

Investing in the low carbon journey

Lessons from the first decade of UK policy on the road to 2050

Prepared for the
LowCVP by E4tech with
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Executive Summary

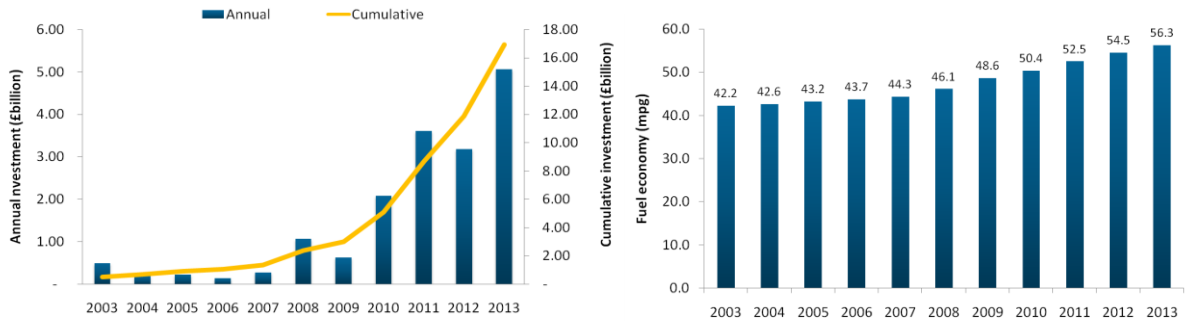
A decade of achievement

A decade ago the UK automotive sector was in a state of decline and a continuation of this trend was seen as inevitable in many circles. Factory and company closures were commonplace, innovation levels were modest, the UK supply chain had become ‘hollowed out’, and environmental regulations were seen as a threat by the industry. The ‘reactive era’ of the early 2000s, when automotive policy was preoccupied with closures and restructuring, started to change with the report of the Automotive Innovation and Growth Team (AIGT) in 2002 which stated “we believe that the (automotive) industry can have a long term future in the UK provided that industry and government work together.” The agenda AIGT set out included improving efficiency in manufacturing, supporting commercialisation of technologies and tackling environmental challenges through a multi-stakeholder group.

The last recommendation was taken forward with the establishment of the Low Carbon Vehicle Partnership (LowCVP) in 2003 which, comprised of an unprecedentedly broad range of stakeholders, began to create a bridge between industry, government and green groups with a view to reconciling commercial and policy pressures with environmental imperatives. Subsequently, the cumulative impact of consistent policy emphasis on environmental achievement and green growth has provided the foundations for a renaissance of the UK automotive sector. The past ten years have seen some great achievements in the UK automotive sector, despite a global recession and strong competitive pressures, leading to benefits for companies, drivers and the nation, including:

- Automotive manufacturing sector turnover climbed from £46.3bn in 2003 to £64.1bn in 2013.
- Rapid recovery in new car production following the 2009 global financial crisis, reaching 1.5 million units in 2013, having fallen to below 1 million in 2009. Production is now almost back to pre-recession levels.
- Exports account for 77% of UK car production, up from 70% a decade ago, and volumes reached a record 1.2 million units in 2012 and remained at this level in 2013.
- Major capacity expansions, new model programmes and reinvestments by BMW, Ford, Honda, Jaguar Land Rover, Nissan, Toyota and Vauxhall, outweighing declines in other firms.
- Productivity per worker up 45% from 2003 to 2013.
- Healthy UK bus and coach sector with nine manufacturers and a total UK market of 3,685 vehicles in 2013.
- 291 unique low carbon investments by 85 different companies were catalogued for the period 2003-2013.
- Confirmed total value of £17.6 billion in low carbon investments (approximately £40 billion by extrapolation).
- Average new car tailpipeCO₂ emissions have fallen by 25% to below the threshold of 130 g/km, ahead of the EU-mandated timetable.

- Average official new car fuel economy has risen from 42.2mpg (2003) to 56.3mpg (2013), reducing costs for motorists.
- Between 2002 and 2012 private consumption of vehicle fuel fell 18% in volume terms per head.
- Rapid uptake of low carbon buses led to over 1,500 in service by 2013.



Low carbon investments by year (left) and UK new car average fuel economy performance (right)

Whether it be the mainstream manufacturing sector or low-volume niche specialists, suppliers or contract engineers, engine plants or motorsports operations, the sense of a dramatic shift into a vibrant, confident and revitalised industry in the UK is palpable – and this despite the global economic recession of 2008/9 from which much of the industry in the European Union is still struggling to escape.

Background to the study

The turnaround in the sector’s fortunes raises some key questions therefore: how far have low carbon policies and technologies contributed to the resurgence in the UK automotive industry, and what lessons can be learned for the years to come? The Low Carbon Vehicle Partnership (LowCVP) sits at the nexus between government, the automotive industry and other key environmental policy stakeholders, so set out to understand the answers. The LowCVP commissioned strategic consultancy E4tech and Cardiff Business School to address these questions objectively, drawing upon a wide range of evidence.

The study sought to establish if there has been a causal link between policies that favour low carbon vehicles and the rising levels of UK automotive investment. Evidence was gathered via a broad industry survey, supported by interviews with senior executives, and extensive desk research. Together these provided a rich evidence base from which several clear messages emerged. These are presented in brief in this Executive Summary and elaborated in the main report.

Evidence

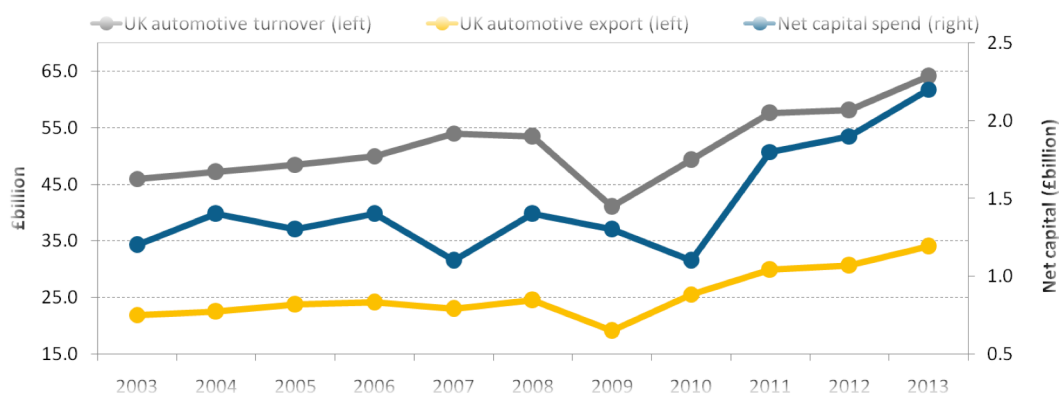
- ✓ 107 survey responses
- ✓ 35,000 words of feedback
- ✓ 14 senior interviews
- ✓ 291 low carbon investments by 85 companies catalogued
- ✓ 74 policies reviewed

A new era of industry-government cooperation

Underpinning the revitalisation of the UK automotive industry has been a new era of industry–government relations through the Automotive Council, formed in 2009. This has enabled industry to speak with a common voice, and government to support industry in their common objectives of creating a compelling investment proposition and supporting low carbon opportunities. Complementing this, the LowCVP has mediated a wider debate beyond the specific interests of government and the automotive industry to encompass fuel suppliers, fleet operators, consumers, NGOs, academics and others with an interest in future mobility. The seeds for co-operation were sown over a decade ago, allowing the industry to respond effectively to the economic crisis and maintain course despite changes of government:

- Automotive Innovation and Growth Team (2002) challenged the view of the auto sector as a sunset industry.
- LowCVP (2003) provides a focal point for stakeholder engagement, including NGOs, academics, road users and others, as well as industry and government, on low carbon vehicle policy issues and wider stakeholder engagement.
- Technology Strategy Board (2007) and Advanced Propulsion Centre (2013) provide consistent support for innovation.
- New Automotive Innovation and Growth Team (2009) defined the industry’s way forward.
- Automotive Council (2009) became the focal point for industry – government dialogue.
- Office for Low Emission Vehicles (OLEV) (2009) and Green Bus Fund¹ (2009) create market conditions for low carbon vehicle uptake.
- Regional Development Agencies and, latterly, Local Enterprise Partnerships support automotive innovation and manufacturing at local level.

In addition, the introduction of binding regulations on new car average CO₂ emissions in the European Union (EU) (2009) provided the Europe-wide certainty for harmonised change for cars (and vans from 2011), while the longer-term policy stability of the Climate Change Act (2008), King Review (2007, 2008) and Stern Review (2006) should not be underestimated in setting the direction of travel.



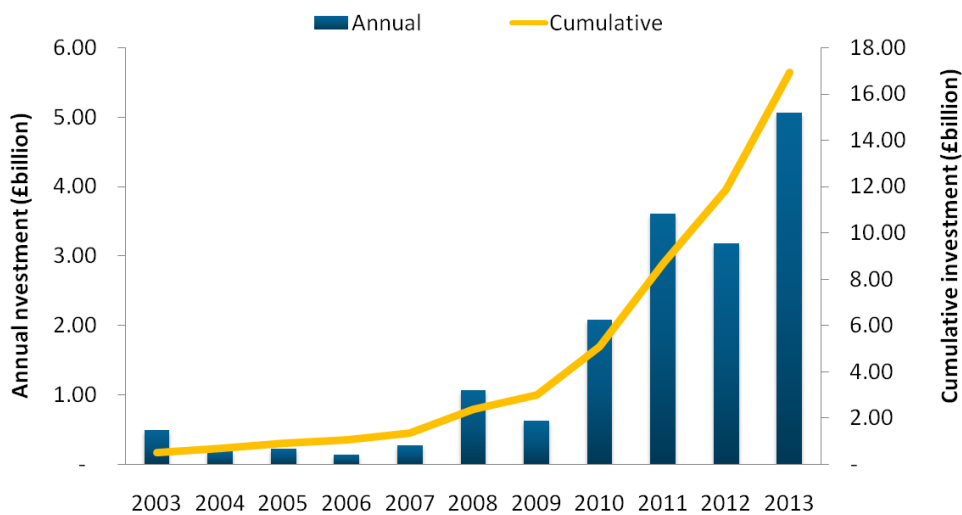
UK automotive sector performance between 2003 and 2013

¹ Note that this policy was implemented differently across UK Devolved Administrations

Automotive investment and low carbon policies

Low carbon automotive investment levels have risen strongly

A strong level of cumulative UK investment was identified by the authors, albeit with some unevenness caused by large investment announcements. Considering investments in R&D and manufacturing for lower and ultra -low carbon vehicles, 291 unique investments by companies were catalogued for the period 2003-2013. These investments were made by 85 different companies with a confirmed total of £17.6 billion. By extrapolation, the true value of investments is possibly of the order of £40 billion because the database only contains definite values for around 40% of the identified investments, and does not include wider multiplier impacts in the supply chain.



Value of low carbon investments by year (nominal value)

Cumulative investments have risen strongly towards the latter part of this study, suggesting that funding and policy structures have gained increasing traction over time.

Industrial policy has helped to turn the tide

“ Government policy context and strategic goals and targets will have a role to play in the investment decision making environment. It may not be the determining factor - but it will be evaluated positively or negatively. ”

Major automotive manufacturer

The changing relationship between government and the automotive industry has been pivotal for the transformation of the sector overall. Respondents spoke of the fundamental change since the ‘reactive era’ of the early 2000s when automotive policy was preoccupied with closures and restructuring. The tide had begun to turn but was rapidly accelerated by the economic crisis which hit the global automotive industry with force in 2008-10. The UK’s response included a proactive focus on support for the automotive industry, notably in areas where the UK had a technological basis for competitive advantage, such as powertrain engineering. Several government-supported

entities were established and continue to play a key role in the automotive industry; the authors heard ringing endorsement for the Automotive Council in particular, and many were also grateful for the role played by the Technology Strategy Board and, latterly, the Advanced Propulsion Centre.

