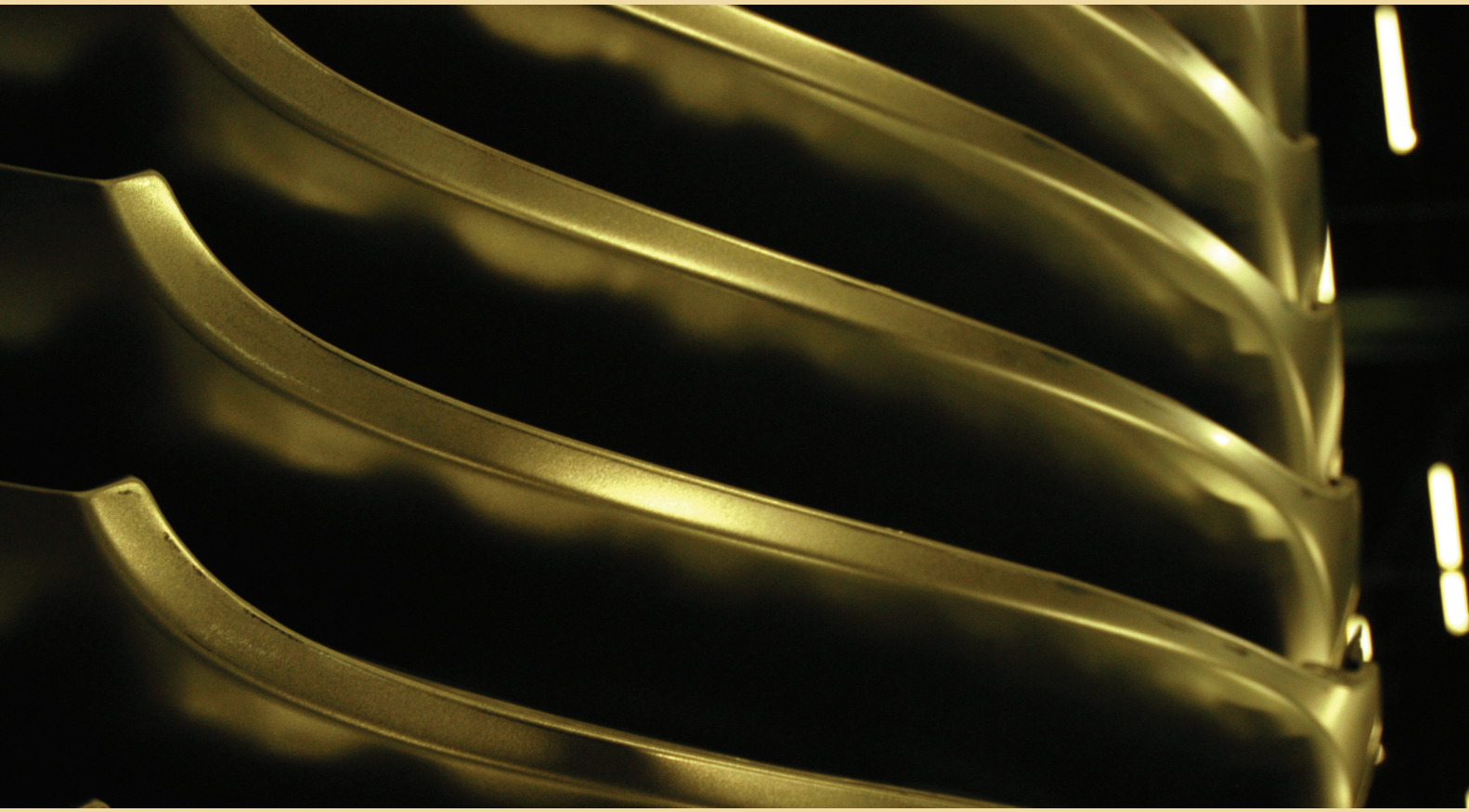
An Independent Report on the Future of the Automotive Industry in the UK

New Automotive Innovation and Growth Team (NAIGT)



A large number of senior people from Automotive companies, Government Departments, Trade Unions, universities and centres of excellence have been involved in the NAIGT.

The report reflects the broad consensus of their views, but does not represent necessarily the views of Government, nor of the individuals, individual companies or organisations involved.

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Foreword by Richard Parry-Jones

The automotive Industry has enthusiastically responded to the Minister's invitation to provide an analysis of the UK automotive sector and develop some recommendations on how we might collectively take the industry forward to ensure its strength and contribution to the UK economy and employment remains very significant.

We present in this report our results and recommendations – unanimously endorsed by all the key participants in the sector. We are committed to success, we have transformed the UK automotive sector in the last decade to a world class player, and we embrace the challenges of international competition and technological revolution to transform the vehicle fleet to a low carbon, much more sustainable system.

We can only do this with close partnership with a pro-active Government, and we welcome their support and look forward to an even more constructive relationship in the future as we implement these recommendations together.

I would like to thank all those who contributed to our work over the last 12 months, especially the NAIGT members, my Expert Group Chairs, their support workers, the staff at BERR, the SMMT and David Bott of the TSB. I would particularly like to thank Rob Smith, who was Project Manager for this team at the BERR until his untimely demise. Our sympathies are with his family and close ones, and we hope that he would have been proud of the results of his work.

Professor Richard Parry-Jones CBE

Executive Summary

BACKGROUND

The Automotive Industry is a large and critical sector within the UK economy. It accounts for nearly half a million jobs, and exports finished manufactured goods worth £8.9bn annually, which represents one eighth of the value of all manufacturing exports from the UK. Furthermore, together with the aerospace industry, it provides a critical bedrock of technology and manufacturing competence for the wider manufacturing sector in the UK.

The industry also includes globally competitive engineering services, construction equipment and motorsport businesses.

Because of the crucial importance of the industry to the UK, in February 2008, the New Automotive Innovation and Growth Team (NAIGT) was given a remit by Shriti Vadera the then Minister for Business to develop recommendations to help secure the future of the industry.

CURRENT STATE ASSESSMENT

The global automotive industry continues to grow worldwide at about 2.5% annually, driven by increasing car ownership in the developing economies. In the mature economies, including the UK, growth is much lower or even absent.

Because of market proximity and local content restrictions imposed by the Governments of many developing nations who wish to encourage the establishment of local automotive sectors, the vast majority of new manufacturing capacity in the last 6 years to support this growth has been in the BRIC countries and within the EU, in Eastern Europe.

Lower labour costs in these developing automotive economies have also stimulated a shift of production eastwards, but this has to date mainly affected the automotive supply base and less so vehicle assembly sites.

Before the present recession, the industry faced the challenges of global overcapacity, unsustainably marginal and inconsistent profitability from many players, and increasing pressure on reducing vehicle emissions, especially CO_2.

The industry's response to this in Japan and Europe has been to invest heavily in productivity through modular design, flexible manufacturing technology and highly skilled shop floor workforces, and in new technologies to dramatically reducing HC, NO_X, particulate and especially recently, CO_2 tailpipe emissions.

The industry has developed a highly integrated industrial system that offers unprecedented value and accessibility to consumers worldwide through efficient logistics, massive scale, global trade, and sophisticated systems integration skills. Technological progress has seen dramatic improvements in vehicle safety, environmental impact, fuel economy, performance and comfort and versatility, while offering an ever increasing choice through model variety expansion.

THE UK INDUSTRY

The UK automotive industry has transformed itself in the last decade from a sector with turbulent labour relations and a poor reputation for quality and productivity to one that is fully competitive. Independent external reliability surveys put UK built cars at the top of the rankings, and productivity and labour relations are among the best in the world.

Until the impact of the global financial crisis, the industry was profitable and self-sustaining in Europe and in the UK.

Technology and modern management practices have transformed the shop floor environment, and product technology embraces lightweight materials, cutting edge design analysis and visualisation tools and the extensive use of integrated electronic systems to extend digital control to most functions of the car.

The climate change agenda is accelerating technological change at an unprecedented rate, and the industry in Europe and the UK has embraced the CO_2 challenge and is investing heavily in people and technology to provide innovative solutions while continuing to offer exciting, safe and satisfying products that people want to buy.

In 2008, 1.65 million vehicles and 3 million engines were built in the UK, by a diverse range of manufacturers in car, commercial vehicle, off-road and premium vehicle sectors. The vehicle production levels (until the present recession began) were relatively stable for some years, but employment has been declining as productivity improved and there has been severe 'hollowing out' of the supply chain. This is important because about 75% of the value of material in a new vehicle is added by the supply chain.

The UK industry faces similar issues to the global industry. While production in the UK does not exceed net demand, the UK industry is not immune from the global overcapacity dilemma, and faces a domestic market where the demand for CO_2 reduction is amongst the most stringent in the world.

In addition, there are a number of unique characteristics of the UK industry that are relevant:

Strengths

- Diverse presence of major Vehicle Manufacturer owners from Europe, Japan, Malaysia, China, Kuwait, India and the US;
- Labour flexibility;
- Productivity;
- Good scale for internal combustion engines (ICEs) manufacture;
- Globally competitive vehicle and power train R&D; and
- Strong premium brands, second only to Germany in global market share.

Weaknesses

- Lack of any global volume vehicle manufacturers (VMs) headquartered in the UK;
- Lack of critical scale for vehicle manufacture (1.7 million versus 4-8 m for France, Germany, Japan);
- Shortage of sufficiently skilled workers – shop floor and R&D;
- Lack of adequate supply base – forcing some VMs and all global Tier 1 suppliers to conduct final assembly operations here and rely on foreign R&D and core technology component development and manufacture;
- Historically high interest rates and strong currency mitigates against export profitability;
- Lack of orchestrated collaboration among manufacturers and Tier 1 suppliers in the UK; and
- Government ambivalence towards the automotive sector and the absence of a consistent long term strategic policy framework.

Compared to other economies with a strong automotive sector, such as Germany, France, and Japan. The UK Government's stance towards the automotive industry has until recently been somewhat ambivalent. This lack of overt, consistent strategic support from the Government, combined with the historically well-documented failures of sections of the industry, had created a negative image for the UK as a preferred place to do business among global automotive players.

This has been reflected, to an extent in the various responses to the impact of the present economic recession; and while BERR's efforts to help have been very welcome, it is clear that there is not as broad a consensus across government here that the automotive industry is vital to the economy as there is among policy makers in of some of our major competitor nations.

RECENT DEVELOPMENTS

With the advent of the worst downturn to hit the industry for decades, the trends to capacity reduction, fixed cost streamlining, consolidation and restructuring have accelerated sharply.

The impact of the turmoil in the financial markets and the economic recession in the short term has not been the major focus of this study. The measures needed to survive the immediate consequences of the financial and market stresses have been addressed by the individual companies and the Society of Motor Manufacturers and Traders (SMMT)[1] working with BERR.

However, the NAIGT group has been closely involved and it is worth highlighting that the measures needed to stimulate demand and provide improvements in cash flow through credit availability and policy support are absolutely vital. Of particular importance is the preservation of the Tier 2 and 3 supply base in the UK, which is in the process of significant collapse as a result of the recession. Without this, the industry faces the prospect of irreversible damage which would endanger its ability to compete effectively and build on the recommendations contained in the rest of this report.

OPPORTUNITIES

Cars provide 90% of all passenger transport needs and commercial vehicles over 90% of all freight transportation needs. This picture is highly unlikely to change in the future, since the advantages in cost and convenience of personal transportation outside very congested urban areas is compelling for most consumers. This will remain the case long after fossil fuels have been phased out. Modal switching offers potential congestion relief for major cities but is not a scaleable, practical alternative to help provide low carbon transport solutions to the UK public. Therefore, the vehicle fleet will undergo a technological transformation to provide a solution that consumers prefer and one that is consistent with the climate change agenda – to provide a low carbon personal transportation system.

The transition from present technology personal transportation to low carbon solutions represents a potential opportunity for the UK automotive sector, but one that we need to be better placed to exploit. In fact, this transition also represents a significant risk, as if low carbon technology is not developed and manufactured here, the present indigenous automotive sector may see significant shrinkage and the UK will become even more dependent on overseas sources.

To transform this threat into an opportunity requires a bold, significant intervention, and a recommendation to achieve this is contained later in this summary and more fully in the main body of the report.

1 www.smmt.co.uk

The regulatory framework provided by the EU in Brussels for a glide path of aggressive CO_2 emissions reduction is the basis for most manufacturers forward technology planning. However, it is essentially a supply-side intervention, aimed at creating obligations for manufacturers and importers to conform to CO_2 emissions levels of a mixed fleet of new vehicles. What is lacking at the EU level is any concerted, harmonised demand-side intervention to complement the present approach and accelerate consumer demand for the low carbon technologies, which face cost and therefore price barriers to adoption at scale.

The UK has an opportunity to provide leadership in this area, and in doing so, create prototype markets for new low carbon products. The approach must be carefully constructed so as to synchronise with ambitious yet realistic timescales to develop new more efficient power trains to make better use of fossil fuels, while more advanced technologies are developed to facilitate the shift to clean electricity. This latter step involves:

- Making cars that use electricity rather than liquid fossil fuel as a primary source of fuel more affordable – via premium and niche offerings initially to gain development learning and move towards scale;
- Switching the generation of electricity away from fossil fuels;
- Providing a charging infrastructure with adequate capacity and sufficient density; and
- Developing second-generation bio-fuels as a further means of reducing fossil fuel dependence for vehicle types that require greater range than electric cars can provide due to energy density limitations.

These factors imply a strategy that encourages both advanced ICE and vehicle technologies for the medium term (to 2020) and large scale electrification for the longer term (to 2025-2030). It is worth resisting the temptation to pick a winner prematurely, however politically attractive it may appear. History teaches us that when the first horseless carriages appeared, powered by a bewildering variety of fuels, and powerplants, it took 30 years between 1870 and 1900, for the ICE engine to establish its dominant position. It is likely to take a similar period for the present switch to emerge with a single winner, if ever. Plurality of solutions in the interim is likely and this is healthy for inter-technological competition.

The creation of a growing low-carbon vehicle market in the UK by intelligent fiscal incentives, provided it has broad support across the political spectrum, can provide manufacturers and suppliers with a sufficient incentive to invest in that technology locally, as it goes some way towards removing uncertainty about demand, and provides 'early adopter' market insights to those who participate. It is critical that these incentives are technology-neutral – in other words, they must be based on desired outcomes, such as CO_2 emissions, not on prematurely chosen technologies, such as electric cars. Logically, it follows that the incentives must be devised on a total carbon chain basis, sometimes known as 'Well-to-Wheels', so as to capture the emissions from power stations, for example. Failure to do this by focusing on tailpipe emissions only will introduce significant failure modes which will obstruct achievement of policy objectives.

Other opportunities include:

- Taking advantage of the shift in public and Government opinion to recognise the value of R&D and manufacturing in the economy;
- Forming much stronger alliances with Government to help drive the sector strategically and channel resources more effectively; and
- Greater collaboration among manufacturers and the supply base in the UK to improve scale – examples include R&D facilities such as test tracks and laboratories, and supply of core commodities such as forgings, castings and logistics.

It is of course a given that great care must be taken to ensure that any collaborative activity proposed here or elsewhere in this report is fully compliant with competition law.

KEY SUCCESS FACTORS

The UK must compete with other nations to secure automotive investments in R&D, manufacturing and assembly operations. At present, the UK offer is not compelling. To create the conditions for greater success, the following critical success factors need to be protected, developed and nurtured:

- A supportive host Government – in policy, rhetoric, tone and responsiveness;
- Industry coordination at a high level to facilitate greater non-competitive collaboration and provide a consensus leadership with a more coherent and effective interface with government;
- Critical mass or scale for operations – often supported by a progressive, strong home market that illuminates and showcases the next significant developments of the sector globally;
- Availability of key skills – management, technical, manufacturing operations; and
- A capable, competitive integrated supply chain of strong Tier 1, Tier 2 and Tier 3 suppliers.

VISION AND RECOMMENDATIONS

The NAIGT vision for the automotive industry in the UK is:

'A competitive, growing, and dynamic industry making a large and increasing contribution to employment and prosperity in the UK, and playing a decisive global role in developing and manufacturing exciting, low carbon vehicle transportation solutions'

To this effect, our recommendations are:

Establish a permanent joint industry/Government Automotive Council to develop, guide and implement a strategic framework for the industry

Key tasks for this body will be to:

- Create a transformed business environment in the UK to provide a more compelling investment proposition 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. Extend this approach to other technologies; and
- Develop a stronger supply base through joint research on focused areas driven by a common agenda, skills provision and enhancement and brokering collaboration opportunities for achieving competitive effective scale in R&D, core technology components and facilities.

These recommendations are described in greater detail in the following sections.

Create a transformed business environment in the UK for the automotive Industry

- Government should place the provision of a world class, efficient, low journey time, high reliability, safe and low carbon personal transportation system as one of its core priorities;
- Government should adopt an explicitly supportive strategy for the automotive industry as part of an enhanced pro-manufacturing agenda;
- This needs to be done on a joined-up cross-Government basis, including the Regional Development Agencies (RDAs), with BERR taking the lead;
- The present complex, arbitrary and often punitive fiscal regime for vehicle ownership and use should be radically overhauled to move to a much simpler, consistent and fair tax regime that incentivises demand for low carbon vehicles. The present regime for encouraging low carbon vehicles is so complicated and disjointed that the desired outcomes are being inhibited;
- The industry needs to do a better job promoting itself to the public and dispelling the sunset industry image. The SMMT should take the lead on this;
- Industry and Government should form a new, very senior level continuous partnership with the industry to steer this strategy into being, and to advocate and deploy resources throughout the sector to optimise synergies among the players. To symbolise and govern this partnership we call for an Automotive Council to be established, building on lessons learned from the Aerospace IGT experience and the previous Automotive IGT;

- This forum should develop further the case for investing in the UK automotive sector, and establish means to pro-actively market this to the international automotive business community. Areas for consideration should include benchmarked R&D support, involving cash-based incentives rather than purely tax-based ones, much simplified business support, the establishment of a new Energy Fund, building on the Carbon Trust, to advise and co-fund investments in carbon reduction both in manufacturing and retailing, and protecting the UK's flexible labour market. The message should provide confidence and certainty to investors that UK plc is in this for the long haul, and is very seriously committed to making it work;
- The **Automotive Council** should also work to identify and implement opportunities for collaboration among VMs and between VMs and Tier 1 Suppliers. Opportunities to share facilities and generic tooling to lower costs and enable a UK manufacturing location to compete for work that might otherwise be done overseas could be identified, a process that is currently very difficult.
- There should initially be a specific focus on the ICE engine sector where the UK designs, machines and assembles nearly 3 million engines per year, yet makes very few of the forged, cast, or machined sub-components or the tooling. These are core industrial capabilities whose leverage, once re-established, goes far beyond the automotive sector.

Co-ordinate R&D efforts to follow the industry-consensus technology roadmap that is a key part of this report. As part of this establish a bold, large scale pilot market to demonstrate, experiment and build the new low-carbon personal transportation system including its infrastructure

- A common technological roadmap to achieve low carbon vehicles has been agreed among all the NAIGT members and supporting companies. This roadmap must now be used to steer publicly funded R&D in Universities and in Industrial partnerships. Significant funding is already allocated to this area, upwards of £100 million per year and this provides a good start;
- Work with the Technology Strategy Board (TSB)[2] has already begun to implement the spirit of this recommendation, using the technology roadmap as a framework; and there is strong evidence of the industry's eagerness to partner in developing the transformational technologies. The most recent call for project submissions has been oversubscribed by a factor of four with qualifying proposals seeking funding;

2 http://www.innovateuk.org/

- A pilot ('Test Bed UK') should be established to test the deployment into the market of the major bundles of technology outlined on the roadmap, where significant market uncertainty, technological or infrastructure discontinuity exist to inhibit normal market forces from bringing the technologies to market. System examples include electrification of transport (EoT) for vehicles, intelligent transport systems (ITS), and alternative fuels. This would apply to electric vehicles, plug-in hybrids, higher blend sustainable second generation bio-fuels, alternative infrastructure and vehicle ownership business models and even battery ownership models;
- The pilot requires the involvement of not only the automotive industry but also other key stakeholders such as energy companies, power distribution companies, transport agencies and urban authorities to develop integrated collaborative solutions and share learning;
- This technology development, including the pilot, will need to be well funded (probably at least £1 billion over 10 years) to send the right signals about its boldness, scale and the importance to any world player of participating. Much of the necessary funding could be delivered through the prioritisation and better direction of existing programmes in this area. For example, the Government is currently spending about £100 million per year in this area in various schemes with varying levels of effective co-ordination. If this level were to be sustained over 10 years, the £1 billion would be funded;
- The pilot requires further definition, but initial thinking suggests a three-phase approach for each of these technologies. For example, for electrification of vehicles we would propose:
  - Small scale demonstrator fleet (250+ vehicles) through 2010/11;
  - Larger scale market test to develop business models (5,000 vehicles) through 2011/14; and
  - Significant vehicle uptake 2014 through to mass scale deployment by 2020.
- This pilot should address infrastructure (fuels, information, roads) as well as vehicle technologies, and should be integrated, not a long list of individual projects with little explicit interconnection;
- This pilot will help to identify and accelerate development of the technology required to move towards the electrification of transport and the opportunities arising from the technology roadmap;
- As well as VMs, Tier 1 global automotive systems suppliers must be involved, as they have unique capability to bring these to market. Small entrepreneurial inventor companies do not have the capability to bridge this gap. Their involvement would act as an incentive to locate at least some R&D resources in the UK, but it would be unwise to try to make the pilot exclusively UK oriented, as global capabilities will also need to be harnessed;

- Public procurement may also provide an opportunity to amplify the scale of the pilot; and
- The pilot should ideally be centred, close to existing automotive activities, to promote agglomeration and clustering of participating companies. Key University partners will be identified to leverage UK R&D investment in low carbon technology as part of the pilot.

Develop a capable high value integrated supply chain

The hollowing-out and loss of high-value jobs in the automotive supply chain has not been only to low-cost countries such as China or Eastern Europe; many have been lost to higher-cost economies such as Germany and France. Therefore, provided the opportunities described earlier are addressed, there is potential to stop this process and rebuild in the UK.

To facilitate this, a UK Supply Chain Council should be established under the leadership of the Automotive Council to promote and oversee the following activities:

- A continuous national supply chain group programme to address the overall competitiveness of UK suppliers and their ability to seize new technology opportunities, by customising and streamlining access to existing and new business support;
- Defining a sourcing roadmap to identify UK sources, gaps and opportunities in support of greater value added localisation in the UK, building on the SMMT's recently launched Automotive Supplier Finder (ASF)[3] service and opportunities for up-scaling by collaboration in appropriate purchasing commodity groups;
- Addressing the internationalisation challenge for UK Tier 2/3 suppliers for both cost down and overseas business development;
- Looking for opportunities to develop/nurture the niche vehicle and supply industry and in construction equipment and motorsport as a potential development source for emerging technologies;
- Reviewing the investment environment requirements to realise these opportunities;
- More generally, promoting the strengths and production and technology capabilities and capacities of the UK automotive supply chain;

Continuing to provide support, in the form of education and training for suppliers, including strategic leadership and management skills, particularly but not exclusively the smaller ones, is a critical requirement. It is, however, crucial that VMs and/or Tier 1 suppliers are involved in sponsoring these programs to improve take-up, and this is a role that the Automotive Council should promote and encourage.

It is recommended that an Institute of Manufacturing Technology is established to be an identifiable catalyst for the revitalisation of automotive supply chain manufacturing and to provide a focus for conducting R&D and complementing education and training

3 www.autosupplierfinder.com/

efforts to improve management, engineering and technical skills. This will address the need for an increased emphasis on a competitive manufacturing environment and improved shop floor technical skills. Ideally this would be achieved by bringing together a core of high quality institutions and facilities and co-ordinating appropriate parts of their activities in a formalised network. Such a network could co-ordinate programmes in conjunction with the Automotive Council and the Research Councils to better target existing funds in order to develop industry relevant production and supply chain capabilities.

The pilot 'Test Bed UK' should be leveraged and marketed to major global Tier 1 suppliers as a reason to consider investing in R&D in the UK. Links with innovative technology companies and inventors can be fostered, and 'on-the-ground' participation encouraged and incentivised. The Institute of Manufacturing Technology would form an important element of 'Test Bed UK', providing academic and R&D facilities as a 'one stop shop' both for attracting inward participation and supporting indigenous companies.

CONCLUSION

The UK automotive sector is vital but fragile, a point that has become even more apparent during the stressful times of the present recession. Short-term support is crucial, as once jobs in this sector are lost, they are gone forever as the car is a global commodity, designed and produced in global industrial networks.

This point is not lost on our economic competitors, who have moved swiftly and loudly to support their home industries. Once economic recovery begins, there is a tremendous, long term future for the industry, supporting developing country growth and mobilisation as well as transforming the car fleets around the world to low-carbon vehicles.

Without a strategic, planned and co-ordinated approach, the industry in the UK will be hollowed out further, the low carbon agenda will by-pass many players, and the industry will be irreparably weakened. On the other hand, if we are bold enough to take the initiative and pro-actively partner between Government and the industry, we can achieve a different outcome.

We have laid out our ideas on how to achieve that different outcome. We have an industry-agreed technology roadmap, and a plan to co-fund its execution with Government. Test-Bed UK can act as a catalyst to provide incentives for more players to invest in high value, sustainable economic activities here in the UK. The work is far from done, and continuity of purpose, a deepening partnership and focus on the critical change areas will be needed. The proposed new **Automotive Council** provides the mechanism to build that future together, and the NAIGT stands ready to continue until such a body is approved and established to make sure that we lose no time in moving forward.

1 Introduction

This section provides background to the New Automotive Innovation and Growth Team, its organisation, the study and the format of the final report.

1.1 BACKGROUND

This report is the result of a year long project launched In April 2008 by Shriti Vadera, then Minister for Business at the Department for Business Enterprise and Regulatory Reform (BERR). She set up the NAIGT with a mandate to produce a 20 year vision for the future of the industry and to make recommendations on how to make the vision a reality. The original vision statement is set out in the NAIGT Terms of Reference at Annex A.

Over 80 senior people from automotive companies, Government Departments, Public Sector Agencies, Trade Unions, as well as universities and centres of excellence have been involved directly through membership of the NAIGT or through membership in one or more of the five Expert Groups. Many others have been involved as part of the stakeholder engagement and validation process.

The timing of the review comes at the most significant point and critical time in decades for the automotive industry. The industry faces new and fresh challenges posed by the immediacy of the global economic downturn. In addition, there are significant drivers, such as the low carbon policies of the Government and the increasing and severe competition from low cost countries. Short term public attitudes and confidence directly threaten the longer term management and future of the industry. Without a concerted response by industry and Government, we believe there are heightened risks of a serious decline in the UK automotive sector.

The NAIGT follows an earlier review that reported in 2002[4]. This led to a number of projects, programmes and initiatives. In many respects the 2002 review revealed similar issues. However, the problems faced then were less acute and the context significantly less challenging. These initiatives and where possible their impact are described in more detail later in this report. They have in turn provided valuable input and informed the development of the NAIGT's strategy.

Automotive is a global industry and this is particularly apparent in the UK context. This results in both opportunities and risks. For example – the report highlights the

4 www.berr.gov.uk/whatwedo/sectors/automotive/publications/page45523.html

increasing trend for UK based VMs to source from overseas and the negative impact that is having on the domestic supply chain; high levels of foreign investment in and thus ownership of UK based automotive companies is in many ways a positive, but it also means that key strategic decisions are often made at overseas corporate headquarters; and the perception by some that UK legislation whilst largely determined by the EU is implemented and enforced more rigorously in the UK than elsewhere in Europe.

In addition, the automotive industry is perhaps uniquely subject to a wide range of external political, social, economic and regulatory pressures including public/consumer sentiment, environmental and safety imperatives, technological changes, and wider economic issues such as exchange rates and taxation. While Government or the industry itself may have limited influence over many of these factors, they (and others) can all have a significant impact on the industry. It is against this background and the more recent challenges of the economic downturn that this Review has been tasked to make recommendations and report.

The current economic downturn has of course had a very significant impact on the industry, both in the UK and overseas. There is a risk given the current difficulties that the industry and others including government will concentrate solely on the short term. The NAIGT concluded at an early stage that it would be quite wrong to do so. There will always be a demand for personal and road freight transport and therefore always a need for an automotive industry. The industry also represents a key part of the UK manufacturing base. So the justification for developing a long term vision remains, despite the current short term difficulties.

1.2 NAIGT VISION

There are a wide range of technology, business improvement initiatives and other related activities within the UK automotive sector driven by a disparate group of companies, government departments, Regions and other and bodies such as Cenex, LowCVP and SMMT. While these all make a contribution to maintaining and improving the competitiveness of the UK industry, NAIGT concluded at an early stage that there is a lack of a clear central vision for the automotive sector to form around and with which to focus attention and provide the basis for an ongoing strategic dialogue between Government and the industry. This vision – and subsequent series of documents identified within this report – would allow R&D spend and value added investment to be better focused and clearer collaboration opportunities to be identified. The hope is that this will result in a higher value for R&D spend and collaboration leading to increased capital gearing for any work carried out in the UK.

These objectives are given greater relevance in the light of the King review's[5] strategy to almost totally decarbonise transport by 2050, which would require a significant proportion of transport to derive it's energy from the generating sector rather than consume fossil fuels. This target for 2050 would provide an 'assured future' for our transport systems, and in the vehicle context, would need to also deliver 'good performance and low carbon'. To achieve this and derive maximum benefit for the UK,

5 www.hm-treasury.gov.uk/king_review_index.htm

industry will not only need to develop the necessary technological capabilities, but also a low-cost and high value-added manufacturing capability in the supply chain.

These considerations have led the NAIGT to the following statement:

NAIGT Vision Statement

'A competitive, growing and dynamic industry making a large and increasing contribution to the UK's employment and prosperity, playing a decisive global role in developing exciting, low carbon vehicle transportation solutions'

The thrust of the NAIGT's work and the recommendations contained within this Report are all designed to a greater or lesser extent to deliver this vision.

1.3 APPROACH

The NAIGT report consists of two parts – the main report and supporting analyses. The main report provides an overview of the UK automotive industry, its position globally and the challenges and opportunities that it faces. The analyses informed the work of the NAIGT Expert Groups and their detailed recommendations. An Executive Summary highlights the key issues and recommendations.

1.4 THE NEW AUTOMOTIVE INNOVATION GROWTH TEAM

The NAIGT membership comprises over 80 senior representatives drawn from across the sector's major stakeholders – including industry, Government, Academia, Unions and centres of excellence.

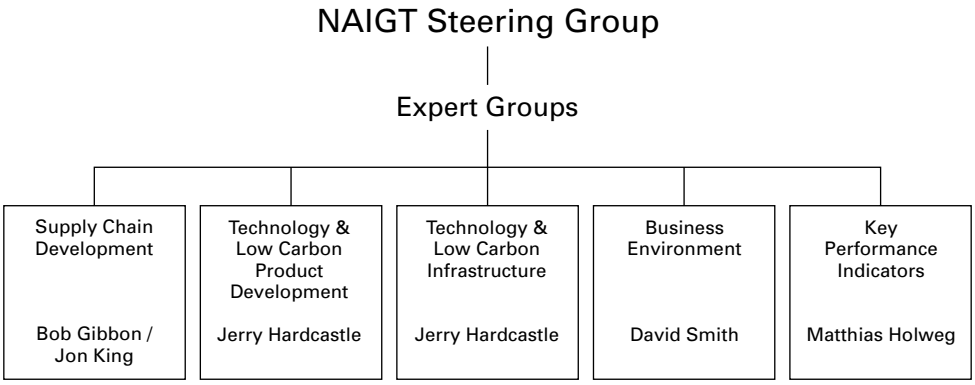
Five Expert Groups supplemented the main NAIGT discussions with a specific focus group tasked to advise on Key Performance Indicators against which the future success and health of the industry could be judged. An independent review of the competitiveness of the industry was also separately undertaken by a small team led by Matthias Holweg, Judge Business School, University of Cambridge[6].

Each NAIGT and Expert Group member was identified and appointed in a personal capacity for the knowledge, experience or expertise they could contribute. In addition, a stakeholder validation event was held in February 2008 at SMMT to test the emerging conclusions. This was aimed at drawing together a collective industry consensus on the priorities and validation of the actions that needed to be taken and shaping the recommendations that need to be put forward.

6 The full report 'The Competitive Status of the UK Automotive Industry' is available at www-innovation.jbs.cam.ac.uk/publications/reports.html

1.5 THE NAIGT PROCESS

Figure 1: NAIGT Organisation



The NAIGT followed a phased programme through 2008 and early 2009. The key elements of the process were:

- Commissioning of an independent assessment of the Competitive Status of the UK Automotive Industry;[7]
- Data collection and consideration of existing reports and studies, including the King Review, the BERR Manufacturing Review[8], the original Automotive Innovation & Growth Team Report[9], the BERR Report on the Business Environment for Japanese Automotive Supply Companies in the United Kingdom April 2008[10], an independent evaluation of the Supply Chain Group Programme[11], amongst others including the House of Commons Trade and Industry Select Committee Report 'Success and Failure in the UK Car Manufacturing Industry' March 2007[12];
- A refining of the initial NAIGT vision and subsequent identification by the NAIGT Steering Group of the major issues facing the industry. Expert Groups were then created to address these;
- Evidence gathering and analysis of the issues by the Expert Groups drawing on the expertise of their members and available information;
- The Expert Groups reported their findings and recommendations to the NAIGT which considered and iterated these into a series of provisional recommendations; and
- Validation of the provisional recommendations of the Expert Groups at a targeted stakeholder event.

7 www.berr.gov.uk/files/file51139.pdf or www-innovation.jbs.cam.ac.uk/publications/reports.html
8 www.berr.gov.uk/files/file47660.pdf
9 www.berr.gov.uk/whatwedo/sectors/automotive/publications/page45523.html
10 www.berr.gov.uk/files/file45472.pdf
11 www.supplychaingroups.co.uk/
12 www.publications.parliament.uk/pa/cm200607/cmselect/cmtrdind/399/399.pdf

The following report summarises the results of that work programme, the conclusions drawn and consensus achieved.

1.6 LEGACIES OF THE 2002 AUTOMOTIVE IGT AND THE LESSONS LEARNT

The first AIGT published in May 2002 created the impetus for a number of initiatives and programmes with an initial commitment totalling £45m over five years. These programmes have been delivered in the intervening period. Five years on it was appropriate to review the success and continuing relevance of these initiatives and programmes. Also publication of recent reports such as the King Review and other regulatory and policy initiatives have further emphasised the need for this strategic review.

The AIGT was a catalyst. It led to the creation of a number of significant programmes. These included:

Automotive Academy

The Automotive Academy was launched on 23 June 2003 and established in March 2004 as a legal entity under the SMMT supported by a DTI (now BERR) grant of £13.5 million. Its aim was to raise skills in the UK automotive manufacturing sector to world class levels through a demand-led national approach to training and a rigorous process to validate approved courses, materials, providers and assessors

By December 2006 it had helped over 2500 automotive employees from shop floor to management, gain recognised qualifications. In December 2006 the Academy was subsumed into the National Skills Academy for Manufacturing (NSA-M)[13] (which operates under the auspices of SEMTA[14], the Sector Skills Council for manufacturing) and the remaining funding (£5m) made available to NSA-M. NSA-M have set up an Automotive section to address the skills issues in the industry. They are continuing to use some of the products developed by the Automotive Academy adapting them for other manufacturing sectors as appropriate.

