

# Technology Strategy Board

Driving Innovation



# Transport

**INTERIM STRATEGIC ASSESSMENT**

**SEPTEMBER 2009**

**TRANSPORT APPLICATION AREA**

# Transport

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### Executive summary

Transport is essential to every aspect of a modern society and plays a key role in supporting economic growth - a 5% reduction in travel time for all business and freight travel on the roads could generate around £2.5bn of cost savings – or some 0.2% of GDP<sup>1</sup>. This challenge, coupled with an evolving low carbon economy, offers the UK's industry base significant opportunity for wealth creation.

This document presents our preliminary views on the business challenges facing the UK transport sector and the ways in which technology can be exploited to meet them.

We have produced it to prompt discussion and elicit feedback from business and other organisations involved in the sector. We would like to hear your comments and will use the feedback to develop our future investment strategy for the Transport Application Area.

As we move forward, we'll use this as the basis of our decisions on where to prioritise our investments to best meet the needs of the sector over the next three years (2009-11).

To give feedback and comment on this document email: [transport@tsb.gov.uk](mailto:transport@tsb.gov.uk)

### How do we see the market drivers and challenges?

Increased demand for passenger and freight transport is outstripping capacity and as a result is having an adverse impact on the environment, the economy and society. The challenges this has created for government and industry are articulated in the Department for Transport's *Towards a Sustainable Transport System* report and re-emphasised in the more recent *Delivering a Sustainable Transport System* reports<sup>2</sup>.

Building on this, our analysis has identified three major challenges for the sector:

- reducing emissions of carbon dioxide (CO<sub>2</sub>) and other greenhouse gases (GHG) from transport to help tackle climate change
- delivering reliable and efficient transport networks and reducing congestion
- sustaining and expanding a competitive and innovative transport manufacturing/service industry.

At the same time, the introduction of new technologies and systems must go hand in hand with ensuring that people and the environment are not put at risk, that there are no adverse impacts on health and safety for users and operators, and that

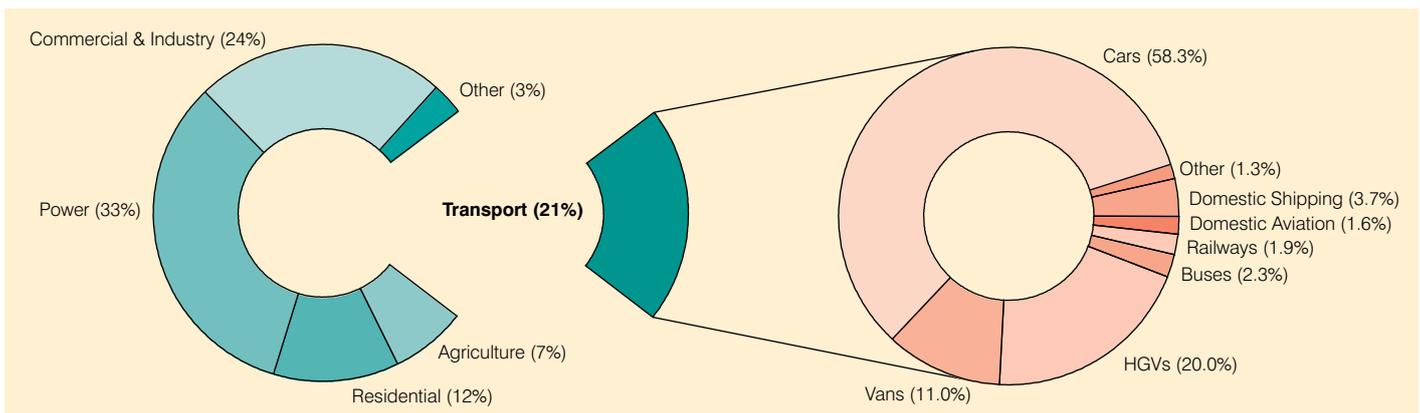
accidents are reduced. These issues themselves offer a range of opportunities for UK industry to exploit.