Low carbon policy has been very influential

“ Back then, environmental regulation was seen a threat not an opportunity. ”

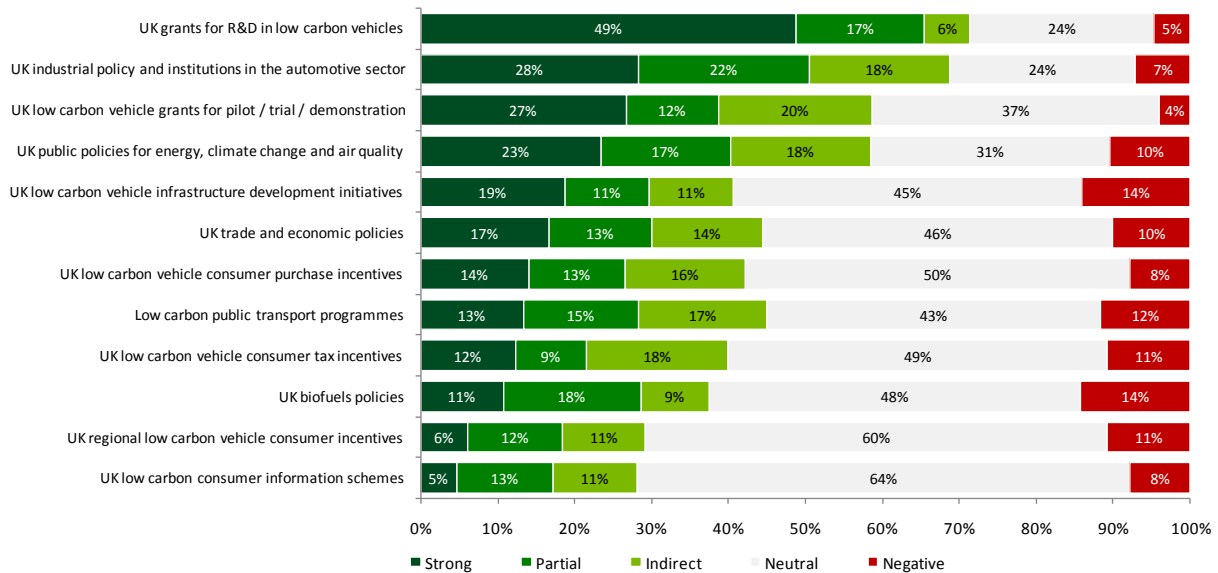
Automotive manufacturer

“ At the highest level, the creation of a level playing field [CO₂ target] by the EC was extremely helpful. A clear long term target is what industry needs – it will find a way to respond. ”

Automotive manufacturer

UK low carbon policies have emerged strongly in the past 10 years. The formation of the LowCVP in 2003, arising out of the work done by the Automotive Innovation and Growth Team (2002), can in retrospect be seen as an important moment for the UK automotive sector, providing a means for stakeholders to work together to contribute to numerous low carbon vehicle policies, structures and initiatives. The Stern Review (2006), King Review (2007) and Climate Change Act (2008) put CO₂ reduction into law, building a sense of stability in climate change policy with a strong bearing on subsequent UK road transport sector policies.

Low carbon vehicle policies have had a strong influence on UK R&D investment in particular, as illustrated by the survey results below – for example 72% of respondents said UK grant programmes for low carbon vehicles had been influential in their R&D investments. Other initiatives also emerged and are acknowledged to have provided strong market pull for low carbon investment, notably the Office for Low Emission Vehicles (for cars and vans) and the Department for Transport's (DfT) support for low carbon buses. However, the primacy of the EU's regulations for new passenger car CO₂ has been critical in providing a 'level playing field' and long term certainty across the whole industry.



Survey responses: Influence of public policy on research and development investment

Confidence is vital for investment

“ Investment decisions are always about more than incentives – policy and stability are vital. ”
Major vehicle manufacturer

Investment decisions are taken on the basis of an assessment of risk and reward and policy confidence is a vital part of reducing risk, especially for the automotive industry with long product development times requiring large capital commitments. Numerous illustrations emerged of how confidence is a result of cumulative effects rather than single policies, with increasingly positive results. In R&D the availability of multi-stage grant programmes has encouraged innovators to start their journey with confidence that they will continue to be supported, if technically viable. In vehicle deployment, OLEV’s long term commitments to low carbon vehicle support are valuable for investors. In manufacturing, senior industry figures reported that collective and cumulative policy measures reinforced the overall confidence that UK Government provides.

In addition to cumulative policy effects, respondents referred to the confidence derived from having a clear channel for dialogue with government (via the Automotive Council and others). Furthermore, importance was attached to the ‘intellectual supply chain’ that is being developed in the UK, ensuring that ideas can be turned into products through an ecosystem of companies and organisations. Finally, respondents pointed to the UK’s membership of the EU as being vital for confidence.

Not everything in road transport policy has gone smoothly

Not surprisingly, there have also been areas where public policy in this sector was not perceived to have succeeded and it is instructive to learn from these. In the automotive sector the abolition of the Regional Development Agencies caused disruption at a time when the industry was being closely supported in some areas, and new structures were not able to step in quickly. Truck sector respondents pointed to the dearth of policy to support low carbon truck deployment, despite incentives to develop technologies. They also cited the tension between technologies and engineering resources required for CO₂ reduction, and those to meet stringent air quality emission regulations (most recently Euro VI).

The study also examined policy on low carbon fuels, where changes in direction and the complexity of fuel and infrastructure investments in general have provided a less stable investment climate for the companies concerned. This is felt particularly strongly in biofuels where investments have stalled to a large extent.

Recommendations

The authors use the evidence and their own judgement to make a number of recommendations for policymakers, summarised below and explained in the following sections.

Stay on course:

- Automotive policy frameworks are mostly working well, in particular due to the sense of urgency as well as consistency of policy, which should not be allowed to diminish.
- There are other priorities but low carbon must remain a vital area of focus.
- Strong emphasis should be placed on the transition from low carbon technology development to manufacturing.

Address remaining automotive sector challenges:

- Attracting further inward investment, especially from component suppliers, would increase UK resilience.
- Future skills needs throughout the supply chain should be supported.
- Low carbon policies need closer alignment with air quality issues.
- A clear framework is required for commercial vehicle efficiency measurement and incentives.
- EU regulations play a key role in harmonising future vehicle CO₂ (and air quality) performance requirements and companies are keen to see the UK influencing this agenda.

Build confidence for the low carbon fuels sector:

- A collaborative approach is needed to define the outlook for automotive fuels.

Stay on course

The initiatives that emerged from the decline of the UK automotive sector and the economic crisis have proved to be largely successful and should be built upon. However, there is a risk that the new structures will subsequently prove vulnerable if the sense of urgency that led to their creation declines. This vulnerability may be to unexpected events (new technologies, competitors or economic conditions perhaps), or to becoming less agile with time (some evidence was offered of this already becoming the case). The recommendation is therefore to maintain a sense of focus and urgency and continue to stress test all of the low carbon automotive ‘apparatus’ in the UK, ensuring delivery of a common government-industry mission and attracting further investment. Surrounding this it is very important that the focus on low carbon is maintained, even as other automotive sector priorities such as autonomous vehicles emerge.

Much of the low carbon innovation that has occurred in recent years in the UK is approaching technological maturity, but is still some way from manufacturing maturity. For the UK to gain maximum value this journey needs to be pursued to the end with appropriate support, thus ensuring that benefits accrue to the UK rather than being driven offshore.

Address remaining automotive sector challenges

The UK supply chain should build up its low carbon (and more general) capabilities, as has already been recognised. The focus of the Automotive Investment Organisation, Automotive Council and others is to reinforce the automotive supply chain in the UK in line with the automotive industrial strategy. This emphasises that UK policy is creating a pull for vehicle development and manufacture, which in turn creates a growing need for a strong supply chain. For low carbon vehicles specifically, the UK’s R&D base creates an attractive context for supply chain actors to develop and manufacture close to what is also a major low carbon vehicle market.

Several commentators noted that skills are becoming a challenge for the further development of the UK automotive sector. This relates not just to highly-skilled university-level graduates, but also to the future technicians for whom apprenticeships and other training are needed. The industry, government and relevant skills bodies have already recognised the need to work closely together (for example via the SMMT and Automotive Council) including the low carbon vehicle areas, to ensure that the UK’s prospects are not hampered by skills shortages.

The contribution of low carbon policies to relieving air quality concerns has been underplayed. Urban air quality is a growing area of concern for many cities across Europe, with many episodes in which ‘safe’ levels of pollutants are exceeded. In some instances the balance between CO₂ and air quality needs to be better managed, and some products can be beneficial on both fronts. Noise is another feature that should be considered alongside CO₂ and, again, there may be synergies as well as trade-offs.

The pressure for commercial vehicles with ever lower air quality impact has had a fuel efficiency cost according to some. The EC’s framework for measuring and comparing commercial vehicle efficiency (currently in development) is required, which in turn will provide a basis upon which fuel efficiency could be incentivised or enforced. This should be taken forward by the EC with UK oversight from OLEV, the DfT Low Emission HGV Task Force and the LowCVP.

EU policy plays an important role in harmonising vehicle CO₂ emissions targets, as well as providing funding for research. Active UK participation in shaping these agendas is important in view of the strength of other automotive interests within the EU.

Build confidence for the low carbon fuels sector

Low carbon fuels, in particular biofuels, currently do not benefit from the same clarity of outlook that automotive players enjoy thanks to the Automotive Council and LowCVP roadmaps. A partnership between government and stakeholders, ideally with an EU perspective, to define the long term outlook for fuels would be valued by the fuels and vehicles industries. This should build on the recently published LowCVP Fuels Roadmap.

Outlook

This report identifies many things that have gone right, as well as some that have gone wrong. However, it is not a manifesto for complacency as the journey has really only just begun. The challenges of decarbonising road transport are enormous, especially as the UK seeks to capture a growing share of the industrial opportunities that this presents. Much work is still required to develop low carbon vehicles, fuels and technologies, and especially to manufacture them in the UK and deliver them to market. Government and industry, along with other stakeholders, through collaboration have made an important start on the journey. Continuing dialogue, support and action is required to ensure that UK industry can deliver upon future targets and build both a vibrant and sustainable industry and vehicle fleet.

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1 Why and how the study took place

1.1 Rationale for the study

1.1.1 A decade of change

It is widely perceived that the UK automotive sector and related industries have been bright spots in an otherwise predominantly bleak UK economic picture in recent years.

High profile investments such as those by Nissan in the battery-electric Leaf plus battery/supply components in the North-East; by Toyota in hybrid car production in Derby; by Ford in EcoBoost engines in Bridgend; by Jaguar Land Rover in low emission technology engine plant in Wolverhampton and elsewhere have created the impression of vibrancy in the UK's low carbon automotive sector and its supply chain.

Apart from car production, the UK has been among European and World leaders in the development and deployment of low emission buses with 1,500 now in operation in the UK. There has been activity too in the development of low carbon technologies for use in commercial vehicle operations.

The UK has been amongst the world leaders in tackling climate change, leading to the passage of the 2008 Climate Change Act which set out legally binding targets for the reduction of greenhouse gas emissions. Other policies have been underpinned by the Climate Change Act, and have helped to send a clear message of commitment to the development of low carbon technologies. In the automotive sector, these have included taxes providing low carbon incentives (company car tax, vehicle excise duty and fuel tax); the provision of innovation and investment support (via the Technology Strategy Board and other funding organisations) and, latterly, national grant and subsidy programmes (such as plug-in car/van grants, Plugged-In Places programme).

The Green Bus Fund (GBF), running for the last five years, has provided £100 million investment into the UK automotive industry and bus operators receive a further incentive from an additional Bus Service Operators Grant (BSOG) rate for low emission buses². The UK is now one of the leading adopters of low carbon buses with most of the vehicles being introduced made locally.

Other policies have focused on the development of infrastructure for low carbon fuels, including those designed to promote the development of a national recharging infrastructure for electric vehicles and to encourage the introduction of biofuels and other low carbon liquid and gaseous fuels.

With investment in low carbon technology development and production apparently strong in the UK over the last decade, the average test cycle emissions of new cars sold has been reduced by over a quarter in the same period (Figure 1). Transport in the UK contributes approximately 23% to overall greenhouse gas emissions annually (DECC, 2014), and investment in low carbon vehicles is vital to reducing emissions and meeting targets. Car drivers have also benefited with average new vehicle fuel economy having increased by about 42% between 2000 and 2013, improved fuel efficiency helping to moderate the overall cost of living increase.