Supply Chain Groups

The Supply Chain Group programme was launched in April 2003. It was jointly funded by the English RDAs and the Devolved Regional, and Regional Assemblies. The programme closed to new applications in October 2006, and all projects were completed by March 2008. The programme comprised of 62 projects that involved 575 suppliers in the automotive and aerospace sectors. Productivity improvements have occurred in participating suppliers adopting new tools and techniques for process improvement. Further commentary can found in Chapter 7. A detailed report 'Evaluation of the Supply Chain Groups Programme'[15] will be published in May 2009.

13 www.nsa-m.co.uk

14 www.semta.org.uk/

15 www.berr.gov.uk/whatwedo/sectors/automotive/index.html

Centres of Excellence

The two Centres of Excellence, Cenex[16] covering low carbon and fuel cell technologies and innovITS[17] covering telematics and technologies for sustainable mobility were set up.

(a) Cenex was established as an independent company in April 2005 with a vision to drive the development of low carbon and fuel cell technologies in the UK.

Cenex are running a number of projects including a fleet demonstration project covering the use of electric vans with Modec and 100 Zytek powered electric Smart cars with Daimler. They are also responsible for running Department for Transport's (DfT) Low Carbon Vehicle Public Procurement Programme for which they are in discussion with a number of manufacturers regarding the supply of Ultra low carbon or electric vans. In addition they host the low carbon and fuel cell technologies Knowledge Transfer Network on behalf of the TSB and provide technology advice to BERR's Automotive Assistance Programme (AAP)[18].

(b) innovITS was established in April 2005, and is the Centre of Excellence for telematics and technologies for sustainable mobility. Its vision is to co-ordinate the UK's validation of new and innovative Intelligent Transport Systems (ITS) as a catalyst to building world-class products and services that enable the UK ITS industry to compete globally.

innovITS assisted BERR, DfT and the TSB to establish the Intelligent Transport Systems and Services Innovation Platform (ITSS-IP). In support of this activity and in alignment with their revised business plan, they now manage the ITS Knowledge Transfer Network[19]. They are also brokering an ITS test track at MIRA April]. Other projects supported by innovITS include: Framework Architecture Classification for Intelligent Transport Systems (FacITS) – develop an architecture for cooperative ITS systems; Sentience – demonstrate technology enabling vehicles to 'see' beyond the horizon through the use of internet-enabled mobile phone communications, GPS and advanced mapping data; Co-driver Alert – How to present incident alerts to drivers via mobile devices.

Low Carbon Vehicle Partnership (LowCVP)

LowCVP[20] was established in 2003 to take a lead in accelerating the shift to low carbon vehicles and fuels in the UK and to help ensure that UK business can benefit from that shift.

It was instrumental in developing and agreeing the early adoption by industry of the CO_2 information label now shown on all new cars in the UK. It also helped inform the 'Gallagher Review of the indirect effects of biofuels production'[21].

16 www.cenex.co.uk
17 www.innovits.com
18 www.berr.gov.uk/whatwedo/sectors/automotive/aap/page50296.html
19 www.innovits.com/its-ktn/network/page/itss-ip
20 www.lowcvp.org.uk
21 www.dft.gov.uk/rfa/_db/_documents/Report_of_the_Gallagher_review.pdf

LowCVP is currently incorporating as a charitable organisation and is focusing upon influencing the market by demand-side and public awareness measures such as the Act on CO_2 website[22] and a rejuvination of the labelling scheme.

Foresight Vehicle

SMMT assumed management of the Foresight Vehicle[23] network in 2004, and is interacting with new potential stakeholders as well as engaging with BERR Automotive Unit and the TSB. They have successfully brokered projects to the TSB Technology Programmes.

They worked jointly with Cenex to establish the Knowledge Transfer Network (KTN) in the area of low carbon and fuel cell technologies. Foresight Vehicle has pioneered the development and use of a web-based technology road map.

Retail Motor Strategy Group (RMSG)

The RMSG[24] was established to provide a forum consisting of senior industry figures enabling strategic input into Government on vehicle retailing issues. It had three main work streams covering the renewal of block exemption regulations; skills; and developing a consumer code for garage service and repair. A key success has been the agreement and introduction of the consumer code, launched in August 2008 with Office of Fair Trading (OFT) Stage 1 approval.

LESSONS LEARNT

The AIGT priorities can be segmented into three distinct areas of focus; these were manufacturing efficiency, skills and technology. In terms of manufacturing efficiency, prior to the AIGT Government had been working with industry to foster lean manufacturing in the automotive sector primarily through the creation of an Industry Forum which built on the Learning from Japan programme. At the time Industry Forum-type interventions were largely made on a company by company basis focusing on particular elements of the production process. The AIGT built on this in two useful ways. Firstly it recognised that competition takes place between supply chains and not just between companies and developed a process for intervention at the level of the supply chain. The National Supply Chain Programme also enabled efficiencies to be made across a whole supply chain and, not confined to a particular region. Evaluation of the programme has shown the value of the customer pull model, with vehicle manufacturers and Tier 1s acting as hosts, in more effectively getting support to smaller suppliers.

Secondly the AIGT recognised that if business could improve its processes by adopting and embedding lean manufacturing techniques that were transferable within companies and across a range of production elements, then it was important and potentially far more effective to train and up skill workers. That is to provide both skills

22 http://actonCO$_2$.direct.gov.uk/index.html

23 www.foresightvehicle.org.uk

24 www.autoindustry.co.uk/automotive_unit/aigt/implementation/retailMotorStrategyGroup?s=y7mew1xudwek68w

and qualifications in the techniques of business improvement so that they in turn could implement measures in other areas without the need to repeatedly call in external management consultants. In addition a better qualified workforce is in itself a driver of competitiveness.

In technology terms, the AIGT identified two particularly important growth areas for R&D, low carbon and ITS. This process, both in terms of identifying the priorities areas, and in terms of brigading content and community through the creation of the two centres has been immensely influential with policy makers. For example, we can track the development of two of the TSB's Innovation Platforms directly to the AIGT priority setting. This has enabled a continuous flow of public R&D investment into the sector which otherwise may not have happened. This has put the UK on a strong footing as both in terms of capabilities and policy making. Work progresses to develop the UK as a leading low carbon economy. The creation of Cenex and LowCVP as independent bodies covering the supply and demand side of low carbon vehicle development has been seen by some as providing welcome flexibility and agility of response. From a different perspective the low carbon space has become more crowded and there has, as a consequence, been a loss of clarity between different roles. That is a potential source of confusion reflected upon by the NAIGT and considered elsewhere in this report.

In terms of the industry's interface with Government, the AIGT was influential in the establishment in 2002 of a free standing Automotive Unit (AU) within the then DTI (now BERR), with dedicated Relationship Managers responsible for developing and maintaining links with the key automotive players in the UK. Since then, AU has made a strong impact and has proved influential across a range of issues of importance and relevance to the industry. As such it has largely fulfilled the remit envisaged by the AIGT, although its visibility across the industry is not universal.

2 The UK Automotive Industry

This section is a summary of the findings of the NAIGT report 'The Competitive Status of the UK Automotive Sector'. It provides background and information on the UK industry, its characteristics and strengths and weaknesses, its structure against which latter observations in the Review are based. Further analysis and details of sources can be found in the full report.

2.1 The Current State of the UK Automotive Industry

Overall, the UK produced 1,649,515 vehicles in 2008, placing it 12th in the global output league. This represents 2.4% of global output in terms of numbers of vehicles. Within Europe, the UK has remained in 4th position throughout since 2000, achieving 8.8% of European output in 2007, down from 9.6% in 2000. Only Germany, France and Italy have indigenous volume vehicle makers in Europe, with all other nations reliant on inward investment for their volume vehicle plants, supplemented in some cases by niche products for local markets. In addition to vehicle production, the UK produces c.3 million engines, and a range of construction equipment.

2.2 Economic contribution

By the standard HMG definition[25], the UK automotive industry comprises of 3,300 businesses, generating some £10.2bn value added in 2007. The automotive industry directly accounts for 5.9% of UK manufacturing employment, 6.4% of gross value added (GVA), and accounts for around 12% of UK manufactured exports, and 13% of manufactured imports. 2008 vehicle production was just under 1.65 million units, down 5.8% as the industry started to respond to a sharp downturn in vehicle markets worldwide. This included 1,446,619 cars (down 5.7%) and 202,896 commercial vehicles (down 5.9%). 77% of the cars, and 61% of the commercial vehicles, were exported.

Manufacturing generates around 14% of the total UK GVA and provides around 10% of total UK employment[26]. It follows that the automotive manufacturing sector directly represents around 0.8% of the UK economy in terms of value added, and directly provides around 0.6% of total UK employment. This excludes goods and services bought in: the true contribution to the economy is probably in the order or two to three times these figures, and some analysis on this is offered below.

25 SIC34, plus 25.11 and 31.61

26 BERR analysis of ONS ABI and 'Blue Book' data

One of the main contribution mechanisms of any industry to a national economy is through employment, and the compensation that is paid to the workers the industry employs. When one considers the number of persons directly employed in the UK automotive industry has shrunk by nearly 110,000 between 1997 and 2007, an average reduction of 4.5% per annum. At the same time, the percentage of persons employed in the automotive industry as part of employment in manufacturing and overall labour market has shrunk, from 6.6% to 5.9% and from 1.1% to 0.6%, respectively.

Although the overall percentage of persons employed in manufacturing as part of the overall labour market has declined during this time as well (from 16.6% to 10.5%), our data show that the decline in the automotive sector was more pronounced than in manufacturing as a whole. While the compound annual growth rate (CAGR) of employment in the automotive industry is (-4.5%), for manufacturing as a whole it is slightly lower at (-3.5%). Put in absolute terms, the UK automotive industry has lost over 10,000 employees on average every year for the last 10 years.

This decline in direct employment in DM34 marks a surprisingly strong trend, and one that stands against the growth in vehicle output. This poses a dichotomy that is not easily explained. While explanations will include the outsourcing of non-core operations to service providers, the employment of agency and temporary workers, as well as gains in productivity, the above cannot account for all of this reduction in direct employment[27]. Instead, these job losses continue to be lost in the component supply chain, with our analyses providing both strong anecdotal and empirical evidence of the "hollowing out" of the UK automotive supply chain.

2.3 Employment

A key measure of employment is the number of persons directly employed by the industry in its manufacturing and assembly operations. In the most direct form, this relates to the workers and staff employed in the manufacturing operations (manufacturing jobs), and of course, the staff employed by the dealerships and sales organisations (service jobs). In addition, these manufacturing and service jobs create further indirect jobs: most prominently, in the various tiers of the component supply chain, and as well as at service providers that support both manufacture and retail operations. The ratio of these indirect jobs, in relation to the direct jobs, is called a "job multiplier". For example, if the job multiplier is five, then every job in vehicle assembly supports four jobs elsewhere in the economy, at component suppliers, at retail operations, and at various service suppliers.

While it was beyond the remits of this study to do an empirical investigation into the job multiplier in the UK automotive industry, it was nonetheless important to estimate this factor, in order to assess the full economic contribution of the motor industry. We therefore employ a meta-analysis of previous studies, in order to estimate a confidence interval for the job multiplier in the UK automotive industry.

27 A full discussion is within the 'The Competitive Status of the UK Automotive Industry" report

Overall we estimate the job multiplier in the UK to be between in the range of k= [6.5,10.4], with a median of k=8.5, which means that in addition to the 45,220 direct employees[28] in vehicle manufacturing, an estimated total of 384,000 UK jobs are directly supported by the automotive industry in the component supply chain, motor retail and general service sectors. It is this figure that more accurately illustrates the true economic importance of the automotive sector to the UK economy, not the direct employment in DM34. In other words, by our estimates the direct employment in the UK automotive industry is at least twice as large as the 180,000 direct employees that the Office of National Statistics (ONS) database features.

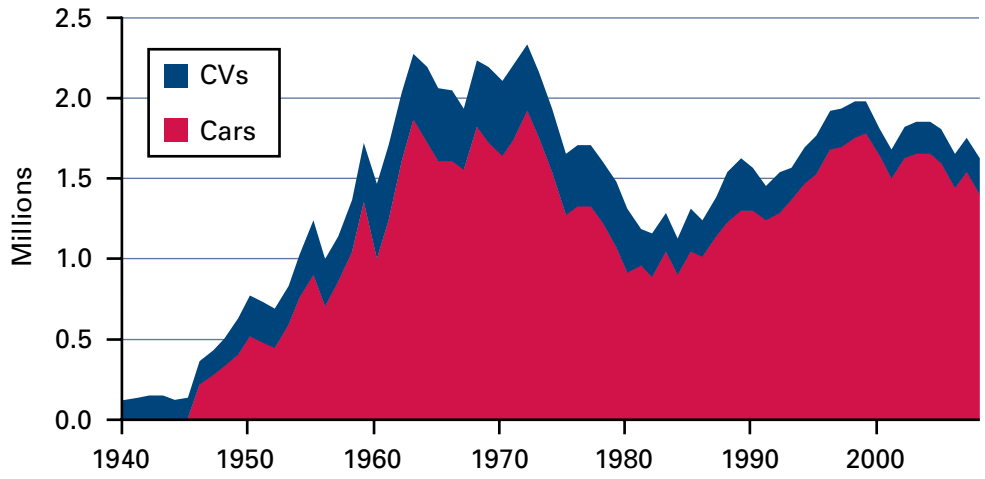
A key question is to what degree is this employment is under threat from off-shoring. Our analyses show that essentially all employment in vehicle assembly, component manufacturing and R&D is under threat of off-shoring, while the employment in motor vehicle retail and services is not. Thus, of the 384,000 directly employed by the automotive sector, we estimate that potentially 330,000 jobs could be lost in the future[29].

2.4 Output

In terms of vehicle output, it is often claimed that the UK industry features a healthy and stable output vehicle, quoting the relatively stable output of 1.5-1.7 million units since 1990.

This argument is misleading on two fronts: first, as Figure 2 shows, if one takes a longer-term view, the UK has in fact seen a great deal of volatility in output since its peak output in 1972. Figure 2 shows the UK's vehicle output in units of passenger cars (PCs) and commercial vehicles (CVs) since 1940.

Figure 2



Source: SMMT

28 Note that this is not the entire employment in DM34 as this already considers component manufacture.

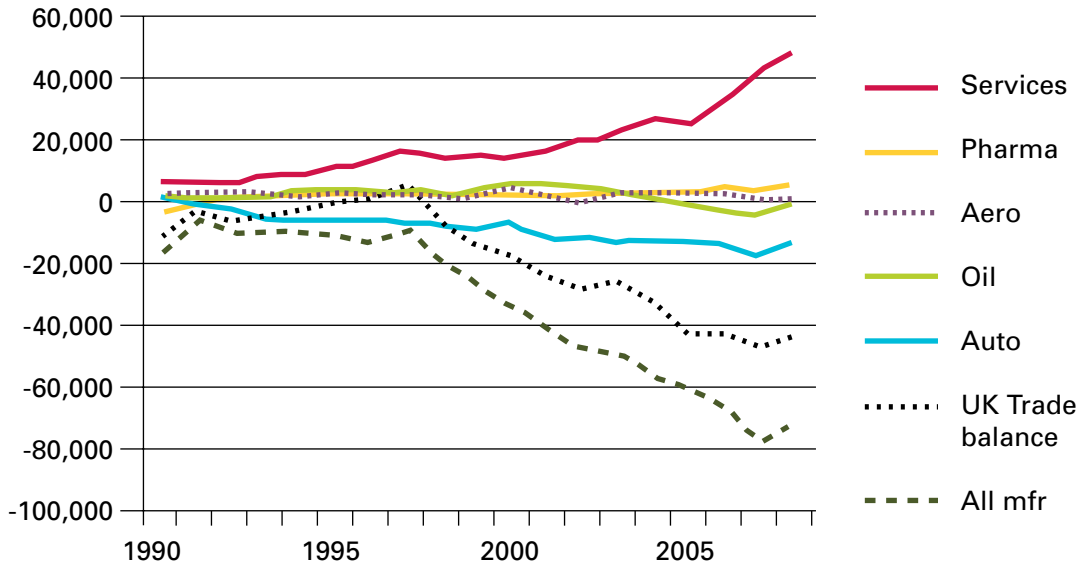
29 Assuming a service and retail multiplier of 1.2, see Holweg et al. 2009 NAIGT report "The Competitive Status of the UK Automotive Industry".

Secondly, while stable at present in absolute terms, the UK is falling considerably behind its competitors. Between 1995 and 2007 the number of passenger and commercial vehicles produced in the UK had a CAGR of -0.09%. This figure puts the UK below the EU average of 0.63%, but above France and Italy, where the CAGR of vehicle produced was -0.11% and -4.56%, respectively. In comparison, Brazil's, India's and China's CAGR of vehicle production between 1995 and 2007 was 4.38%, 8.72% and 13.84%, respectively. At the same time, the global CAGR of vehicle production was 2.60%. Overall, the UK's share of world vehicle production has dropped from 3.34% in 1995, to 2.43% in 2007.

2.5 Trade balance

While being a strong contributor to UK exports, on balance the UK automotive industry is a net importer: the most recent trade data shows a narrowing of the automotive sector trade deficit, though only because the decline in UK vehicle markets caused fewer vehicles to be imported. Exports were £27.1bn, up 7.2% and totalling 12.2% of UK manufactured exports. However, imports were down 6% to £39.7bn, totalling 13.4% of UK manufactured imports. This yielded an automotive sector trade deficit of £16.75bn. An analysis of UK trade in goods shows that the automotive sector is the single largest exporter, but by a rather larger amount the single largest importer, and as such has the largest trade deficit of any sector.

Figure 3: UK balance of trade across various sectors £m



Source: ONS

2.6 Conclusions

The automotive industry does still play a significant role in the UK economy, both in terms of employment and contribution to value-added and exports, but it is in decline on most key indicators. It is fragile due to a continued loss of scale, and the danger of "supply chain hollowing out" is more pressing than ever. The loss of scale was presented as a major threat by the last AIGT in 2001/2002, and unfortunately the

scenario that was laid out then (the continued loss of volume car production) has now come to fruition.

Since the last AIGT report in 2002, the UK has seen a disproportionate share of plant closures[30]. The perception is that the UK has more lenient redundancy laws and exerts less political pressure, so that the UK has been affected by the shift in global manufacturing footprint more so than its peer group. The UK suffers partially from the lack of a "national champion": believing, given the sensitivity involved, it seems it may be politically more acceptable for firms to reduce capacity in the UK rather than in their respective home markets.

The UK automotive manufacturing sector has moved further away from volume car production by indigenous companies, towards greater dependence on inward investors, and a bias towards luxury and niche vehicles, together with engine manufacture. However, this is not disadvantageous *per se*, as specialisation enables UK firms to compete through differentiations of their products and hence retain a comparative advantage in these markets. However, a shift from the volume car production created a new challenge whether the UK component supply base will be able to retain the scale needed to compete internationally. We also see many of the current engine manufacturing operations (apart from Ford) as neither embedded nor independent, as they strongly depend on the vehicle assembly operations that they serve.

Although the automotive sector directly contributes 0.73% to the UK's GDP and the compound annual growth rate of GVA is 1.12%, over the past decade the industry's contribution to the UK economy has been declining as the industry has not been expanding as fast as the overall economy. This reduction is not due to temporary economic downturn, but a long-term trend and the consequence of competing in a mature industry, which has seen a drastic shift in manufacturing footprint over the past decade towards sourcing from low-cost countries. The UK's global production share has fallen by 25% since 1995, to 2.4%, and is falling faster than in Germany or France, but less so than Italy. The employment in both the manufacturing sector in general, and the automotive industry in particular, show a clear downward trend that can partly be explained by productivity gains and outsourcing of non-core activities or the use of agency labour but this will not be the whole story. Instead we argue that a combination of the above, plus a reduction in employment in the UK component supply base could possibly be causing this trend.

The status of the component supply chain is another area of concern: our survey shows a consistent decline in UK sourcing across all firms surveyed, and a further projected decline at most firms. As sourcing from the UK is decreasing, the danger of "hollowing out" emerges, whereby the UK supplier base is no longer able to serve the vehicle assembly operations. With 50+% of value sourced from suppliers (while vehicle assembly only accounts for c.12% of value-added of the final product), the competitiveness of the supply chain is an even more important measure than labour productivity at vehicle manufacturer level.

30 The plants closed were MG Rover at Longbridge, Peugeot at Ryton, GM at Luton, Ford at Dagenham, Jaguar at Browns Lane, Coventry, Aston Martin at Newport Pagnell. The plant openings were Rolls-Royce at Goodwood and Aston Martin at Gaydon.

Note on UK construction equipment sector

The construction equipment sector is worth over £8bn to the UK economy and employs over 50,000. Over 75% of UK production is for export and over one third of the construction equipment made in Europe comes from the UK. The sector in the UK is diverse and ranges from major international OEMs such as JCB, Caterpillar, Komatsu and Terex. There is also a strong supplier base that ranges from engines, drive train and tyres through to specialist component and accessory producers in the fields of electronics and hydraulics.

3 The Relative Performance and Competitiveness of the UK Industry

This section considers the issues surrounding the importance nationally of a competitive UK automotive sector, UK competitive importance internationally and the role of existing institutions.

In order to assess the relative strengths and weaknesses of the UK as a location for the manufacture of motor vehicles and components, we surveyed senior industry leaders of firms that currently have operations in the UK. We triangulated this data with secondary data from EuroSTAT[31] and the Organisation for Economic Co-operation and Development (OECD)[32] in order to place the UK in context with its immediate peer group, France, Germany, Italy and Spain (hereafter FGIS). Further information can be found in the full report "The competitive status of the UK automotive industry."

The following section sets out the findings of a survey of selected industry leaders with regards to their perceptions of the UK automotive industry, its strengths and weaknesses in relation to its peer group[33] as a proxy for likely location and investment decisions to be made by the multi-national vehicle manufacturers and component suppliers.

3.1 Key strengths and weaknesses of the UK

The analysis of industry leaders' perception shows that the most prominent strengths of the UK automotive industry are labour flexibility (13 out of 16 stated that it has a positive impact on the industry's level of competitiveness), and the quality of R&D resources. To a lesser extent, interviewees noted the following as additional strengths: governmental subsidies, barriers to exit and taxes and tariffs (see table overleaf).

31 http://ec.europa.eu/**eurostat**

32 www.oecd.org/

33 Further detail on the survey can be found in The Competitive Status of the UK Automotive Industry

Table 1: Industry leader's perception of the UK's relative strengths and weaknesses, on a 5-point Likert scale (with 5 being the strongest)

	Average score	No of answers
Labour flexibility	3.94	16
Quality of R&Ds resources	3.71	17
Governmental susidies	3.31	13
Barriers to exit	3.29	14
Taxes and Tariffs	3.27	15
Interaction with government	3.18	17
Labour productivity	3.06	17
Quality of local suppliers	3.00	16
Logistics and infrastructure	2.88	17
Skill level workforce	2.76	17
Availability of local suppliers	2.53	15
Envionmental regulation	2.44	16
Availability of skilled labour	2.41	17
Labour cost	1.94	17

In-depth interviews revealed that interviewees value UK labour flexibility most, mainly because of the flexible working hours they are allowed to employ, but also because of the relatively lower level of unionisation[34]. They stated that this competitive advantage was mostly relevant in relation to Western Europe and less so to Eastern Europe or the BRIC countries. Interviewees also favourably noted the quality of R&D resources in the UK, but claimed that these could be coordinated better on a national level. Some interviewees specifically mentioned the R&D tax benefits as a major competitive advantage of the UK.

Interviewees also commented on the strengths ranked somewhat lower. They pointed out that though the UK government does not generally provide more subsidies than other European governments, it does provide them sufficiently, mostly directly (in the form of grants) but also indirectly. They also claimed that the UK was especially strong because of the ease to close down operations, especially in relation to Western Europe (according to them, this was difficult to assess in CEE and BRIC because few have actually tried to leave up to now)[35]. As for taxes and tariffs, interviewees mentioned that the UK was on par with its European counterparts overall, and slightly better because of the relatively lower personal taxes. Some interviewees also noted that the customs service was especially effective in the UK, in relation to Western European countries as well as BRIC countries.

34 One interviewee, however, mentioned that in his operation legacy labour agreements made it extremely difficult to operate on a competitive level comparable to that of similar operations in Western and Eastern Europe.

35 Some, however, noted that this was a major disadvantage of the UK automotive industry, since the government made less effort than other European countries to retain automotive manufacturing.

The analysis showed that the most salient weaknesses of the automotive industry in the UK are relative labour costs, availability of skilled labour and environmental regulation. Though many did agree that there is a deficit of skilled labour in the UK, they had varying opinions as to the nature of unavailable skills: several interviewees claimed that the deficit was most pronounced in skilled mid-level management, while a few others stated that they had most difficulty in finding enough engineers. One interviewee even asserted that the deficit was most prevalent among skilled blue-collar workers. Most of the interviewees agreed on the fact that one of the main reasons they are finding it difficult to recruit skilled labour is that the most accomplished high-school students and graduates do not opt for engineering, and even those who do prefer to accept offers from the financial sector rather than from the manufacturing one.

3.2 THE UK FROM AN INTERNATIONAL PERSPECTIVE

Interviewees were then asked to rank the developments in sourcing from the UK relative to France, Germany, Italy and Spain (FGIS). The comparison between interviewees' answers regarding the UK and FGIS shows quite a few prominent differences (see table 2). In the figure, the lower the score the better the UK does in relation to its peers. Thus, the UK is perceived to be more competitive than FGIS in labour flexibility and barriers to exit, while FGIS are clearly more competitive than the UK in the availability of local suppliers, the skill level workforce, the availability of skilled labour. In other words, the UK is currently competing mostly on labour flexibility, and the least cost for capacity adjustment, while suffering from disadvantages in terms skilled labour and the availability of local suppliers.

Table 2: Industry leader's relative perception of the UK's to FGIS, on a 5-point Likert scale (with 5 being the strongest, and 3 being equal).

	FGIS	UK	Difference
Labour flexibility	2.13	3.93	-1.81
Barriers to exit	1.92	3.29	-1.37
Taxes and Tariffs	3.23	3.27	-0.04
Labour productivity	3.19	3.06	0.13
Interaction with government	3.44	3.18	0.26
Labour cost	2.38	1.94	0.44
Logistics and infrastructure	3.47	2.88	0.59
Government subsidies	3.92	3.31	0.61
Envionmental regulation	3.14	2.44	0.70
Quality of R&D resources	4.43	3.71	0.72
Quality of local suppliers	4.00	3.00	1.00
Availability of skilled labour	3.50	2.41	1.09
Skill level workforce	3.88	2.76	1.12
Availability of local suppliers	4.00	2.53	1.47

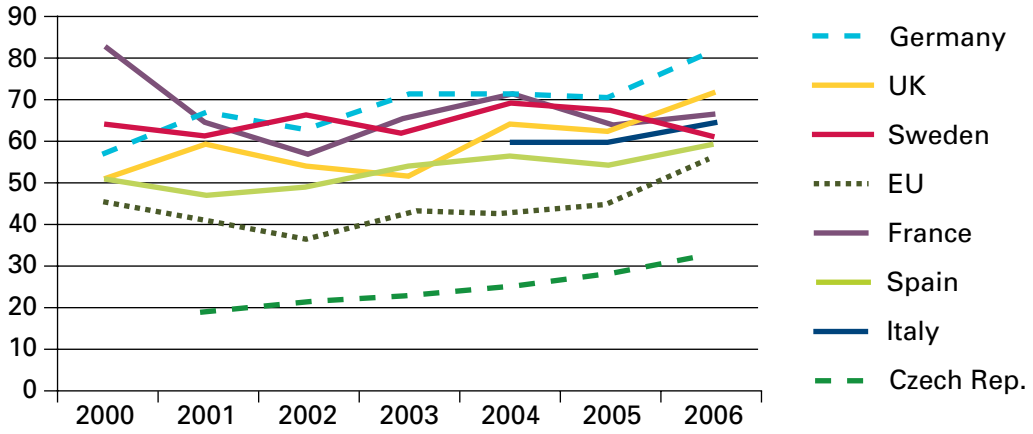
Relative advantage to the UK in Green, Relative disadvantage to the UK in Red.

Some participants in this primary research claimed that the UK government and public opinion seem to value industry less than in other European countries, which often leads the government to be less encouraging and protective of the national industry in relation to its counterparts from the mainland[36]. Other interviewees mentioned that UK suppliers and manufacturers began employing innovative manufacturing techniques ahead of their mainland competition, thus improving the overall competitiveness of the national industry.

3.3 PRODUCTIVITY – AN INTERNATIONAL COMPARISON

In terms of productivity, the UK has made significant progress, does not lag behind its peer group in terms of productivity in terms of €/head. In fact, as Figure 4 shows, the UK is only second to Germany, and considerably ahead of the EU average.

Figure 4: Automotive labour productivity €K/head



Source: SMMT

Thus, the often held image of poor quality and productivity, as well as poor industrial relations that have marked several decades of UK automotive manufacturing, has to be revised. The UK automotive industry has undergone a major transformation since, and is now able to compete on part with its European and international competitors.

3.4 SHIFT IN SOURCING AWAY FROM THE UK

The component supplier base is a vital element in the value chain. As statistical data on the component supply sector is limited, or conceptually problematic, industry leaders were asked to provide details regarding several aspects of their sourcing operation in the UK. The average percentage sourced from the UK in the operations

36 One interviewee, for example, mentioned that over the last couple of years PSA was thinking about closing some of its underperforming plants it and closed down car plants at Ryton and another plant in France. While the French government acted against closure, the British one did little (in fact, UK offered PSA an RSA grant for the Peugeot 207, which PSA declined to take up: the interviewee's commentary was inaccurate on this point). Eventually, the Ryton plant was shut down, while the French plant is still operating.

of the interviewees was 34% (with a standard deviation of 24.7%). 12 out of the 15 interviewees have stated that this percentage has decreased in the past 5 years (4 said that the decrease was significant). None stated that the sourcing from the UK had increased over the last 5 years. This pessimistic sentiment was confirmed regarding the future, where 11 out of the 15 interviewees stated that sourcing from the UK is likely to decline further (5 claimed that the expected decline will be significant). Only one interviewee replied that the future holds a moderate potential increase in sourcing from the UK.

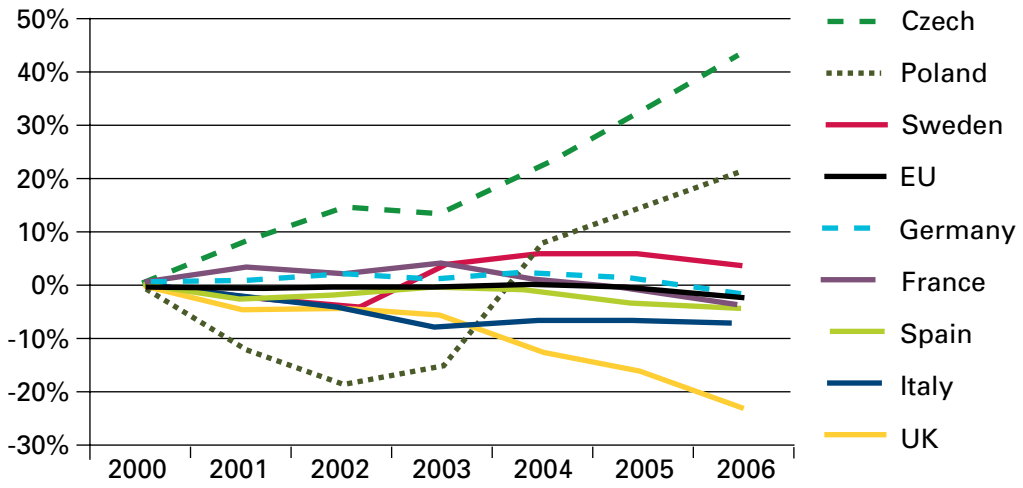
Many industry leaders believe that reality is worse than the numbers they provided for two main reasons. Firstly, though OEMs' spending in the UK is declining, it is accompanied by a similar – if not much more significant – decline in sourcing by Tier 1 suppliers, further decreasing the value added by the UK automotive industry as such. Several industry leaders had specific data to support this argument. Secondly, while in some cases the overall spending in the UK remained largely the same over the years, its structure has changed significantly. For example, one OEM, seeing many of its Tier 1 suppliers leave the UK, in-sourced production of a major component , leaving the overall spending in the UK relatively constant, but hiding a significant decline in the number of UK suppliers working with it.

3.5 TRENDS IN EMPLOYMENT ACROSS WESTERN EUROPE

All developed economies have suffered from a shifting manufacturing footprint, where manufacturers decided to offshore their operations to low-cost locations. The European automotive industry has seen a particular trend towards "East-shoring", whereby capacity moved from Western Europe into Central and Eastern Europe.

The decline in UK employment overall can be explained by this trend. However, we found that the UK has lost out disproportionately against its peer group. All Western regions have suffered from a shift in manufacturing foot print, the UK however has seen significantly more plant closures than other European countries.

Figure 5: Auto sector employment trends (2000 baseline)



Source: EuroSTAT

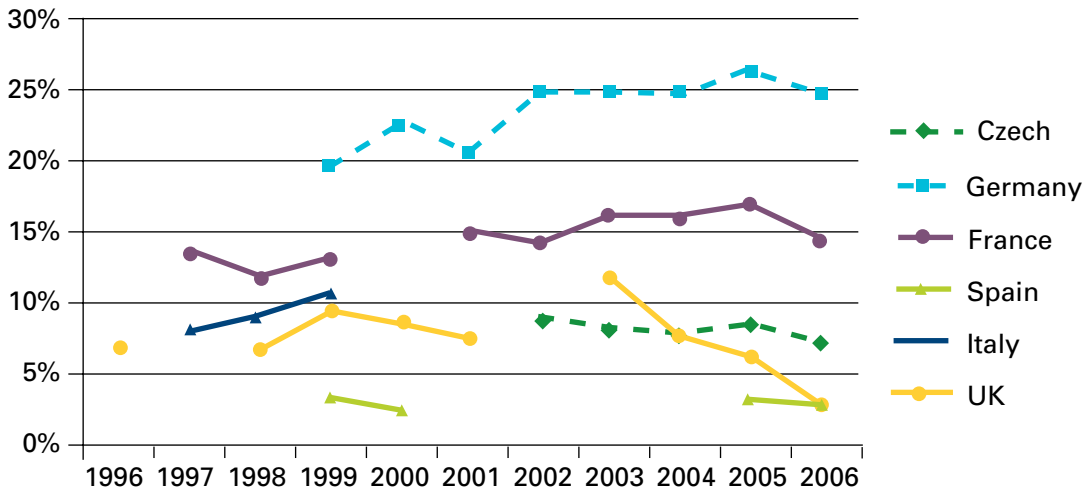
The reason for this relative decline is twofold: first and foremost, flexibility cuts both ways. It is attractive to invest in the UK, but in times of crisis, the downside is a higher propensity to use that flexibility by closing plants in the UK. Secondly, this is amplified by the Government's non-interventionist approach which has meant that it is simply easier and less costly (politically) to close plants in the UK, rather than elsewhere.