### Challenge: emissions and climate change

Carbon dioxide has been identified as a significant greenhouse gas and a major challenge for industry to address because of its predicted impact on climate change and future economic performance<sup>3</sup>. The UK's Climate Change Act<sup>4</sup> mandates a reduction in domestic CO<sub>2</sub> emissions of at least 26% by 2020 and of at least 80% by 2050 (from 1990 levels).

Currently, 21% of total domestic GHG emissions are produced in the transport sector. A major factor in this is the use of hydrocarbon-based fuels such as petrol and diesel, since currently almost all transport energy in the UK is provided by such fuels. Although more than 90% of transport CO<sub>2</sub> emissions are due to road transport, emissions from other types of transport are increasing as demand for passenger and freight transport continues to grow. Currently, these figures do not include the contribution of international aviation and shipping, which the Committee on Climate Change states should be taken into account for longer term emission reduction targets<sup>5</sup>.

Figure 1: UK Greenhouse Gas Emissions (2007)<sup>6</sup>





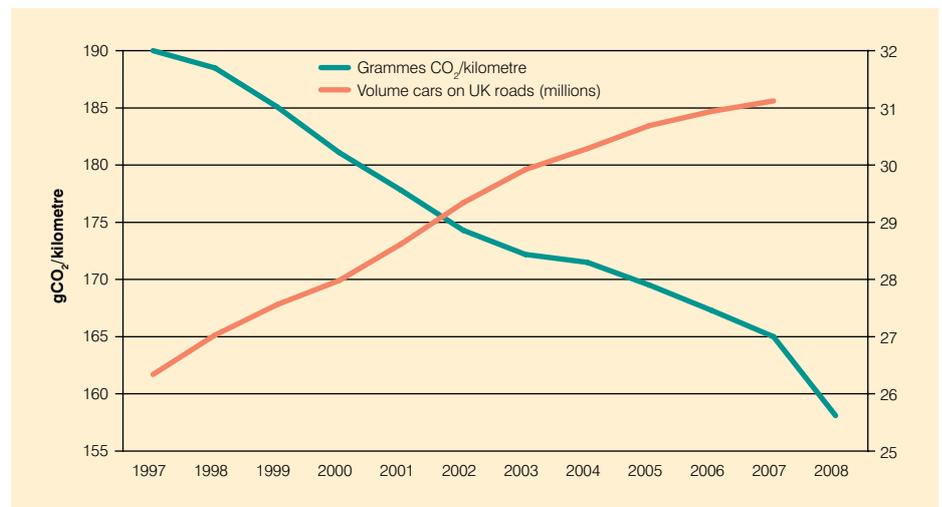
## Government and industry setting emissions targets

In 2008, the Advisory Council for Aeronautical Research in Europe (ACARE) reviewed and updated its strategic research agenda<sup>7</sup>. The strategy is based on social aspirations (cleaner environment, safer travel and more security) as well as the benefits of a more industrially competitive Europe. Like the first strategy in 2001, it was produced through a joint effort by industry and policy makers across Europe. The strategy defines emission reduction targets that cover aircraft, aircraft management and the environmental performance of the aerospace industry's manufacturing base and states that achievement of these goals will require 'important breakthroughs both in technology and concepts of operation'. The targets include: reducing CO<sub>2</sub> emissions per passenger kilometre by 50%, cutting noise to 50% of current average levels and achieving an 80% reduction in NO<sub>x</sub> emissions. It also describes how air traffic management and, more generally, minimising industry impact on the environment through greener manufacturing, maintenance and disposal have an important role to play.