² BSOG is implemented differently across different UK Devolved Administrations

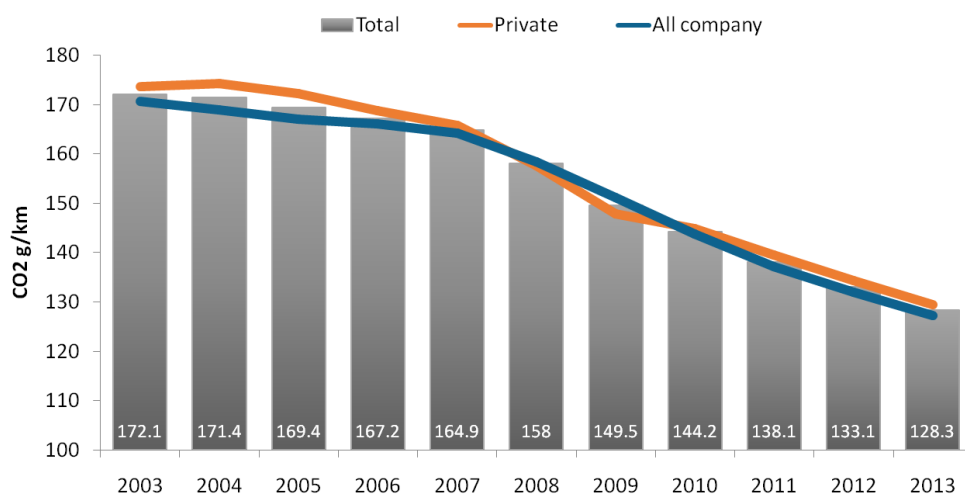


Figure 1: UK new car CO₂ emissions from 2003 to 2013

Source: SMMT 2014

1.1.2 Study objectives

The objectives of this study are to provide a comprehensive evidence base on low carbon investment in the UK automotive sector, and consequently to use this to examine whether there is a causal link between a consistently supportive policy and the apparent increase in the rate of low carbon investment in automotive and related production, research and development – including in the supply chain - over the last decade. The findings have been used to provide high level recommendations for future policy, which would serve to increase the attractiveness of the UK for inward investment into the low carbon automotive sector.

1.2 Approach to the project

1.2.1 Need to establish causation

Most observers would agree that the UK has a number of low carbon vehicle (LowCV) policies, and that the UK automotive sector has enjoyed a substantial renaissance in recent years, including LowCV technology and manufacturing. However, establishing a causal link between policy and investment in LowCVs is extremely complex.

Complicating issues include:

- **Diversity of policies:** There have been many LowCV policies, from the rise of the national R&D programme under the Technology Strategy Board and EPSRC, to local incentives for manufacturing, to the introduction of user incentives such as CO₂-based benefit-in-kind tax for company cars, and schemes for low carbon buses. Together these create both a technology / manufacturing push and a market pull.
- **Diversity of investments:** Spend that can be considered an “investment” is difficult to categorise in a consistent way. The largest individual sums are investments in new or refurbished factories, of which there have been several. However investment in R&D, and in training & skills can be significant inputs to the success of manufactured products; the

purchase of LowCVs, while classified as revenue by the OEM, is an investment by the buyer. In the case of, for example, New Bus for London, this investment is a significant sum with a direct impact on the development of new technology. The argument is less clear for an individual car buyer, but considered en-masse the significant shift towards LowCV purchase (investment by owners) has clearly influenced the products.

- **Diversity of stakeholders:** Although dominated in size terms by a handful of OEMs, the sector also comprises component suppliers, service suppliers, innovators, operators and other stakeholders, each with their own financial and business structure – against which one must define a common causal link between policy and investment. For example the causal link must be relevant to the investment in a factory, an R&D centre, a prototype, or a fleet of vehicles, and to the different types of organisation investing in them.
- **Diversity of reasons for investing:** Choosing to invest in the UK will always be a complex decision involving multiple factors. In the case of a manufacturing investment, influencing factors could include existing sunk investment, buyer trends, favourable UK employment law, location/access to EU market, English language, currency exchange & stability, workforce labour rates and skills, infrastructure, corporation tax, market deregulation (buses) and local fiscal incentives, as well as low carbon vehicle policy.
- **Diversity of technology solutions:** While some technologies, for example Nissan’s investment in the Leaf in Sunderland, are clearly LowCV technology, others are more evolutionary but nonetheless lower carbon than their predecessors – for example, manufacture of improved ICEs at Hams Hall and Bridgend.
- **Consistency / quality of data:** There is no contemporary dataset of UK automotive investments, even for manufacturing alone.
- **Confidentiality:** In many cases, investment decisions may be commercially confidential. Data may be unavailable, and if it is available, reasons behind a decision may be sensitive – for example exposing reasons behind a decision to invest in the UK as opposed to another country could provoke adverse political or trade union reaction in that country.
- **Baseline:** In order to demonstrate a causal link, a counterfactual, contrasting or baseline case is required. LowCVP has requested the use of low carbon fuels; however comparison is complicated by differences in technology readiness (success in lightweight bodies and efficient ICEs, vs lack of success, so far, in hydrogen infrastructure), and influences of EU or global policy (at EU level, policy on car tailpipe emissions is clear; while policy on biofuels is far from clear). The low carbon fuels situation is in itself sufficiently complex for a study of this size.

In order to, as far as possible, develop balanced causation analysis a triangulated approach was used. Multiple sources of both primary and secondary evidence were gathered. These include a widespread call for evidence, and a series of stakeholder interviews, as well as the development of a policy database and an investment database.

1.2.2 Stakeholder survey

The stakeholder landscape is complex, with many actors of varying size and function. Given the primary objective of this study – to explore the relationship between low carbon policy and (subsequent) investment – the inclusion of as many stakeholders as possible was vital. Therefore the

call for evidence was issued as a public invitation and run as an online survey. This decreased the risk of selectivity, increased the exposure to as many stakeholders as possible, and allowed different views – both between and within organisations - to be expressed. The list of participants, where organisation name was provided, is shown in Appendix 2.

The questionnaire was designed to allow respondents to quantitatively score the impact of a spectrum of policies and policy-driven initiatives on their UK investments (across various elements of the value chain) over the past decade. A qualitative section also allowed respondents the opportunity to discuss their answers and communicate their opinions on the impact of policy on their investments. The questionnaire (shown in Appendix 1) categorised approximately 50 policies to cover 12 broad areas of UK-specific policy and asked for qualitative scores and commentary.

The call for evidence had a very positive response rate – receiving 107 fully completed questionnaires containing some 35,000 words. The sample quality was also notable –respondents were mostly director or CEO-level, or equivalent, and represented a fairly balanced view of the industry (as shown in Figure 2).

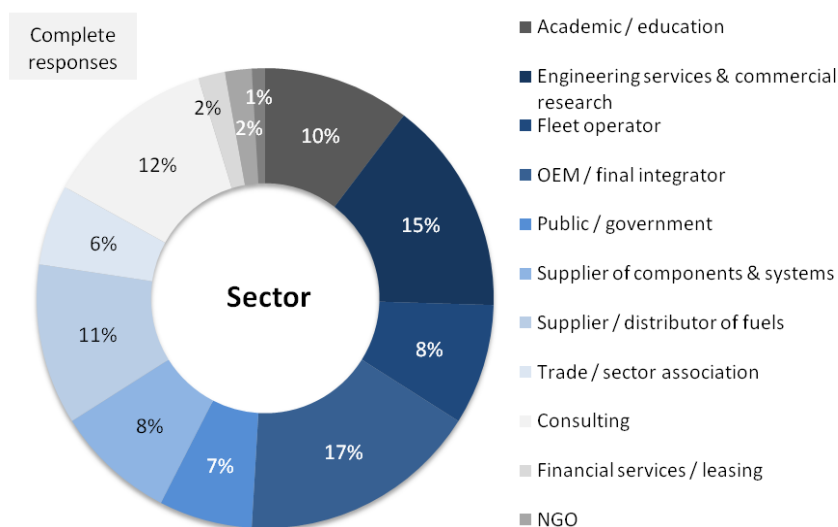


Figure 2: Call for evidence responses by sector

1.2.3 Policy timelines

The policies used in the call for evidence were further expanded and used to develop policy timelines, alongside other sources of automotive-specific information. The purpose of these timelines is to provide an illustration of the temporal link between policy and policy-supported initiatives and corresponding changes in macro data – for example investment in R&D, vehicle sales, or vehicle emissions – over time. The timelines are shown in Figure 15 to Figure 18.

1.2.4 Investments database

The investment database is a complementary piece of evidence which tracks low carbon and related investments in the UK over the past decade. Currently no such database exists, and sourcing detailed information remains a challenge. The investment database used in this study was created using publicly available secondary data, and was validated and expanded by feedback from the call for evidence and structured interviews.

Construction of the database was achieved via published, referenced sources (e.g. press reports; press releases), and where possible cross-checked against other sources, with a focus on the major players such as the OEMs from the industry side and Technology Strategy Board from the government side. In definitional terms whether a specific investment qualified as ‘low carbon’ is a difficult question given the continuum of possibilities from “marginal low carbon” (very evolutionary investments in new mainstream products) through to radical departures in terms of powertrain or body architecture. Wherever possible the research sought multiple sources for each investment, though it is not always possible to ensure that stated spending announcements are the same as actual outcome spending. In addition the research screened the data to remove multiple announcements regarding a single investment.

1.2.5 Stakeholder interviews

Finally, the stakeholder interviews were conducted with 14 prominent industry organisations (named in Appendix 2). These interviews explored details of significant investments – including size and timing – as well as exploring the organisation’s perspective on the investment(s), reasons for selecting the UK for the investment, positive and negative links to UK policy, and the role of that policy versus more widely applicable EU & global legislation. The interviews also served to identify key messages, which corroborated those ascertained from other sources. Interviewees were candid, on condition of anonymity, though quotations from interviewees (and survey respondents) have been used throughout the report.

Together these sources of evidence provided not only a large volume of information, but also a high quality of evidence. Further, the triangulation provided an important means to identify and substantiate the conclusions – supplying the golden threads that tie this story together.

2 Structure, policy and outcomes

The automotive industry in the UK has enjoyed a resurgence that would have seemed rather unlikely ten years ago. Whether it be the mainstream manufacturing sector or low-volume niche specialists, suppliers or contract engineers, engine plants or motorsports operations, the sense of a dramatic shift into a vibrant, confident and revitalised industry is palpable – and this despite the global economic recession of 2008 from which much of the industry in the European Union is still struggling to escape. In the early 2000s the automotive industry in the UK was thought by some within the industry and by many external observers to be facing inevitable decline despite the continued economic importance of the sector to the UK. Key changes to the structural relationship between the industry and government initiated in the early 2000s provided the framework for a cohesive policy response, a framework that proved sufficiently robust to withstand the investment freeze of the global economic crisis in 2008 and which, along with wider industry investments, allowed the UK automotive sector to recover from the crisis with remarkable alacrity, albeit that the industry benefited to a significant extent from continuing growth of non EU markets, particularly China and Russia, as well as the earlier recovery in North America.

2.1 Rising investment levels across the automotive sector

“ At the highest level, the creation of a level playing field [CO₂ target] by the EC was extremely helpful. A clear long term target is what industry needs – it will find a way to respond. ”

Automotive manufacturer

Key to the performance of the UK automotive industry has been rising investment in products, in technologies and in new production facilities. In turn, this investment has in part arisen from the perception that the UK is favourable as a location for investment due to a range of factors such as labour flexibility, access to the EU market, low rates of corporate tax, and related matters (see e.g. Holweg *et al.*, 2009; KPMG, 2014). The significance of continued trading relationships with the European Union was a clear message that emerged from the interviews with key stakeholders, resonating with the findings from KPMG (2014). Not only is the EU seen as crucial as a market destination for UK exports, it is also a key source of components and materials. Additionally, and relevant to this report, KPMG found the EU to be highly important in terms of establishing a cohesive and consistent set of Type Approval rules and a pan-EU regulatory framework for new car CO₂ emissions, while also supporting continued R&D in the UK. The UK being within the EU is therefore to be understood as a key contextual factor within which UK low carbon policy interventions have been undertaken. Industry interviews confirmed this point. For example one respondent said: “At the highest level, the creation of a level playing field [CO₂ target] by the European Commission was extremely helpful. A clear long term target is what industry needs – it will find a way to respond”.