3.6 R&D INTENSITY

Capital investments and R&D expenditures are two of the major determinants of an industry's sustainability, that is, a determinant for its ability to innovate and compete in the future. Our data clearly points to the fact that both these expenditures in the UK automotive industry have shrunk considerably over this time horizon. Overall, Europe is still in a strong position with regards to R&D, and vehicle design. Overall, a recent OEM study showed that – by origin of OEM – 28% of vehicles are developed by European manufacturers, 48% by Japanese, and 23% by US firms. With the downturn in the US this is likely to reduce to 15% overall, with the remainder increasing. Thus, Europe is still in a very strong position overall. In the UK, Ford, Jaguar and Land Rover together spend close to £1bn annually on R&D in the UK, which accounts for over 80% of the entire annual sector spend.

In our analysis we consider the R&D expenditure as a percentage of gross value added by the automotive sector, or in simpler words, we ask what percentage of the money in automotive earned is reinvested into the sector. Figure 6 shows the comparative performance of the UK over time against its peer group.

Figure 6: R&D expenditure in DM34 as % of GVA in DM34



Source: EuroSTAT. Missing data points not available.

As can be seen, the R&D intensity in the UK has been decreasing sharply since 2003. One main reason has to be seen in the fact that R&D tends to be conducted in the home market of the OEM, and here the UK suffers from a lack of indigenous producers. In absolute terms, we see a decline in both R&D expenditure and capital investment that puts the UK in a weak position with regards to playing a major role in the development of new energy-efficient and low-carbon power trains.

Given its low R&D intensity, the UK is essentially competing as an assembly location, with any other nation in the world. This is a fundamentally different from Germany and France, where the R&D intensity is considerably higher.

3.7 CONCLUSIONS

Overall the UK has undergone a transformation away from its poor image of the 1970s and 1980s; the UK industry is now as productive as its peers. It does feature high labour cost, but not the highest in Europe. Its main advantage is labour flexibility, as well as low barriers to exit. This makes the UK an attractive location for investment in upturn, but it equally means that the UK is likely to be more affected by downturns, as plant closure are easier and less costly in the UK, than in manufacturers' home markets, for example.

The main concerns about the current state of the UK automotive industry are the loss of scale in the local supply base ("hollowing-out"), and a persistent lack of (or inability to hire and retain) qualified labour. The reduction in sourcing from the UK is one of many indicators that point to a significant reduction in the supplier base, not just (visibly) at first tier level, but also at second and third tier level, where the SIC classification obscures the sector affiliation.

In terms of future competition, the sharp decline in R&D intensity means that the UK is effectively competing as an **assembly location** only, which means that it has to

compete against any other nation bidding for a new model. This nature of competition is very different from France or Germany, which are competing as high-cost but also strong R&D locations. So far, the UK is poorly placed to make any significant contribution to the challenges of a technology shift towards low-carbon power trains – largely because the relevant R&D is being conducted in the OEM home markets, i.e. outside the UK. In our view it would nonetheless be possible to attract some of this R&D activity into the UK through a long-term, large-scale demand-side intervention. In other words, the UK needs to become a leading **market** for such low-carbon vehicles, through programmes such as Test Bed UK and others, which in our view in the medium turn will attract the respective industrial activity. At present the UK industrial landscape features a limited scope for battery, hybrid, fuel-cell and hydrogen power trains, compared to countries like Germany or Japan.

4 A Positive and Supportive Business Environment

This section provides commentary on the current Business Environment and specific issues that the Business Environment Expert Group of the NAIGT considered key to the future success of the industry. It deliberately focuses on the future rather than the short term pressures posed by the credit crisis, given the longer term focus of this project. That said, it is impossible to ignore the current situation, and it provides an opportunity to test recommendations against current experience.

4.1 THE BUSINESS ENVIRONMENT IN CONTEXT

The primary challenge for this part of the work was identifying what the business environment actually was, and which were the important drivers for change. Assuming to start with that nothing was ruled out, the business environment is clearly a very large and disparate concept. Aside from the technical and regulatory parameters that shape the product and hence the business environment, there are a range of other parameters.

Regulation more generally is of course a big driver, covering planning, environmental issues, employment, health and safety, among others. The fiscal regime shapes many areas from exchange rates to customer purchasing decisions, to the manner in which corporations can manage their profitability and organise their group structure. Other factors include employment policies, technology drivers and public and government perceptions of the sector.

Having identified a myriad of possible drivers, it was necessary to focus on a core of priority areas to catalyse the path towards a positive business environment. These core areas were identified as follows:

Supply chains

A vision for stronger links for the UK supply base into emerging markets and facilitating it being within the gift of the sector itself. Opportunities exist, but a joining up strategy is missing. The sector needs to act concertedly to maximise impact and develop an inspirational vision. This area was also identified by the Supply Chains Group and taken forward to recommendations in that part of this report.

Cross sector engagement

Allied to this is the issue of cross sector engagement to provide "economies of scale" and derive greater traction for the UK in securing investment and embedding supply chains. Key issues are the identification of other sectors and cross over or common technologies that could provide supply chain opportunities and the role of universities and trade associations in fostering these links.

Getting the right skills

This remains a key challenge. The sector has already identified image and skill retention problems, and is working to tackle these. For example, the RMSG flowing from the last AIGT has taken forward work with the IMI to understand and fill gaps. This is in addition to work undertaken by individual companies on training and apprentices, and the IMI's own work. However the danger is that just as the sector gets on top of today's issue, in increasingly competitive business and skills environments, the world has already moved on. Attracting and retaining the right skills requires evaluation of the future needs of the sector, and development of a strategy to attract and retain those individuals in the face of that strong competition. This is a long term problem requiring early foundations to be laid. Tying into the technology road map work in this report is essential to identify the trends and technologies which will predicate the necessary skill sets and target groups to attract. The automotive sector does need the "ipod generation" and the computer/systems integration engineers not naturally associated with industrial or automotive.

Raising the sector's profile

This was more generally was identified as another aspect of this image problem. The sector has a good story to tell, but needs to examine the causes of poor perception to help identify the solutions. Starting early with children, and opening their eyes to the sector's opportunities was seen as important. The low carbon agenda could also boost perception of sector.

Government's perception of, and attitude to, the sector was also key. There was a view that while support for other sectors such as agriculture and finance seemed to be readily available, Government was reluctant to provide similar support for the automotive sector. A key desire was for access to all aspects of "Government" to be made easier, preferably via a single point of contact.

Reducing sector CO_2 more rapidly

This is an important competitiveness lever. The sector at product level has made strides towards the goal of lower carbon product, andis facing up to the challenge of new regulatory targets on tailpipe CO_2. Other requirements are bearing down on the sector to reduce energy consumption and cut carbon emissions at the process level- volatility in global energy prices, cost down pressures, as well as regulatory one like the EU emissions trading scheme and UK Carbon Reduction Commitments. The sector has an opportunity to take concerted action around understanding and sharing information on current best practice and availability of funding (EIB, Carbon Trust, Tax

system flexibility, acceptance of novel approaches). Awareness raising with the supply chain and out to dealerships would be required. Opportunities might exist in new manufacturing processes to eradicate energy intensive segments. Given all the pressures to reduce, progress seems slow or patchy. A significant effort has gone into developing the product to be more fuel efficient, but progress on the process change appears slower. This is possibly due to inertia in the manufacturing process due to fixed plant and equipment, or concerns over the payback times for investment in lower carbon plant and equipment. Clearly this sort of investment is becoming a necessity rather than a luxury.

The fiscal regime

This was also identified as an important factor. This encompasses a broad range from the taxation regime affecting the product and consumer choice (e.g. Vehicle Excise Duty (VED), company car benefit in kind rates) the general fiscal regime (e.g. Business Rates, Corporation Tax, exchange rates, interest rates) and Government support (Grant for Business Investment (GBI)[37] Low Carbon Innovation Strategy[38] and TSB funding etc). Complexity of the taxation structure remained an issue, as did knowing where to start accessing assistance. There remains a perception that state aid rules were not applied consistently, and fathoming the complexity of assistance was identified. Critical was a long term consistent approach with visible clear links to policy objectives. Concerns were expressed to ensure the consistency between local and national fiscal schemes such as congestion charging and VED: differential rates based upon different criteria make it extremely difficult for corporations and consumers to make informed purchase decisions, or manufacturers to respond to policy demands.

The conditions for business in the UK should not be considered in isolation and the wider context of how the UK is benchmarked against other EU and global competitors cannot be forgotten. All of this leads to building a picture of UK opportunities and areas for improvement to create the right conditions to prevail for a prosperous automotive business and improved UK offering to attract and retain investment in the sector.

4.2 A POSITIVE BUSINESS ENVIRONMENT – CREATING A WINNING FRAMEWORK FOR BUSINESS TO INVEST IN THE UK AUTOMOTIVE INDUSTRY'S FUTURE

The Government's stated role is not to pick winners, but it does have the responsibility to create a positive investment framework for winners to continue to invest in the future of the UK industry alongside its overall macroeconomic and national policy responsibilities.

The starting point is to understand the current situation, identifying the strengths and weaknesses of the UK offering. Comparing this to the vision set out earlier leads to

37 www.berr.gov.uk/whatwedo/regional/investment/page29183.html

38 www.dft.gov.uk/pgr/scienceresearch/technology/lctis/lowcarbontis

the development of a strategy or steps to achieve the vision and improve the UK offering.

Drawing out the findings set out above, the following issues have been identified:

Firstly there is presently a weak business case for new (as opposed to replacement) investment in the UK either at the OEM or Tier 1 level. In fact, the UK is probably way down the shopping list compared to Asian markets or the newer EU member countries.

Secondly, the UK, alongside other continental European countries does not have a structural cost advantage compared to these countries – and its strongest competitive advantage of labour flexibility is also a disadvantage during a recession where there is significant restructuring.

Thirdly there is no strong domestic growth potential in the car market that would require incremental capacity and the UK also suffers from a lack of critical mass in technology that might attract global suppliers, even though it does still have a good skill base in design and engineering.

In fact the overall business environment for the domestic industry is challenging and potentially fragile. With virtually all the industry foreign-owned and most investment decisions made outside the UK, this is the risk side to the vibrant and multi national sector embedded in the UK when compared to competitors. Whilst other EU states are seeing their sector go through similar change with foreign direct investment increasing (France, Spain and Czech Republic are examples) the UK is at the forefront of this. The lack of a national champion remains an issue too. This situation, coupled to the hollowing out of the supply chain in recent years, is the risk side of the equation.

However, alongside these serious issues, there are positive points too. The industry has transformed itself in terms of productivity and quality over the last twenty years driven by the influence of the Japanese transplant sites. It makes a significant contribution to national prosperity, skilled jobs and the balance of payments and now is the second largest global player after Germany in the premium sectors with several globally competitive UK brands.

Low carbon technologies present both the catalyst and the opportunity for the industry to continue to reinvent itself, reinvest in existing sites and secure long-term employment and technology capability. Additionally currency movements and changes in global logistics costs may provide a window for investment in UK sourcing for OEMs.

Yet despite this progress, the industry has an image problem. The case for taxpayer support for the industry is not widely accepted – in fact many in government and parliament, independent commentators and potentially the wider public still have an outdated and negative "British Leyland" perception of the car industry and view the industry as being in terminal decline. The taxpayer business case therefore needs to form part of the conclusions for the overall investment framework and the industry will have to sell this case strongly to the wider public and to overseas investors. Clearly

there is a significant public relations job to be done to raise the perception of the sector to counter this negativity.

In the short-term the business environment currently presents some major challenges for the industry in the UK and indeed globally. The Government, working with the SMMT, has implemented a series of proposals to support the industry by stimulating demand and mitigating the direct impacts of the credit crunch, especially around credit availability. All the UK's major competitors have introduced substantial and in some cases massive support and subsidies for their domestic industries. The UK continues to argue for and seek a level playing field within the EU on automotive interventions to avoid putting the UK industry at a further competitive disadvantage.

In response to the current crisis affecting the industry, the Government has introduced a broad range of measures both targeted to the sector and of more general benefit. These have been well publicised and a table summarising the key points is attached. This is of course a welcome recognition of the importance of the sector to UK jobs, prosperity and innovation, but remains a specific response to circumstances. Tackling the fundamental issues identified above will require concerted, strategic, and long term action centred around raising the perception and awareness of the wealth of good things associated with the sector, and joining existing resources together strategically to form a greater end result.

4.3 RECOMMENDATIONS

These recommendations are focused on actions that government and industry can take jointly to provide the right business investment environment in both the medium and longer-term rather addressing the short-term adverse economic situation (although there are lessons to be learned from the present crisis):

(1) Strengthen certainty and credibility

- A permanent Industry/Government forum a "National Automotive Council" should be created to manage the future evolution of this automotive policy and provide governance. The proposed Council must involve key decision makers from industry and across government to ensure focused tracking of execution and implementation of NAIGT recommendations as well as the sustainability of ongoing policy and strategy recommendations. The national policy will be implemented consistently regionally through effective RDA engagement to avoid independent or conflicting regional initiatives.
- The Automotive Council should publish a long-term UK Automotive Framework to provide business and overseas/inward investors with certainty around the investment environment through 2025. The framework should be benchmarked against best practice internationally and will be integrated into the national Manufacturing Strategy[39] and coordinated with other sectoral strategies. The framework should be proactively "sold" to overseas investors.

39 www.berr.gov.uk/files/file47660.pdf

- The BERR Automotive Unit should take the lead within Government to ensure NAIGT recommendations are incorporated on a joined up basis across Government into all policy, funding and activity – e.g. business support systems, skills and innovation agenda, UK Trade and Investment (UKTI)[40] and RDA targets etc. Government should also ensure that the UK application of EU rules does not disadvantage UK industry compared to implementation in the rest of the EU.

(2) Improve UK investment offer

- Simplify and maximize incentives and funding for upgrading and developing existing (and new) manufacturing locations and provide new funding for investment in collaborative testing and research facilities (tied to Technology roadmap). Ensure business support is simplified and focused on improving access and customized interventions for SME's and larger companies through local business relationship managers. Review the effectiveness of fiscal tax incentives (e.g. R&D) – a cash funding alternative may be required to provide the right incentive to start-ups, overseas investors or indigenous investors with tax losses.
- Co-fund carbon reduction -- a new Energy Fund, potentially administered by an expanded Carbon Trust, should be set up to advise on and co-fund investments in carbon footprint reduction across the industry (including retail) as part of the UK's wider industrial commitments to carbon reduction. This could be linked to European funding mechanisms such as the EIB Clean Transport Facility
- Focus public procurement – Government should establish public procurement policies to actively direct and promote use of UK produced vehicles, goods and services by all government departments, agencies and taxpayer-funded bodies including existing OEM's and niche/low carbon companies.

(3) Widen collaboration

The Automotive Council should co-ordinate forums (building upon other IGT/RDA-driven investments) to promote cross-sector collaboration (e.g. aerospace, renewables, defence) and stronger business-university collaboration around science and technology development as part of integrated UK industrial and science policy. This should include both product and process R&D (e.g. through interventions such as the proposed Institute of Manufacturing Technology). There should be an expansion of the role of universities as cluster and cross-sectoral knowledge integrators with additional support from research councils.

(4) Promote positive automotive industry image

Through the SMMT and Manufacturing Insight, the Automotive Policy/NAIGT recommendations should be used to promote a positive image for the industry and attract future talent from interventions at school and higher education.

40 www.uktradeinvest.gov.uk/

(5) Get the monetary and fiscal message right

- Credit systems – there should be a review of temporary bank/credit related actions to see if further longer-term changes are required with UK banks and credit insurance arrangements to avoid a repeat of present difficulties in future downturns.
- Align tax systems to policy – continue to ensure that UK domestic national and sub-national tax systems (e.g. VED or congestion charges) are technology neutral and promote interests of UK industry as well as other goals (revenue, carbon reduction etc.).

(6) Protect flexible labour markets

Existing labour-market flexibility should continue to be protected and new regulations should be introduced to provide companies with temporary wage support during periods of significant production changes or dislocations.

(7) Expand and deepen skills provision

Sector skills (SEMTA) offerings should be further developed to fully meet industry needs at apprentice, NVQ 2-4, management and leadership skills and HE automotive qualifications (e.g. degrees in automotive related topics); Efforts should be made to promote the retention of key skills in UK (including returning overseas nationals who were trained in the UK).

4.4 CONCLUSIONS

In conclusion, the key recommendation is the first. The creation of the Automotive Council is the catalyst to provide the long-term framework. The Council will, as a priority, need to take all the NAIGT recommendations and develop an agreed work plan as a strategic path to create a positive business environment.

5 Technology and Low Carbon

This section considers the challenges posed by the drive to lower carbon vehicles and the need for an infrastructure to move to a transport system based around energy from the generating sector rather than liquid fossil fuel based. Specifically it addresses the need for the right infrastructure.

5.1 TECHNOLOGY AND THE DRIVERS OF CHANGE

There are a number of drivers of change within the sector and these are either currently legislated, about to be legislated, or future concerns. One of the most significant historical drivers is tailpipe emissions, which have been regulated by legislation for several years. The same is the case for crash, noise and safety legislation all of which impact significantly on manufacturers. The newest driver for change is CO_2 reduction and the forthcoming legislation framework to be established for 2012 and 2020. This will have a major effect on the market, especially when linked to advertising campaigns, raised awareness of climate change, and fiscal incentives such as VED targeting lower carbon emitting vehicles. There is a rising interest in energy security, although perhaps to a lesser extent within the UK automotive sector than elsewhere.

The interest in achieving significant reductions of CO_2 by 2020 and the UK Climate Change Act 2008[41] with legally binding reductions in greenhouse gas (GHG) emissions of 80% by 2050, combined with the UK's agreement to increase renewable energy within the transport mix, provide compelling reasons to push forward on more advanced technologies within transport as highlighted in reports such as the King Review.

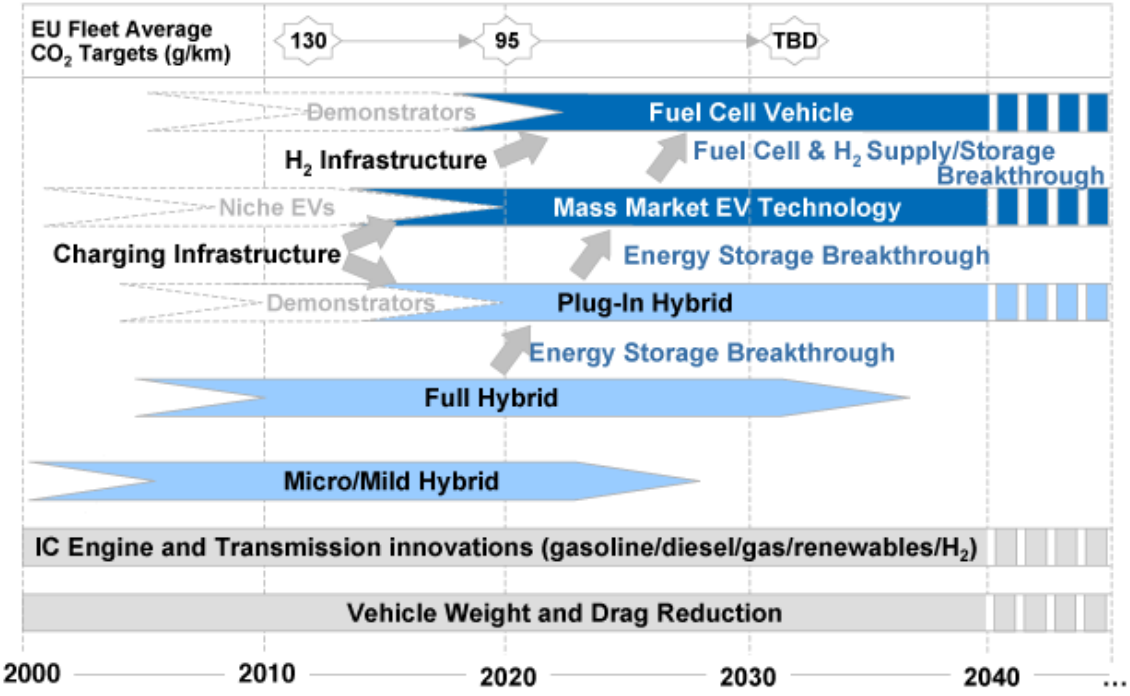
The Gallagher Review of the indirect effects of biofuels production has also highlighted the difficulties of increasing the level within the transport mix in the next ten years while sustainability issues are yet to be resolved. The Group concluded therefore, that a drive towards EoT should be accelerated in order to address the drivers of change identified and take advantage of a business opportunity in component development and supply for electric drive and associated ancillaries/storage systems and other related componentry. This would need to run in parallel with more conventional technologies such as ICEs, light weighting, reduced drag and various hybrid technologies.

41 www.opsi.gov.uk/acts/acts2008/pdf/ukpga_20080027_en.pdf

5.2 INDUSTRY CONSENSUS TECHNOLOGY ROAD MAP

Considering that the move to reduce CO_2 emissions and the necessity to move towards low carbon transport two key documents have been developed by the NAIGT and are included within this report. It is intended that these documents remain 'live' and can be adapted as social, political and economic circumstances change the demands for new technologies.

Product development roadmap[42]



At this moment a clear and focused Product development roadmap is required in order for the sector to agree what are the key technologies against timescale that will be required in order to achieve the ambitious targets set for CO_2 reduction in the sector. The roadmap is identified above and shows under each technology bar what the key issues are against timescale. Within the broad acceptance for this technology roadmap, it is identified that each individual OEM will have a different route through the roadmap and the timescales will be dependant on OEM vehicle DNA among other issues.

It should be noted that the roadmap is considered a high level overview and is complementary to and builds on the work previously undertaken by Foresight Vehicle

42 See Appendix F for full Product Development Roadmap

Research Development Roadmap[43]

	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

The technology roadmap broadly identifies the technologies required to move the automotive sector forward on the key driver of CO_2. NAIGT identified that to underpin the technology roadmap a research focused roadmap was also required. This is shown in detail within Appendix F but headlined above and should be used to direct research funding into the sector. The aim of the research roadmap will be to build consensus from the UK university base on where research should be focused into automotive applications. This will have the effect of maximising research funding value, developing strong partnerships between academia and the vehicle manufacturing sector, and maximising the opportunity for commercialisation of our UK technology institutes work though SMEs into mainstream development within 'Test Bed UK'. The increased focus in research to solve the issues associated with electrification of transport could also raise awareness of, and interest in STEM-based careers. Within the work of NAIGT we have taken both roadmaps and tested them with a wider audience. The appendices include the wider engagement audience and it is therefore believed that this is a valid and accepted set of recommendations for the UK automotive industry and academe.

5.3 TEST BED UK

Test Bed UK is proposed as an umbrella brand which is then responsible for managing the major activities within the NAIGT roadmaps. The first programme could be EoT with others such as ITS etc. following. With each programme, the aim would be to develop real world application that could be rolled out to the mass market, at which point, the technology takes on its own momentum.

43 See Appendix E for full roadmap

Individual vehicle manufacturers are tackling the CO_2 challenge and are increasingly seeking partnerships to introduce the necessary vehicle infrastructures to support the electrification of transport. The UK is no exception to this however, and to date these partnerships are relatively small scale and are being established in isolation and without reference to each other. The UK has an opportunity to take a global leadership role in this area by leveraging the unique political, social and geographical conditions.

The UK demographic (relative population density and distribution amongst large city conurbations) provides an ideal environment for the introduction of plug in hybrid and electric vehicles. Couple to this the presence of major manufacturers from UK, Europe, Japan and the USA and a highly developed niche vehicle manufacturing capability and we can envision the UK as the ideal place to introduce and develop this new technology field.

Numerous demonstrator projects have already been established in the UK under the auspices of organisations like CENEX and TSB but with some improved co-ordination and funding these could be further developed to create a nucleus of low carbon vehicle testing that would attract R&D activities to the UK from global and niche vehicle manufacturers.

The NAIGT proposal is to create a linked cities and regions approach to developing and rolling out the technologies identified by the roadmap and supporting the growing need for infrastructure linked to vehicles in areas such as EoT and ITS. This will allow manufacturers to showcase the new technologies and for customers to experience real life application. Once a technology has been developed and tested, the plan would be to replicate and role out to mass market and Test Bed UK moves on to the next major project. This model of roll out can be compared with the early adoption of mobile phone technology where commercial companies established the networks on a profit driven basis from the highest return links and nodes during the first phase and rolled out the technologies as the market established and further coverage became economically viable.

The reasons for and benefits of such an approach are:

- UK transport market is distinct and separate from other global markets and so has the potential to lead world in development of new transport models;
- Allows UK to collaborate with other global "demonstrator" projects;
- Promotes partnerships that do not currently exist and facilitates the need to create a formal partnership mechanism between regulators, industry and consumers;
- Business model innovation is at least as important as technology innovation for the introduction of electric power supply for personal mobility solutions;
- The need to lead the development of new customer/user behaviours to get best out of new technologies;
- Gives UK Plc a voice in advanced technology development e.g. standards, regulations;

- Creates a potential to become skills centre; and
- Outlet for research institutes to demonstrate capability to industry.

We believe that the above benefits broadly fit within BERR's 'Industrial Activism' agenda which identifies future trends and supports industry to maximise its competitive advantage in the relevant area.

In order to stimulate the activity and attract investment to the UK it is estimated that a funding budget of £1bn would be required over ten years delivering several programmes under the Test Bed UK umbrella.

5.4 HOW WE MEASURE CO_2 EMISSIONS IN VEHICLES

Currently we measure new car registrations based around a Tank to Wheel (TTW) assessment of the CO_2 emitted over the New European Drive Cycle (NEDC). As we move forward with alternative fuels and EoT, rather than the current reliance on fossil fuel, it is important that we consider a new measurement method.

We would recommend that we develop proposals for the current system of measurement to move towards a well to wheel (WTW) measurement method taking into account the CO_2 created in the Well to Tank (WTT) part of the process. Our target would be to introduce such a change by the 2020 timeframe.

As a further development, it would be beneficial to investigate how we could start measuring the vehicles energy efficiency (again on a WTW basis). A measurement of energy efficiency would focus attention towards reducing energy consumption (MJ/km) over a drive cycle which would be complementary with carbon reduction. This could be introduced as a parallel system initially to ensure continuity and acceptance of the new standard.

Towards a longer legislative timeframe, we should consider the implications of Life Cycle Analysis (LCA) on energy and CO_2 consumption. It should be noted that as we move towards significant reductions in emissions from the 'in use phase', the relative importance of 'manufacturing' and 'disposal' will change.

It is also recommended that we establish a broad understanding of the legislative framework beyond 2020 and towards targets for carbon reduction in the 2030 and 2050 timeline with a reference to energy consumption base.

6 A Stronger and More Competitive Supply Chain

The remit of the Supply Chain Development Expert Group was: "to consider the competitive position of the UK industry in the context of the key trends, both threats and opportunities, affecting global and national supply chains, and to develop industry-led solutions to address those challenges and improve the competitiveness and attractiveness of the UK supply chain."

6.1 REVIEW THEMES

In carrying this out the Group deliberately undertook a wide-ranging review of all the key issues affecting the competitiveness of the UK supply chain, and their interrelationships, and on this basis then concentrated on four major overlapping themes: ensuring the competitiveness of the UK supply chain to meet present and future requirements; developing manufacturing competencies and capabilities in the supply chain; how to attract R&D and other value added activity to the UK from VMs and Tier 1s; and research and innovation support, especially academia-industry collaboration.

6.2 ENSURING THE COMPETITIVENESS OF THE UK SUPPLY CHAIN

As reflected in the BERR Report on the Business Environment for Japanese Automotive Supply Companies in the UK[44], a competitive UK supply chain is essential to retaining and increasing investment by VMs in the UK, as well as maximising the added value in that supply chain. Supply chains, rather than individual companies, compete on the international stage.

Skills requirements

This Report also highlighted the management shortcomings seen in UK suppliers, such as short-term reactive attitudes and a lack of strategic thinking and long-term investment in new technologies. The recommendation was for a greater focus on management capability to be incorporated into supply chain improvement programmes.

44 www.berr.gov.uk/files/file45472.pdf

The concentration on lean manufacturing/process improvement in previous/existing programmes, such as the National Supply Chain Group (SCG) programme jointly run by BERR and the RDAs (which closed in March 2008 and was the result of a recommendation by the previous AIGT), was seen as a necessary but not a sufficient requirement for competitiveness. There was an equal and pressing need to enhance leadership and management skills to address strategic issues and to maximise both the benefit from and the sustainability of improvement programmes, an assessment with which the Group concurred from its experience.

Localisation

The need to support the identification of UK suppliers for VMs and Tier1s was also a conclusion of the Report. In some cases Tier1s did not have the resources to undertake a comprehensive search and in other cases had assumed that there was no UK capability.

The Group noted the progress that had been made since in response in developing a pilot Automotive Supplier Finder service through SMMT working with BERR and the RDAs and related specialist bodies. It endorsed the importance of developing a user friendly and comprehensive service as part of an approach to maximise value added in the UK.

Internationalisation

Similarly there was agreement with the Report's conclusion of the importance of support for the internationalisation of UK suppliers' business – and for the better regional and UK wide coordination of what is available from different agencies/ activities and its integration with wider business improvement programmes. This was with a view to helping them more actively to exploit opportunities in emerging countries, both as new markets and centres of lower cost production as part of their overall competitiveness strategies. This may be through direct exports in some cases, but in the automotive industry it more often requires some presence through direct investment or partnership with a local company,

In addition to tackling international markets to take advantage of the major growth in demand that this offers, there are wider benefits from such engagement with the global economy. Evidence shows that companies that invest and sell overseas improve their productivity, innovation and financial performance. Selling overseas helps businesses achieve economies of scale and levels of growth and revenue not otherwise possible. Such companies are more likely to have capital to invest in new innovation and product development in the UK and to maintain or create jobs, and exporting companies have a markedly higher R&D intensity than non-exporters. Effective international collaboration/partnerships again offer opportunities to strengthen UK suppliers.

Independent evaluation of SCG programme

The independent evaluation which has been completed on the national SCG programme, which supported 62 projects involving 575 suppliers employing 160,000

people over its 5 year life, has confirmed the major productivity gains and improvements in quality, cost and delivery which can be obtained through such programmes. A particular feature was improved customer-supplier relationships and communication.

There was a high degree of additionality to such outputs, with the majority of assisted businesses stating that they had done little or no business development of this kind prior to getting involved in the programme, and the considerable behavioural change caused and skills developed suggested that improvements would be sustained on an ongoing basis beyond the programme. The customer pull model, with VMs and Tier1/2s acting as hosts, clearly helped to reach more suppliers than other programmes.

The experience of the national SCG programme was considered to be particularly relevant, but the scope for shared learning and development with other existing supply chain programmes, such as SC 21 in aerospace and in the regions, was also recognised.

Fundamental competitiveness – the continuing need for support

These results were seen as encouraging, but they needed to be built on further to ensure a continuous improvement culture and the take-up of new and enhanced techniques in a situation where the competition was moving on. This applied across all Tiers of the supply chain, although there was still a particular need to reach the smaller suppliers down the chain.

There remained a continuing requirement to address supply chain efficiency and partnership relationships as well as the competitiveness of individual firms on a holistic basis. Although in the medium-term the greater activity would still be linked to meeting the needs of existing technologies, there was a need to ensure that the wider competencies were in place to exploit the emerging opportunities in the new low carbon technologies.

There was a clear need for such support and development down the supply chain, but a difficulty in creating the demand for and take-up of such services, particularly among the smaller firms with more limited management capacity. A strong message that came from these firms was confusion about the availability of the wide range of public sector schemes, and difficulties of readily accessing those amongst them relevant to their circumstances.

Variability of regional support was a problem too for SMEs, as was the multiplicity of bodies involved, in addition to the perceived inflexibility/ineffectiveness of access. The need to improve delivery performance was a constant theme at SME level.

Marketing/major company engagement

A further conclusion from the national SCG programme, where initial take-up was significantly delayed, was the importance of strong marketing of any programme and of direct and active engagement with potential hosts. Obtaining the buy-in and ongoing

commitment of the VMs and Tier1 suppliers has been a crucial element in the success of the three pilot supplier development programmes, that started in 2008. One each with Honda, Nissan and Toyota and a nominated Tier 1, were initiated as one of the early responses to the conclusions of the Report on the Business Environment for Japanese Automotive Supply Companies in the UK.

SMMT Industry Forum[45] and the NSA-M are running these pilot programmes for BERR to address management capability and wider strategic skills, as well as process improvement, to build on the best practise of the national SCG programme. These pilots should be completed by March 2010, but already some useful lessons are being learnt, which the Group has incorporated into its thinking on process improvement and effectiveness.

While it was recognised that some valuable individual regional supplier development programmes appropriately continued to be run, there was an overriding need for any new programme that addressed the issues outlined to have national coverage, even if programmes were delivered regionally, as supply chains are national, or indeed international. Availability of a national scheme is necessary to engage effectively and coherently with decision-makers in potential hosts, both in the UK and overseas.

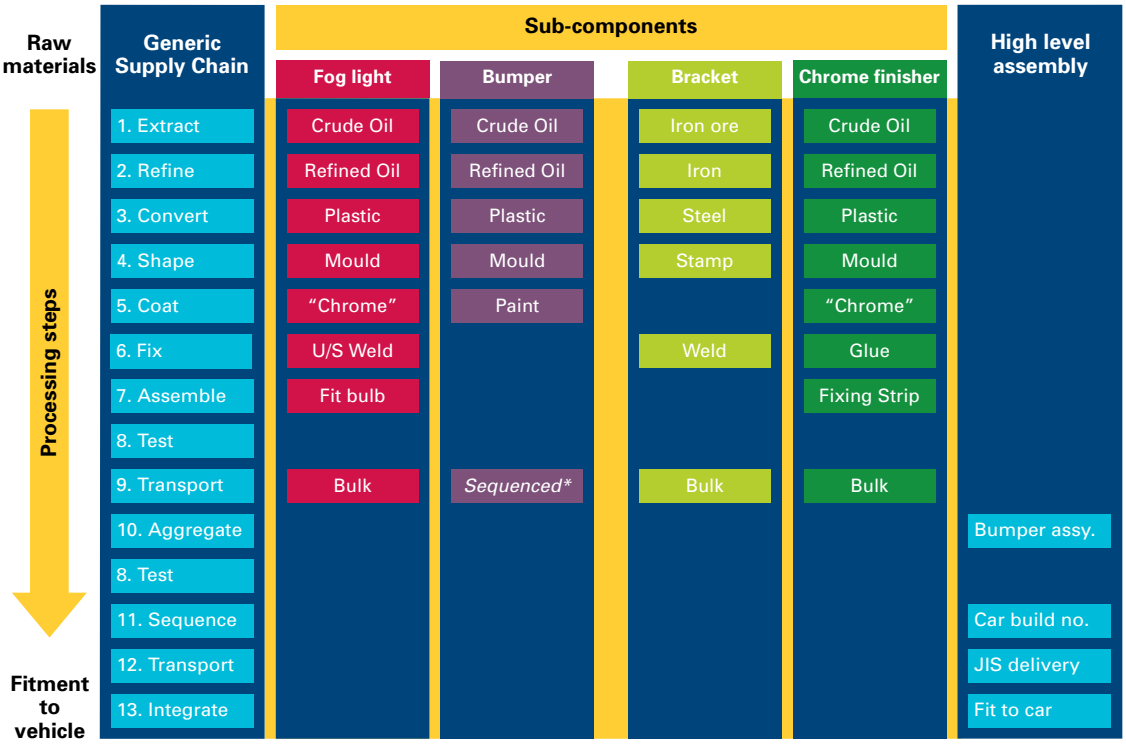
6.3 DEVELOPING MANUFACTURING COMPETENCIES AND CAPABILITIES

The UK appears to have suffered more than other Western European countries from the "hollowing out" of key manufacturing competencies in its supply chain in recent years particularly from the loss of value-adding operations below Tier1 final assembly operations where overseas competition has prevailed. This view is supported by both anecdotal evidence from industry, primary research in the Report on the Business Environment for Japanese Automotive Supply Companies in the UK, and additional (but limited) broad analysis of the industry that was possible from the standard statistical framework (as reflected earlier in this report.)