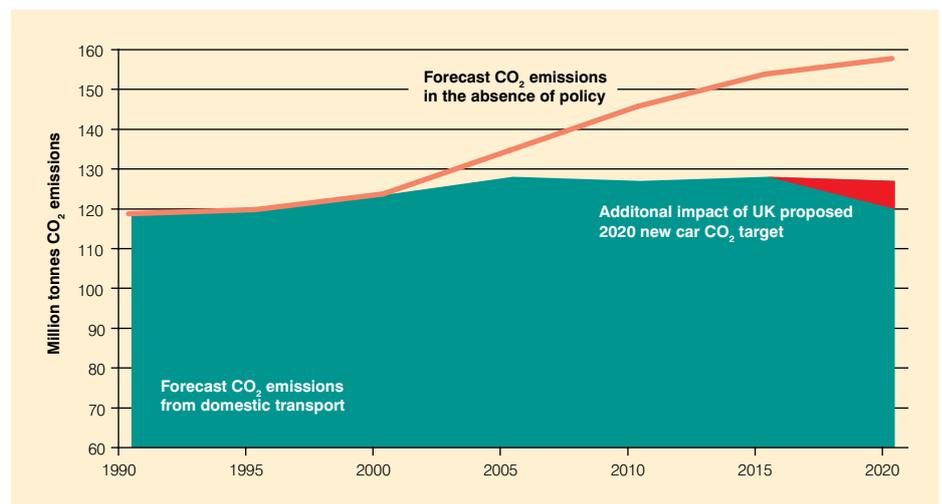
Policy and regulation have been at the heart of emissions control in the transport sector. For many years, this was led by concerns over air quality and pollutants such as carbon monoxide, nitrous and sulphurous oxides (NO<sub>x</sub>, SO<sub>x</sub>), particulates, other hydrocarbons and noise. Regulation has driven vehicle developers to introduce new technologies and systems to reduce vehicle emissions and alleviate their negative impact. While these pollutants still remain a concern in terms of air quality and climate change, CO<sub>2</sub> and other GHGs have risen up the agenda for the transport industry and society to address.

The transport sector accepts that emissions targets must be addressed as, despite new technologies that have reduced vehicle CO<sub>2</sub> emissions per mile travelled, increasing demand for all modes of transport means that, if improvements are not made, CO<sub>2</sub> emissions will continue to rise. The major contributor to UK emissions will still be the growth of road transport<sup>8</sup>.

**Figure 2: UK average new car CO<sub>2</sub> emission and car volumes on UK roads<sup>9</sup>**



**Figure 3: Historical and forecast CO<sub>2</sub> emissions from domestic transport, UK<sup>10</sup>**



New technology continues to play a significant role in addressing this challenge. Industry is already investing heavily to help resolve the problem through improved vehicle performance, new power systems and alternative fuels, all of which require extensive scientific and engineering research and development.

The Technology Strategy Board and national and regional government see climate change as an opportunity for wealth creation and, together with industry and academia, are investing in technologies and systems that address this challenge. These range from power electronics and components for electric road vehicles and infrastructure, through to engines and wings for the next generation of single aisle aircraft.

### **Challenge: reliable and efficient transport networks**

The Department for Transport states that in certain places the current capacity of transport networks cannot meet the demand that is, or will be, placed on them. This results in delays and, more importantly for business, adds cost to their operations because of the inability to predict journey times reliably.

Congestion across all modes of transport is not just an inconvenience in terms of lost time. It also costs the UK economy billions of pounds a year, which the *Eddington Transport Study* estimated could be £7-8bn of GDP per annum for road congestion alone. Air traffic delays are also a problem. Queues of passengers on the ground and aircraft in the air also have an economic cost and recently the US Federal Aviation Authority estimated 'air traffic delays cost the US economy up to US\$41bn in 2007'<sup>11</sup>.

### **Congestion**

The inefficiency congestion causes also drives up emissions of GHGs and pollutants. Large urban environments, inter-urban corridors and international gateways bear the brunt of transport congestion as these are areas where volumes of road, rail and air traffic are greatest, but even away from such centres, accidents and adverse weather conditions create localised congestion that is equally disruptive and costly at a local level. As demand for passenger transport and freight movement grows, congestion and inefficiency across the transport network is likely to worsen in the future and have an even greater impact.

Investment in new infrastructure is one option, but is often difficult to introduce because of economic, environmental or social reasons and may only deliver short-term benefits as demand grows. Optimising the performance of the network through the introduction of new vehicle and infrastructure technologies enables improved network management that can also deliver more sustainable benefits. It also provides the opportunity to generate real-time data on traffic conditions and network status that can be used to better inform the travelling public.