2.1.1 Structure of the sector in the UK

The UK automotive industry is unusual in a number of key respects, which should be borne in mind when international comparisons are made. In particular, for its size the UK has an especially rich mix of vehicle producers comprising (as of end 2013) seven mainstream car manufacturers, seven commercial vehicle manufacturers, nine bus and coach manufacturers, eight premium and sports-car manufacturers, more than 100 specialist and niche manufacturers, eight out of the eleven F1 teams, and 19 R&D and design centres (SMMT, 2014). The leading car manufacturer is Nissan, with just over half a million cars in 2013 – notably including the Qashqai (286,000 units) and Juke (147,000 units). Other leading brands in 2013 included Land Rover (340,000 units); Toyota (179,000); MINI (174,000 units) and Honda (138,000 units). The commercial vehicle segment is dominated numerically by Vauxhall (43,000 units) with DAF as the major heavy truck manufacturer (15,400 units). The sector therefore shows exceptional diversity compared with other major automotive manufacturing countries, which lends it a strong degree of resilience. It is significant to the entire economy, and of course particularly important to specific locations. Overall, the SMMT (2014) estimates the UK automotive industry in 2013 accounted for over 772,000 jobs of which over 160,000 were directly employed in manufacturing and 38,500 employed in motor sport. With an estimated turnover of £64.1 billion, the UK automotive sector produced £12 billion in value added to the economy and exports worth over £30 billion.

Engine production has a structural surplus with a typical average of about 2.5 million engines built in the UK, against car assembly of a typical average of 1.5 million units. The major exporters of engines in 2013 were Ford who produced 1,528,000 engines at two sites (Bridgend and Dagenham) that were all for export – with the exception of some engines still supplied to JLR – and BMW with 408,000 engines at Hams Hall (with UK MINI production of 174,000). Nissan, Toyota and Honda all have engine manufacturing in the UK. Hence, engine exports are a significant feature of the UK sector.

While car exports have continued to constitute about 80% of output, it should be noted that car imports also remain very high (86% in 2013), with the UK usually showing a net trade deficit in the automotive sector (Holweg *et al.*, 2009). In 2013 the UK market was 2.26 million units compared with UK production of 1.51 million units.

The commercial vehicle sector in the UK has not performed as strongly in recent years, with exports in particular falling since 2007. As a consequence, production also has been falling in recent years. The UK is particularly weak in the heavy commercial vehicle sector, with only Leyland (Paccar) and Alexander Dennis Limited being of any significant size. In 2003 total commercial vehicle production (including buses) amounted to 209,000 units; by 2013 the total had fallen to 88,000 units due to structural changes and also reflective of European demand levels. Commercial vehicle registrations in the UK in 2013 were 330,000 (9% lower than the 2003 level) which again reflects a structural weakness in the export balance of the sector due in no small part to the loss of production of Transit as a result of the closure of Ford's Southampton facility in 2013, whose products numerically dominate commercial vehicles.

The bus sector has fared somewhat better than commercial vehicles in recent years, as have the more specialist producers such as JCB. The question of policy and impacts with the bus sector are discussed in detail in section 2.3.1.3 below.

The motor sport sector is often regarded as the ‘jewel in the crown’ of the UK automotive industry, and undoubtedly there are synergies across and between the sport segment of the industry and the mainstream business of high-volume car manufacturing (e.g. lightweighting, aerodynamics, monitoring and management systems). In some regards motor sport is more akin to the aerospace sector, a concern mentioned by some respondents in our interviews with key stakeholders, in that the technology bias of low carbon funding support (in R&D) might not be appropriate to the mass production side of the car industry, although changes in the regulations introduced for the current F1 season are designed to make technology developments here more relevant to road cars; only time will tell if this has been successful. On the other hand, the strong motor sport element of the UK automotive ‘scene’ might also be said to reflect a deeper pro-car attitude in British culture that is also manifest in other aspects– for example the UK has a particularly large number of enthusiast clubs for all manner of brands and models and in fact around half of all historic vehicles in the EU are registered in the UK. In turn this suggests a deeply rooted sympathy and enthusiasm for the automotive industry that should help contribute to the further revival of the industry in the emergent low carbon era.

2.1.2 Dramatic recovery from global financial crisis after 2009

In the ten years from 2003 the UK automotive industry performed much more strongly than many observers had anticipated, in particular in the period from 2009 when the sector recovered rapidly from the impact of the global financial crisis. Mindful that the UK automotive sector, in the early 2000s, was thought to be facing certain decline as a consequence of intensifying competition, the actual outcomes have been remarkable. As Figure 3 shows, sector turnover grew steadily up to about 2008 when, in common with the automotive industry across Europe, turnover fell dramatically (by around 20%) as the domestic and international markets stalled. Thereafter the recovery of turnover from the low point of 2009 has more than made up the lost ground. Employment continued on a long-run decline (with stabilisation after 2011) but export value and overall value added both recovered from the 2008 period. Employment stabilisation is a significant achievement considering the major previous restructurings at Ford and MG Rover. In addition, evidence from the investment database suggests that significant numbers of new, high quality jobs have been created in R&D, resulting in higher economic value.

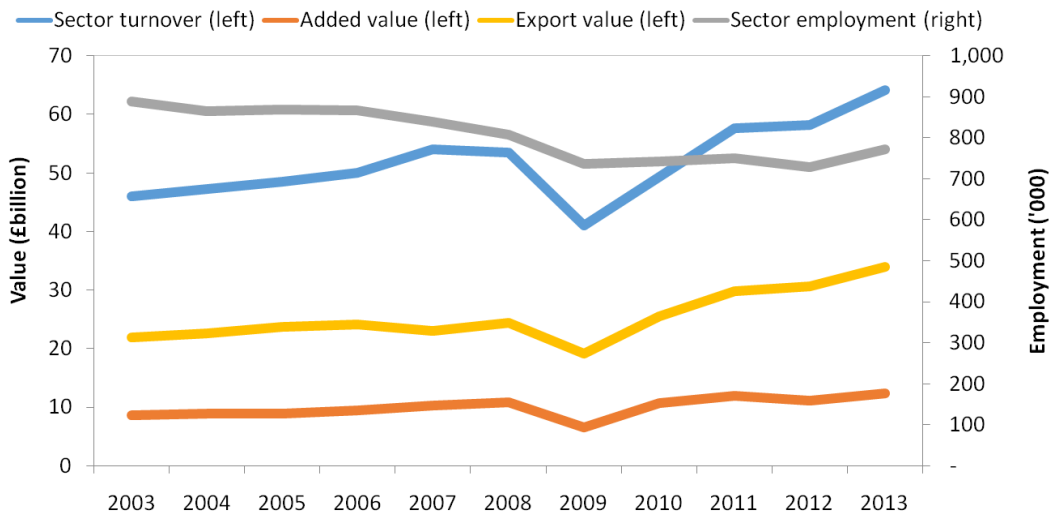


Figure 3: Economic data across the UK automotive sector

Source: SMMT 2013; 2014

Underlying the robust economic performance is a similar story with car production and exports, as is indicated in Figure 4. Both production and exports bounced back after 2009. Domestic UK market new car registrations have not shown such a strong rate of decline or recovery around the 2008 crisis – with registrations showing a more general slow decline from the peak of 2.5 million cars in 2003 to the bottoming-out of the market in the period 2009 to 2011, and a steady subsequent recovery. Put another way, the rebound of UK production owes much to achievements in the export markets, and in reality the success shown in both EU and non-EU markets over this period. Between 2009 and 2013 the average growth rate in UK exports outside the EU was an impressive 31%. It is worth noting that the downturn in 2009/10 would have been more substantial but the scrappage scheme at that time accounted for some 400,000 new sales, a proportion of which would not otherwise have occurred.

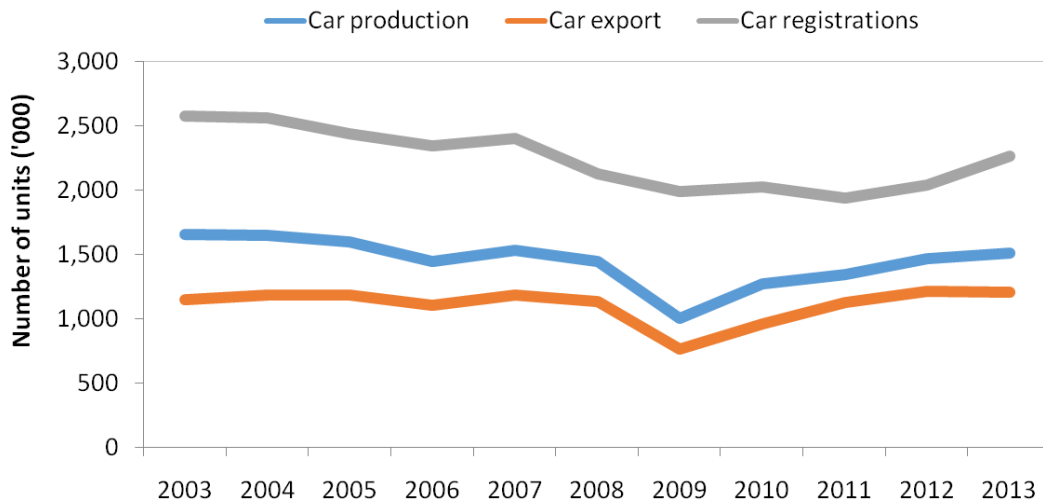


Figure 4: UK passenger car production, export and registration

Source: SMMT 2013; 2014

It is certainly the case that with regard to commercial vehicles the relatively flat period before 2007 was quickly followed by a marked decline in registrations, production and exports. Commercial

vehicle sales are often a leading indicator for wider economic conditions, so it is not surprising that the decline in registrations preceded that for new cars. However, while the UK market for commercial vehicles is slowly recovering, the same cannot be said for UK production and exports that have both failed to recover from the crisis period due to changes in the industry structure.

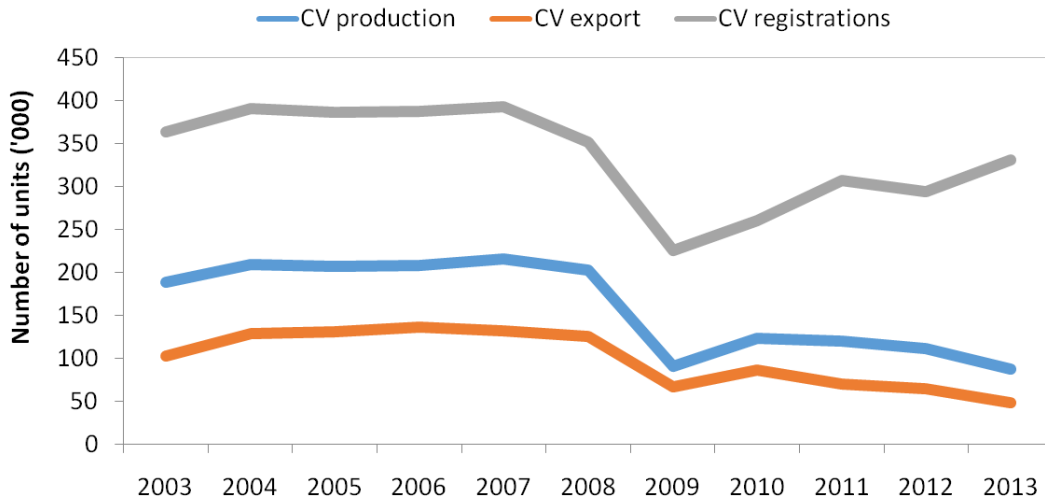


Figure 5: UK commercial vehicle production, export and registration

Source: SMMT 2013; 2014

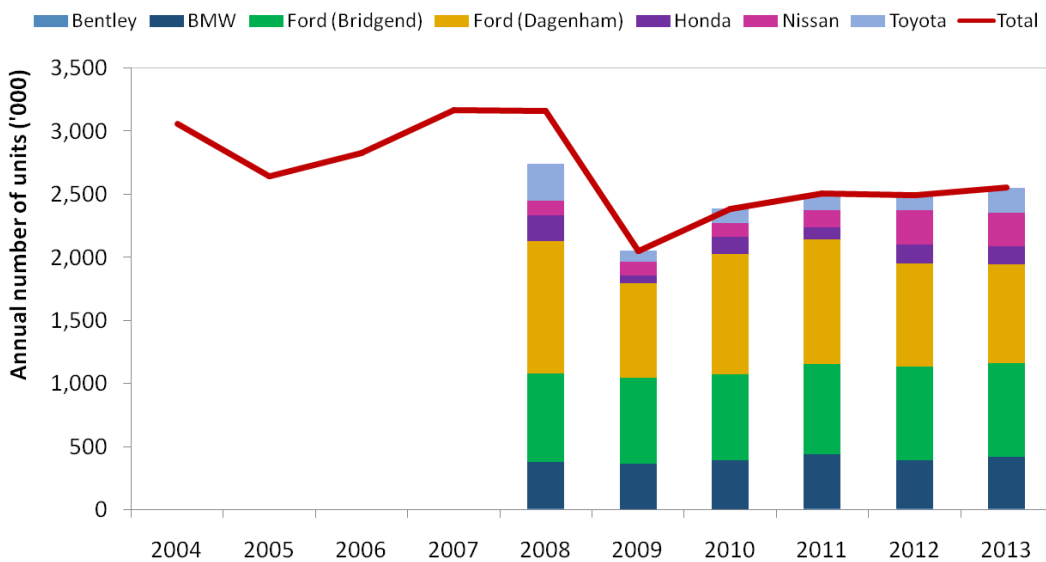


Figure 6: UK engine production by manufacturer

Source: SMMT 2013; 2014

As has been noted, the UK has over recent years produced more engines than can be matched by new car assembly, and is therefore a significant exporter of new engines. As illustrated in Figure 6, overall engine production was established at around 2.5 million units per annum in the early to mid-2000s but the global crisis resulted in a drop of nearly 1 million units in the period 2008 to 2009. However, since then the recovery has been strong in terms of engine production, with Ford in particular contributing considerable volumes from both Bridgend and Dagenham, most of which go for export. In contrast, Nissan does manufacture engines in the UK, meeting around half of new car assembly volumes.