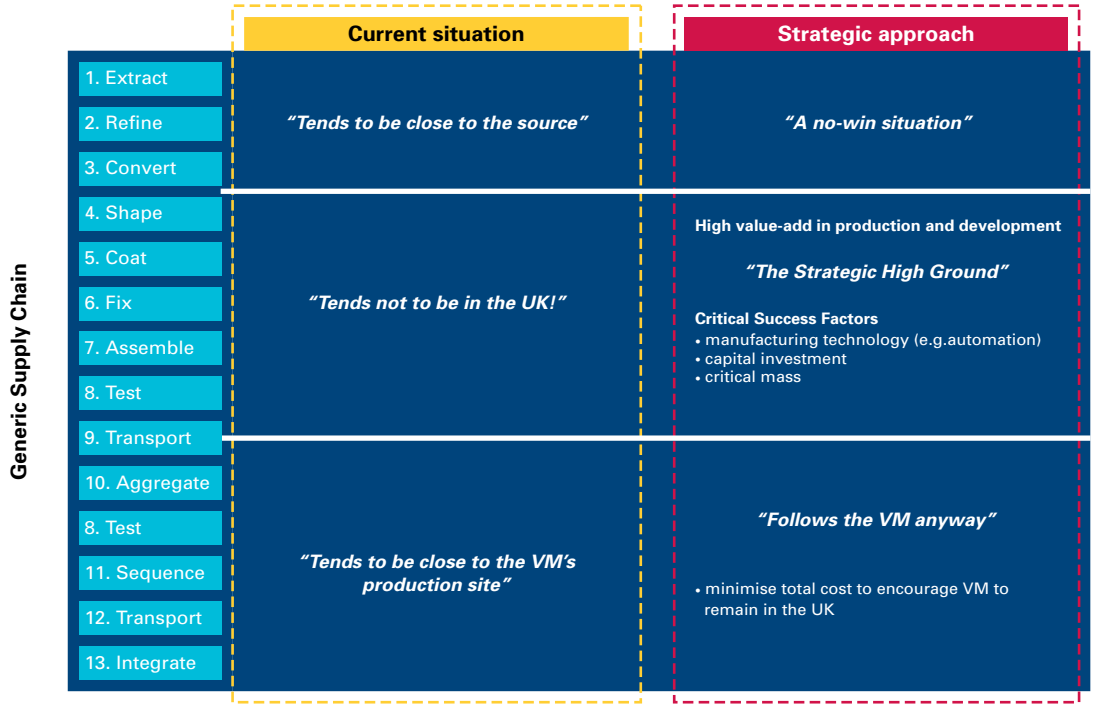
This has particularly affected the high-value added production and development which is carried out prior to just-in-sequence/just-in-time final assembly, which for inventory/transport reasons needs to be in close proximity to VMs in the UK. An illustrative generic example of these "middle ground" value added activities – and key factors influencing them – is given at Figure 7.

45 www.industryforum.co.uk/

Figure 7: Generic supply chain analysis, using example of car bumper production



* May lead to immediate warehousing



Trends in the total cost equation

Some of the changes in the UK supply chain are long term and a consequence of global trends, others not. It is not only about prime cost, i.e. price of components, but also about total cost competitiveness, including the more intangible costs, which includes the effects of quality, delivery, flexibility of service, responsiveness to changing customer requirements, design capability etc.

Significant changes are also now occurring in this total cost equation, not least with increasing transport costs and environmental concerns about the carbon footprint of extended supply chain operations. UK suppliers have some natural situational advantages to exploit in this respect, as well as the scope to increase the value they can add to many parameters. The current fiscal exchange rate also offers a particular window of opportunity to repatriate activity back to the UK, which can then be consolidated with further improvements to processes that can be adopted at a later stage.

Some changes, in particular those that arose out of lower labour costs in Eastern Europe, may be reversible as labour rates equalise and the transport cost changes, etc have more impact. However many of the components brought into the UK do not come from lower cost countries, but advanced economies, such as Germany, France, and Japan. The evidence from these countries, which have not suffered a similar speedy or extensive "hollowing out" of their industry, suggests that a critical success factor in many of these activities has been the investment in and application of manufacturing technology, which has reduced the impact of labour and offered advantages in quality.

Opportunities for gaps in the UK supply chain

This was also a conclusion of the Report on the Business Environment for Japanese Automotive Supply Companies in the UK, which drew attention to the strong opportunities identified for further local procurement in specific sub-sectors such as metal pressing, plastic moulding, aluminium and iron casting, metal forging, and machining and tooling. While these might be seen as more traditional sub-sectors, many had non-labour intensive processes. There were also some key new technologies, which need to be implemented in order to remain competitive.

It was recommended that particular attention should be given to the needs of these sub-sectors. However there is clearly a need to decide the key priorities as it is not always possible to pick winners. Such opportunities could be met, either by new/ existing UK suppliers or the attraction of further inward investment. The characteristics of the most favourable opportunities would seem to be:

- Large and\or heavy products (high transport costs);
- Low labour content or the potential to significantly reduce the labour element through automation;
- Products which VMs do not see as differentiators; and
- High variety (e.g. coloured)

There may well be structural gaps in the overall UK supply chain capability, which adversely affect the overall competitiveness model, including time as well as other costs. An example could be machine tool industry capability to carry out rapid tooling changes during programme launch periods, but this, as with the more general opportunities, needs to be explored further with the industry.

Creating the right investment environment

Creating the right investment environment to attract such developments will be crucial – in terms of specialised skills (e.g. in robotics, maintenance, machine tooling), investment incentives, and infrastructure. Just as this sector of industry has hollowed out over recent decades, so, inevitably, have the skills to support it. Reversing this trend will therefore not only require investment in new equipment but also in the people with the right skills that are necessary to apply it. This applies to relevant management as well as technical and engineering skills. Given that many of the OEMs and suppliers are international companies who can invest wherever they choose, the level of those skills will have to be competitive and globally renowned.

There is also the issue of ensuring a critical mass of business opportunities to justify such investments in the appropriate levels of manufacturing technology. Engine manufacturing provides an example of the potential scope for pooling pre-competitive information on common company requirements to provide such greater critical mass, with more certainty and stability for potential suppliers. This is a particular UK strength,with over 3 million engines produced a year, but production is fragmented between a number of major manufacturers. While none individually might attract the necessary investment to meet, for example, foundry and forging requirements, their combined demands could offer an attractive economy of scale, and greater certainty for suppliers.

The cross-sectoral aspect to these issues was also recognised. Many of these activities represent core manufacturing competence, and support other UK manufacturing industries than automotive. There might be wider opportunities to assess common requirements across sectors, if similar requirements exist in other manufacturing sectors.

Niche vehicles/opportunities

In addition to the volume manufacturers, to which the above comments particularly relate, the UK has a strong niche vehicle sector, which tends to have a larger UK supply base and do more of its R&D in the UK than than those producers. Similar circumstances exist for much of the construction equipment and motorsport sectors. Alongside these existing opportunities, which need to be maximised, there are also new dynamics in "niche" areas, with new technologies offering further market opportunities to both existing and new companies other than the existing major players, and for differentiation by R&D, i.e. a leapfrog opportunity. There are also new supply chain models appearing which the UK could be well placed to exploit, in particular any move to rapid response built to order vehicles.

6.4 ATTRACTING R&D AND OTHER VALUE ADDED ACTIVITY INTO THE UK FROM VMs AND TIER1s

A key feature of the UK automotive sector is the significant overseas ownership of the major vehicle assembly plants and their supporting Tier1 suppliers. This limits the level of parallel R&D activities that are carried out in the UK and renders a large part of the sector as an assembly-only activity, since the general practice is for Tier1s to align their R&D facilities close to those of their major customers. This pattern has also contributed to the hollowing out of the supply chain at the Tier2/3 level, which has helped to build the view of a lack of excellence in manufacturing technology and productionisation that is referenced in the Report on the Business Environment for Japanese Automotive Supply Companies in the UK.

There is thus a need to try and attract more of the core, as opposed to merely applied, R&D of VMs and Tier 1s. This will be very difficult to achieve given present patterns of such activity, but some leverage may be obtained through the changes pending or achievable in the new greener technologies and the UK's manufacturing technology capability.

Requirement for significant differentiating UK action

Significant and differentiating action is required if VMs/key suppliers are to see the UK as their second home for development of new automotive technologies.

The Group considered that there was potential for a 'green region', as envisaged in the 'Test Bed UK' proposal, bringing together industry and academic support, with prototype, testing and demonstration facilities, to provide the necessary critical mass and impact to change thinking about the UK in this respect. The discontinuity provided by the new challenges and risks of the emerging technologies provides us with a particular opportunity, if we can make the most of the excellence of the UK academic research base.

A large-scale strategic intervention, however, as part of a long-term commitment to the development of industry, rather than multiple 'small' projects, is undoubtedly required in order to attract the attention, interest and support of key overseas decision-makers, not least because of the increasing competition and new initiatives in other countries. Such a clear national framework, coupled with a well-funded research programme, would provide the basis for effective dialogue with such companies. The Report on the Business Environment for Japanese Automotive Supply Companies in the UK also emphasises the importance of workforce skills in attracting investment.

Importance of global Tier 1s

The need is to attract more VM R&D as a first step, as such customer design demand is a pre-requisite for Tier1s to undertake R&D in the UK. The major Tier1s are a critical part of the equation, as the productionisation and integration capabilities necessary to take a new idea to the scale required by the industry are particularly concentrated in these companies and the VMs. Small entrepreneurial companies do not have the

capability to bridge this gap but they can provide innovative intellectual property as a contribution to enhance overall competitiveness and attract inward investment.

In terms of future development, much greater collaboration and cooperation is required between Tier 1s and VMs and more widely with new technology companies, as the initial costs of the transition to low carbon technology will be high, and the early volumes of viable production low.

Ensuring wider benefits for the UK supply chain

Such an environment would in turn provide more opportunities for existing UK companies as well as greater scope to grow new companies. As reflected above, in maximising the benefit for the UK supply chain particular attention needs to given to the importance of manufacturing and production technology development, so as to ensure that the UK benefits from the production stage, and moves on from being considered as a good innovator but a poor implementer. Any approach, in addition to delivering the necessary research support for industry, would also need to provide business case and business support for UK start-up technology and supply chain companies – as well as for incoming investors.

There may be opportunities to develop clusters of companies at all levels around a particular technology. This would provide greater critical mass in terms of research, skills and support services, and act as a differentiating magnet for attracting further company investment. Particular attention should be given to identifying and supporting the development niches which offer the most opportunity and where the UK has an advantage.

A successful combination of the academic research base and the existing niche technology companies in this way could provide a powerful incubator for developing 'leapfrog' technologies, products and processes, as well as attracting the major Tier1s, important in their own right and as a bridge between a good idea and volume supply for the mass market.

6.5 RESEARCH AND INNOVATION SUPPORT

The fundamental view from the Group was that Government spending on university research and interventions with industry is not well enough directed for the benefit of UK plc.

Industry is driven by short-termism (for example, a technology company out-sources component manufacture to China to save money, providing immediate technology transfer opportunity for the emerging Chinese industry). Also, many SMEs are not sufficiently aware of their benchmark position in terms of real world class performance, and therefore fail to aspire to achieving such performance. There is a lack of recognition of the consequent need to change, and that they compete for capital globally, rather than with traditional competitors. Many in industry still feel that government has lost interest in manufacturing, and so does not believe there is help available. Continued promotion and demonstration of government support is crucial

and ways need to be found to more effectively support industrial R&D in the UK, and to ensure more of the value-added benefits "stick" here.

Research funding

In the academic world, the method for research funding through the Research Assessment Exercise (RAE) is a traditional model, based on peer reviewed published papers. This can become a self-perpetuating exercise for the top universities, with many good new universities excluded from this 'top table', and introduces a focus on academic rather than industrial priorities. Many academic professionals are also not skilled in marketing university capabilities to industry. There is no effective 'clearing house' to enable this.

The Research Councils appear to lack a common, long-term strategy that should provide sufficient stability for the Universities to plan for the longer-term. Manufacturing has been structurally under-funded by Research Councils particularly EPSRC for many years. This can possibly be explained by a perceived lack of government interest in the sector.

Centres of excellence

Existing centres of excellence need to be given a greater mandate and, together with other expertise, be drawn into a coordinated network/ governance structure, in order to generate a larger centre of excellence that can compete on good terms with the MIT/Fraunhofer models in the USA and Germany. It is worth considering what can be gained by adapting the principles of these models for the UK, with more focus on productionisation of process and manufacturing excellence for basic research.

There is also a need to integrate the totality of research more closely, from basic through to near market pre-competitive programmes (that are developmental or pre-competitive), and ensure that areas of most value to UK plc are addressed and hence benefit industry. There is a parallel need to increase companies' awareness of and to ease access to academic support

International benchmarking

Lastly, there is a lack of current international benchmarking on R&D spend in automotive sector for the UK, which makes comparison, gap analysis and countermeasure development more challenging. The last comparative analysis of all R&D spend in the automotive sector on an international basis was in 1987. A national set of data would provide the basis for well-planned intervention from Government, with a more forward view of potential market failures being developed to inform the development and review of both catch-up and leapfrog programmes.

6.6 RECOMMENDATIONS

Overview

Based on the above evidence and consultation with the industry, the Group have made three interlinked recommendations, which together in their view form the basis for an integrated and a long term national strategy for supply chain improvement and development. These are:

(1) To establish a UK Automotive Supply Chain Council – as sub-group of the proposed Automotive Council – with responsibilities for the following activities:

- Establishing a continuous national supply chain group programme to address the overall competitiveness of UK suppliers and their ability to seize new technology opportunities, by customising and streamlining access to existing and new business support;
- Establishing a Sourcing Roadmap to address the top down challenge for the OEMs and Tier1s to identify UK sources, structural gaps and opportunities for greater value added localisation in the UK, including looking at common needs to provide a greater critical mass of opportunity and reverse the current 'hollowing out' trend;
- Addressing the internationalisation potential for UK Tier 2/3s for both UK cost down and international business development, and how this could best be supported;
- Looking for opportunities to develop/nurture the niche vehicle and supply industry and in construction equipment and motorsport as a potential development source for emerging technologies;
- Reviewing the investment environment requirements to realise these opportunities; and
- More generally promoting the strengths, and production and technology capabilities and capacities of the UK automotive supply chain.

There should be an international benchmarking activity that provides a common, total cost of operation, set of data to support these activities, so that continuous review and prioritisation can be more easily accomplished. SMMT's ASF provides a base on which to build on in identifying local suppliers.

(2) To establish an Institute of Manufacturing Technology to provide a focal point for the revitalisation of automotive supply chain manufacturing, with a two-step approach:

- Pull together a core of existing high quality institutions and facilities, with revised and coordinated funding streams, to make a statement of intent for UK manufacturing revival.
- Use this as a blueprint for setting up a single framework for industry/ university collaborative research, to be progressively implemented over the existing RAE cycle of activity.

Example establishments that could be coordinated in this way at the first stage are Warwick Manufacturing Group, Cambridge Institute for Manufacturing, the forthcoming Manufacturing Technology Centre at Anstey, Coventry, the Advanced Materials Research Institute in Sheffield and the Advanced Forming and Forging Centre at the University of Strathclyde, with support from Warwick Business School and/or University of Bath School of Management. Such a formalised network would facilitate a more focused and coordinated approach to developing the necessary industry relevant technology and the supporting education, training and skills development.

(3) The Pilot 'Test Bed UK' should be leveraged and marketed to major global Tier 1 suppliers as a reason to consider investing in R&D in the UK. Links with innovative technology companies and inventors can be fostered and 'on-the-ground' participation encouraged and incentivised. The Institute of Manufacturing Technology would form an important element of 'Test Bed UK', providing academic and R&D facilities as a 'one stop shop' both for attracting inward participation and supporting indigenous companies.

Although differing priorities and timescales will attach to their implementation, these suggested actions are interdependent, and all are integral to the transformation of the UK supply chain. These recommendations need to developed and driven by the industry, and the Group sees the leadership and vision for and the ongoing prioritisation, review and monitoring of resulting initiatives being provided by the proposed Automotive Council and the subordinate UK Automotive Supply Chain Council.

6.7 BACKGROUND DETAIL ON PROPOSALS

A continuous national strategic supply chain group programme

A continuous national strategic supply chain group programme should be established, which brings together in a customised, focused and integrated way existing support for industry to address the overall competitiveness of UK suppliers, and is delivered particularly through host VMs and Tier 1s.

A *continuous* national programme, subject to ongoing monitoring and review with industry through UK Automotive Supply Chain Council, is considered necessary in an increasingly competitive international environment to facilitate a continuous improvement culture and to avoid the current hiatus in such support which has occurred at the national level since the national SCG programme closed at the end of March 2008 (and earlier for new projects.) The ongoing introduction of new techniques and key strategic skills development is essential if the UK is to retain and further develop its existing supply chain capacity.

The aim is not just for the UK supply chain to "catch-up" across the board with Western European competitors, but to fully harness UK competencies and achieve, in conjunction with other recommendations, selective "leapfrog" competitive advantage in respect of new technology market opportunities. A continuous review process as

recommended with industry will allow such a programme to be upgraded and to proactively address potential/forthcoming market failures as necessary.

Such a programme would need to be a substantial one, if it was to have the strategic impact necessary to ensure that the UK has a world-class supply chain in future years. What is proposed however is essentially about focusing and packaging existing and evolving public sector business support, and building on existing business support structures, although a certain amount of additional resource would be needed for national/regional management and coordination. There would be need for alignment with other existing supply chain programmes, such as SC 21[46], and complementary regional programmes.

The approach would be to build on the experience of the previous national SCG programme and the pilot programmes with the three Japanese VMS in leveraging the customer pull benefits of using the VMs/Tier1s as the hosts for the programme. One important programme option would be to encourage hosts to consider opportunities for greater localisation of supply in the UK. Further details on the type and content of the programme envisaged are given at Annex D.

Establishing a Sourcing Roadmap

The proposed UK Automotive Supply Chain Council should undertake as a priority a review to identify the barriers to suppliers investing in manufacturing technology in the UK and the requirements for potential localisation of supply, including establishing common needs which could provide a greater critical mass of opportunity for UK suppliers. There is an ongoing need for a "sourcing roadmap" to describe the overall national position and to identify the opportunities and the structural and emerging gaps, so that the Council can develop a strategy to inform and guide development.

Such a review should draw upon on the views of the both the major suppliers, as well as of VMs, in its own forum and more widely. This should be aimed at non-UK based as well as UK based suppliers in order to more effectively address gaps and opportunities. It would update and refine as necessary the information collected on the factors affecting investment decisions as part of the survey for the Report on the Business Environment for Japanese Automotive Supply Companies in the UK. It should include:

- Conducting research into all the elements of the value added chain in total cost terms, so as to better understand where the opportunities lie for the UK, taking advantage of changes in manufacturing technology and international labour and transportation costs:
- Identifying the critical skill sets necessary to support facilities which could exploit such opportunities;
- Reviewing the investment environment requirements that would incentivise investment in such areas in the UK; and

46 www.sbac.co.uk/pages/80338686.asp

- As part of this considering ways to exploit the strengths of the UK niche vehicle sector, and the construction equipment and motorsport sectors

It will not be possible to generate a positive business case for the UK in all fields, hence the need for further research into the most favourable opportunities in total cost (not simply price) terms compared to key competitor groupings. Such research should include a review of likely forward trends in the key cost variables, and the major players in the industry coming together on a non-competitive basis to identify common requirements, so as to refine the broad gap analysis already established in terms of value added "middle ground" activities which feed into existing jit/jis operations.

The cost model should compare the UK with various international regions – both advanced economy competition (Western Europe, Japan) and emerging markets/lower cost country competition (Eastern Europe, China, SE Asia, etc.) Any key structural gaps that could affect overall competitiveness in pursuing such aims, for example tooling, should also be identified as part of this process.

This should be coupled with an understanding of the total cost model behind any price, such as the transportation costs throughout the chain, the effect of different labour rates in various countries along the chain, differing tax regimes, custom duties, etc. so that full economic comparison can be made.

Reviewing the investment environment requirements to realise these opportunities

Industry and Government should review ways to increase supplier competencies in key value-adding manufacturing sub-sectors at Tier 2/3 in the UK supply chain, including the scope for targeted assistance

The critical importance in many of these activities of the investment in, and application of, manufacturing technology/automation, especially against a background of labour differentials continuing to decline and transport costs increasing, appears to provides a leapfrog opportunity for UK industry, if properly exploited, which could reverse the relative "hollowing out" of recent years. The proposed review would provide a basis for both industry and Government to take an informed strategic view on whether/how to fill these gaps. It could be a good opportunity for attracting inward investment if the UK is able to offer sufficient economies of scale from the proposed pooling of requirements, or serve as an expansion opportunity for existing companies or new start-ups with venture capital support.

In particular UK needs to provide an environment in which multi-national suppliers make their manufacturing technology investments in the UK rather than say France or Germany. That will require skills development, investment incentives, promotion and infrastructure, especially to build up initial momentum. It is important to have a positive message from Government about manufacturing, and effective education and training are also necessary requirement, but it is the investment environment that makes the difference.

As a response to the outcomes of such a review therefore Government should consider the scope for tax or other financial incentives to encourage suppliers to make the necessary capital investment in key new technologies in the UK rather than overseas, including the need for venture capital funding.

It was also the view of the group that a major and visible initiative to train and develop technicians, engineers and managers skilled in the operation and development of the manufacturing technologies necessary to exploit the opportunities in these key sub-sectors, would be an appropriate response. This, linked to the proposal to establish an Institute of Manufacturing Technology, would send a clear and tangible signal to industry about the changing environment in and intent of the UK, as well as providing the necessary critical skill base (see below.)

The infrastructure, space and transport link implications, including access to major customers and potential cluster benefits, would need to be subsequently reviewed with wider groups of stakeholders, including RDAs and local authorities.

As reflected earlier, these sub-sectors represent core manufacturing competence, and would also support UK manufacturing industries other than automotive. These recommendations will also need therefore to be reviewed with other representative groups and organisations, including stakeholders from the relevant sub-sectors (for example the Metals Forum).

Establish a strategy to address the internationalisation potential of UK suppliers

A joined up strategy to address the internationalisation potential of UK suppliers, and in particular develop two-way strategic trading links with key emerging markets, should be developed

The UK Automotive Supply Chain Council should review the availability and delivery of existing support to help UK-based automotive companies to trade and invest overseas, and provide the leadership and vision in developing such a strategy. This should in particular address:

- Facilitating a coordinated approach to developing relationships and logistics arrangements with key emerging overseas markets/supply bases; and
- Providing more coordinated and strengthened support for the internationalisation of UK suppliers, as an integral part of the proposed supplier development programme outlined earlier.

Better Programme Coordination

The proposed Supply Chain Council should review existing and proposed support schemes and the extent to which they needing strengthening or extending or could be delivered more effectively to the automotive sector. There is also a need to better leverage industry knowledge and networks to contribute to the delivery of these aims, in terms of identifying opportunities, or strengthening international partnerships in manufacturing or R&D.

It is important to link both existing and new programmes of support for internationalisation with other supplier development activity focused on business improvement and the needs of whole of the business, so as to ensure maximum benefit for the UK supply chain and the best use of resources.

It was noted that this is one of the aims of the current pilot supplier development programmes with the Japanese VMs, where the diagnostic review of the business on a holistic basis would show the value of such activity as part of the company's overall competitiveness strategy. In addition to aiming to link in UKTI support where appropriate, training modules relating to the make in/buy out decision and best cost country sourcing are being developed for the pilot programme. The focus is deliberately 'best cost country', including manufacturing the appropriate parts in the UK, rather than lower cost country sourcing, in line with the need to look at the total cost equation rather than merely price. This provides a model on which it seems sensible to build further.

Global Value Chains

The section on the increasing complexity and specialisation of global value chains in the Manufacturing Strategy[47], and the opportunities which this gives UK manufacturers to be more competitive through global sourcing and partnership, is particularly relevant in this context. One of the responses is the UKTI programme of support for companies to identify manufacturing value chain opportunities in India and China, which is currently being developed as a result and is to be extended to other markets. This needs to have an automotive focus as part of its approach and be coordinated with any wider supplier development activity, as do other initiatives such as UKTI's Fiscal Stimulus Programme, and their regional network of international advisers, which have small and medium-sized firms as a particular part of their remit.

One priority is to develop stronger UK supply chain links to take advantage of the market opportunities and supply base potential of emerging markets, especially in Asia, and to encourage emerging market companies to establish UK sister facilities and research activity. However, it has also to be recognised, given the likelihood that a majority of cars in developed markets will continue to be designed in Germany, Japan and the USA, that companies will need to be able to operate in these markets if they are to become actively engaged in these supply chains. The nearer emerging markets of Eastern Europe may also offer more manageable opportunities for some smaller companies.

Establish an Institute of Manufacturing Technology

A single framework for industry-university collaboration should be introduced to provide research structures capable of supporting and ensuring sustainable UK based manufacturing. There is a need to develop new technical capability in the UK in order to improve competitiveness, both in terms of alternative business models, which address current issues on profitability, improving UK value added , and exploitation of

47 www.berr.gov.uk/files/file47660.pdf

emerging technologies, and to address the technical education, training and skill gaps at management, engineer and undergraduate levels.

The implementation of this should be by way of a bold and significant first step, not least in order to capture the attention of the overseas ownership of many of the UK's vehicle manufacturers and Tier1 suppliers. This will also provide alignment with the concept of a 'UK Test Bed' for the development and introduction of Low Carbon vehicle technologies, described in the previous section of this report.

Formalised network

This first step should be to establish a national 'Institute of Manufacturing Technology' (IMT) to provide a focal point for the revitalisation of automotive supply chain manufacturing. This would be achieved by pulling together a core of existing high quality institutions and facilities into a formalised network, with revised and coordinated strategies and funding streams, to make a statement of intent for UK manufacturing revival. Example establishments that could be coordinated in this way could be Warwick Manufacturing Group, Cambridge Institute for Manufacturing, the forthcoming Manufacturing Technology Centre at Anstey, Coventry, the Advanced Materials Research Centre in Sheffield and the Advanced Forming and Forging Centre iin Glasgow, University of Strathclyde, with support from Warwick Business School and University of Bath School of Management.

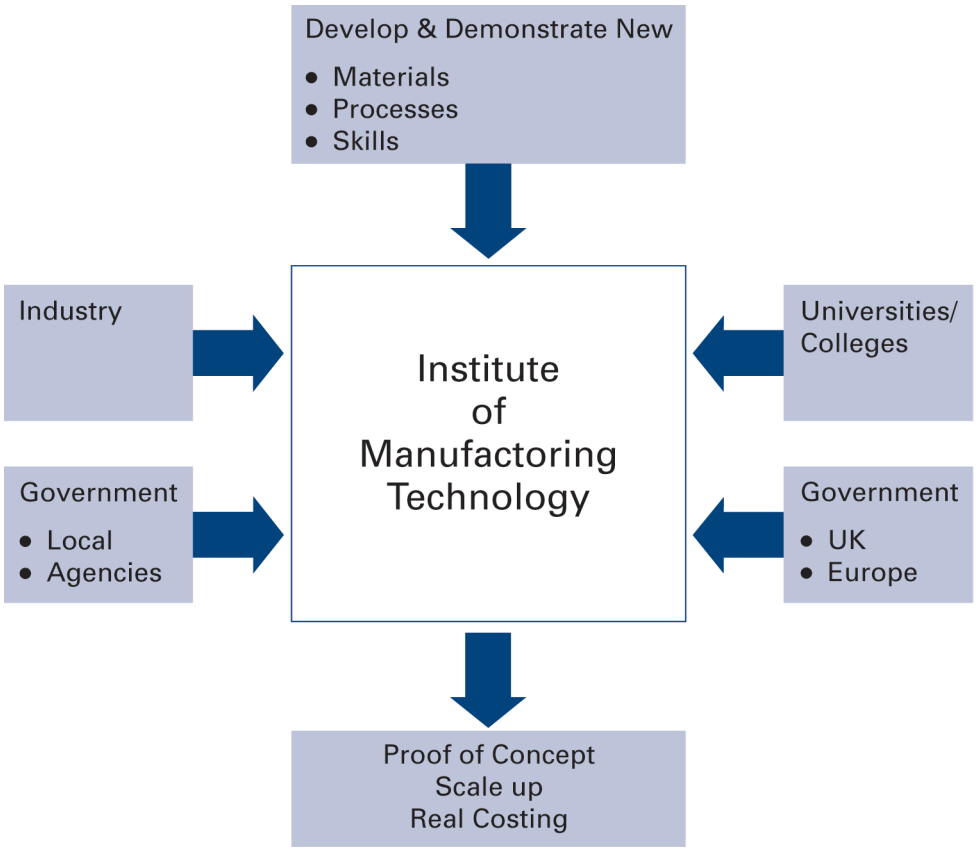
This is proposed as the first of several steps in moving to a model proposed by the University of Bath, School of Management to establish such Institutes to provide a collaborative and coordinated approach to the creation of world class knowledge in the areas of Innovation, Product and Process Development and Manufacturing Competitiveness. Such a formalised network could co-ordinate programmes in conjunction with the Automotive Council and the Research Councils to better target existing funds in order to develop industry relevant production and supply chain capabilities. Funds would be targeted at developing new technologies and business models, and to ensure the UK has a 'joined-up process' to the development of industry relevant education, training and skills.

Close links with industry will be central to achieving these aims. This is timely in the context of the Lambert Report on business-university collaboration[48] and the 'House of Commons Innovation, Universities, Science & Skills Committee' Reports on Engineering & Re-skilling[49]. The aim would be to develop a regional, national and international network involving key Universities and colleges, leading manufacturing sectors, together with SMEs and public sector stakeholders. This would be achieved by creating co-located industrial/academic teams focusing on specific industrial problems and future solutions. Research would be cross-disciplinary in nature, and would deliver demonstrator projects, proof-of-concept projects and product and service innovations. Such an approach would mirror institutions in countries such as Germany, Japan and the USA. A schematic format for this model is set out at Figure 8.

48 www.hm-treasury.gov.uk/lambert_review_business_university_collab.htm

49 www.publications.parliament.uk/pa/cm/cmdius.htm#reports

Figure 8: Institute of Manufacturing Technology: Collaboration and Integration



Automotive dimension

These issues and responses are relevant to UK manufacturing industry as a whole, as indeed is the work of the existing centres referred to above. Within this the IMT needs to provide the leadership and focus to ensure that the specific needs of the automotive industry are met, so that the hollowing out of recent years can be reversed.

The fundamental aim is to ensure that the UK can sustainably achieve levels of productivity which outstrip those of at least our Western European competitors. As reflected above, much of the fundamental capability and infra-structure necessary to enable this transformation already exists in the UK. It needs however to be better focused on the needs of industry, and in particular those of the automotive sector, which is characterised by:

- Complex, often safety critical products;
- High volume;
- High value products with corresponding quality expectations;
- Highly cost sensitive;
- Extended international supply chains; and
- Product lifecycles that rarely exceed five years

It must be recognised that these requirements, whilst overlapping those of other sectors (e.g. aerospace), in combination represent a unique challenge.

In essence this is a broad ranging technical challenge but the corresponding management skills must also be developed. The focus must lie therefore on the development and application of specialist engineering skills and management within those fields. The IMT must set the agenda, create the network to deliver and certify and promote the results. The Automotive Council provides a coordinated "voice of the customer" to the IMT.

Wider implications

As this develops, it should then be used as a blueprint for setting up a single framework for industry/university collaborative research, to be progressively implemented over the existing Research Assessment Exercise (RAE) cycle of activity. New metrics should be introduced into the RAE to reflect working with industry and wealth creation, as well as academic excellence. This would ultimately provide a unified governance and coordination mechanism and a transparent single fund for academic funded industrial research, aimed to address the emerging strategic challenges for the UK as a whole.

The aim of this approach is to build on the strengths of UK research and innovation with an emphasis on improving the productionisation and commercial exploitation of both existing and new product technologies. This will help to rebuild the UK's reputation as a centre of excellence in high value manufacturing as well as research.

This should be supported by a programme of continuous benchmarking of government and industry R&D spend against other main industrial nations. Analysis of topic areas would inform the review and update of the technology roadmap and the required research roadmap, which would provide focus and priority for future research programmes.

7 Summary of Recommendations and Next Steps

This section summarises the recommendations within this report the majority of which are linked to the two big ideas of the Automotive Council and Test Bed UK.