The trialling of active traffic management on the M42 is an example of where new thinking, the introduction of technology, and improved network management, has been successful in reducing congestion and improving journey time reliability. There are opportunities to build on this more broadly across the transport sector to understand how technology can be applied to control vehicle movement better and how the information this creates can be better exploited by transport operators and users<sup>12</sup>.



### **Users**

People obviously play a strong role in the transport system, and decisions made by private and commercial users mean that technology can only deliver part of the overall solution. Understanding why people make certain journeys and why they chose a particular mode of transport is important. If these decisions can be influenced by real-time information on the available options, this could be a way of encouraging people to switch from one type to another. Providing services built around real-time information that allows all users to make better informed journey planning decisions, as well as offering alternative options when there is disruption, could help to relieve demand for journeys on overstretched parts of the transport network.

**Challenge: industrial competitiveness**

The UK possesses world-leading original equipment manufacturers and an underpinning supply chain base that delivers technologies and services to vehicle manufacturers and infrastructure providers across the sector. The UK's strong manufacturing base is already at the forefront of developing low carbon transport technologies and related services. It is essential that this position be sustained and expanded and for UK industry to remain competitive, particularly for strategically important parts of the supply chain. Globalisation and competition from emerging economies present additional challenges to UK industry<sup>13</sup>. As a result there has been fragmentation of some supply chains and the outsourcing and off-shoring of certain technical and operational functions. This has left the UK stronger in some elements of the supply chain than others.

**Aerospace**

The UK's aerospace industry is the largest in the world outside the US. Worth £5.5bn to GVA, 63% of its total sales arise from exports. The sector directly employs over 124,000 people (a 25% increase since 1995) and supports a further 276,000 jobs across the whole UK economy<sup>14</sup>.

In 2008, the industry reviewed and updated its National Aerospace Technology Strategy, which states the UK position on future priorities for the industry<sup>15</sup> and sets out a research agenda for future systems and technologies to be developed based on UK industrial capability. The National Aerospace Technology Strategy provides a tool for the industry and supports its focus on the technologies and platforms required to meet current and future low carbon air transport targets.

**Automotive**

The UK automotive industry remains a major manufacturing sector for the UK economy. It is an industry that has a breadth of engineering expertise that is exploited globally. It contributes £10.2bn in GVA (6.4% of total UK manufacturing value-added)<sup>16</sup>, exploiting home-grown systems strengths across the supply chain in on-road, off-road and motorsport vehicles.

It is the UK's biggest exporter of finished manufactured goods - almost £9bn a year, one eighth the value of all manufacturing exports from the UK. The sector directly employs over 45,000 and it is estimated that a further 384,000 UK jobs are directly supported by the automotive industry in the component supply chain, motor retail and general service sectors<sup>17</sup>. The recent New Automotive Innovation and Growth Team report has provided an up-to-date view on the strengths of the UK industry base and the opportunities that exist around future demands for low carbon vehicle performance and the systems and infrastructures required to deliver them sustainably.

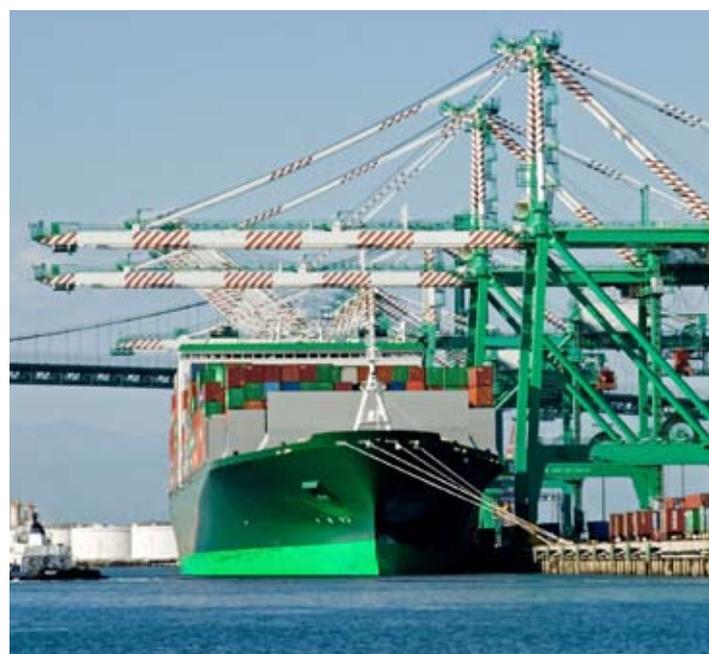
**Marine and rail**

The UK has a strong defence shipbuilding and more general ship repair industry. This is complemented by world-leading leisure craft and marine equipment manufacturers. Directly employing almost 60,000 people, the marine industry contributes £1.6bn to GDP and has a strong export market.