2.1.3 Low carbon investment levels

Investment levels for the entire sector are difficult to obtain with any degree of certainty and precision using official data. To provide an insight into low carbon investment by the industry a database of cases was created, giving some opportunity to understand the scale and trends in investment over time. Major investments are usually publicised, though there may be an elapsed time period before such announcements are put into action, and there is always a question over whether an announcement is ‘new money’ or the repackaging of a previous decision.

There are 291 unique low carbon investments by companies catalogued on the database for the period 2003-2013. These investments have been made by 85 different companies with a confirmed total of £17.6 billion. The database captured the largest investments by virtue of the publicity they were accorded, and the much smaller R&D investments supported by e.g. Technology Strategy Board, but in other cases the value figure was not recorded or reported. By extrapolation, the possible value of investments is over £40billion because the database only contains definite figures for 4 in 10 of the identified investments. In addition, an unknown value of investments related to those identified will have occurred elsewhere in the supply base.

Many projects have been supported by government grants such as those from the Technology Strategy Board, which are often match-funded and typically represent a little under 50% of the total investment (due to state aid rules) allowing for private company input to be estimated. To take Technology Strategy Board funded projects alone, there will be at least another £117 million in investment to match the public contribution. Taking a wide definition of low carbon investments, Figure 7 illustrates the number of investments per annum from 2003 to 2013.

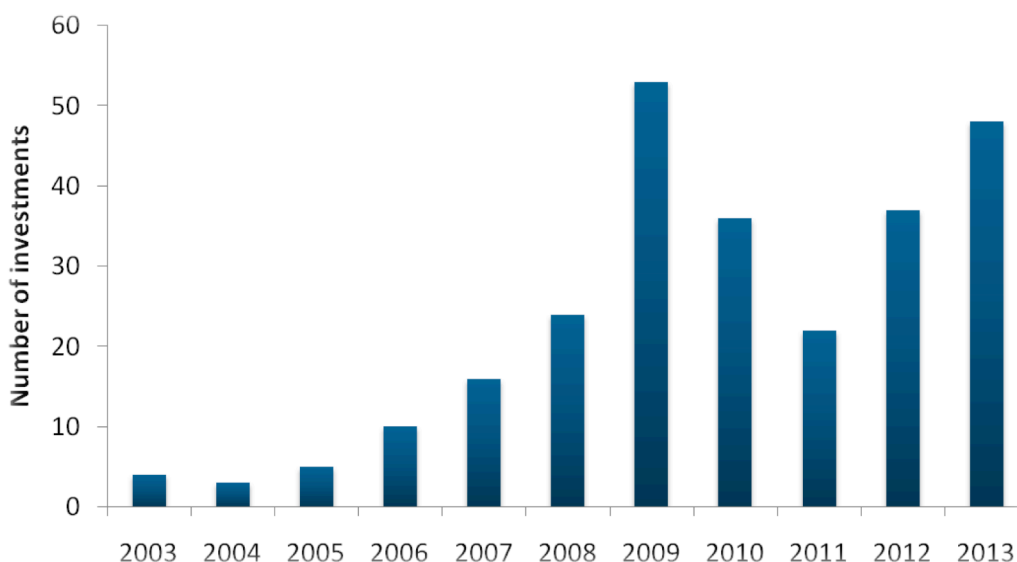


Figure 7: Number of low carbon investments by year

Source: CAIR 2014

Figure 7 illustrates that from a low base the number of low carbon investments grew strongly during the mid-2000s. While the total fell during 2010 and 2011 due to the impact of recession, subsequent recovery from 2012 onward has been noticeable. The higher number of – probably lower value – investments early on in the recession in 2009, perhaps reflects the government’s initial response to

the recession as an opportunity to promote a green, low carbon economy, while subsequent commercialisation of such technologies may have led to fewer, larger, near-market investments from primarily the private sector, as reflected in Figure 8.

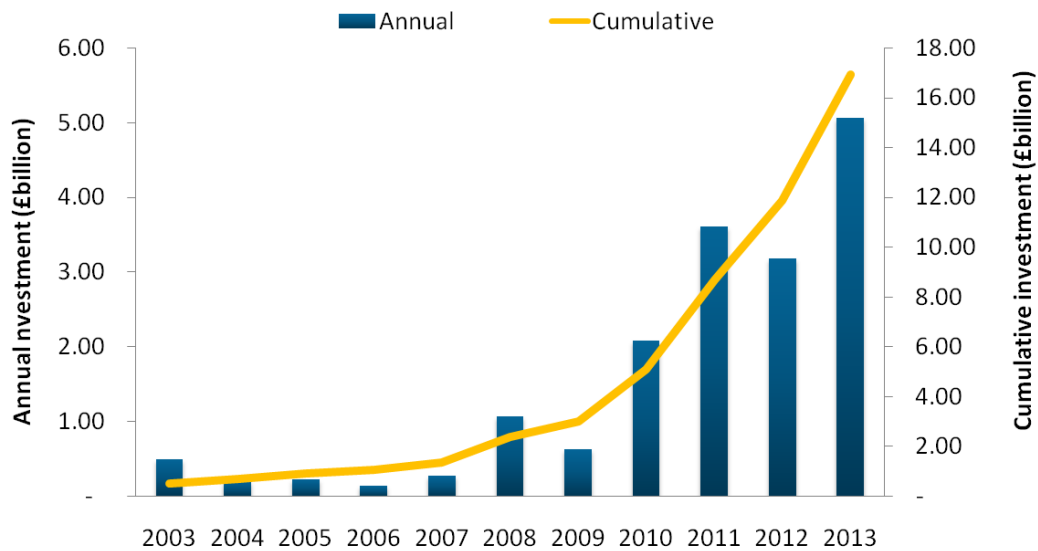


Figure 8: Value of low carbon investments by year

Source: CAIR 2014

Figure 8 illustrates that towards the end of the study period, and in particular after 2009, the value of investments rose strongly, more so than the number of investments. Indeed the last completed year (2013) shows over £5billion in investment. It is probable that the more recent investments are better reported or recorded in data sources, which may result in a slight bias. One interpretation is that investments are moving out of the research and early development phases and into more substantial manufacturing investments, as in the case of the Nissan Leaf for example. The investment for the Nissan Leaf and associated battery plant was announced in 2011 and amounted to £420 million with production stated to start in 2013. Figure 7 and Figure 8 could then be interpreted as perhaps indicating that initial public sector investments and programmes were subsequently added to by larger private sector investments, whereby the public sector activity, such as Technology Strategy Board and OLEV inputs, had a pump-priming effect.

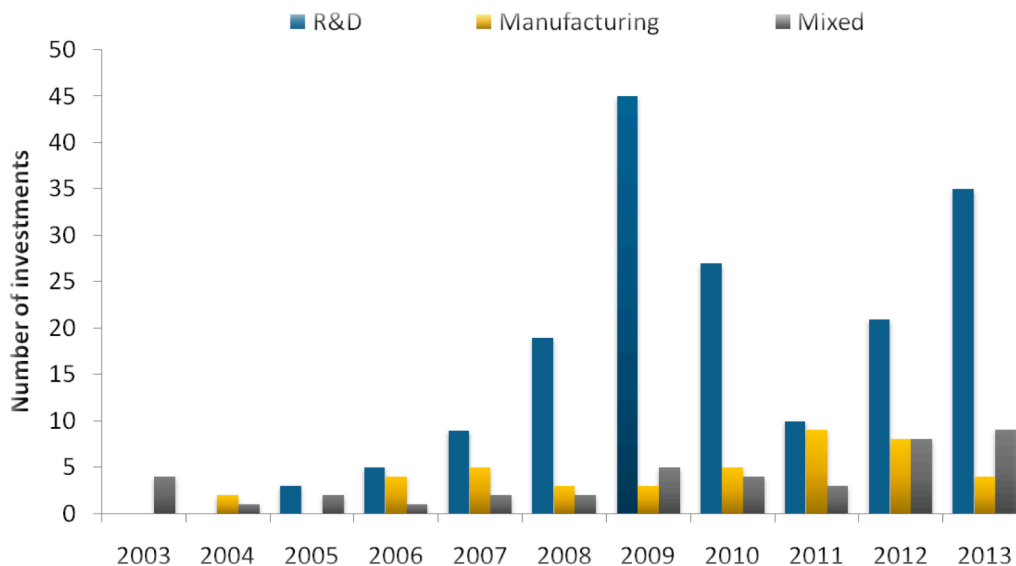


Figure 9: Number of investments by type per year

Source: CAIR 2014

As Figure 9 illustrates, over the period from around 2006 to 2007 the number of R&D investments grew substantially, whereas later in the period 2010 to 2012 inclusive there were fewer but larger manufacturing investments. The third category of ‘mixed’ is where the announcement related to both R&D and manufacturing, but did not make clear the distribution of investment across the two activities.

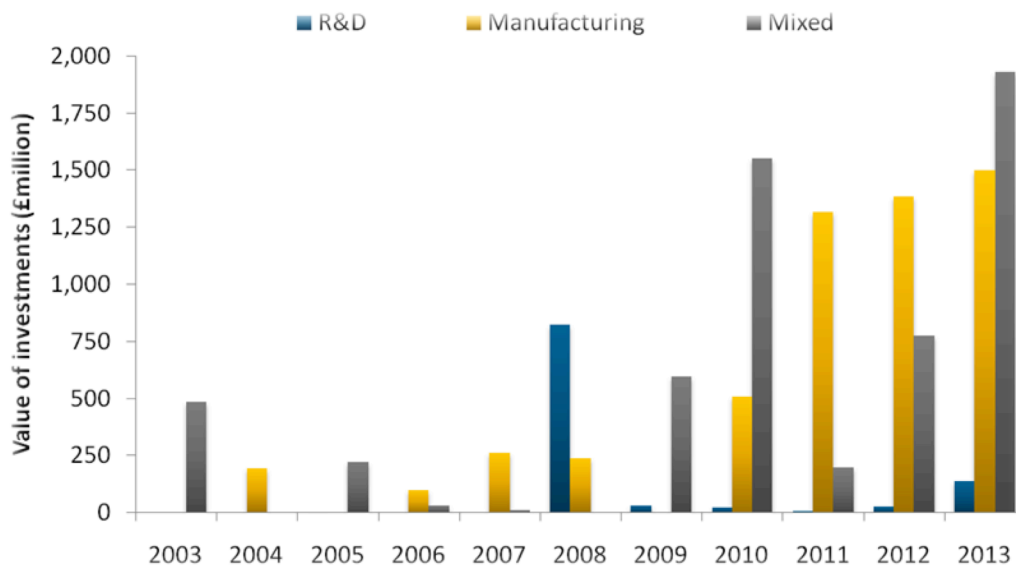


Figure 10: Value of investments by type per year

Source: CAIR 2014

These findings are supported by Figure 10, highlighting the higher value of investments in manufacturing over the course of the ten-year period, including a larger investment in projects that were both manufacturing and R&D.