7.1 TABLE OF RECOMMENDATIONS

Area	Recommendation	Lead
To create a transformed business environment in the UK for the Automotive Industry	Establish at a senior level joint industry/ Government Automotive Council	Government/ industry
	Automotive Council to publish a long-term UK Automotive Framework to provide business and overseas/inward investors with certainty around the investment environment through 2025	Automotive Council
	BERR Automotive Unit should take the lead within government to ensure NAIGT recommendations are incorporated on a joined up basis across government into all policy, funding and activity	BERR
	Simplify and maximize incentives and funding for upgrading and developing existing (and new) manufacturing locations and provide new funding for investment in collaborative testing and research facilities (tied to Technology roadmap).	Automotive Council/DIUS/ TSB
	Ensure business support is simplified and focused on improving access and customized interventions for SME's and larger companies through local business relationship managers.	Automotive Council/BERR
	Co-fund carbon reduction – a new energy fund potentially administered by an expanded Carbon Trust to advise on and co-fund investments in carbon footprint reduction across the industry	Automotive Council/Carbon Trust

Area	Recommendation	Lead
	Focus public procurement – establish public procurement policies to actively direct and promote use of UK produced vehicles, goods and services by all government departments, agencies and taxpayer-funded bodies	Government/ Office of Government Commerce
	Automotive Council to co-ordinate forums to promote cross-sector collaboration and stronger business-university collaboration	Automotive Council/DIUS/ BERR
	Promote Positive Automotive Industry Image	SMMT
	Review temporary bank/credit related actions to see if further longer-term changes are required with UK banks and credit insurance arrangements to avoid a repeat of present difficulties in future downturns.	BERR/HM Treasury
	Align tax systems to policy to ensure that UK domestic national and sub-national tax systems (e.g. VED or congestion charges) are technology neutral and promote interests of UK industry as well as other goals	HM Treasury
	Protect Flexible Labour Markets	BERR
	Further develop sector skills (SEMTA) offerings to fully meet industry needs at apprentice, NVQ 2-4, management and leadership skills and HE automotive qualifications	Automotive Council/SEMTA
To establish a bold, large scale pilot market to demonstrate, experiment and build the new low-carbon personal transportation system including its infrastructure	Develop and update a common technological roadmap to achieve low carbon vehicles	Automotive Council/industry
	A pilot ('Test Bed UK') should be established to test the deployment into the market of the major bundles of technology outlined on the roadmap	Automotive Council/ Government/ Industry
	Integrate and co-ordinate existing bodies/funding mechanisms to provide a single programme management structure to deliver low carbon technologies	Automotive Council/ Government/ Industry

Area	Recommendation	Lead
To develop a more competitive and high value added supply chain	Establish a UK Supply Chain Council under the leadership of the Automotive Council	Automotive Council
	Establish a continuous national supply chain group programme	Supply Chain Council
	Establish a sourcing roadmap to address the top down challenge for the OEMs and Tier 1s to identify UK sources, structural gaps and opportunities for greater localisation in the UK	Supply Chain Council
	Review the business environment requirements to realise opportunities	Supply Chain Council
	Establish a strategy to address the internationalisation potential of UK suppliers	Supply Chain Council
	Look for opportunities to develop/ nurture the niche vehicle and supply industry as a potential development source for emerging technologies	Supply Chain Council
	Establish an Institute of Manufacturing Technology to provide a focal point for the revitalisation of automotive supply chain manufacturing	Automotive Council/ Government/ Industry
	Establish a single framework for industry/University research	Automotive Council/ Government/ Industry

7.2 KEY PERFORMANCE INDICATORS

In order to devise effective policies, it is vital to be able to monitor the impact of any policy made. Therefore, we have devised a set of Key Performance Indicators (KPIs) that in our view should be monitored to track the performance of the industry in terms of **competitiveness, growth,** and **innovation.**

The KPI subgroup[50] was assembled to provide the broadest possible representation of industrial representation from the passenger car, commercial vehicle and construction equipment sectors, as well as representatives from the regional development agencies, BERR and academia.

The KPI subgroup first of all recognised the conceptual difficulties in developing a set of key performance indicators capable of representing the diversity of the automotive industry, from large multinational enterprises to SME-sized second and third tier suppliers, working across a range of products from passenger cars to construction equipment. Thus the subgroup acknowledged that some measures are more applicable to certain sub-sectors of the industry, while overall the aim was to cover all economic activity in the sector in the UK.

Secondly, it was recognised that any measure proposed will be imperfect, as in most cases either the input data is unavailable or incomplete, or the effort in collecting the required data is economically unviable, or both. Typical problems include the inconsistent interpretation of industry classifications by companies submitting information to the ONS, levels of aggregation that are too high, lack of availability of international comparative data, and measurement cycles that are too long and thus do not permit for a continuous and up-to-date measurement. Specific emphasis was placed on devising a balance of retrospective or output-based measures and forward looking measures, although it was recognised that common indicators, such investment, were far from perfect in this regard. Finally, the objective was to use as few measures as possible, that is to focus "on the vital few", in order to provide the best possible set of measures while requiring a reasonable amount of effort in compiling and tracking data.

The matrix overleaf provides the set of "NAIGT recommended measures" in the categories of competitiveness, innovation and growth:

We suggest that these measures are applied consistently, and longitudinally, in order to monitor the performance of the UK automotive industry, and to inform future policy decisions.

50 A list of Expert Group members is at Annex B and details of other contributors to this work can be found in 'The Competitive Status of the UK Automotive Industry'.

Table 3: NAIGT Matrix of Key Performance Indicators

	Retrospective or output-based KPIs	Forward-looking KPIs
Competitiveness	1. The UK's relative global share of vehicle production, by segment	2. Value-added per employee, which allows for international comparisons at SIC classification level 34 and 34.1, 34.2 3. Skill levels, in terms of % of workforce with NVQ, HNDs, degrees, or other.
Growth	4. Vehicle production output, in terms cars and commercial vehicles, in units per month 5. Export –import balance in terms of value and units of production. *Note: if available this should be done for passenger cars and commercial vehicles.*	6. Ratio of capital investment (in terms of total value) and total turnover per sector, on a rolling 5-year horizon. *Note: we consider a relative rather than absolute measure more appropriate here.*
Innovation	7. Fleet CO_2 emissions, measured across all vehicles produced by the firm in the UK. *Note: this measure can be applied at firm level, as well as at segment level (to compare a firm's performance in relation to its peer group).* 8. CO_2 emissions to produce one unit (including emissions, landfill), by vehicle category (passenger cars and commercial vehicles).	9. R&D expenditure in SIC 34, as a % of Gross Value Added in SIC 34, as a measure of the extent to which the sector reinvests in R&D in the UK.

7.3 NEXT STEPS

It will be for the Automotive Council to develop prioritised work plans to deliver the majority of the detailed recommendations listed above and to continue to champion their implementation. The NAIGT believes that it is vital to maintain the momentum that has been generated by its work. It is important therefore, that the Automotive Council is established as soon as is practicable and should hold its inaugural meeting by September 2009. In the interim period, the NAIGT will hold a number of additional meetings to oversee the establishment of the Automotive Council and to manage the transition of this work to it.

Annex A: NAIGT Terms of Reference

VISION AND TERMS OF REFERENCE FOR THE NEW AUTOMOTIVE INNOVATION AND GROWTH TEAM – CREATING A STRATEGY FOR 2025

VISION

To develop a strategy for sustained success for the UK automotive sector to 2025 and beyond, particularly in the context of the twin challenges of low cost competition and the transition to lower-carbon transport, building on the UK's particular industrial, commercial and technological strengths. This will be delivered in a report to Ministers, with specific recommendations for action by government and/or industry, by the end of March 2009.

OUTCOMES AND SUCCESS FACTORS

The two key Departmental Public Service Agreement (PSA) targets which underpin this Review are:

- Raise the productivity of the UK economy (PSA1); and
- Deliver the conditions for business success (PSA6)

OBJECTIVE

To achieve these targets the objective of the NAIGT is to engage key stakeholders from industry (and through a separate parallel Communications Group involving other Government Department's) produce a comprehensive report that contains a series of recommendations and an action plan aimed at ensuring an automotive industry that:

- continues to develop in the UK and adopts world class innovation; protects jobs; promotes growth; and encourages overall prosperity in the UK;
- anticipates, develops, adopts and embraces technological changes in response to a range of societal, technological, environmental, economic, political and infrastructural drivers, so as to inform and influence policy making in the future; and
- retains its international competitiveness by attracting internationally mobile investment; and

- that global issues such as low cost sourcing and new market opportunities are fully taken into account in development of the UK national strategy.

TERMS OF REFERENCE

- identify key performance indicators and success factors in support of the NAIGT;
- investigate the barriers and challenges posed by existing EU and national legislation to ensure the UK has the right regulatory framework to encourage the competitiveness of a world class industry to continue to develop in the UK;
- assess the evidence of the strengths, weaknesses and opportunities for each of the different sectors that make up the automotive industry together with identification of market trends (gaps and hotspots) using an evidence based approach;
- review the impact of the previous AIGT and its legacy programmes and government interventions in support of the sector;
- take account of the evidence and the implications of the King Review on low carbon cars; and the departmental report on the Business Environment for Japanese Automotive Supply Companies in the United Kingdom (September 2007); and
- produce a report that makes recommendations to government that are capable of being taken into account in policy making, and to produce an action plan for industry.

SCOPE AND TIMESCALE

The NAIGT's remit will cover the UK automotive manufacturing sector in its fullest sense, from research and development, to design engineering, to components, systems, niche and volume vehicle manufacture, including construction equipment. It will additionally consider the challenges and opportunities presented by development of transport and other areas affected by Government policies and the impacts positively and negatively which they can have on the competitiveness of the automotive sector, and identify areas for improved and informed decision making.

It will include consideration of developments in both the motor sport and automotive retail sectors and seek to maximise synergies, though it is not intended that the Group's eventual recommendations should specifically target those sectors. In addition the Review will consider the scope for technology transfer between the automotive and other sectors.

In terms of timescale the members of the NAIGT Steering Group will be appointed by April 08, with potential priority work streams for further research identified by the 2nd quarter 08 (by June 08). The aim is for production of recommendations by Q4

(December 08), with publication of the Action Plan and recommendations by Q1 2009 (March 09).

The NAIGT will report to the Secretary of State for the Department of Business, Enterprise and Regulatory Reform.

NAIGT MEMBERSHIP

The group will be chaired by Richard Parry-Jones, until recently Group Vice President and Chief Technical Officer for Ford Motor Company. Members are drawn from across the industry and the Review will engage as necessary with Government officials, Regional Development Agencies and the Devolved Administrations through the Communications Group.

Department for Business, Enterprise and Regulatory Reform
February 2008.

Annex B: List of NAIGT and Expert Group Members

NAIGT STEERING GROUP

Name	Organisation
Richard Parry-Jones (Chair)	**RPJ Consulting Services Ltd**
David Bott (observer)	Technology Strategy Board
Simon Edmonds	BERR
Paul Everitt	The Society of Motor Manufacturers & Traders
Bob Gibbon	National Skills Academy for Manufacturing
Jerry Hardcastle	Nissan
Matthias Holweg	Judge Business School, University of Cambridge
Hermann Kaess	Bosch
Roger Putnam	Retail Motor Strategy Group
Dave Shemmans	Ricardo
David Smith	Jaguar and Land Rover
Nigel Stein	GKN plc
Matthew Taylor	JCB Excavators
Oliver Zipse (until 01/2008) Jurgen Hedrich	BMW (UK)

SECRETARIAT

Rob Smith	BERR
Paul Mullins	BERR

SUPPLY CHAIN DEVELOPMENT EXPERT GROUP

Name	Organisation
Bob Gibbon (Chair)	**National Skills Academy for Manufacturing**
Graham Broome	SMMT Industry Forum
Chris Bryant	Jaguar and Land Rover
James Davies	Calsonic Kansei
Rachel Eade	Birmingham Chamber of Commerce/Accelerate
Sami Falou	North West Development Agency
Andrew Graves	Bath University
Jon King	Corus Automotive Engineering
Sean McKenna	GKN Driveline
Hamish Peters	Supply Chain Groups, PERA
Paul Sefton	IngPro
Keith Smith	Plastics Products International
Nick Spencer	BMW (UK) Manufacturing
Jag Srai	University of Cambridge
Jim Sumner	Leyland Trucks
Martin Ziegler	Bosch

TECHNOLOGY AND LOW CARBON PRODUCT DEVELOPMENT EXPERT GROUP

Name	Organisation
Jerry Hardcastle (Chair)	**Nissan**
Dave Shemmans (Deputy Chair)	Ricardo Plc
Jon Beasley	GKN
Hugh Blaxill	Mahle
Peter Bruce	St. Andrews University
John Clack	Bosch
Andrew Frazer	Ford
Tony Harper	Jaguar and Land Rover
Neville Jackson	Ricardo
Tim O'Brien	Technology Strategy Board
David Ruffell	TATA
Sachin Suchak	Department for Transport
Werner Rothfuss	BMW

TECHNOLOGY AND LOW CARBON INFRASTRUCTURE EXPERT GROUP

Name	Organisation
Jerry Hardcastle (Chair)	**Nissan**
Dave Shemmans (Deputy Chair)	Ricardo
Thomas Becker	BMW
Richard Blundell	Th!nk
John Cooper	BP
Helen Foord	GM
Nigel Foster	Arup
Richard Hair	Eon
Mark Johnson	Jaguar and Land Rover
Bob Joyce	Jaguar and Land Rover
Nick Lee	PSA
Martyn Mangan	Advantage West Midlands
Phil Pettitt	InnovITS
Jun Qiao	ETI
Neal Skelton	ITS UK
Henry Winand	Intelligent Energy
Simon Wood	Lotus

BUSINESS ENVIRONMENT EXPERT GROUP

Name	Organisation
David Smith (Chair)	**Jaguar and Land Rover**
Roger Putnam (Deputy Chair)	Retail Motor Strategy Group
Nik Armistead	Bosch
Bob Bolam	BMW
Tim Leverton	JCB Excavators
Andrew McCall	Jaguar and Land Rover
Steve Norgrove	GKN
Rob Oliver	CEA
Dave Osborn	Unite
Konstanze Scharring	SMMT
Neal Skelton	ITS UK
Graham Smith	Toyota

KEY PERFORMANCE INDICATORS EXPERT GROUP

Name	Organisation
Matthias Holweg (Chair)	**Judge Business School, University of Cambridge**
Robert Baker	SMMT
Fernando Galindo-Rueda Phil Davies	BERR
Colin Herron	One North East
John Hollis	BMW
Tim Leverton	JCB Excavators
Rob Oliver	CEA
David Smith	Jaguar and Land Rover
Jim Sumner	Leyland Trucks

Annex C: Sources of information presented to or considered by the NAIGT

The Competitive Status of the UK Automotive Industry – a report to the New Automotive Innovation Growth Team published by Matthias Holweg, Judge Business School, University of Cambridge, May 2009, www-innovation.jbs.cam.ac.uk/publications/reports.html

King Review of Low Carbon Cars - H M Treasury October 2007 and March 2008, www.hm-treasury.gov.uk/king_review_index.htm

Davidson Review Implementation of EU legislation – HM Treasury, November 2006, www.berr.gov.uk/files/file44583.pdf

Stern Review on the Economics of Climate Change – HM Treasury, October 2006, www.occ.gov.uk/activities/stern.htm

Leitch Review of Skills - H M Treasury, December 2006, www.hm-treasury.gov.uk/leitch_review_index.htm

The Eddington Transport Study - Department of Transport, December 2006 www.dft.gov.uk/about/strategy/transportstrategy/eddingtonstudy/

Gallagher Review of the indirect effects of biofuels production – Renewable Fuels Ageny/Department of Transport, February 2008, www.dft.gov.uk/rfa/_db/_documents/Report_of_the_Gallagher_review.pdf

Enterprise: unlocking the UK's talent - Department for Business, Enterprise and Regulatory Reform, March 2008, www.berr.gov.uk/files/file44992.pdf

Manufacturing Review – Department for Business, Enterprise and Regulatory Reform, September 2008, www.berr.gov.uk/files/file47660.pdf

Low Carbon Transport Innovation Strategy - Department of Transport, May 2007, www.dft.gov.uk/pgr/scienceresearch/technology/lctis/lowcarbontis

Report on the Business Environment for Japanese Automotive Supply Companies in the United Kingdom - Department for Business, Enterprise and Regulatory Reform, April 2008 www.berr.gov.uk/files/file45472.pdf

House of Commons Select Committee Review on performance Success and failure in the UK car manufacturing industry March 2007 and Government response – fourth Report of Session.
www.publications.parliament.uk/pa/cm200607/cmselect/cmtrdind/399/399.pdf

Automotive Industry Growth Team Report – Department for Business, Enterprise and Regulatory Reform, May 2002
www.berr.gov.uk/whatwedo/sectors/automotive/publications/page45523.html

Evaluation of the Supply Chain Groups Programme – Department for Business, Enterprise and Regulatory Reform, May 2008
www.berr.gov.uk/whatwedo/sectors/automotive/index.html

Annex D: Details of proposed new national supply chain group programme

Type of programme

The type of programme envisaged is essentially similar in broad terms to the approach currently being tested and developed in the pilot supplier development programmes being run with the three Japanese VMs, which itself builds upon and extends the best practise of the previous national SCG programme, SC21 and regional programmes, and in respect of business to skills development, Advantage West Midland's (AWM) Premium Automotive R&D (PARD) programme. It has to:

- Address the overall competitiveness of individual participating companies in a customised way in line with their priority needs, as well as supply chain efficiency and partnership relationships;
- Develop key skill sets at all levels of the business to NVQ standards to ensure key future competencies and the sustainability of competitive improvements in the context of the need for total process chain competence, including innovation and design;
- Be designed to enhance the competitiveness of existing supply chains and encourage the competitive development of new supply chains in the emerging fields of low carbon technologies;
- Streamline the entry point in accessing public sector funding, particularly for SMEs, which have limited management resources to interact with the complexity of delivery bodies and support programmes available;
- Be a nationally delivered, but non-automotive specific, programme. It is equally applicable to manufacturing as a whole, and sector distinctions break down the further one goes down the supply chain;
- Derive its sector focus from engaging the lead OEMs/Tier1s to act as the host bodies to promote and support these programmes, and ensure that those lower down the chain, often SMEs, are reached and engaged;
- Be strongly promoted and branded to send a positive signal to the industry, both at VM and supplier level, that we want to retain and grow their activities here, and to ensure the active engagement of the VMs and Tier 1s; and
- Utilise/employ high quality experienced relationship managers/ business advisers to manage the critical interface with the company and the drawing in of specialist support and training.

One of the lessons of the pilots has been the importance of getting the enthusiastic buy-in and commitment from the VMs and Tier 1s upfront. This may, depending on individual company circumstances, have to be done on an international as well as a UK basis to gain recognition from key decision-makers in multi-national companies. Developing the UK supply chain is only partly aligned to VM/Tier 1 business needs, and there is a clear value in a support programme building on common ground and developing a more comprehensive and structured programme of supplier improvement and development for the wider benefit of UK plc than would otherwise have been the case.

Core Programme content

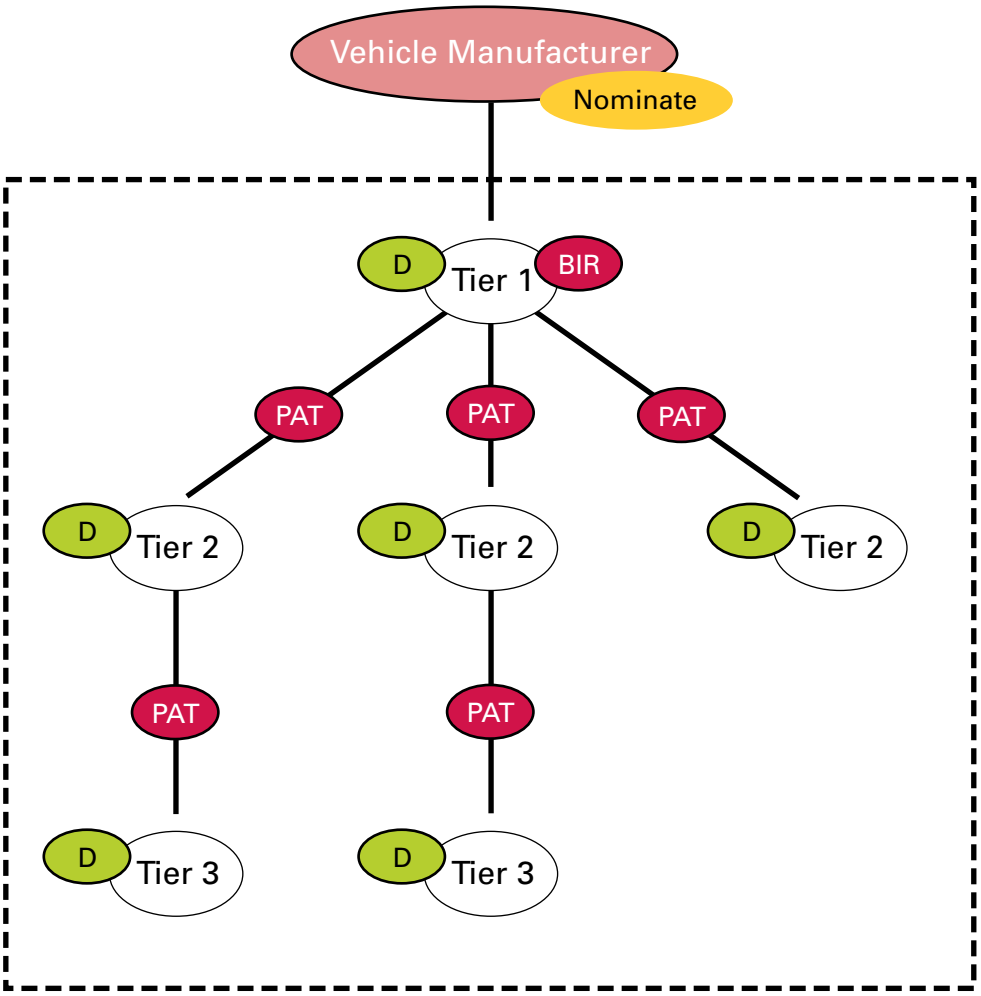
The core of the programme is essentially concerned with the more effective customising and delivery of existing and evolving public sector business support. In the case of skills development, for example, it would be seeking to make best use of Train To Gain/SEMTA support, but in other areas, as the national SCG programme which was jointly funded by DTI/BERR and the RDAs, would have implications for RDA budgets. A message from the stakeholder event was the necessity of doing a better job of communicating what initiatives, programmes and facilities are currently available and ensuring that these are taken advantage of, as well as developing new initiatives.

The value of BERR's current Business Support Simplification Programme (BSSP)[51] in radically reducing the number of public sector support schemes available was recognised. However it was felt that this needed to be coupled with a stronger advisory interface, both to diagnose companies' requirements in a holistic business context and to facilitate their delivery and take-up more effectively. The skill levels of the external advisors, in terms of business understanding and consultancy delivery, will be crucial to the success of this support.

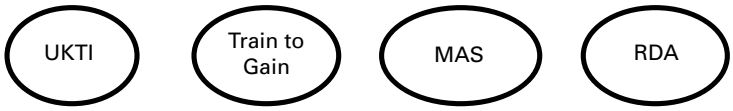
A series of business reviews and diagnostics both at the individual company and supply chain level would be required. Coaching and mentoring, from senior management through to operational levels, would be key parts of an effective approach to embedding skills. Aspects of this, drawing on the experience of the pilots, are illustrated in terms of a model supply chain group at Figure 9.

51 http://www.berr.gov.uk/whatwedo/enterprise/simplifyingbusinesssupport/page44802.html

Figure 9: An illustrative supply chain group project



Examples of additional resources to be drawn upon as required:



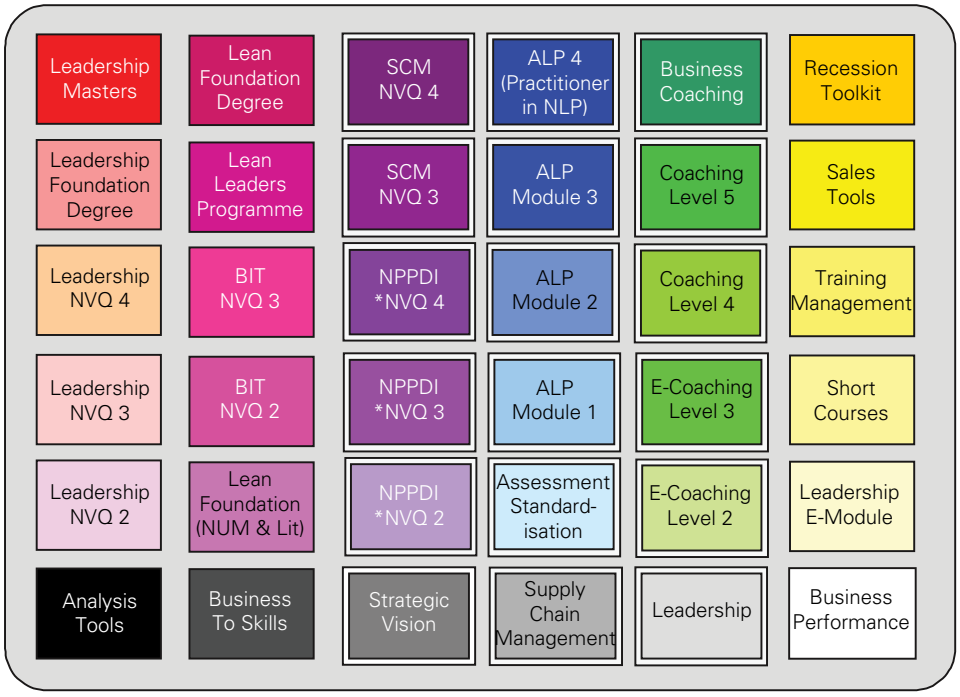
BIR — The Business Improvement Review: an objective, data driven, strategic diagnostic toolkit designed to help host companies establish the business case and priorities for supplier selection/development and develop robust supplier development projects in their supply chains.

PAT — The Partnership Assessment Tool: an objective 2-way diagnostic tool designed to help companies better understand the nature of the relationships between a customer and its suppliers. It is used both to guide the direction of supplier development projects and to measure progress.

D — Holistic Strategic Business Review and Business to Skills Diagnostic – diagnostic tools, geared to the particular circumstances/size of the company involved, that helps individual participating companies to identify their overall strategic needs and priorities, and links business objectives to skills investment to business improvement.

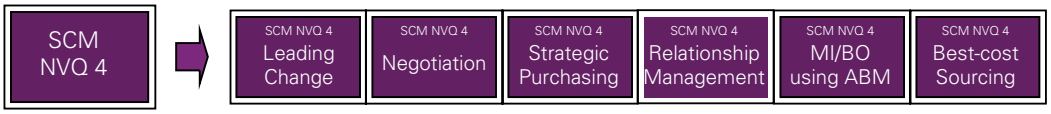
This example shows a vehicle manufacturer sponsoring and supporting a Supply Chain Group programme, including nominating a Tier 1 supplier to act as host. It is possible for other tiers to institute or host, and for participating suppliers to be at one tier rather than multi-tiers.

Figure 10: Examples of additional resources to be drawn upon as required:

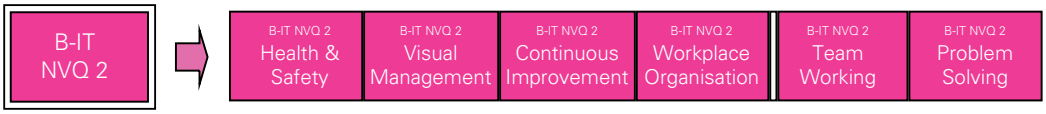


*New Product and Process Development and Introduction – in development

The broad ranging portfolio of Skills Academy programmes generally comprise a number of modules as illustrated below:



SCM = Supply Chain Management MI/BO = Made In/Bought Out
ABM = Activity Based Management



B-IT = Business Improvement Techniques NVQ = National Vocational Qualification

In addition either individual modules or non-qualification programmes (yellow) can be brought together to deliver a customised outcome. For the larger companies with internal training facilities the Skills Academy offers them the same high level of learning facilitation courses as it offers professional training institutions via its suite of Advanced Learning Practices (ALP) programmes.

Determining which range of programmes is best for each individual company is achieved using the Business to Skills analysis tool which, in addition to linking critical key skills to real bottom line benefits, also provides an on-going dynamic benchmarking capability.

Not all learning requires training so the Skills Academy also offers both direct coaching of teams and individuals from approved coaches to a range of courses to help develop internal capabilities. This ties in well with the Skills Academy's "Learning Engine" which incorporates a world-class systems approach to maximise the benefit of work based learning. As used in the pilot programmes, this is particularly focused on using mentoring and coaching when learning is being applied in the workplace, so that skills are more embedded and bottom line benefits cemented into the learning outcome.

As with the pilots, the programme needs to address strategic leadership and management skills as well as process improvement/lean manufacturing, and to draw in other public sector support as necessary, for example from UKTI, to address the competitive requirements of companies as a whole. Particular merit was seen in the "paint box" of accredited world-class training programmes being developed by NSA-M to meet company needs in line with the issues highlighted in the Report on the Business Environment for Japanese Automotive Supply Companies in the UK. These include product and process improvement implementation skills, recognising that the ability to innovate is key to future competitiveness and value added, and to taking advantage of the new low carbon opportunities. Some further details are given at Figure 10.

Experience from the national SCG programme was that the entry-level capability of companies (both host and supplier) was very variable. This again points to the importance of customising all activities to the individual situation. It is possible to envisage in some cases that early engagements might focus particularly on a 'levelling up', with subsequent engagements with the same companies applying latest best practice, and hopefully leapfrog techniques, to gain differentiation. Particular attention however needs to be given to introducing and supporting both EDI (Electronic Data Interchange) at SME level, as this is essential to participation in modern supply chains, and PDM (Product Data Management) capability, which is key to enhancing the ability to add greater value and innovate in supply chain companies.

Clear metrics/business benefits should be established for the programme at the outset to provide the basis for such a rigorous review process. This, coupled with ongoing benchmarking of international best practice and trend analysis, would provide excellent monitoring data and opportunity for accelerating progress over time. Programme benchmarking has to be what is globally competitive/best in class. Average is no good. Again the involvement of the VMs and international Tier1s in the Automotive Council sub-group will help to facilitate and ensure this standard. A techniques research programme could also be put in place to support a key aspect of this through the proposed Institute of Manufacturing Technology.

Programme options

An additional option, which could be considered in due course, would be to set up a national supply chain excellence accreditation grouping for companies that have successfully participated in the programme. As well as offering a visible recognition of improvement to potential customers, this could help generate and show enthusiasm for participating and improving at the individual supplier level, and avoid insularity/continuity problems for companies that might be in and out of specific programmes.

Two other options which should be introduced to address concerns that such an OEM/Tier1 hosted supplier development programme might not get beyond existing supply chains, and so help to improve and grow other existing and new companies, are:

- A promoted programme option of encouraging host companies to identify new UK suppliers to meet potential localisation requirements; and
- Scope should be left for different points of entry to allow lower tier companies, to act as programme drivers if they wish.

It is planned to test out the localisation option in one of the three pilots currently being run, making particular use of the pilot ASF service. This would also help the development of the ASF service, as the active use of such a service by the VMs and Tier1s is vital if it is to develop self-sustaining critical mass. The attraction of potential business would accelerate supplier registration and them ensuring that details of their full capability on the system were comprehensive and up-to-date.

This would be an option within the programme, which in the view of the Group should be particularly promoted in appropriate circumstances. There is also potential scope to link this activity and the use of ASF more generally to the recommendation about increasing supplier competencies in the UK.

Although using VMs and Tier1s as the hosts would be expected to be the main approach, particularly at the outset, there is value in maintaining flexibility to allow lower tiers to act as hosts if they wish, as sometimes happened in the national SCG programme.