The UK's rail sector is more fragmented, but has a leading position in elements of the financial, operational, engineering and manufacturing parts of the industry<sup>18</sup>, with market leaders in rolling stock and services sectors.

Both marine and rail industries are currently developing roadmaps based on future challenges and national capabilities.

These transportation industries are complemented by service-led industries, businesses from other sectors such as information and communication technologies, electronics and more general systems integrators who develop and implement technologies that help manage the transport network and optimise the movement of people and freight through the transport system. The range of industries that can deliver the needs of the transport sector demonstrates how complex the challenges are and how extensive the opportunities are for innovation and wealth creation.

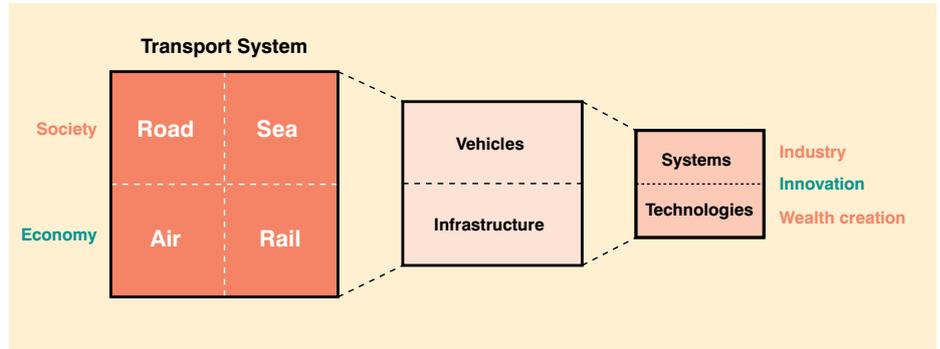


## What is our approach to the sector?

The Technology Strategy Board is taking a holistic approach to the transport sector, considering it as a complex series of inter-related systems. Each of these systems has a role to play in addressing the challenges of climate change and network reliability, and successful integration of the key technologies and transport modes must be achieved to optimise the system as a whole.

We are developing an understanding of how innovation can address today's challenges, but also the wider inter-relationships between society, economy and the transport system to unlock the challenges of tomorrow. To support our thinking, we are working closely with industry to understand its perspectives on the challenges and its business priorities, so that we can assess where UK companies are best-positioned to develop products and services that meet market

**Figure 4: Transport as a 'system of systems'**



needs and help the drive towards a sustainable transport system.

By taking such an approach and by working closely with other investors in research and development such as central and regional government, academia in the UK and the European Commission's research programmes, we can be more effective in assessing where to prioritise our investment to achieve the best returns for the UK as a whole.

## What do we see as the main technology-based opportunities?

The Technology Strategy Board has already published a series of strategies that have assessed UK capability for developing and exploiting a range of technologies<sup>19</sup>.

