G	Tech demonstration for benefits			↗	↗	↑
E	Lightweight structures	G	G	G	Lightweight steel, aluminium	Carbon fibre composites	Smart components & materials	→	↑	↑
F	Vehicle energy mgmt	G	G	G	Thermal mgt, e-ancillaries	Energy mgt strategy PHEV,EV	Energy mgt strategy fuel cells	↑	→	↗
	Driver info systems	G	G	G	Economy aids	Innovative driver interaction methods		→	→	↗
	ITS		G	G	Info enabled control: topology, V2I	Electronic horizon: incl. traffic, V2V		↘	↗	↗
G	Electrical infra.		G	G	Smart metering / charge points	Future charging options (e.g. fast charge)	Smart grid / energy mix	↑	↑	↗
H	Advanced process tools	G	G	G	Virtual prototyping			↗	→	↗
	Integrated tool-chains	Y	G	G	Multi-domain modelling	Standards for tool integration		↗	→	↗
	Auto-optimisation methods	Y	G	G	Multi-attribute optimisation			↗	→	↗

5. Strategic Technologies for the UK Automotive Industry

5.1 Subsequent to the NAIGT report the Automotive Technology Working Group, an expert group consisting of companies who have a 'significant Automotive R&D presence in the UK' has started the detailed study of the Product and Research Roadmaps and the Evidence Base and has proposed the initial four strategic areas for further study.

Internal Combustion Engine

5.2 Development of the internal combustion engine offers the most effective short term route to CO2 reduction. The UK already has all the necessary elements of the supply chain from research to mass production. There are strengths to be leveraged such as companies with a fundamental expertise in

combustion technology, active fuels and lubricants companies and expertise in motorsport engine technology. The weakness is the lack of key Tier1 suppliers

5.3 Proposal - invest in the development of the next generation low CO2 engine technologies and the development of engines for Range Extended Vehicles. Study how to attract key Tier1 suppliers of engine components to participate in UK development activities.

Energy Storage and Energy Management

5.4 Energy storage and Energy Management are fundamental technologies to support the mid and long term low carbon vehicles, hybrid, electric vehicles and fuel cell vehicles. The UK has fundamental research ability in battery chemistry, flywheel technology and capacitors. The weakness is that the UK has an underdeveloped supply chain to move from start up companies to mass production of these technologies. Some OEMs have elected to conduct this activity in house but there are other OEMs that are actively seeking external support. There is an opportunity to encourage the product development and supply chain capability around integration of these components into vehicle ready systems – i.e. the packaging of cells into packs and the supply of packs, or the combination of flywheels and batteries.

5.5 Proposal - invest in the research and development of Energy Storage and Energy Management systems. Study how to develop an integrated UK supply chain for these technologies.

Lightweight Vehicle and Powertrain Structures

5.6 Lightweight vehicle and Powertrain structures are applicable to all future Low Carbon vehicles. Lightweight technologies could be a disruptive force in terms of vehicle manufacturing and assembly method. The UK has expertise in lightweight aluminium and steel vehicle technology, lightweight motorsport technology and niche vehicle development and manufacturing skills. The UK Aerospace industry provides an opportunity for cross industry collaboration. All the supply chain elements are present in the UK but are not necessarily linked today.

5.7 Proposal – invest in an integrated collaborative research programme and the development of a lightweight concept vehicle to explore the opportunities. Promote collaboration between Automotive and Aerospace companies in the UK

Power Electronics and Electric Machines

5.8 The UK has some excellent fundamental technology around Power Electronics and Electrical Machine design. There is an opportunity to develop a world class design engineering capability in this area. However there is no supply chain to develop these technologies to mass production at this time.

The UK may have aspiring companies in this field but it is unclear how to develop the supply chain to compete with the emerging competitive countries.

5.9 Proposal - invest in the research and development of Power Electronics and Electric Machine systems. Study how to develop an integrated UK supply chain for these technologies.

6. Recommendation to the Automotive Council

6.1 The strategic technology proposals have been reviewed by the NAIGT Steering Committee and are endorsed for Automotive Council approval.

6.2 We recommend that the Automotive Council promotes partnerships and collaborations in the 4 key strategic technology areas.

6.3 Universities, R&D groups, SMEs, UK Tier1/2/3 suppliers, invited Global Tier 1 suppliers and OEMs will be encouraged to work together and leverage both UK and EU financial support to seize the opportunity to develop these technologies here in the UK.

7. Technology Council next steps (Short Term)

- Automotive Technology Council to continue to study the Low Carbon Vehicle Roadmaps and Evidence Base of UK capability and potential to develop further the Strategic Technologies for UK Automotive

- Set short term objectives to drive the technology development towards the goals set out in the Product Roadmap

- Promote the Test Bed UK concept to Global Tier 1 and beyond