Annex E: NAIGT Technology Road Map

The EU is adopting a fleet average CO_2 target for passenger cars of 130g/km phased in from 2012 to 2015 with non-compliance penalties

Europe: CO_2 legislation key features

- Applies to European **new passenger cars (M1)**
- **Phase-in** of **130 g/km** standard from **2012 to 2015**

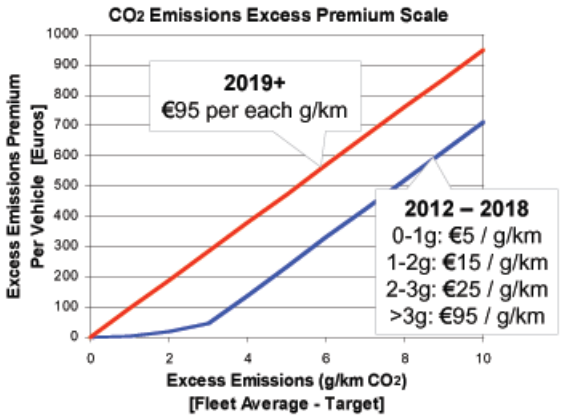
Year	Fleet %
2012	65%
2014	75%
2015	100%

- **Super-credits** for vehicles <50g/km CO_2 (2012 to 2015)
- Long term target of **95g/km** fleet average CO_2 by **2020**
- **Specific CO_2 targets** defined by **vehicle mass**

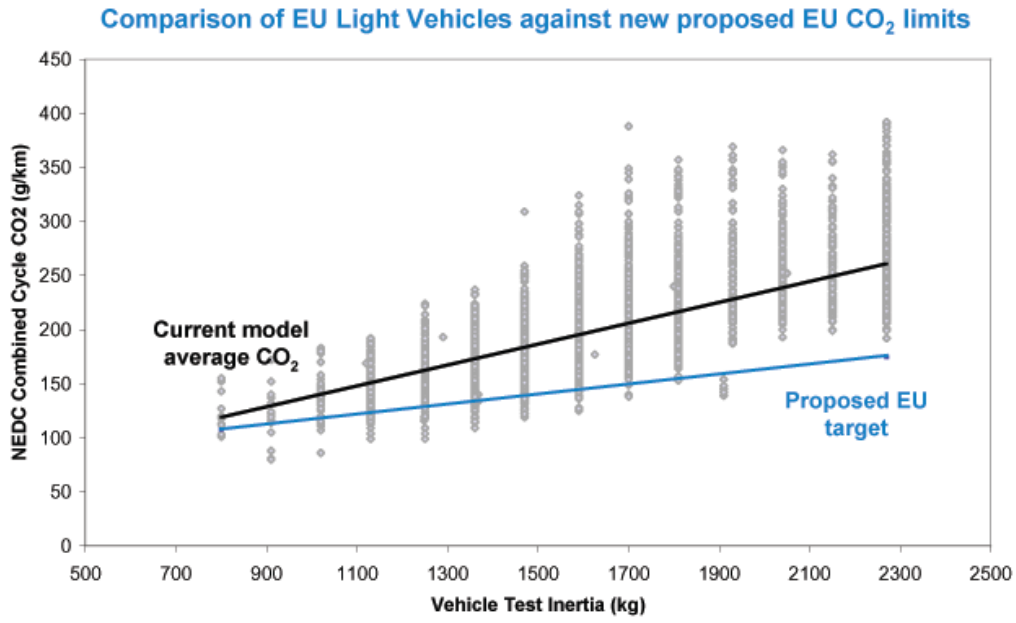
Permitted specific emissions of CO_2 =
130 + a x (M – M_0) g/km

M = mass of vehicle in kg
(with bodywork in running order)
M_0 = 1372.0
a = 0.0457

- Targets apply to **manufacturer's fleet average** - no requirement for each individual vehicle to meet its target
- **Pooling** may be carried out between OEMs
- **Penalty scale increases**



Most current vehicles would not meet 2012 limits. There are challenges for all segments, but large vehicles require most improvement



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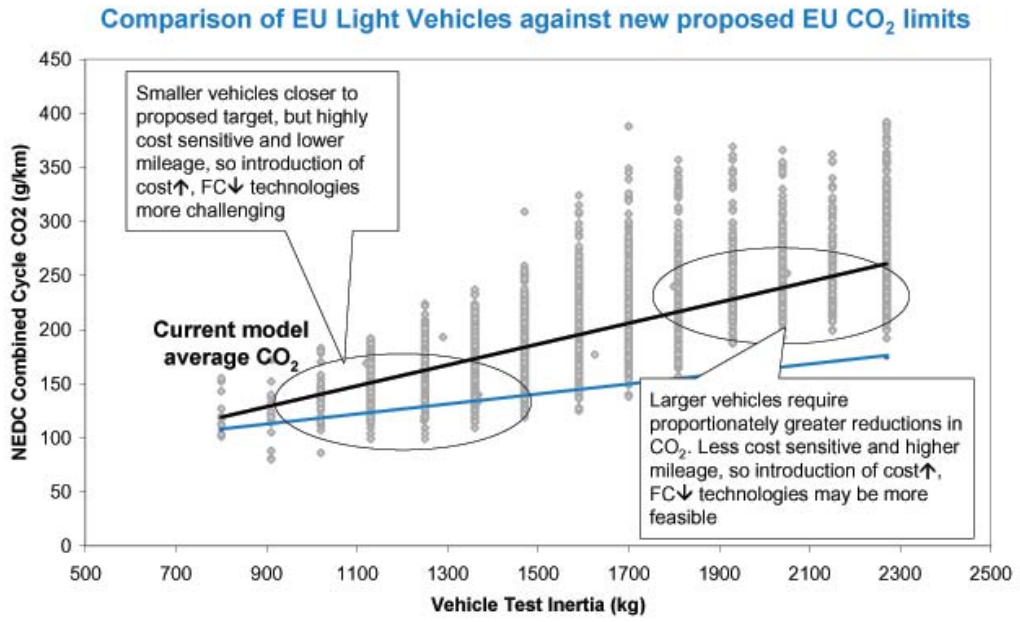

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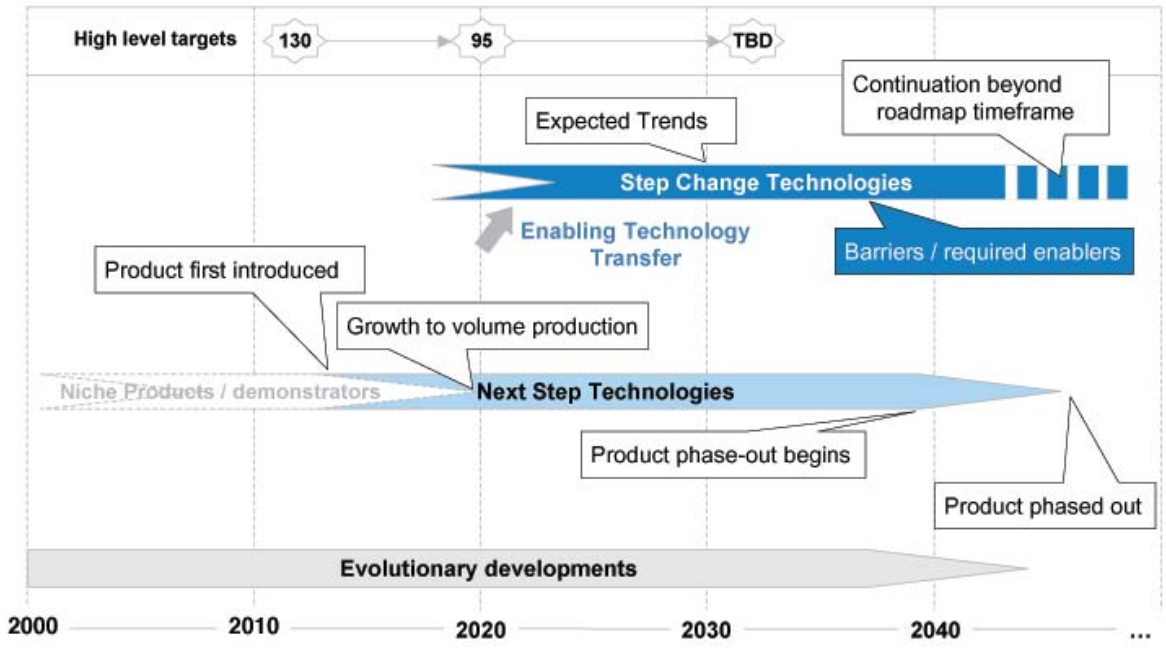
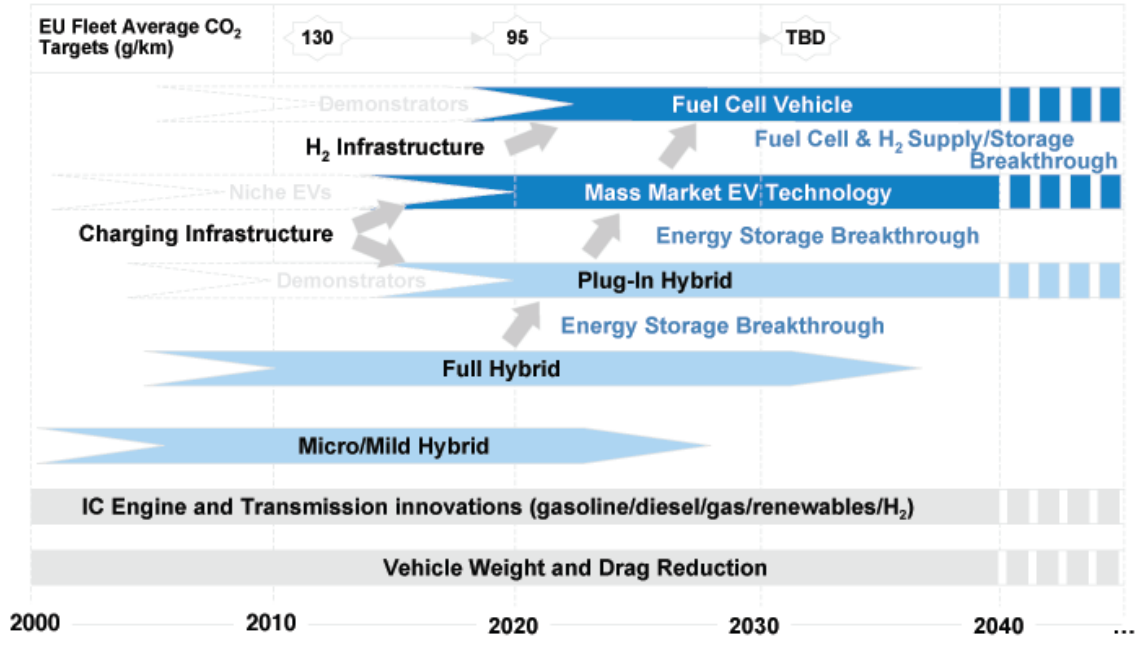
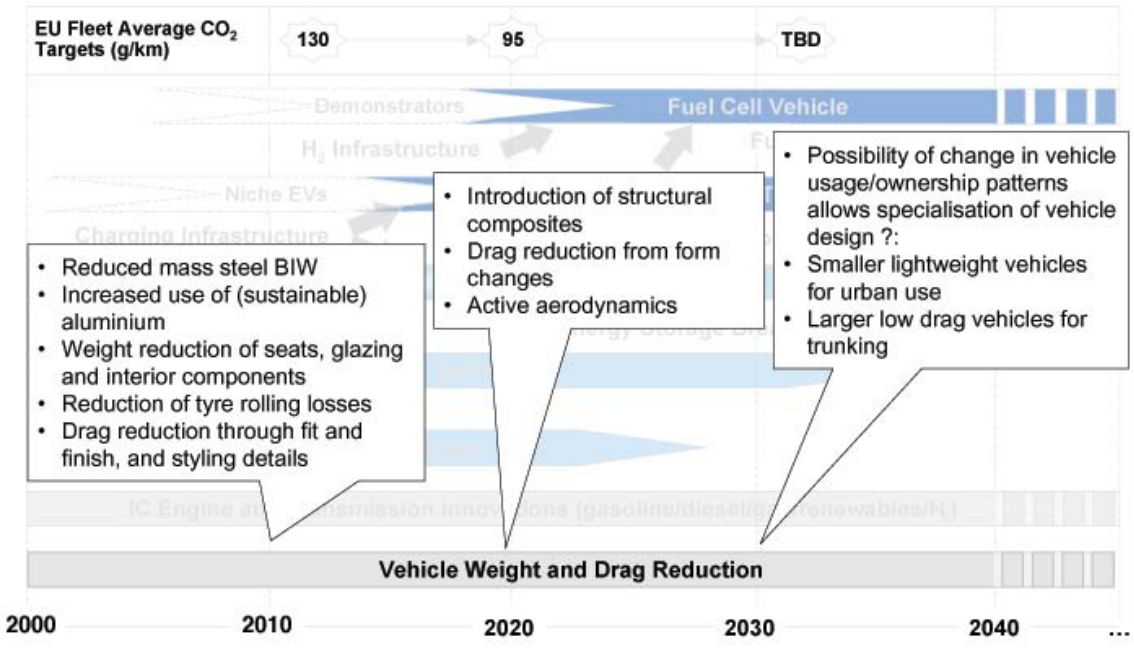


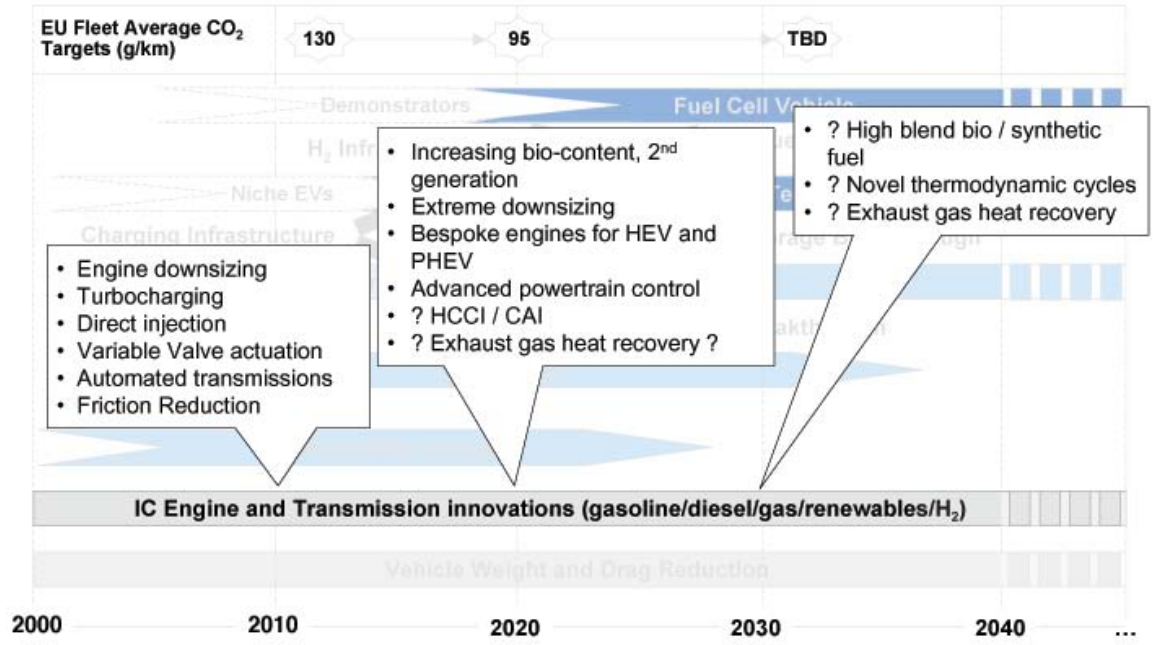
Whilst individual manufacturers will prioritise certain technologies to fit with their brand values, OEMs share a common view on the high level Technology Roadmap



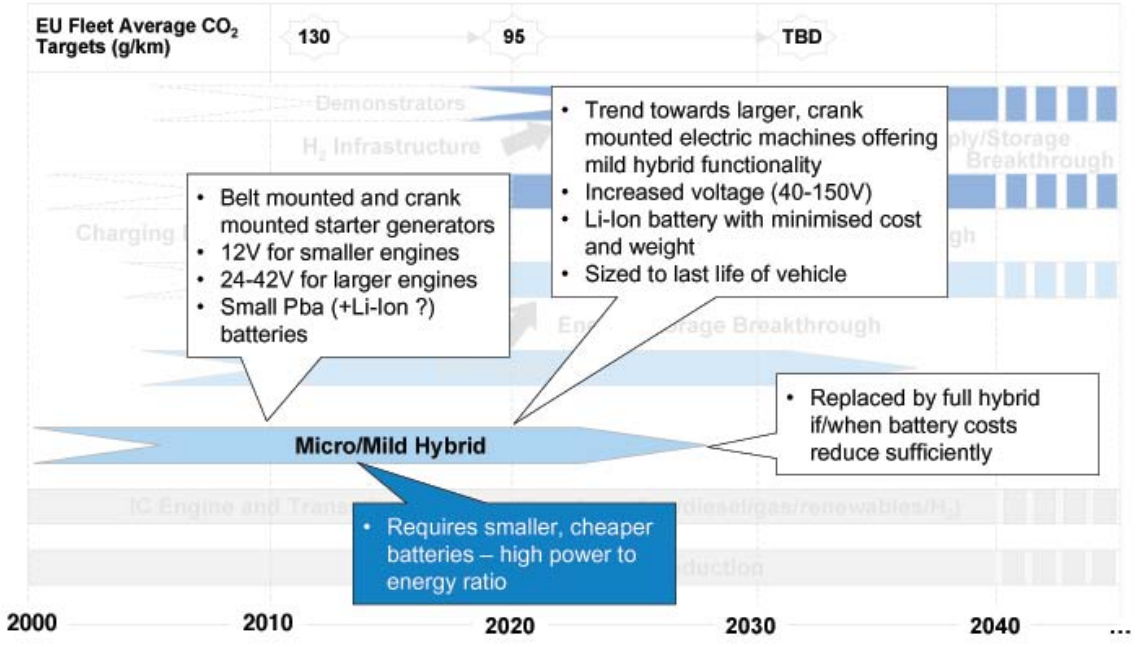
Vehicle weight and drag reduction will continue to evolve within the constraints of the owners requirements for functionality



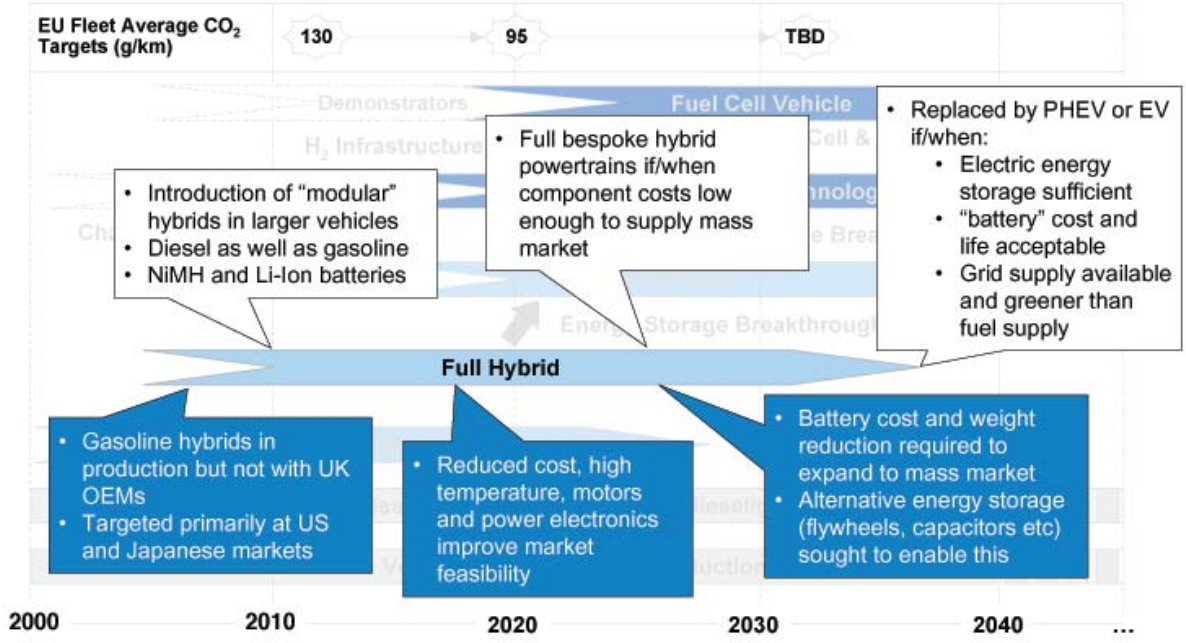
IC engines and transmissions will develop to become lighter, more efficient and to meet the specific needs of hybrid and plug-in applications



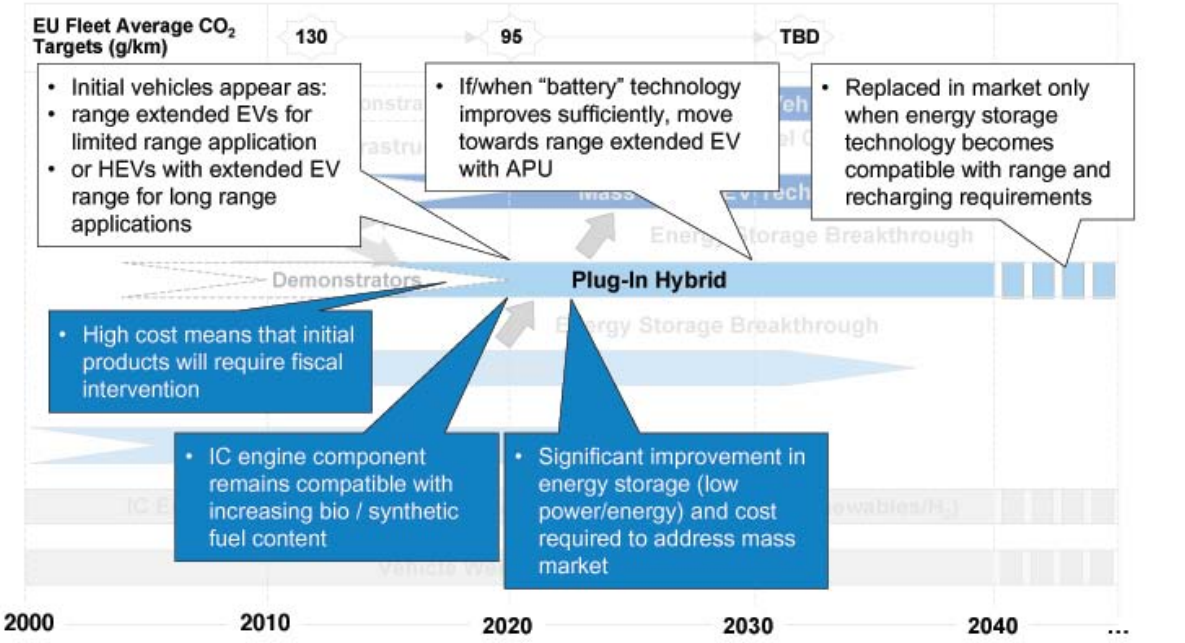
Whilst battery and electric machine costs remain high, cost effective solutions for urban and semi-urban vehicles will be attractive



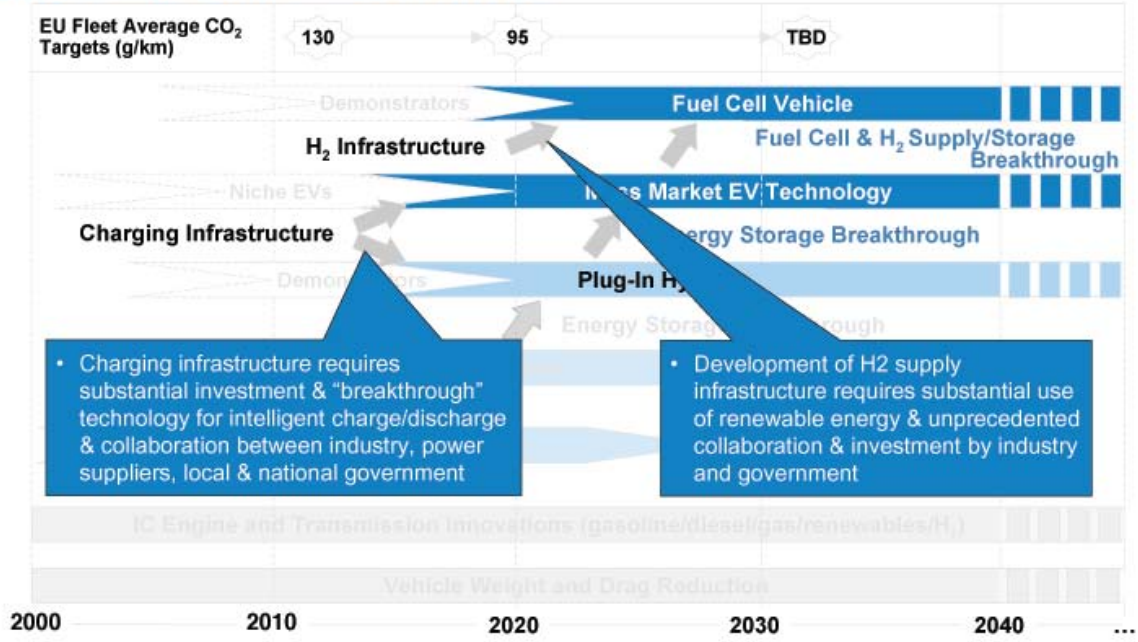
As battery costs and capabilities improve, migration from niche market to mass market for full hybrids may become possible



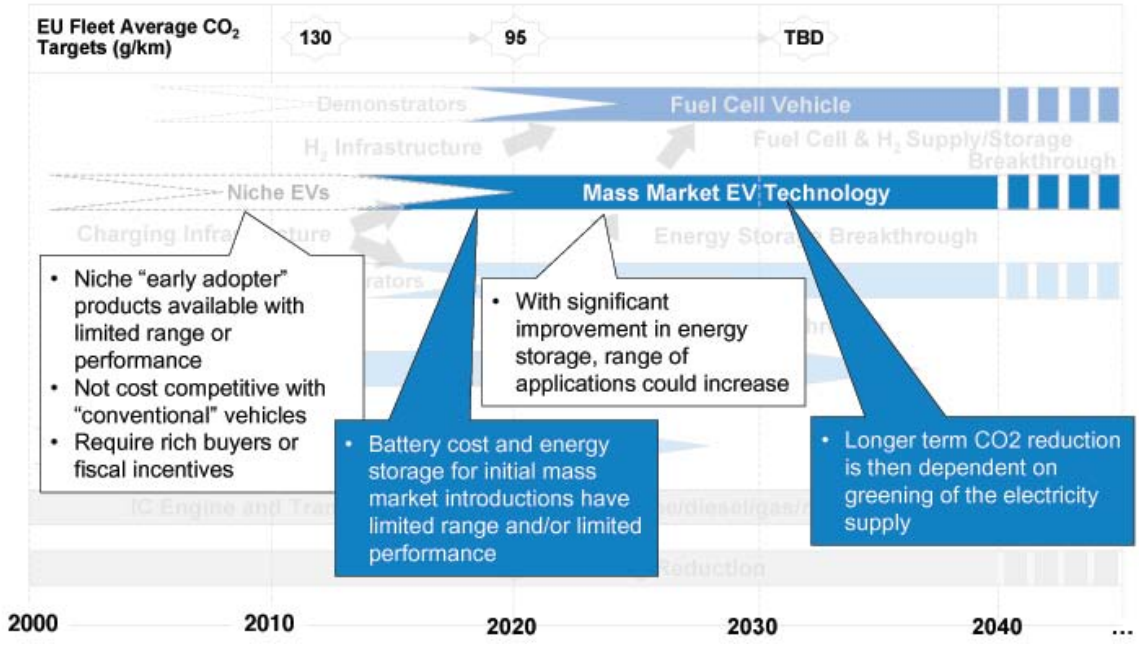
Transition to Plug-In Hybrids requires reduction in battery weight and to enable acceptable EV range



Significant improvements in energy distribution & infrastructure will be required for significant electrification of transport whether battery or hydrogen fuel cell powered

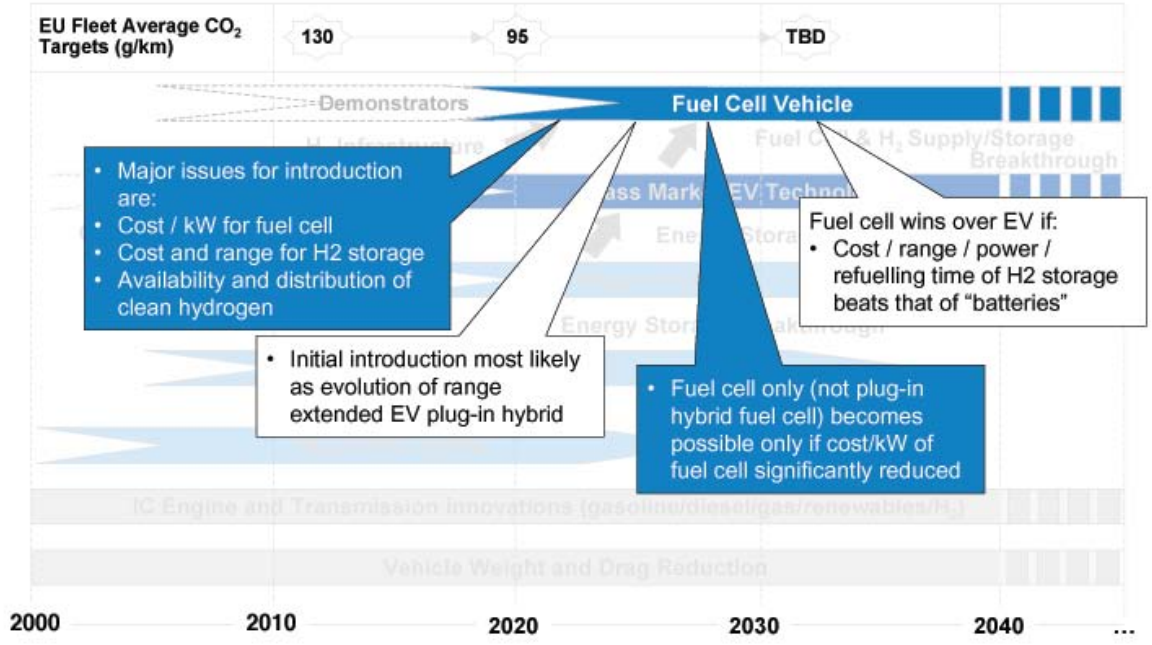


Only with significant improvement in energy storage and cost of batteries could complete electrification of transport be envisaged



Sources of information presented to or considered by the NAIGT

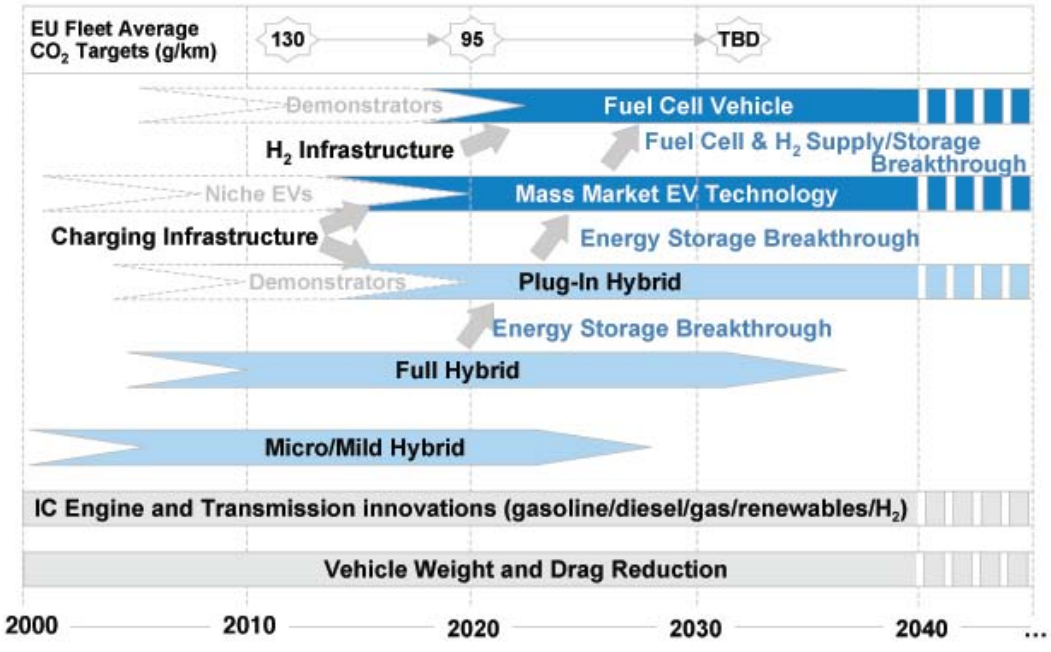
Whether Fuel Cells or EVs become the long term future will depend on the relative development rates of renewable H_2 vs. electricity, and fuel cells+hydrogen storage vs "batteries"



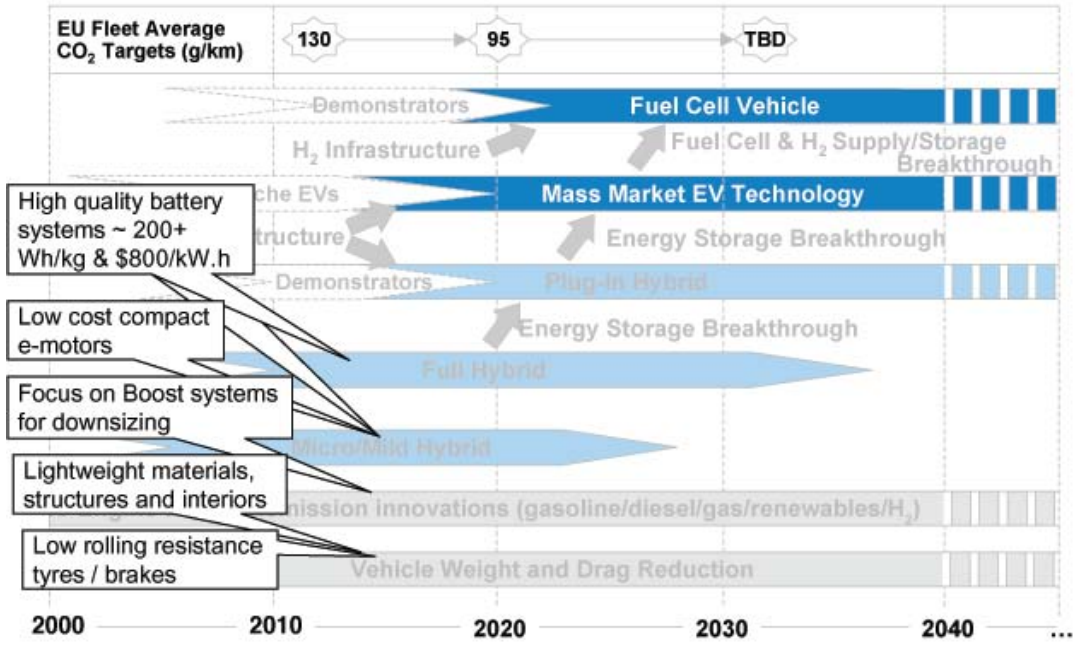
- **All OEMS share a common product technology roadmap** and recognise the same technical and commercial barriers.
- **Individual manufacturers will implement technologies which best address their own brand values** and market sectors.
- In the **near to medium term, improvement of conventional powertrains and transmissions can have a significant impact on fleet average CO_2** by providing moderate benefits for a large proportion of the fleet
- Introduction of increasing levels of **hybridisation / electrification is 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
- Widespread uptake of **electric vehicle technology is dependent on availability of batteries with low cost and high energy density**,
  - along with the **availability of an infrastructure**
- Whether the long term future will be based around **fuel cells or electric vehicles is dependent on the relative pace of progress** of
  - cost effectiveness, package size, weight and refuelling time of fuel cell + hydrogen storage (+ battery ?) vs battery
  - Availability and distribution infrastructure for clean hydrogen vs clean electricity

NAIGT Common Research Agenda

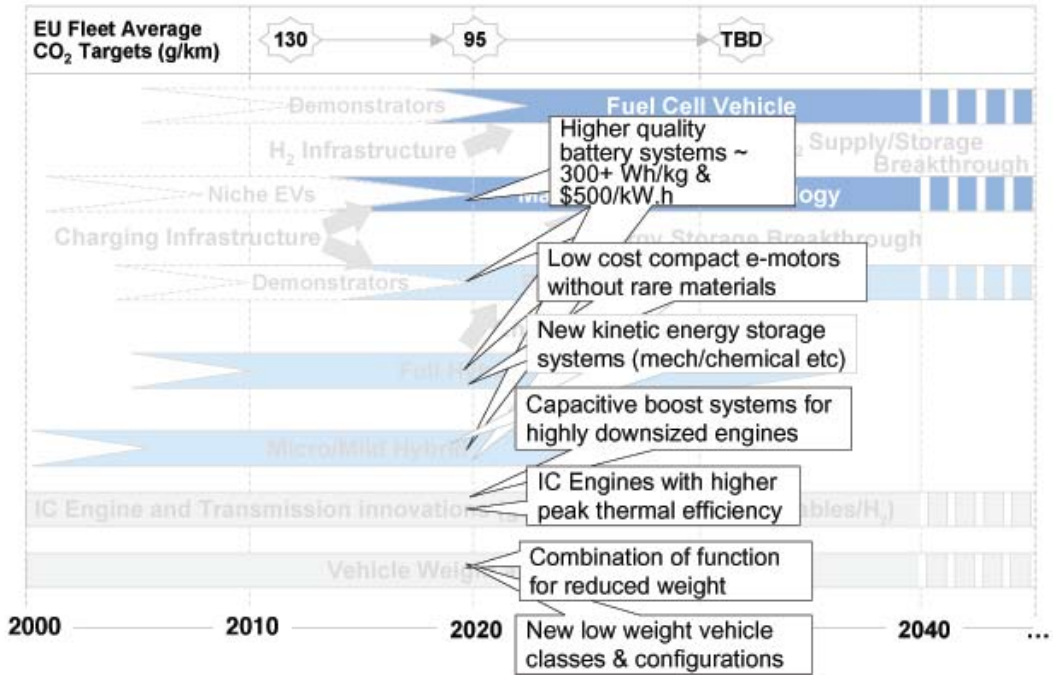
The Consensus Product Roadmap, mutually agreed by OEMs, defines future direction to develop products that will benefit UK plc



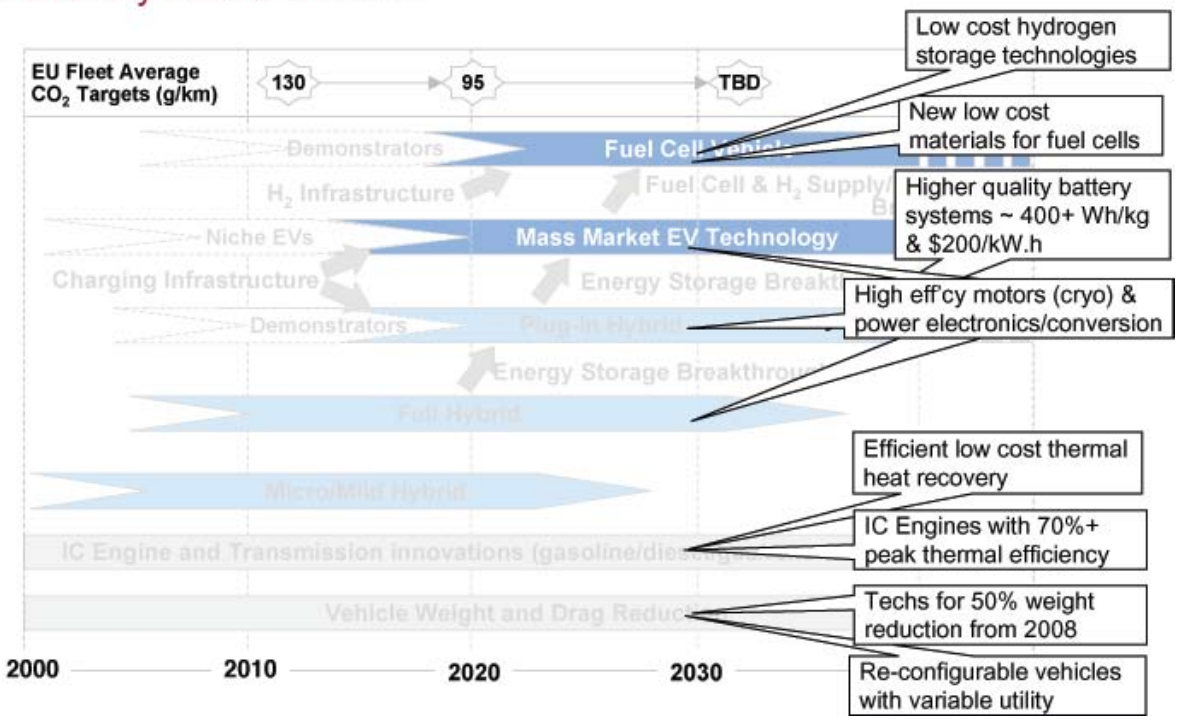
Immediate research & development required to commercialise products to be competitive