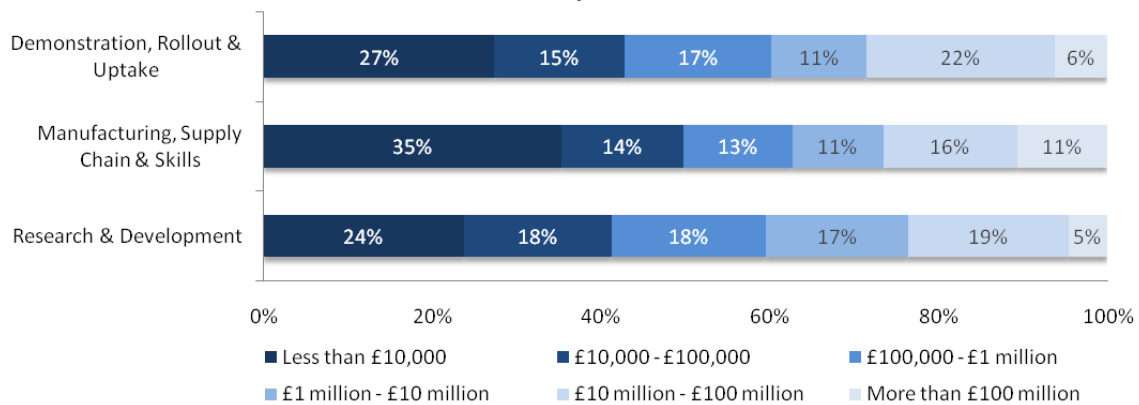


Figure 11: Cumulative investment spend between 2003 and 2013

Source: E4tech industry survey 2014

The cumulative investment spend shown in Figure 11, as measured in the call for evidence, reported that between 59% and 63% of respondent’s expenditure was under £1 million across all three value chain categories. Interestingly, above the £100,000 threshold research & development (R&D) accumulated 59% of spend compared to manufacturing, supply chain & skills’ 50% - though manufacturing, supply chain & skills spend above £100 million was higher at 11% versus R&D’s 5%. Ignoring investments below £10,000, all three value chain categories had a majority spend in the £10million - £100million bracket.

Table 1: Low carbon investments by the mainstream OEMs

Name	Total	Confirmed Value (£)	Announced Funding (£)	Focus of Investments
BMW	9	825 million	3.1 million	Developing mild hybrid MINI/bodies for electric MINI and reducing emissions for high fuel consumption Rolls Royce brand
Ford	12	2.32 billion	74 million	Improving the efficiency of the company's diesel engines such as the Eco Boost
Honda	4	347 million	none	Reducing emissions of Civic model; production of hybrid model moved to UK
JLR	35	8.98 billion	83 million	Lowering emissions in models like Range Rover, investing in range extenders, flywheel technology and aluminum
Nissan	17	1.37 billion	66 million	Most notably expanding into electric vehicle production with the Leaf

Toyota	13	433 million	6.3 million	Reducing emissions across the range but also producing the Auris hybrid model
Vauxhall	3	357 million	20 million	Improving carbon emissions in Astra and Vivaro models

In Table 1, announced funding relates to the stated funds made available from public sources such as the Technology Strategy Board in one or more projects. Confirmed value relates to the total investment made across one or more projects. In the case of Honda for example, no public funds were received but there are nonetheless four cases with a total confirmed value of £347m.

Hence, as can be seen from Table 1, the largest mainstream car manufacturers operating in the UK are all captured in the database, though not all have benefited from funding support for their projects. While some of the OEMs have a focus on evolution (e.g. Ford, Vauxhall) by reducing the emissions of diesel and petrol engines, others have made significant technology advances in new production models including the Nissan battery electric Leaf and the Toyota Auris petrol-electric hybrid. It is also notable that JLR has been particularly prominent in leading R&D projects in low carbon auto-mobility.

Importantly, new investments (including those for low carbon mobility) are an opportunity to enhance productivity and quality with the installation of new capital equipment, new tools, and new working practices. As such these investments are a vital part of the continuing competitiveness of the UK automotive industry. Major expansions to R&D capacity or the creation of new low-carbon product lines are not generally substituting for other investments so much as being complementary and additional: the paradigm example being the Nissan Leaf.

Table 2: Low carbon investments by OEMs for large vehicles

Name	Total	Confirmed Value (£)	Announced Funding (£)	Focus of Investments
Alexander Dennis	7	3.2 million	2.3 million	Worked on hybrids, stop-start technology and producing ever lighter buses with conventional engines
Caterpillar	4	3 million	3.5 million	Reducing fuel consumption on conventional vehicle engines such as their Dieselmex 672
Dennis Eagle	4	16.5 million	8.5 million	Attempts to improve technologies to reduce emissions of diesel trucks while also exploring parallel hybrid engine technology

JCB	2	52 million	3.3 million	Producing more fuel efficient engines and looking to develop regenerative braking technology
Optare	6	17 million	2.1 million	Explored dual fuel, fly wheel and hybrid technologies, also producing the UK's first full-size electric buses produced in the Solo
PACCAR	5	2.1 million	1 million	Using the Leyland plant as a base for developing hybrid (lithium ion battery plus regenerative brakes) and all-electric DAF LF trucks
Wrightbus	12	245 million	8.2 million	Focusing on producing lighter buses, as well as fly wheel technology and full diesel electric hybrids

A similar snapshot is offered in Table 2, highlighting the major players in the heavy duty sector of the UK, with direct and indirect funding often benefiting these OEMs as they move towards low carbon in the large vehicle market. Table 2 illustrates also that while some companies such as Wrightbus have been assiduous in making public their investments and the support obtained from government funds, others have perhaps been less so. The OEMs have addressed both evolution and revolution; for example, Dennis Eagle and Caterpillar have focused on making their diesel trucks and plant vehicles more efficient and less polluting, while companies such as Optare and Alexander Dennis have also looked at innovating in terms of utilising hybrid systems. In addition to using funding mechanisms such as the Technology Strategy Board in common with the previous car OEMs, bus operators in particular also benefit from the Green Bus Fund allowing local authorities and service operators to place large orders of greener technologies with these and other manufacturers, providing an added incentive to innovate in this area.

“We wouldn't have been able to do any of this (innovation activity) if we were not able to earn money from exports”

Specifically low carbon investments and more general business investments are closely linked. As one OEM observed in interview, it is only because of the success of (their) mainstream products in the market in recent years that it has been possible to pursue the specific low carbon investments: “Our renaissance in the post-recession period has been powered by a fresh product pipeline that enabled us to expand into global markets... we could exploit the upturn”. A similar comment was “we wouldn't have been able to do any of this (innovation activity) if we were not able to earn money from exports.” Inevitably, not all investment has been captured, notably the smaller academic investments in underlying technologies have been excluded. Investments in the database include research, product development, manufacturing plant and skills development (capacity building).

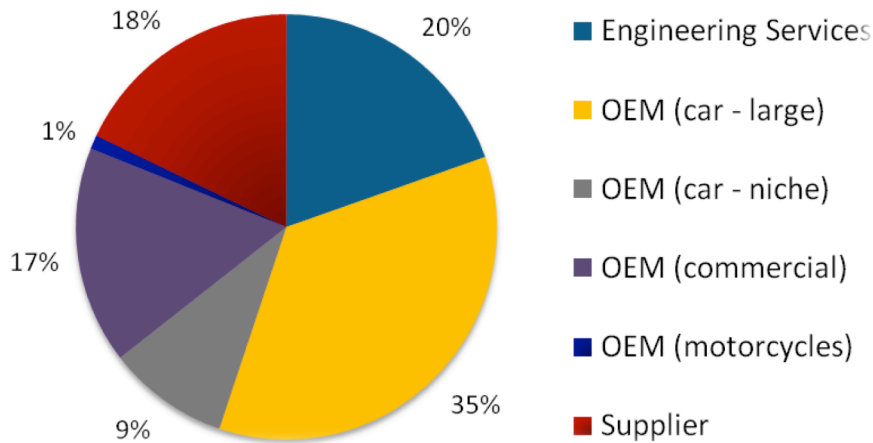


Figure 12: The number of investments by business type

Source: CAIR 2014

Figure 12 shows that the investment database has representation from a broad range of businesses in the UK automotive sector, from truck and bus projects through to suppliers and major OEMs. The significance of the engineering services sector is clear enough, as is (arguably) the relative weakness of the supplier sector.

In conclusion with regards to investments, over the past decade, the database seems to indicate growing momentum for low carbon vehicles, with increasing numbers of investments and higher values for those investments. Investment covers both R&D and manufacturing, suggesting further planning for a low carbon future in addition to practical measures being taken to reduce emissions in the short-term. Indeed in discussions with the stakeholders it was apparent that much work was being undertaken to ‘de-risk’ potential technologies with a view to long-term targets and requirements that might not arrive until 2050.

The swell in investments appears to go hand-in-hand with increasing government support in terms of funding, most notably with the Technology Strategy Board but with other sources such as the Regional Growth Fund also proving significant.

It seems likely that the impetus for low carbon investment will continue, with recent announcements such as the £1 billion government/industry funded Advanced Propulsion Centre and the £500million committed to ultra low emission vehicles by the Deputy Prime Minister earlier in 2014.

Importantly, rather than sweeping policy compelling the industry to act in the same way, the funding opportunities provided allow room for companies to develop niches and adopt individual approaches to lowering emissions – they have freedom to innovate and deduce how best to make low carbon fit their business operations and represent their brand identity.

2.1.4 Other indicators

The fluctuations in vehicle output and employment underpin a long-run improvement of productivity, measured in terms of vehicles per employee, which is all the more impressive when the increased complexity of the vehicles is taken into consideration. Capital investments are part of the

story, while clearly greater capacity utilisation makes a significant difference to the overall performance. In addition new working methods, for which significant credit must go to Nissan, Toyota and Honda, have been important alongside greater skills and training.

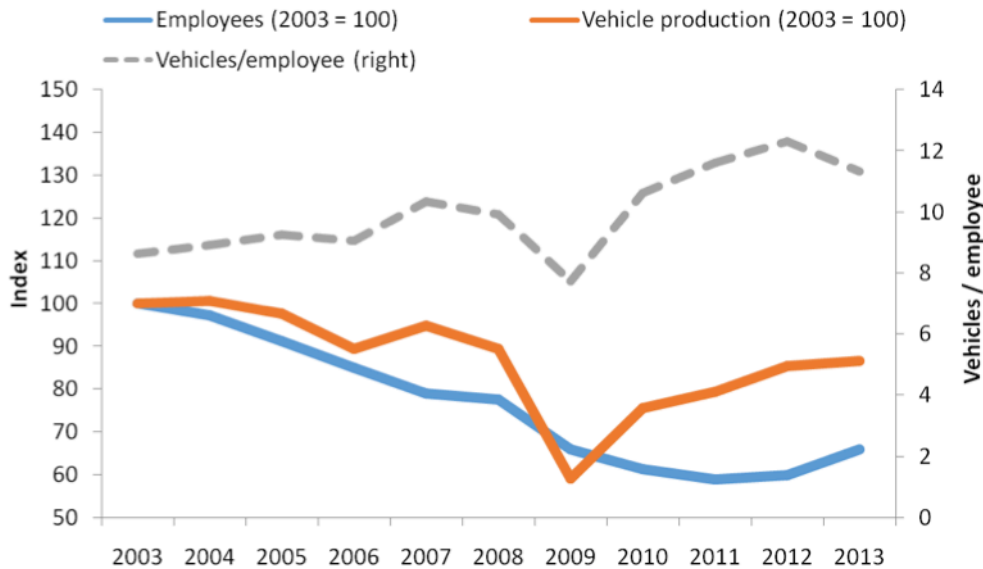


Figure 13: UK automotive manufacturing productivity index, 2003 to 2013

Source: E4tech 2014 (adapted from SMMT 2013, 2014)

2.2 Industrial policy has played a strong role

The changing relationship between government and the automotive industry has been pivotal for the transformation of the sector overall. Inevitably, there is a time interval between the creation of policy, the official launch or start of that policy, and any subsequent impact in the industry. Equally, the measurement of cause and effect is by no means straightforward, not least because investment decisions by industry are unlikely to be purely mono-causal, but rather reflect a diverse range of influences that come to bear upon such decisions. Low carbon vehicle policies, whether in the market itself, or via mobility service operators, or directly in relation to the manufacturing part of the automotive industry are also but part of a broad range of generic and industry-specific policies that can have a bearing on investment decisions. In this sense, attempts to bring forward low carbon vehicle technologies in the realm of research, in manufacturing, or for vehicles in use must be understood to be decisions taken with reference to a broad investment climate. Moreover, industrial policy tends to act in a collective and cumulative manner on the industry over an extended period of time, particularly as confidence grows once it becomes apparent that policy, and the underlying commitment to the industry, is likely to remain relatively stable.