### The key technologies relevant to the transport sector

Area	Benefit	Example technologies
<b>Materials technologies</b>	Increased energy efficiency and safety	<ul style="list-style-type: none"> <li>■ lightweight vehicle components and structures</li> <li>■ materials and coatings for use in aggressive environments (eg high temperature and corrosive)</li> <li>■ materials design for extended life, recycling and reuse</li> <li>■ enhanced structural durability and safety</li> </ul>
<b>Energy/power</b>	Energy efficiency and safety	<ul style="list-style-type: none"> <li>■ biofuels</li> <li>■ hydrogen and fuel cells</li> <li>■ battery and electrical technologies</li> <li>■ engines and vehicle design for fuel efficiency</li> <li>■ design for integration with new fuels and technologies</li> </ul>
<b>Electronics systems</b>	Improved vehicle/infrastructure management and performance	<ul style="list-style-type: none"> <li>■ sensors and control systems</li> <li>■ power management</li> <li>■ lighting and displays</li> </ul>
<b>Information and communication technologies</b>	Improved systems development and operation	<ul style="list-style-type: none"> <li>■ intelligent transport systems</li> <li>■ modelling and simulation for:                             <ul style="list-style-type: none"> <li>– technology and systems development</li> <li>– transport systems operations</li> <li>– manufacturing</li> </ul> </li> </ul>
<b>High value manufacturing</b>	Underpinning, competitive industrial capability	<ul style="list-style-type: none"> <li>■ manufacturing systems</li> <li>■ automation technologies</li> <li>■ service systems</li> </ul>

There are also elements that cover the whole range of technologies:

- systems integration: understanding how to optimise the performance of new technologies in new or existing systems
- knowledge exchange: understanding how industry needs can be met by technologies or expertise exploited elsewhere either within the sector or in other industries.

## What have we done so far to address the challenges?

The Technology Strategy Board is already making significant investments with industry and public sector partners. Currently, we are investing in a portfolio of collaborative research and development projects across the transport sector that has a current value of over £650m.

Alongside this, we have launched two 'innovation platforms' in the transport sector. We set up innovation platforms to pull together policy, business, government procurement and research perspectives and resources to generate innovative solutions that address specific challenges.

### Low Carbon Vehicle Innovation Platform

We set up the Low Carbon Vehicle Innovation Platform to promote and deliver low carbon vehicle research, development and demonstration in the UK. Currently, this initiative is focussed on addressing the challenge of emissions from road transport as road vehicles are the main contributor of transport CO<sub>2</sub><sup>20</sup>.

### Intelligent Transport Systems and Services Innovation Platform

The Intelligent Transport Systems and Services Innovation Platform aims to deliver research and development that addresses the challenge of establishing reliable and efficient transport networks and specific issues associated with people and freight movement, network management, congestion, user travel information, safety, crime, and infrastructure and vehicle connectivity.

### Other activities

- We made a commitment in our corporate strategy *Connect and Catalyse* to promote the competitiveness of the UK aerospace sector, by aligning investment with the National Aerospace Technology Strategy.
- We have been working with partner organisations at academic, national and regional government levels to align investment and deliver better value to the UK economy.
- We have supported knowledge transfer activities through our knowledge transfer networks in low carbon, aerospace and intelligent transport systems and knowledge transfer partnerships that enable companies to obtain knowledge, technology or skills which they consider to be of strategic competitive importance, from the further/higher education sector or from a research and technology organisation.
- We are working with the Department for Transport to identify how the new SBRI programme can use government procurement to drive innovation. So far the SBRI scheme has been used for a competition looking at 'Synthetic Environments in Managed Motorways'<sup>21</sup>.

## What will we do next?

In the coming years the Technology Strategy Board will:

- develop and publish a strategy that explores and defines how we can make the best investments to meet the challenges of the transport sector and optimise wealth creation
- continue to invest in collaborative research and development, and in the Low Carbon Vehicle Innovation Platform and the Intelligent Transport Systems and Services Innovation Platform
- ensure our technology-inspired strategies keep abreast of developments relevant to the transport sector
- develop a better understanding of issues related to systems integration and knowledge transfer and how these might be addressed through our activities
- continue to work with our partners in industry, central and regional government, the research councils and other organisations involved in investing in transport-related research and development
- launch a knowledge transfer network to cover the transport area and work with it to strengthen industry consensus on challenges and cross-sector networking around the themes affecting the whole industry.

## How you can get involved

This document will be the basis of discussions with businesses and sector organisations to inform the development of a more detailed strategy for publication.

To make your contribution to the debate please contact [transport@tsb.gov.uk](mailto:transport@tsb.gov.uk).



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*The Technology Strategy Board is a business-led executive non-departmental public body, established by the Government. Its role is to promote and support research into, and development and exploitation of, technology and innovation for the benefit of UK business, in order to increase economic growth and improve quality of life.*

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