Medium term Research agenda defines opportunities for collaborative pre-competitive programmes



Longer term research agenda defines direction for fundamental & University based research



Common Research Agenda summary

	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

NAIGT Common Product Roadmap

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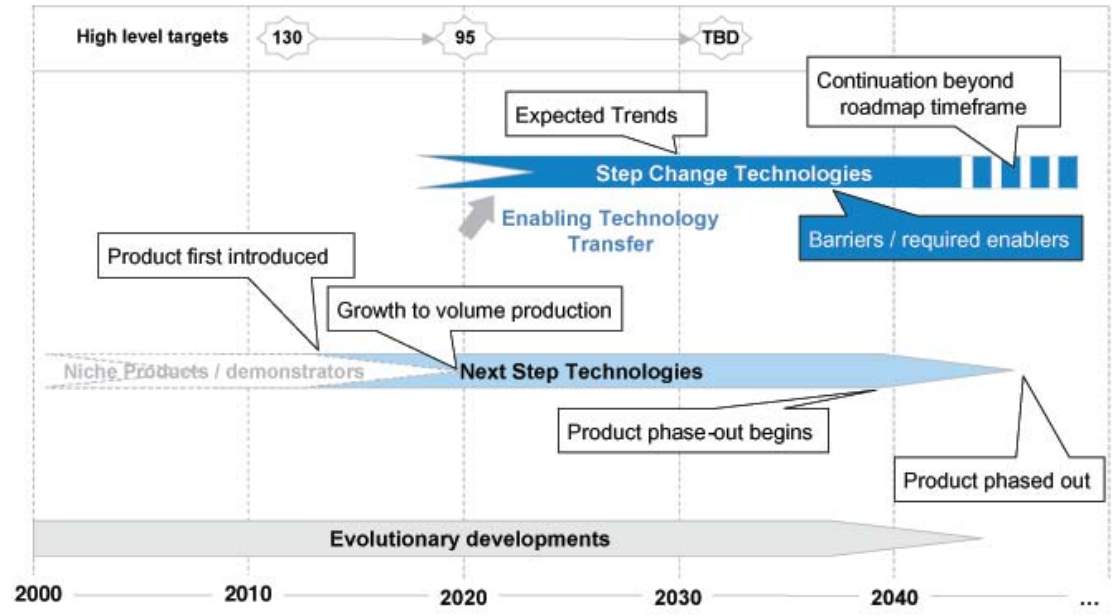

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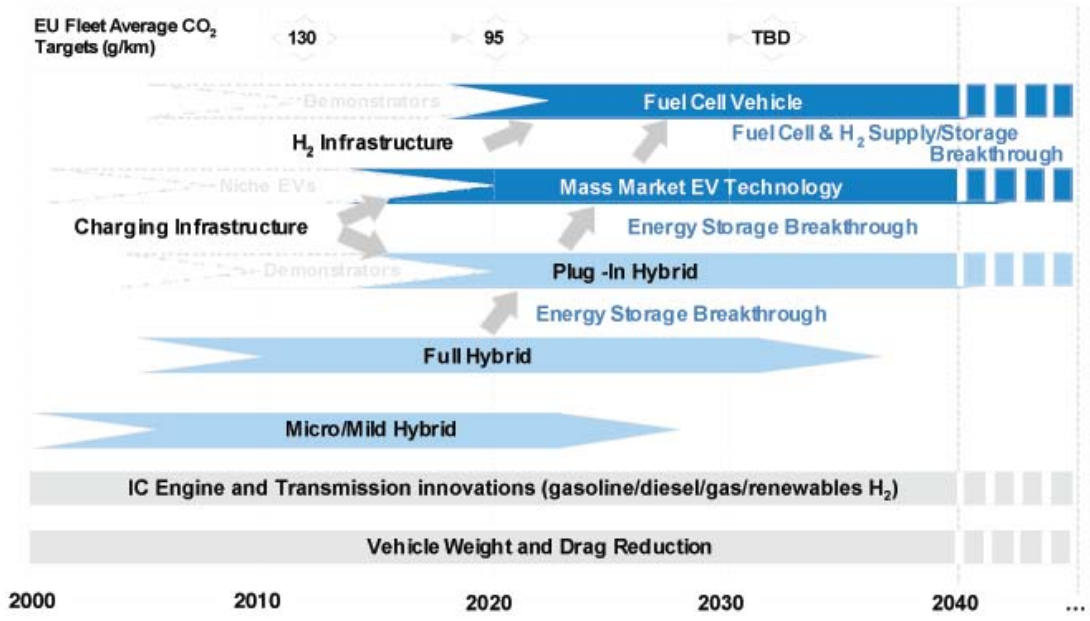

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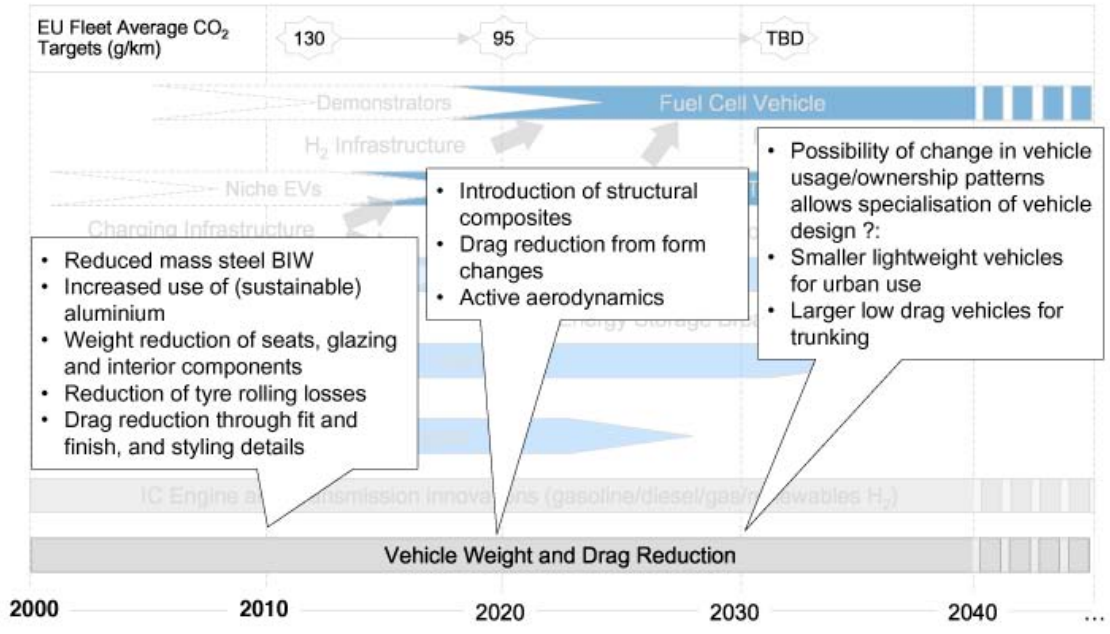

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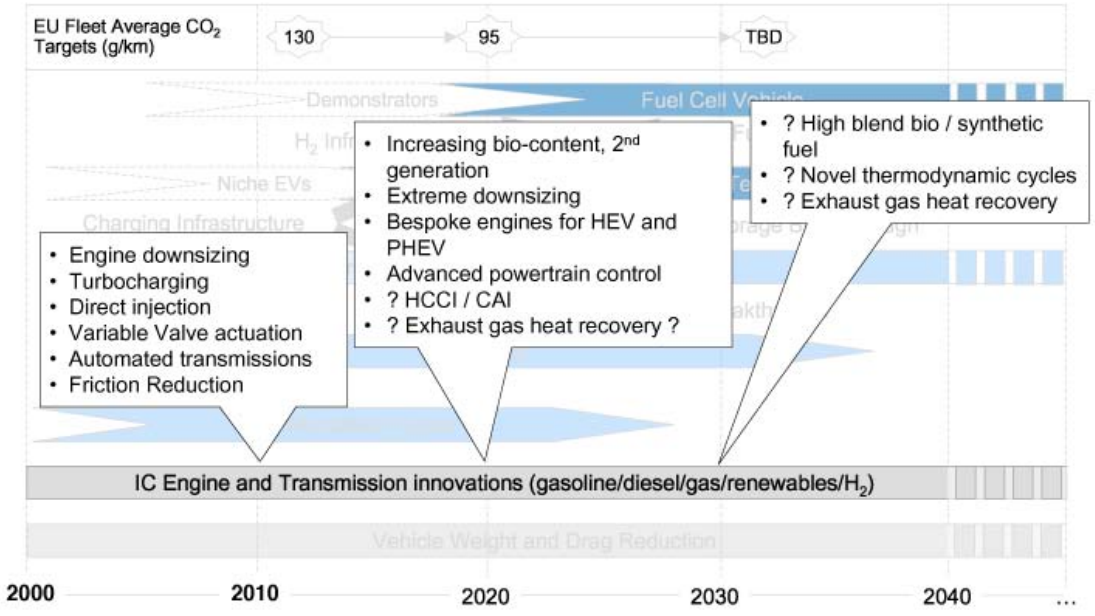

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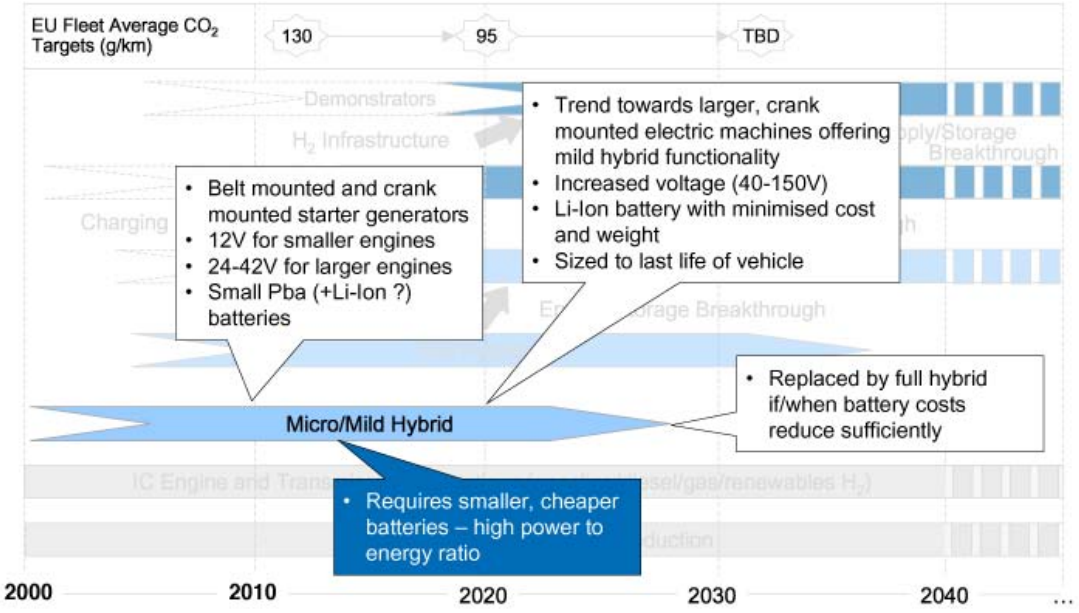

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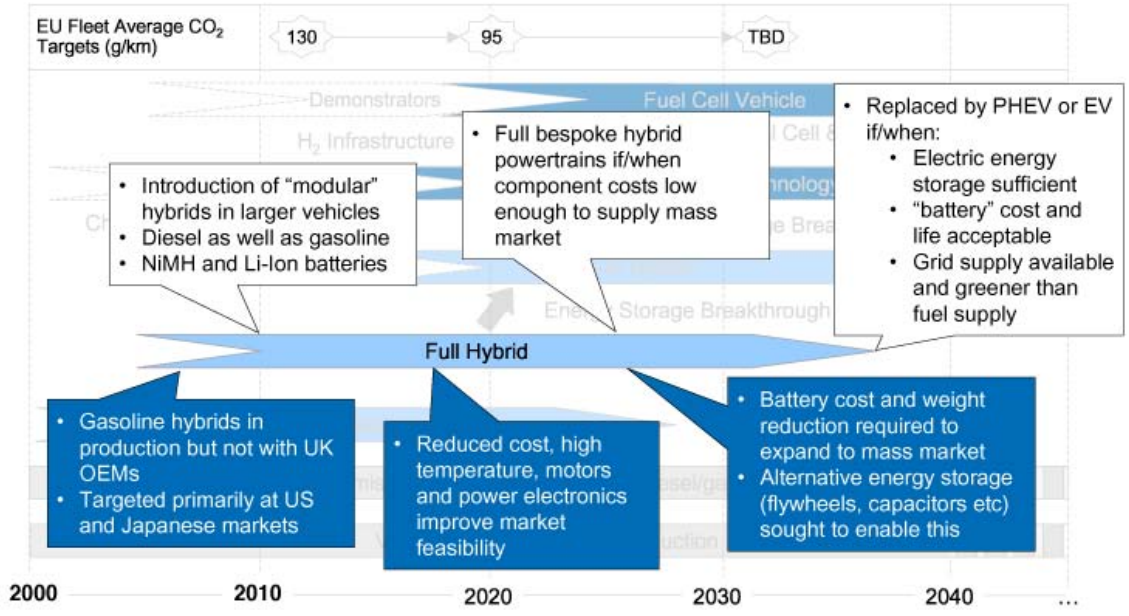
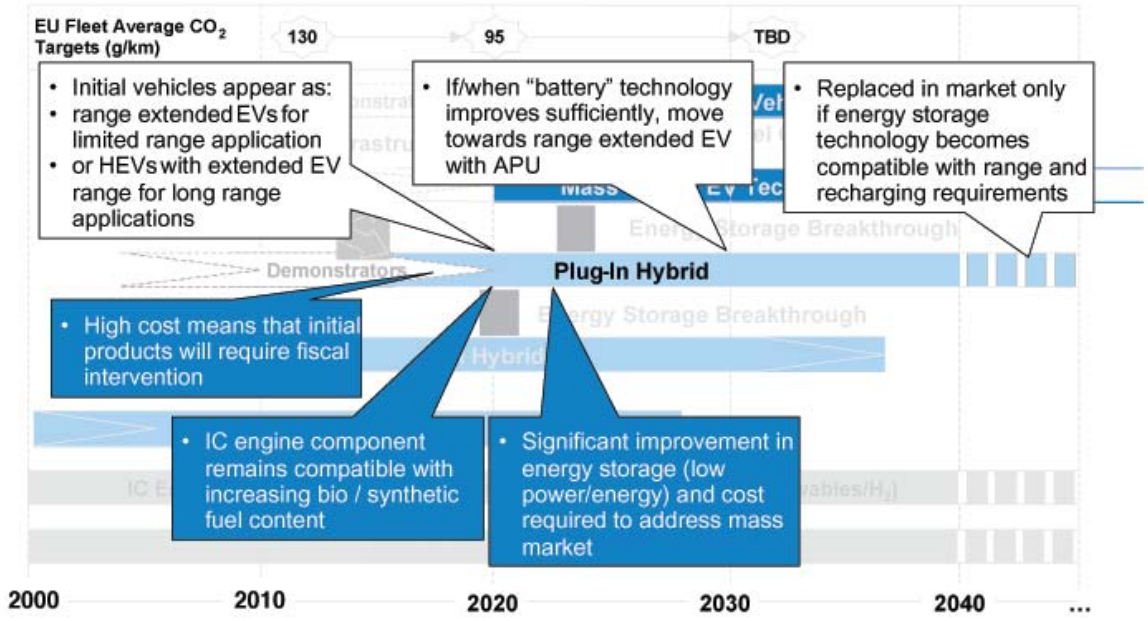
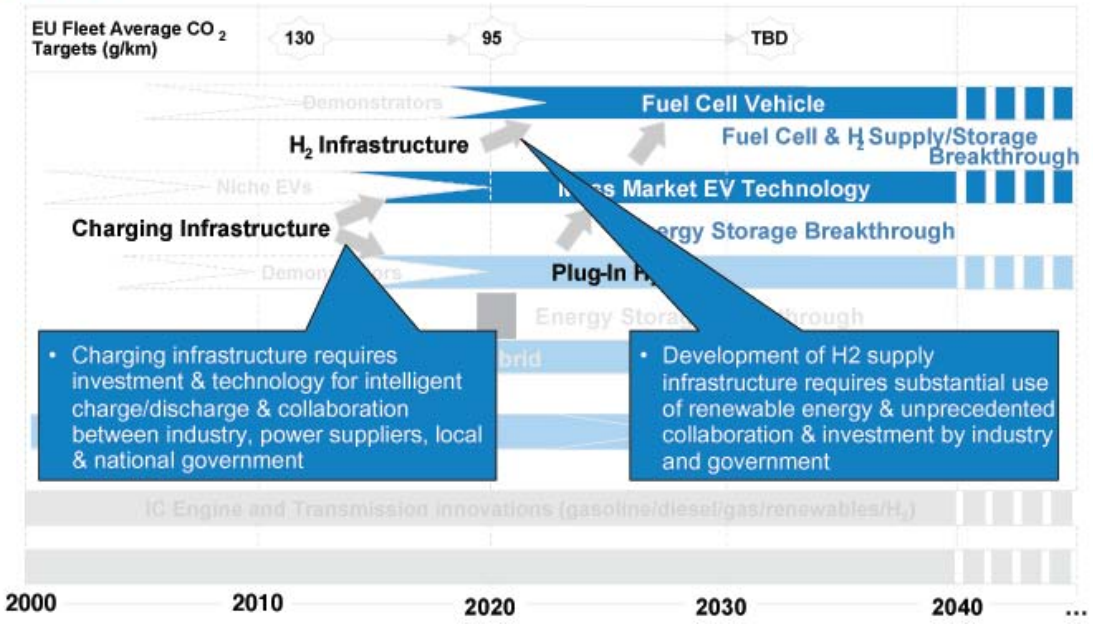


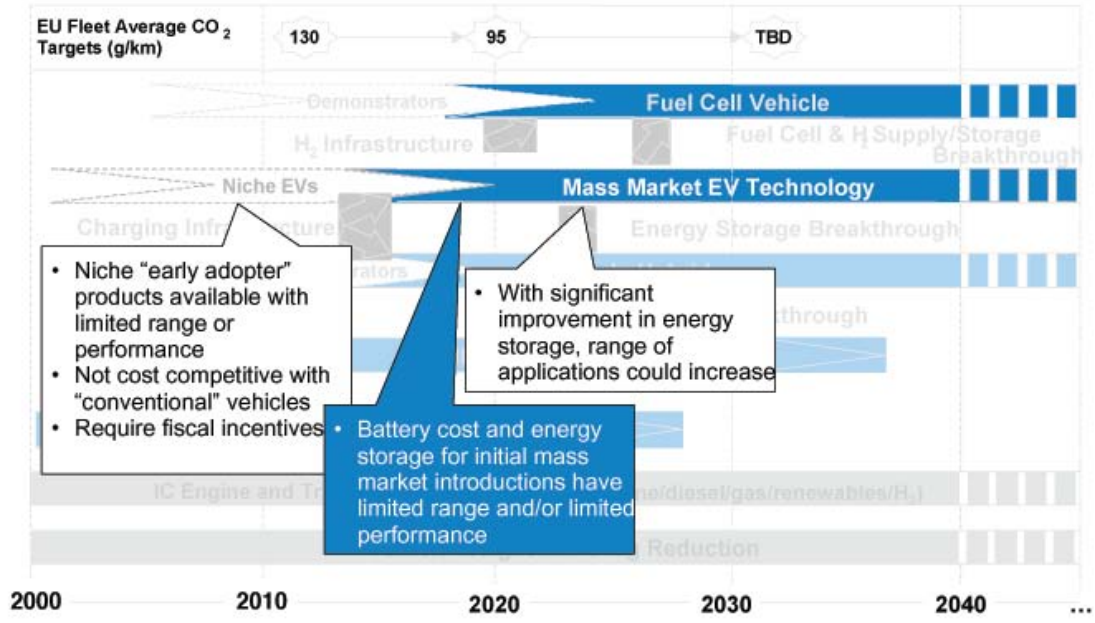
Transition to Plug-In Hybrids requires reduction in battery weight and cost to enable acceptable EV range, and sufficient charging infrastructure



Significant improvements in energy distribution & infrastructure will be required for electrification of transport whether battery or hydrogen fuel cell powered



Only with improvement in energy storage and cost of batteries could complete electrification of transport be envisaged.



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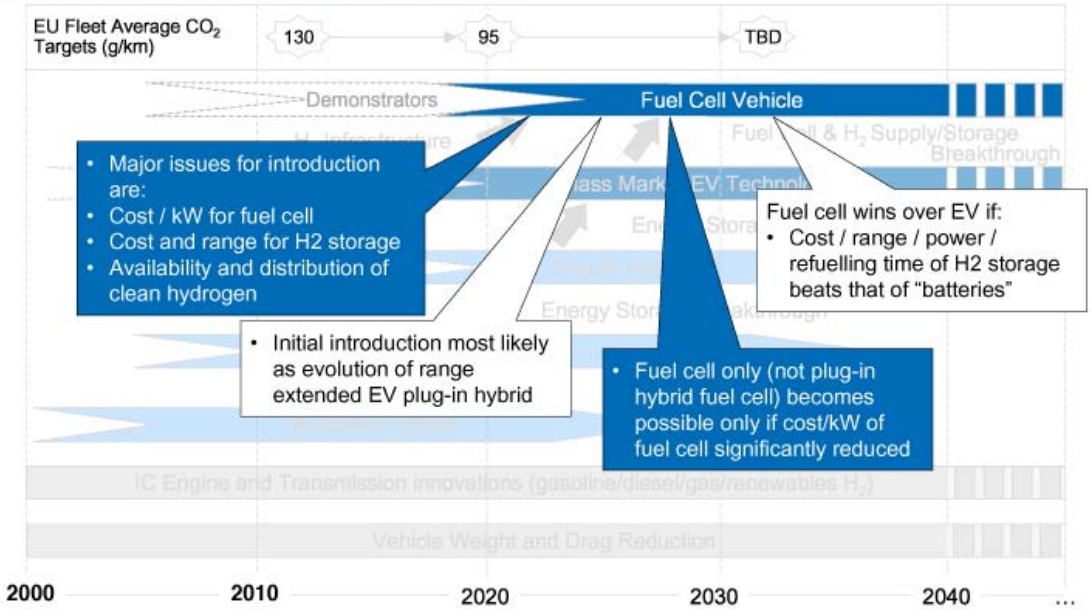
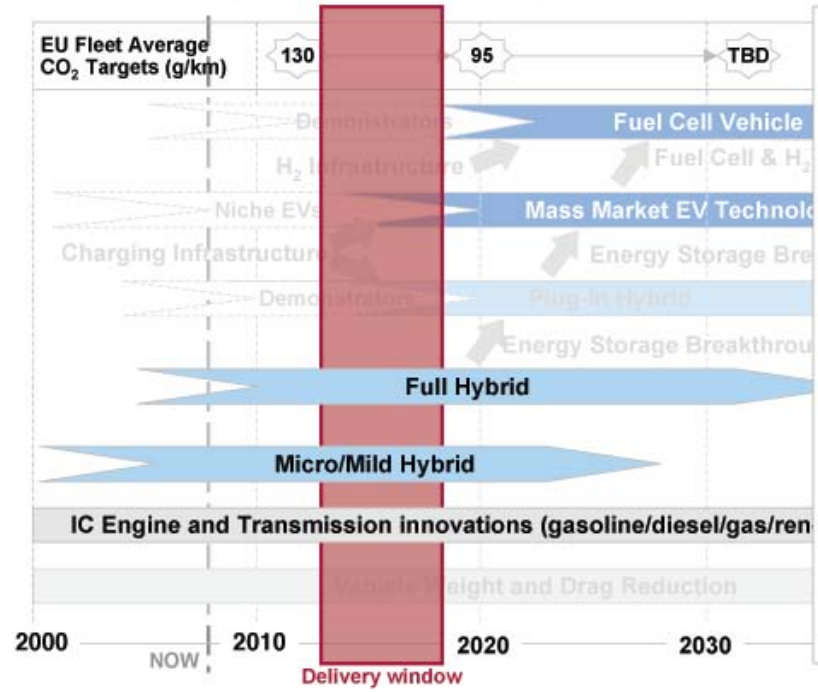


Common Research Agenda – Mapping Product Technology Demands to Research & Development Needs

The research required to enable the vision of the consensus product roadmap has been outlined for three stages of the timeframe

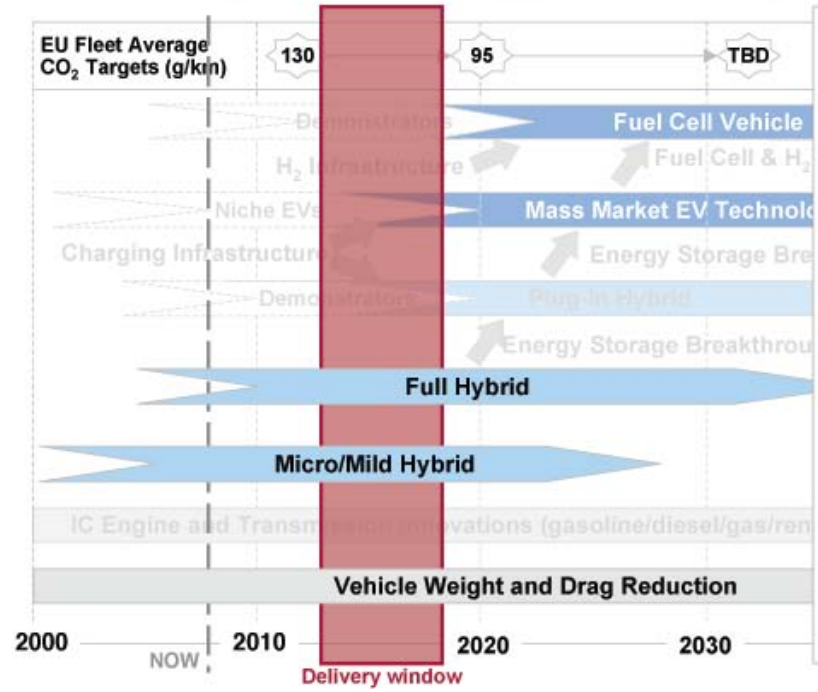
- Research requirements have been compiled with input and agreement from Jaguar Land Rover, Ford, Nissan, Tata and Ricardo
- Research is categorised according to six technical areas:
  - **Propulsion** technology
  - **Energy storage** technology
  - **Vehicle efficiency** technology
  - **System control** technology
  - **Energy & fuel supply** technology
  - **Processes & tools**
- The timeframe for research is defined in terms of three stages:
  - **Short term:** pre-competitive development, 5-10 years from production
  - **Medium term:** industrial research, 7-15 years from production
  - **Long term:** fundamental research, 10-20 years from production
- Timeframes determined by the available time to target product release, assuming that research starts now – at this stage, no account of required / possible rates vs. current status

Propulsion technology
– research requirements to support short term products



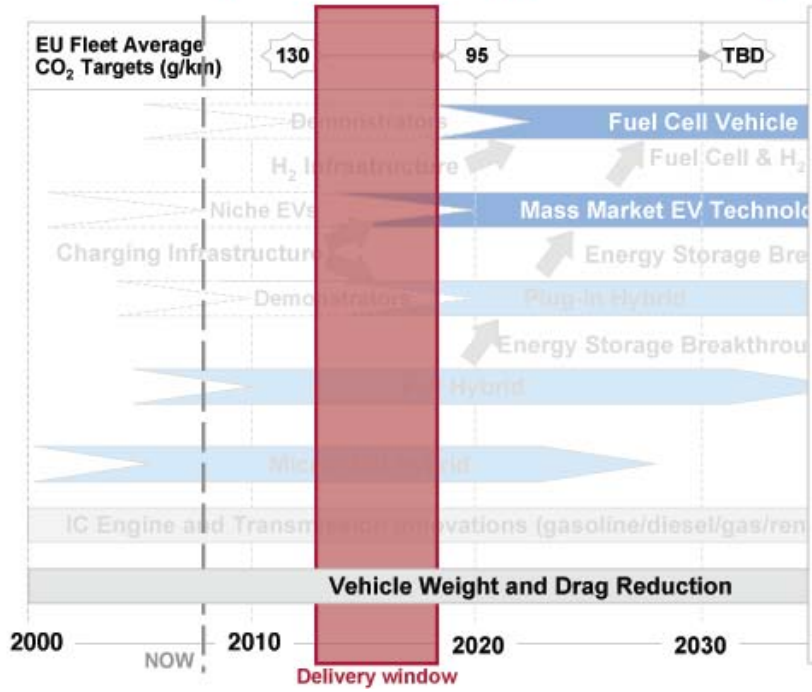
- Reduction of cost/kW and kW/litre of electric machines, drives and power electronics for HEV configurations
- Achieving CO2 reduction whilst meeting future legislative emissions
- Reducing engine size, mass and friction
  - Advanced boosting systems
  - Variable valve actuation
- Reduction of transmission losses and improvement of actuation

Energy storage technology
– research requirements to support short term products



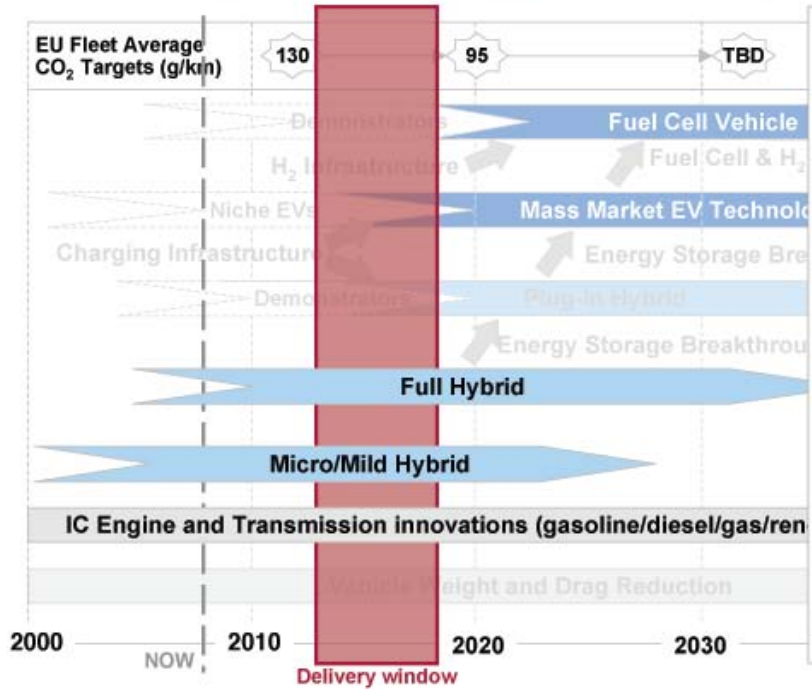
- Development and demonstration of battery technologies in mass production form:
  - Increased specific energy (200+ Wh/kg)
  - Reduced cost ($800/kWh)
  - Improved durability
- Development of intelligent battery management systems to meet vehicle requirements with smallest possible battery

Vehicle efficiency technology – research requirements to support short term products



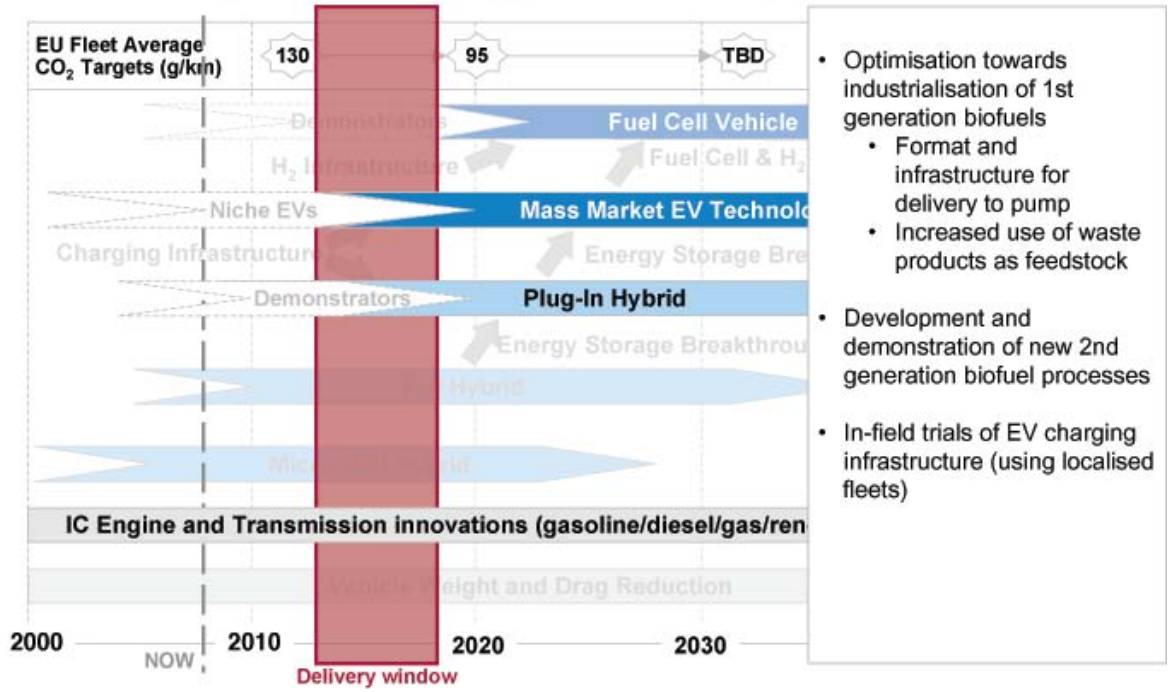
- Reduction of vehicle mass through innovative design and advanced materials & processes
  - Development of lightweight vehicle structures
  - Development of lightweight interior components/systems
- Reduction of vehicle drag through detailed design
- Reduction of tyre rolling losses with acceptable ride and noise
- Reduction of brake drag