Various UK industrial policies and institutions in place in the automotive sector between 2001 and 2013 are shown in Figure 14 below, along with macro measures including automotive turnover, value added (economic contribution), export value and net capital investment. These are discussed in more detail in the sections that follow.

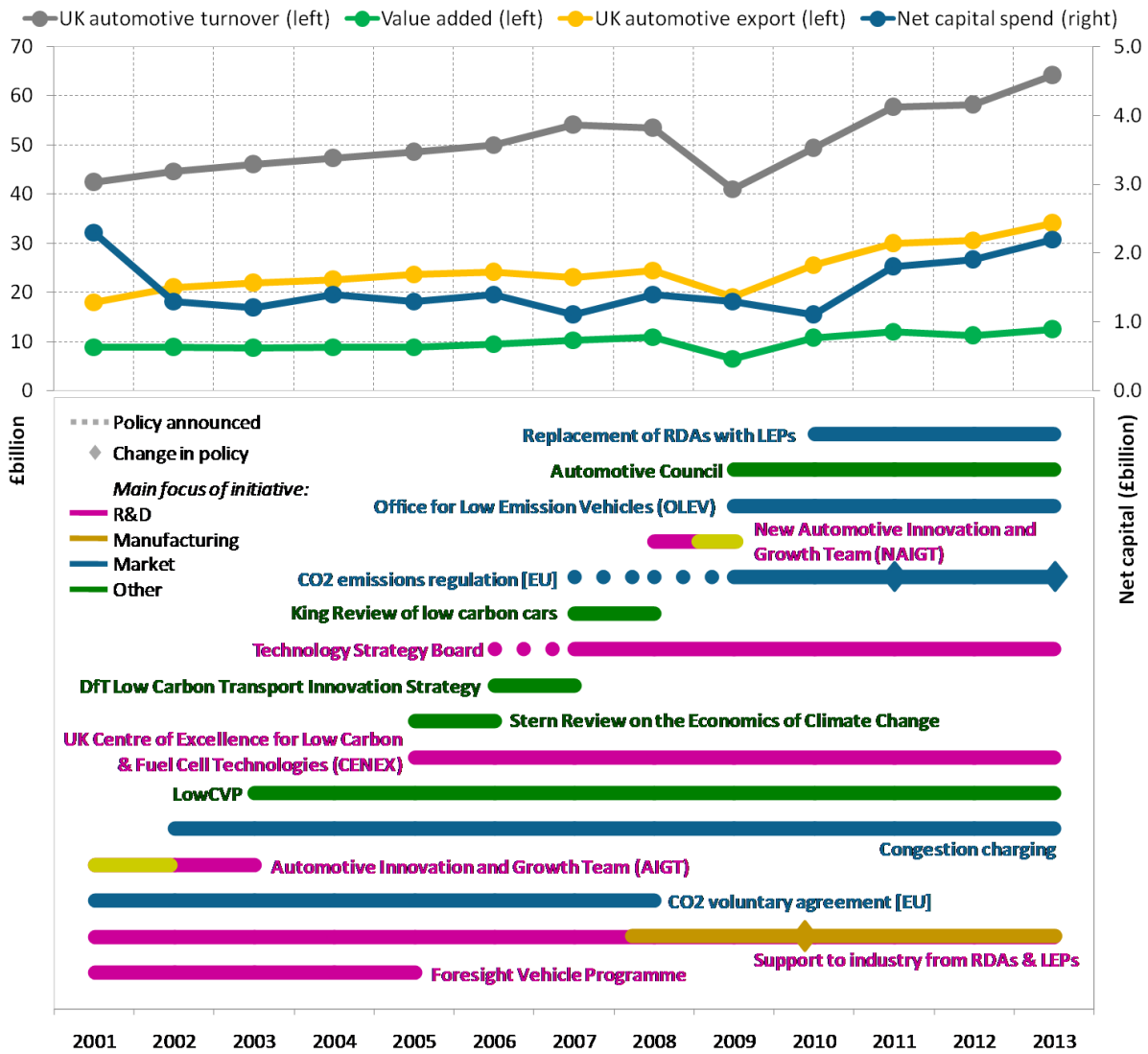


Figure 14: UK industrial policy and institutions in the automotive sector between 2001 and 2013

Sources: E4tech 2014, SMMT 2012; 2013; 2014

2.2.1 Reactive era

“ Back then, environmental regulation was seen as a threat not an opportunity. ”

Automotive R&D services company

In the early 2000s prospects for the UK automotive industry appeared mixed at best. While the industry had been bolstered by the earlier arrivals of Nissan, Honda and Toyota there remained significant questions over the future occasioned by high-profile cessations of car assembly at Ford Dagenham (2002) and Vauxhall Luton (2002). By the mid-2000s this sense of crisis had developed further with the closure of MG Rover at Longbridge (2005) and Peugeot at Ryton (2006), taking thousands of direct and indirect jobs with them. The closure of the Browns Lane plant at Jaguar (2004) suggested that volume manufacturers were not the only ones under pressure. Interviewees characterised the industry as fragmented by low volumes, a ‘sunset’ industry that was unattractive to potential new recruits. Moreover according to one influential industry participant “...environmental

regulation was seen as a threat not an opportunity.” This accords with the general picture painted by Holweg *et al.* (2009) in which the contribution of gross value added by the automotive industry to the UK economy was declining (from 1.16% in 1995 to 0.73% in 2006).

Industrial policy appeared largely passive in the face of these challenges, with the stance of government being to recognise the need for managerial decisions to be taken in support of the long-term global interest of the businesses or in response to unavoidable market pressures. However, it may be that this very unwillingness on the part of government to offer direct financial support or seek to compel companies to retain labour actually served to underline a key attraction of the UK for investment – relatively flexible labour laws.

In technology terms the main area of government and industry partnership was the Foresight Vehicle programme which was announced in 1995 and ran effectively to 2005. This was a wide-ranging programme but entailed a key structural innovation that has proven of long-term value: the automotive sector technology roadmap. The roadmap was published in 2002 (Phaal, 2002). Foresight Vehicle also initiated funding for so-called Research Networks projects that allowed partnerships of mutual interest to form around key technologies. The Foresight Vehicle programme had five thematic areas of interest:

- EPT: Engine Powertrain
- HAEFV: Hybrid, Electric, Alternatively Fuelled Vehicles
- ASSET: Software, Sensors, Electronics and Telematics
- FASMAT: Advanced Structures and Materials
- DMAP: Design and Manufacturing Process

Of importance also was the creation of the Automotive Innovation and Growth Team in early 2002. An early recommendation (AIGT, 2002) was that Foresight Vehicle be refocused within the constraints of EU state aid rules, with an emphasis on projects with potential for commercial exploitation – reflecting a concern that earlier efforts were too diffuse and concerned with enabling research. However, as the later New Automotive Innovation and Growth Team (NAIGT) (2009) reported, by the period 2003 to 2006 the UK was characterised by a small and declining R&D intensity compared with notably Germany and France. In addition, concerns have been evident over a long time period over the relative weakness of the UK automotive components supply base, and with recruiting and training apprentices and engineers into the industry. The weakness in R&D at this time was partly attributed to the lack of a large-scale indigenous OEM.

2.2.2 Crisis and the emergence of industrial policy

“ 2008 was a turning point for the automotive industry... the emergence of economic collapse and energy crisis at the same time transformed the industry. ”

Automotive company CEO

The UK automotive industry continued to show structural problems well into the mid-2000s and beyond, with for example the loss of specialist manufacturers TVR (2006) and Marcos (2007), and of LDV (2009) alongside the closure of the Ford Transit plant in Southampton (in stages to 2013). The

global economic crisis of 2008 brought a sharp downturn in UK sales, production and exports – with investment inevitably suffering also.

However, while such an event might previously have been expected to signal a further decline in the UK automotive industry, the global economic crisis was accompanied by a brief UK hiatus, followed by a strong recovery ahead of much of the international competition.

Two publications of significance highlighted by interviewees from both industry and policy were the Stern Review (2006) and the King Review (2007, 2008). The Stern Review highlighted not only the necessity for a low carbon economy, but also that early steps along that pathway would help reduce the need for larger, more disruptive and more expensive changes later. The King Review, which focused on the automotive sector, highlighted the emergent opportunities around low carbon technologies for vehicles along with the need for a clear strategy to achieve these technologies. These two influential reports can thus be said to have helped codify at a political and industrial level the imperative of pursuing a low carbon future.

Once the global recession started in earnest Peter Mandelson, the then Business Secretary, outlined two key facets of industrial policy. The first was what he termed ‘market-driven industrial activism’ (Stratton, 2008) that would seek to build on existing industrial capability in the UK. The second was that the future of the economy lay with the “...next industrial revolution and the low-carbon and post-carbon technologies that will define the 21st century” (quoted in Stratton, 2008). Moreover, there was to be a distinct attempt to focus on key sectors that were thought to combine an existing presence in the UK together with substantial growth opportunities for the future. The automotive industry was identified as one of eleven such sectors.

2.2.3 New collaborative approach and structures

“ There was a planets in alignment effect which led to...focus, consolidation and acceleration of effort, ending in the present day and APC...really interesting things started to happen around this time... with the formation of the Technology Strategy Board and the NAIGT. ”

Major automotive company

The formation of the LowCVP in 2003, arising out of the work done by the Automotive Innovation and Growth Team, can in retrospect be seen as an important moment for the UK automotive sector, providing a means for stakeholders to contribute to numerous low carbon vehicle policies, structures and initiatives.

It is notable that some of the perceived industrial weaknesses or problems of the early 2000s came to be seen as helpful later on as new collaborations and structures were put in place. Hence the fragmented nature of the automotive industry in the UK relative to volumes also reflected a relative lack of competition between the various businesses comprising the industry, and this in turn helped underpin a collective stance to government and a willingness to collaborate among industry partners. Equally, the relative flexibility with which manufacturing plants can be downsized or closed, which tends to render the UK vulnerable to such actions in recession, also makes the UK rather more attractive as an investment location once growth resumes.

Economic recession also helped to concentrate minds and focus on ensuring a long-term, post-crisis future. As one industry respondent observed with regard to collaboration across the industry to achieve these goals: “...a damn good financial crisis helps...”

“*The Automotive Council has been working fantastically... and government genuinely listens.*”

Automotive company CEO, Automotive Council member

Probably the most consistent (unprompted) theme to emerge from the interviews was the resounding endorsement of the Automotive Council. The Automotive Council was established in 2009 following a recommendation from the New Automotive Innovation and Growth Team (2009). The New Automotive Innovation and Growth Team itself was established in 2008 by Shriti Vadera, Minister for Business at the Department for Business Enterprise and Regulatory Reform (BERR) with a mandate to produce a vision and pathway for the industry over the following 20 years. It comprises 80 people from industry, government, public sector institutions, trade unions, and academia. The Automotive Council has three working groups: Supply Chain; Technology; and Business Environment and Skills. Importantly, the Automotive Council has been able to speak with one voice for the industry (albeit with some concerns with regard to commercial vehicles and buses), and to engage in a continuous dialogue with government.

A culminating output of the first phase of the Automotive Council’s activity was the 2013 launch of the Automotive Industrial Strategy (by BIS and the Automotive Council) which lays out the industry’s priorities, amongst other things aligning industrial and low carbon objectives: “By 2040 almost none of Europe’s new cars will be powered solely by a traditional petrol or diesel engine. This once in a lifetime technology change offers the UK an opportunity to create tomorrow’s vehicles, increase its market share and create new supply chain companies”.

Government-industry dialogue has helped with the programmes to develop technologies, but also with the more market-facing initiatives such as the Plugged-in Places schemes (see OLEV, 2013) and the continued roll-out of recharging infrastructures.