System control technology – research requirements to support short term products

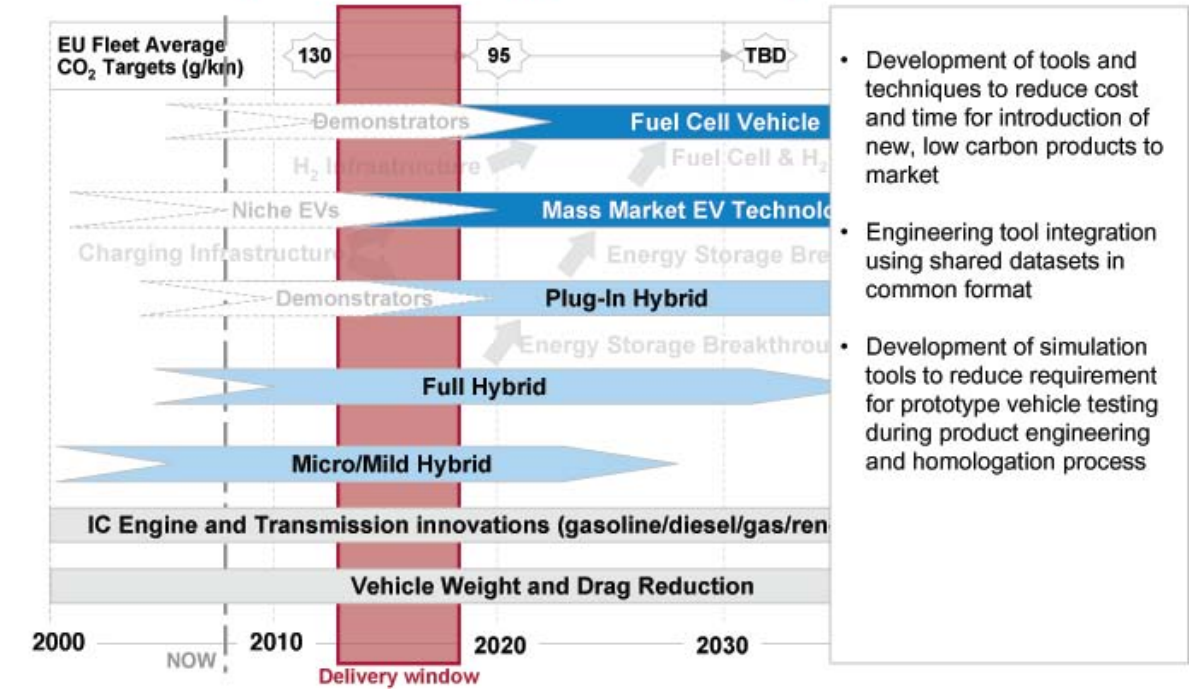


- Supervisory control at vehicle level
- Development of hardware and control systems to optimise in-vehicle energy management
- Reduction of parasitic losses from ancillary equipment
- Intelligent thermal management for fast warm-up
- Reduce CO_2 impact of cabin air conditioning

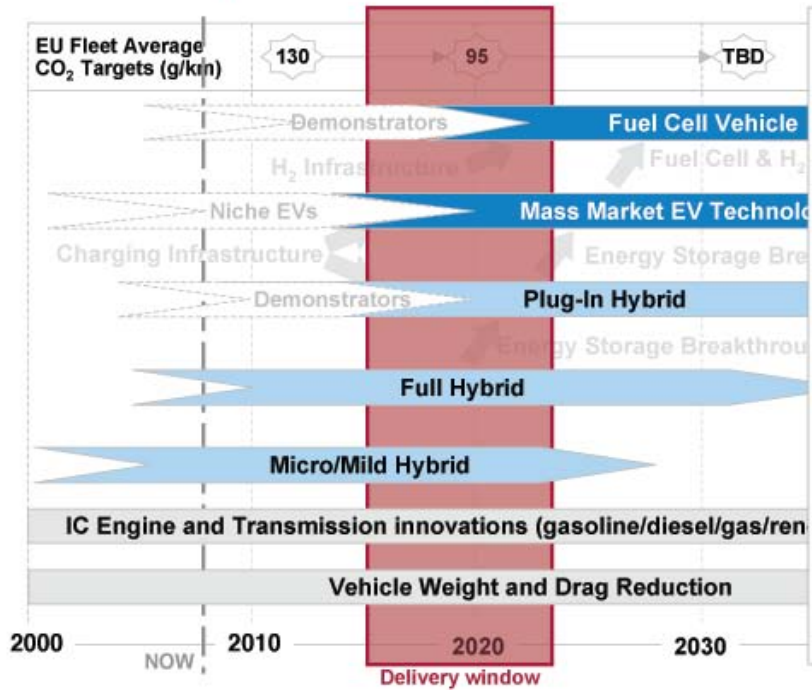
Energy & fuel supply technology – research requirements to support short term products



Processes & tools – research requirements to support short term products

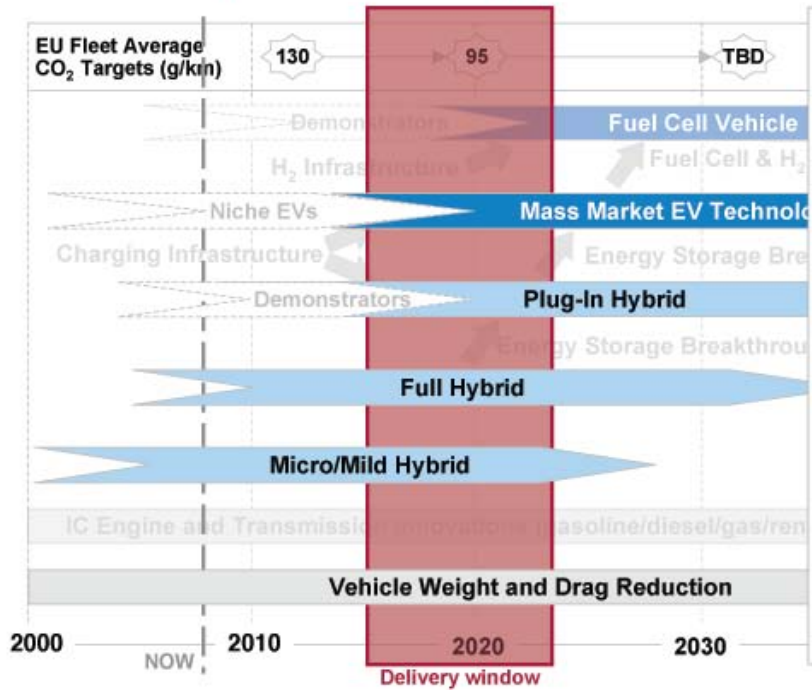


Propulsion technology
– research requirements to support medium term products



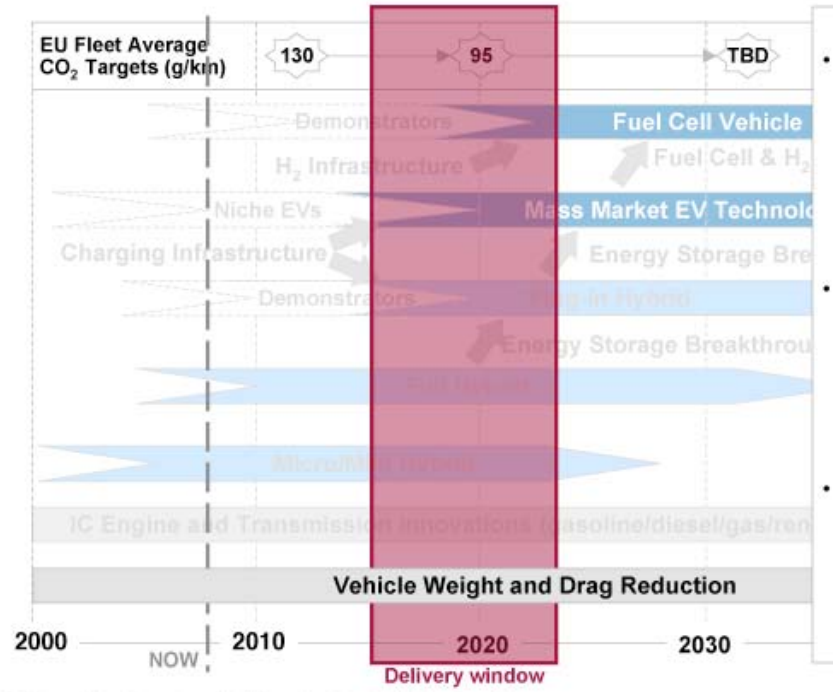
- Improvement of IC engine thermal efficiency by more radical measures:
  - Extreme downsizing
  - Modified thermodynamic cycles
- Development of bespoke engines for high efficiency PHEV/range extender EV
- Intake air management including capacitive boosting
- Development of all-electrical actuation systems
- Further electric machine cost and weight reduction – particularly for traction motors (full vehicle power)

Energy storage technology
– research requirements to support medium term products



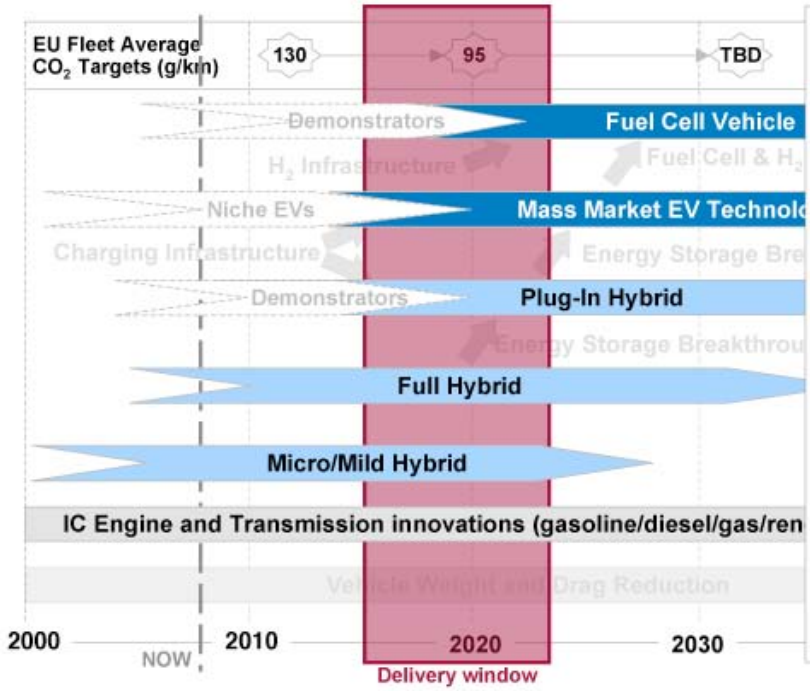
- Development and demonstration of next generation battery technology
  - High P/E for HEV app's
  - High E for EV and PHEV app's
  - Increased specific energy (300+ Wh/kg)
  - Reduced cost ($500/kWh)
- Flexible battery management systems (adaptable to many cell types and pack configurations)
- Alternative energy recovery & storage systems
  - Mechanical (flywheel)
  - Chemical
  - + ?...

Vehicle efficiency technology – research requirements to support medium term products



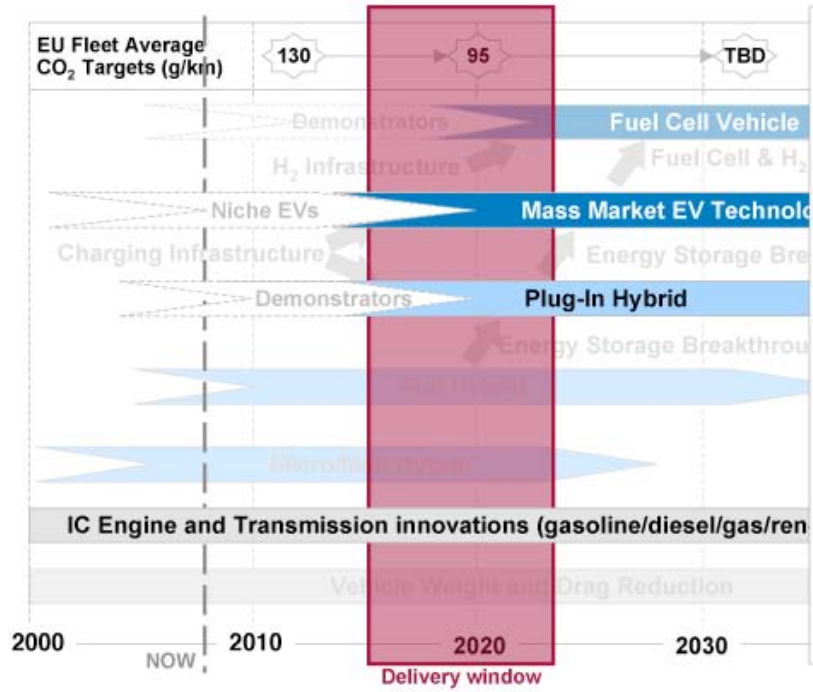
- Challenging of existing perceptions of vehicle requirements
  - New vehicle concepts
  - New vehicle segments
  - Powertrain optimised to vehicle demands
- Combining of systems to deliver existing (+improved?) functionality with reduced weight & cost
  - Redefine system boundaries
- More extensive reductions in weight and losses

System control technology – research requirements to support medium term products



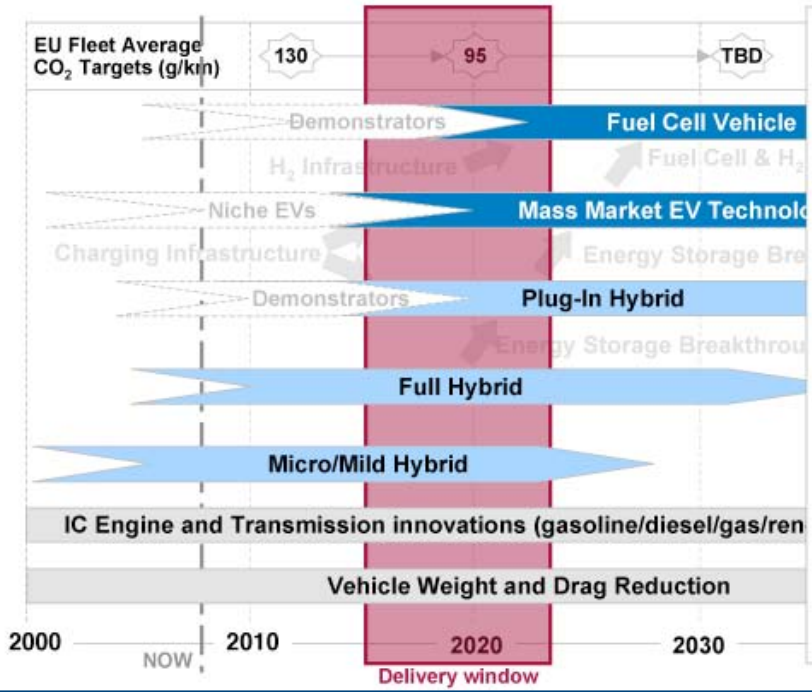
- Demonstration of information enabled control at vehicle level – for routing, energy management & safety:
  - Real-time route optimisation for best CO_2 and journey time
  - Powertrain optimisation for recognised routes
  - Integrated control of powertain and HVAC
  - Vehicle-to-vehicle
    - Collision avoidance
    - Platooning
  - Vehicle-to-infrastructure
    - Traffic sensing
    - Road charging
  - Driver assistance
    - Active braking
    - Active steering (collision avoidance, lane departure)

Energy & fuel supply technology
– research requirements to support medium term products



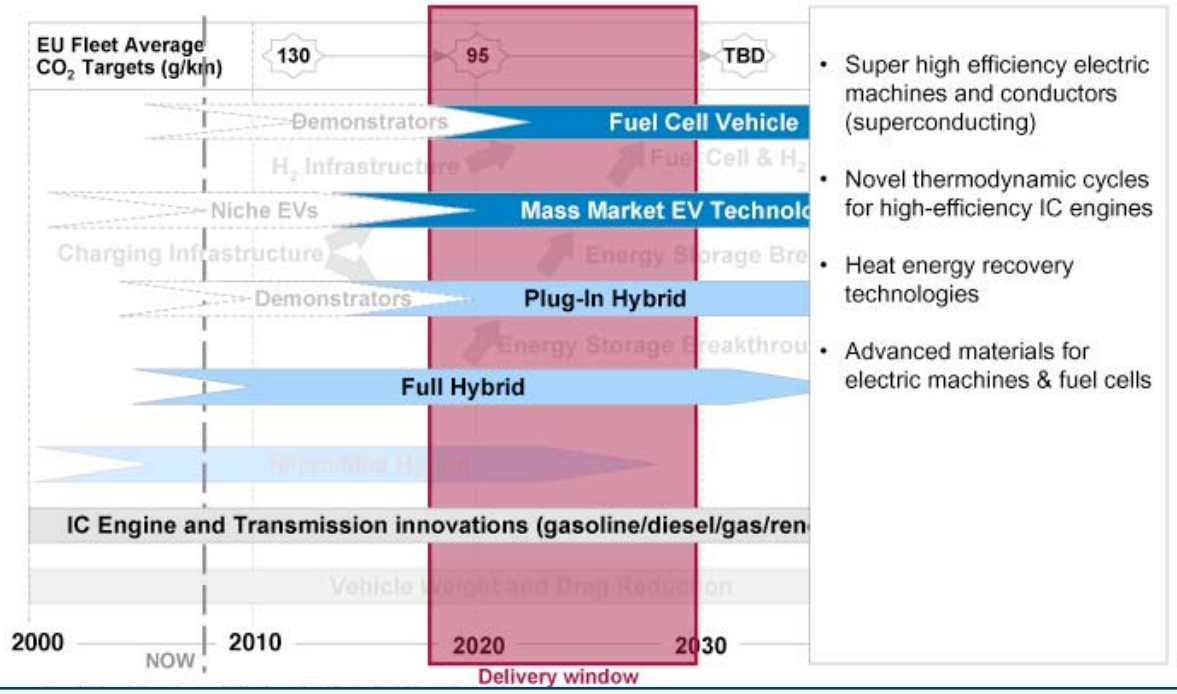
- Implementation of large scale EV recharging infrastructure
  - Including integration to grid demand
  - Fast charge capability ?
- Demonstration of 2nd generation biofuels at industrial scale (process and distribution infrastructure)

Processes & tools
– research requirements to support medium term products

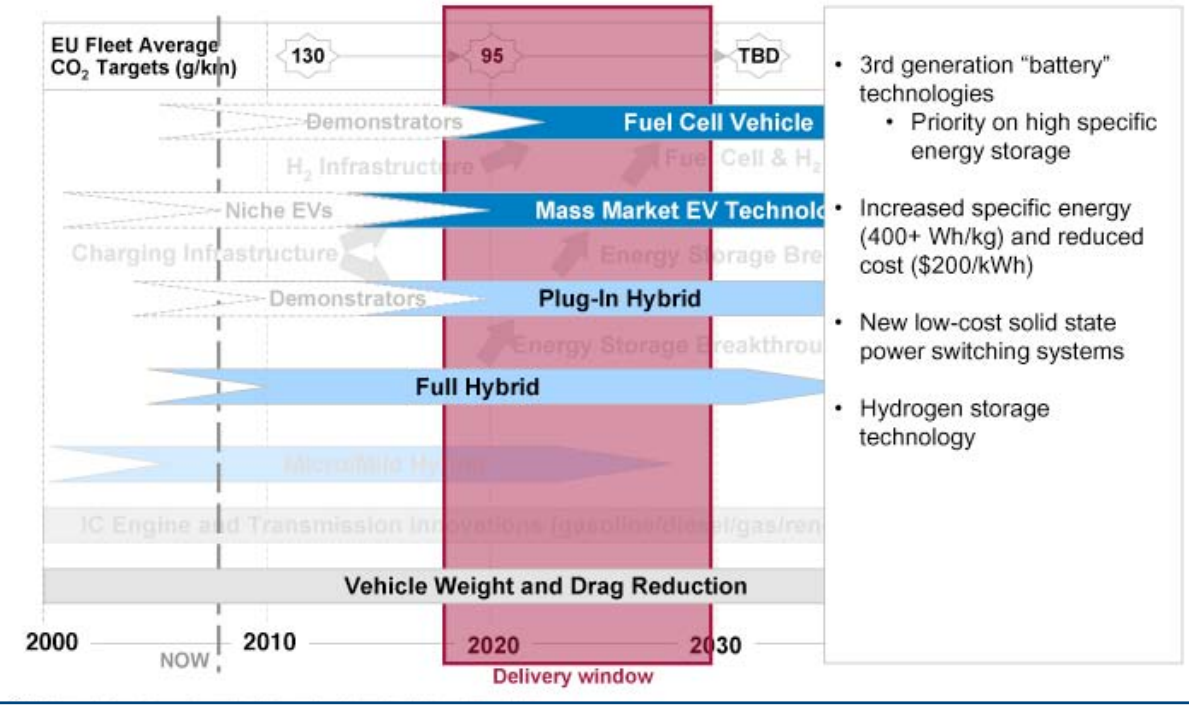


- Fully integrated simulation methods with shared datasets and user interfaces
- Automatic optimisation for cost, weight and lifecycle CO_2 of:
  - Mechanical design
  - Materials selection
  - Control parameters
  - …
- Migration of control system calibration from engineering activity to system functionality

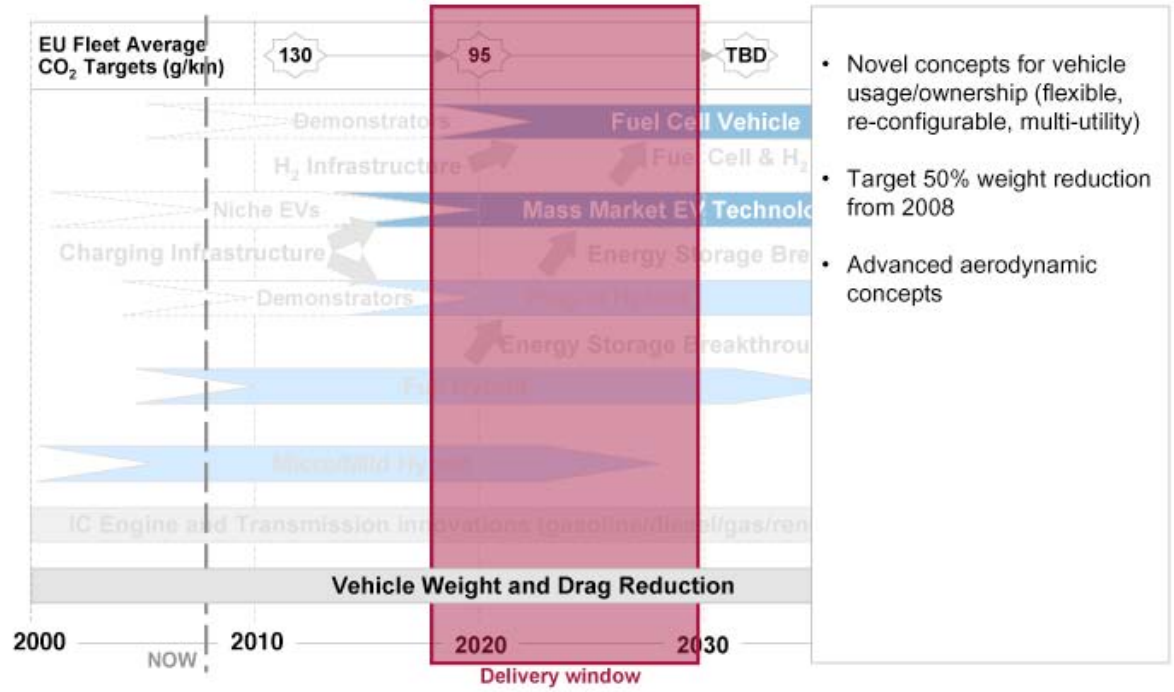
Propulsion technology
– research requirements to support long term products



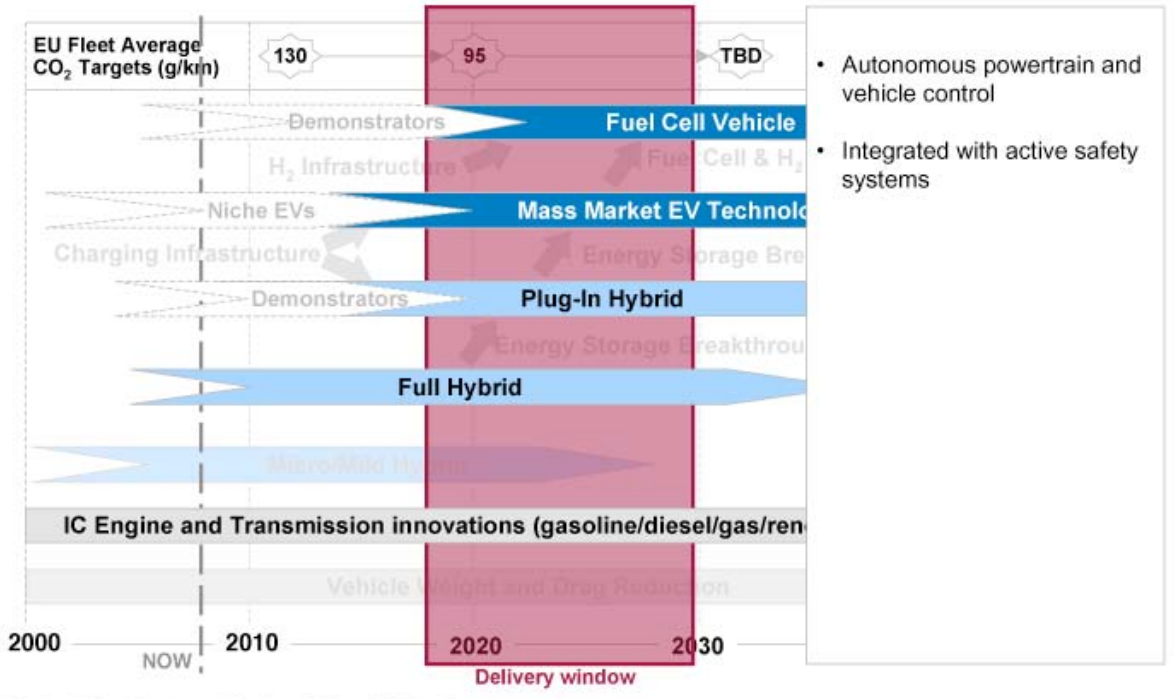
Energy storage technology
– research requirements to support long term products



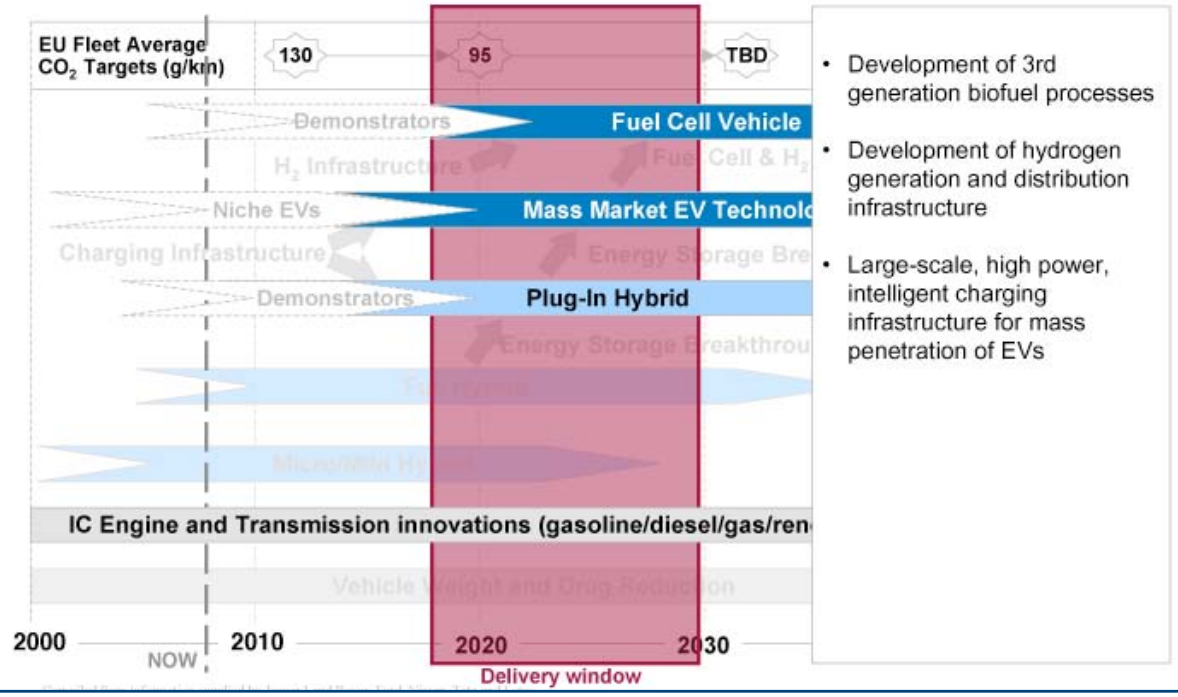
Vehicle efficiency technology – research requirements to support long term products



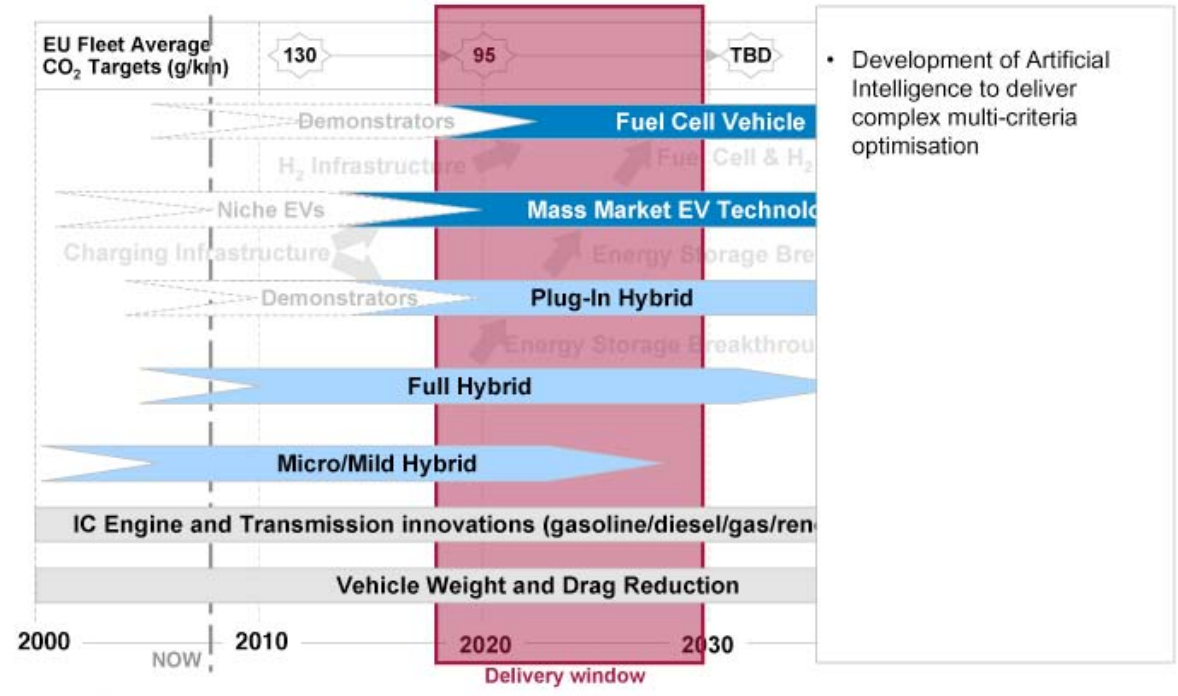
System control technology – research requirements to support long term products



Energy & fuel supply technology – research requirements to support long term products



Processes & tools – research requirements to support long term products



Common Research Agenda summary

	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

A full -size version of the Technology Roadmap is available on the BERR website at www.berr.gov.uk/files/file51139.pdf

Annex F: Glossary of Acronyms and Organisations

Act on CO_2 http://actonco2.direct.gov.uk/index.html

ASF Automotive Supplier Finder Service www.autosupplierfinder.com/

BERR Department for Business Enterprise and Regulatory Reform www.berr.gov.uk

BRIC Brazil, Russia, India and China

BSSP Business Support Simplification Programme www.berr.gov.uk/whatwedo/enterprise/simplifyingbusinesssupport/page44802.html

Carbon Trust www.carbontrust.co.uk/default.ct

Cenex Centre of Excellence for low carbon and fuel cell technologies www.cenex.co.uk

Climate Change Act 2008 www.opsi.gov.uk/acts/acts2008/pdf/ukpga_20080027_en.pdf

CV Commercial vehicle

DfT Department for Transport www.dft.gov.uk/

EIB European Investment Bank www.eib.org/

EoT Electrification of Transport

EPSRC Engineering and Physical Sciences Research Council www.epsrc.ac.uk/

EuroSTAT European Statistical Service http://ec.europa.eu/eurostat

FGIS France, Germany, Italy and Spain

Foresight Vehicle www.foresightvehicle.org.uk

FacITS Framework Architecture Classification for Intelligent Transport Systems www.innovits.com/public/info_/innovits/facITS%20flyer%20200409.pdf

GVA Gross Value Added

HM-Treasury www.hm-treasury.gov.uk

HND Higher National Diploma

ICE Internal Combustion Engine

innovITS UK ITS Centre of Excellence for Transport Telematics and Sustainable Mobility www.innovits.com

ITS Intelligent Transport Systems – Knowledge Transfer Network www.innovits.com/its-ktn/network/home.php

ITSS-IP Intelligent Transport Systems and Services Innovation Platform www.innovateuk.org/ourstrategy/innovationplatforms/intelligenttransport.ashx

LowCVP Low Carbon Vehicle Partnership www.lowcvp.org.uk

NSA-M National Skills Academy for Manufacturing www.nsa-m.co.uk/

NVQ National Vocational Qualification

OECD Organisation for Economic Co-operation and Development www.oecd.org

OEM Original Equipment Manufacturer

OFT Office of Fair Trading www.oft.gov.uk

ONS Office for National Statistics www.statistics.gov.uk

PARD Advantage West Midlands' Premium Automotive R&D programme www.advantagewm.co.uk/working-with-us/business-clusters/automotive.aspx

PC Passenger car

RDAs Regional Development Agencies www.berr.gov.uk/whatwedo/regional/regional-dev-agencies/index.html

R&D Research and (Technological) Development

RMSG Retail Motor Strategy Group www.autoindustry.co.uk/automotive_unit/aigt/implementation/retailMotorStrategyGroup?s=y7mew1xudwek68w

RAE Research Assessment Exercise www.rae.ac.uk/aboutus/

SCG Supply Chain Group www.supplychaingroups.co.uk/

SEMTA Sector Skills Council for Manufacturing www.semta.org.uk/

SMMT Society of Motor Manufacturers and Traders www.smmt.co.uk/home.cfm

SME Small and medium-sized enterprise

TSB Technology Strategy Board www.innovateuk.org/

TTW Tank-to-Wheel

UKTI UK Trade and Investment www.uktradeinvest.gov.uk/

VED Vehicle Excise Duty

WTW Well-to-Wheel

Printed in the UK on recycled paper containing a minimum of 75% post consumer waste.
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