“*Without Technology Strategy Board support we would not have made it through 2008-10.*”

Automotive SME

Other key successes from collaboration have been the Technology Strategy Board, established in current form in 2007, and the Office for Low Emissions Vehicles created in 2009. While the Technology Strategy Board is essentially industry-facing, OLEV has more concern with the take-up of low carbon technologies and hence with issues such as infrastructure deployment for vehicle recharging. At least in terms of passenger cars, the overall thrust was, as one respondent in the policy community put it, to create a “clear, consumer-led, technology agnostic pull for low carbon vehicles”.

As one industrial respondent cited, there was a “planets in alignment” effect which led to “...focus, consolidation and acceleration of effort, ending in the present day and APC [Advanced Propulsion Centre]...really interesting things started to happen around this time... with the formation of the Technology Strategy Board and the NAIGT.”

Two interviewees cited the changing attitude of trade unions as a further enabler of the renaissance. The constructive and collaborative stance taken during and since the crisis towards the need for labour flexibility was seen as influential to investment (and avoided disinvestment) decisions. Trade unions continue to be represented within the Automotive Council.

2.2.4 Evidence of link to investment levels

Stakeholder interviews offered important insights into the link with investment levels, with the general view being that individual and / or specific policy initiatives or items of funding support (e.g. for an R&D project) did not have a direct link with later investments in manufacturing capability. While this may sound like a negative finding for low carbon policy, it is not in fact the case.

First and foremost respondents from industry were keen to emphasise that major investment decisions were multi-faceted rather than mono-causal. The policy environment in general and with regard to low carbon vehicles are critical aspects taken into consideration when investment decisions are being made, but so too are other issues such as the ability to access a single European market.

Second, the collective and cumulative impact of policy is vital for building up capacity, both intellectual capacity and physical facilities, which in turn will enable major investment decisions to be supported. Part of this is about having technologies readied for the time when they are required. It is also about the transition towards mass manufacturing in a controlled process so that unexpected outcomes are avoided. In practice, major companies like JLR have been able to accumulate capacity at quite a remarkable pace through a combination of recruitment with suitable skills and in-house training. To some degree this is also a reflection of another strength for the UK ‘climate’, namely the large number of internationally-regarded universities contributing highly educated individuals to the industry.

Third, in some cases funding provided a critical tipping point for a company, either with respect to moving forwards with a low carbon technology or indeed for the long term future of the business itself. For example, one respondent said “We would not be where we are today without that government [Technology Strategy Board] funding... it was absolutely critical.”

Fourth, funding helped establish networks and partnerships (and indeed whether certain partnerships would or would not work), which in turn formed the basis of more enduring relationships to bring technologies into a greater state of readiness. Interviewees talked of growing the ‘intellectual supply chain’ along with the relationships. One respondent said “What the funding [from Technology Strategy Board] does is that it creates a gravitational field to make companies come together.”

Additionally, several industry respondents talked of the ‘climate’ within which the automotive industry was regarded, and how this has changed. According to one experienced industrialist: “Politicians and the press have a renewed enthusiasm for the auto sector, and the Low Carbon

Vehicle Partnership has been a positive part of this shift in status and opinion with regard to the automotive sector.” Another talked of the excitement engendered in the sector around new technologies.

2.3 Low carbon policies have been influential

2.3.1 Policy timelines

Policy is rarely a singular event, and often one successful policy may guide the way for another while an unsuccessful initiative may stimulate change or a rethink. However, the outcome or impact of a policy is not always obvious or straightforward. Various macro indicators may be influenced by a single policy, but often this is in combination with other factors. Time lags are a further complication, as policy implementation or change may also not lead to immediate alteration of these macro-indicators.

2.3.1.1 Research & Development policy

“ As a very small business with limited resources these [Technology Strategy Board grants] have been the most important driver for the progress and development of the business, and have enabled us to create very significant projects with other ambitious companies in the sector with very positive outcomes and real opportunities for large scale commercial success. ”

Automotive SME

Figure 15 illustrates the progress of policy supporting R&D investment, against the R&D expenditure by the automotive industry at large from 2001 to 2013. The focus of this study is the period 2003 to 2013, but policies in place prior to 2003 are shown due to the lag effects mentioned previously.

From 2001 to 2003 a relatively stable investment level is shown, along with some notable initiatives such as the Foresight Vehicle Programme – which was setup by the DTI in 1995, and later administered by the SMMT – and the voluntary CO₂ agreement, followed by a slight decrease in investment as these initiatives came to an end. Concurrently, automotive turnover was steadily increasing at this time.

Despite having multiple support mechanisms available until around 2006, these were less cohesive than the years that followed – as is seen in the widening gap between turnover and R&D spend during this time. The Automotive Innovation and Growth Team was part of a series of Innovation and Growth teams setup by the DTI following a March 2001 White Paper on Enterprise Skills and Innovation (DTI, 2001). The Automotive Innovation and Growth Team report (2002) made several recommendations which sought to strengthen the UK automotive industry, including refocus of the Foresight Vehicle Programme to emphasise commercial exploitation potential, establishment of a centre of automotive excellence and development to take forward work on low carbon and fuel cell technologies, and a low carbon transport partnership. In 2003 the Low Carbon Vehicle Partnership (LowCVP) was established, a public-private partnership created to support and encourage the shift to low carbon transport, and in 2006 the UK Centre of Excellence for Low Carbon and Fuel Cell Technologies (CENEX) was born under the auspices of the LowCVP. Despite these and other support

mechanisms already available until around 2006, and increasing industry turnover, the investment in R&D continued to decline.

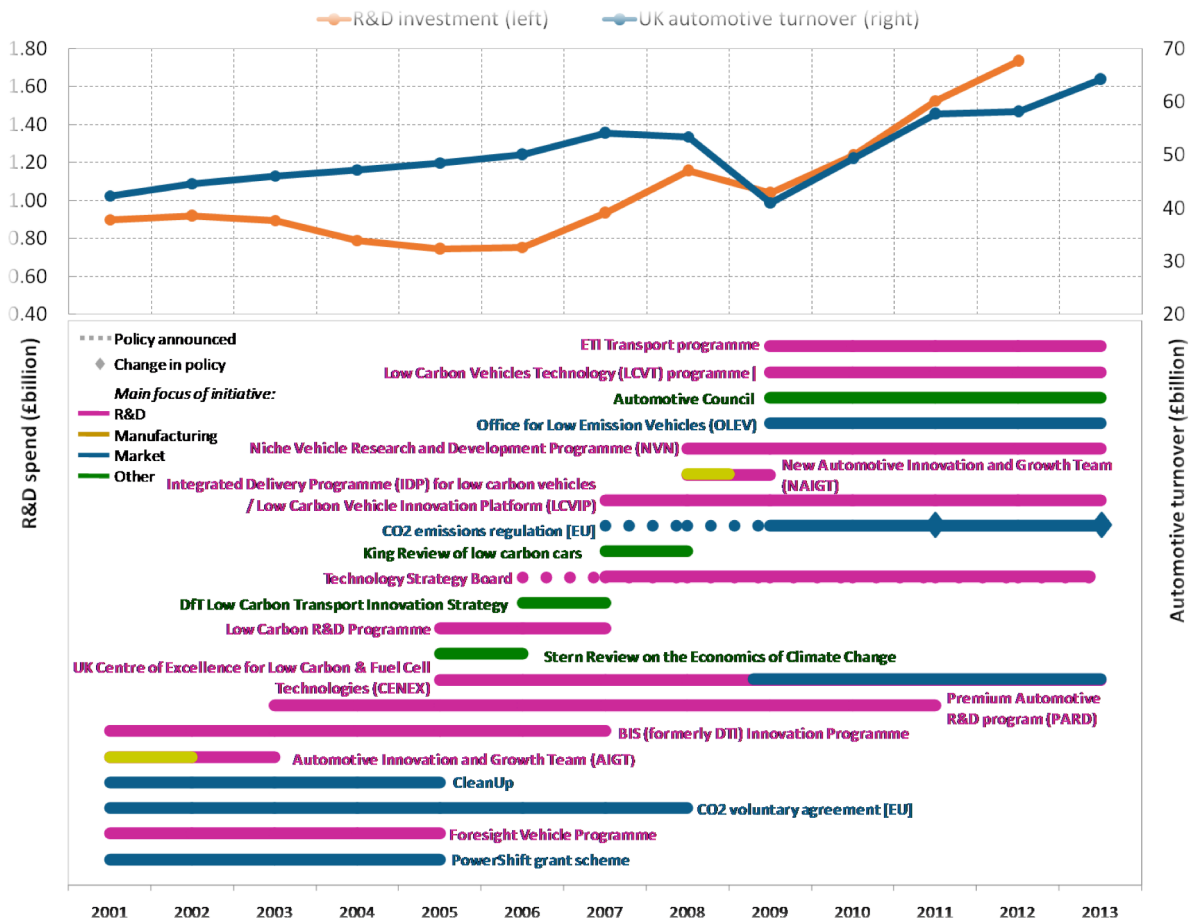


Figure 15: R&D-focused policy and R&D investment in the UK

Source: E4tech 2014, ONS 2012, SMMT 2012; 2013; 2014

In 2004 plans were announced to operate the Technology Strategy Board as a non-departmental public body and allow it a broader role across multiple industries, and in July 2007 the new Technology Strategy Board was established. The introduction of the Low Carbon Vehicles Innovation Platform (LCVIP) and the Integrated Delivery Plan (IDP) coincided with a substantial upswing in R&D investment. The LCVIP, working with industry and other funders, is aimed at supporting UK-based R&D in low carbon vehicle technologies and the surrounding supply chain, and has to date leveraged £350 million of innovation investment (Technology Strategy Board, 2014).

Concurrently, the Stern Review (2006) and the King Review (2007, 2008) highlighted the importance of low carbon transport, and together with the introduction of the EU’s CO₂ emissions regulations in new cars (2009) provided a strong impetus for further investment in low carbon technology. The New Automotive Innovation and Growth Team (NAIGT), established in 2008, was tasked with reviewing the opportunities in the UK automotive industry by developing a 20 year vision, identifying the challenges involved and the strategy required to overcome them. Particular focus was placed on the transition to lower carbon mobility. From the recommendations of the New Automotive Innovation and Growth Team, the Automotive Council was established and a technology roadmap drawn up to support collaborative R&D and exploit government investment more effectively. Also, in

2009, the Office for Low Emission Vehicles (OLEV) was setup to support ultra-low carbon automotive technology from development through to deployment. OLEV plays an important cross-government role, joining up policies between several contributing departments: Department for Transport, Department for Business, Innovation & Skills, and Department of Energy & Climate Change.

There has been a significant drive by both government and industry to foster a collaborative approach to growing the low carbon automotive sector and funding vital research, and cohesive policies put in place to support this. Correspondingly, an increase in R&D investment is seen (Figure 15), slowed marginally by the financial crisis. A solid unification of initiatives from 2009 onwards has been accompanied by strong investment and industry growth. To emphasise the importance of an integrated policy approach, Holweg *et al.* (2009) note that “investments and R&D expenditures are two of the major determinants of an industry’s sustainability”.

R&D grants have benefited both small companies and large organisations. One SME in the survey noted that “as a very small business with limited resources these have been the most important driver for the progress and development of the business and have enabled us to create very significant projects with other ambitious companies in the sector with very positive outcomes and real opportunities for large scale commercial success”.

2.3.1.2 Trial, demonstration and consumer-focused policy

“ *The continued existence and expansion [of policy] is vital to persuading investors to support activity here rather than abroad.* ”

Automotive manufacturer

Figure 16 displays the introduction of various policies and initiatives centred on pilot, trial and demonstration projects as well as consumer-focused grants and incentives. Corresponding macro indicators to showcase the success or failure of such schemes are difficult to isolate, however an uptake in alternatively-fuelled cars as well as a decrease in carbon emissions may be signs of long-term policy success.

Early tax incentives pre-date 2003 - and correlate with a strong increase in new car diesel share and a steady, though less spectacular, CO₂ reduction through dieselisation. The introduction of mandated vehicle emissions standards has had a strong positive impact on the reduction of average vehicle emissions, despite diesel saturation, via the availability of an increasing number of sub-100g/km cars. However, the uptake of alternatively-fuelled vehicles has been significantly less steep.

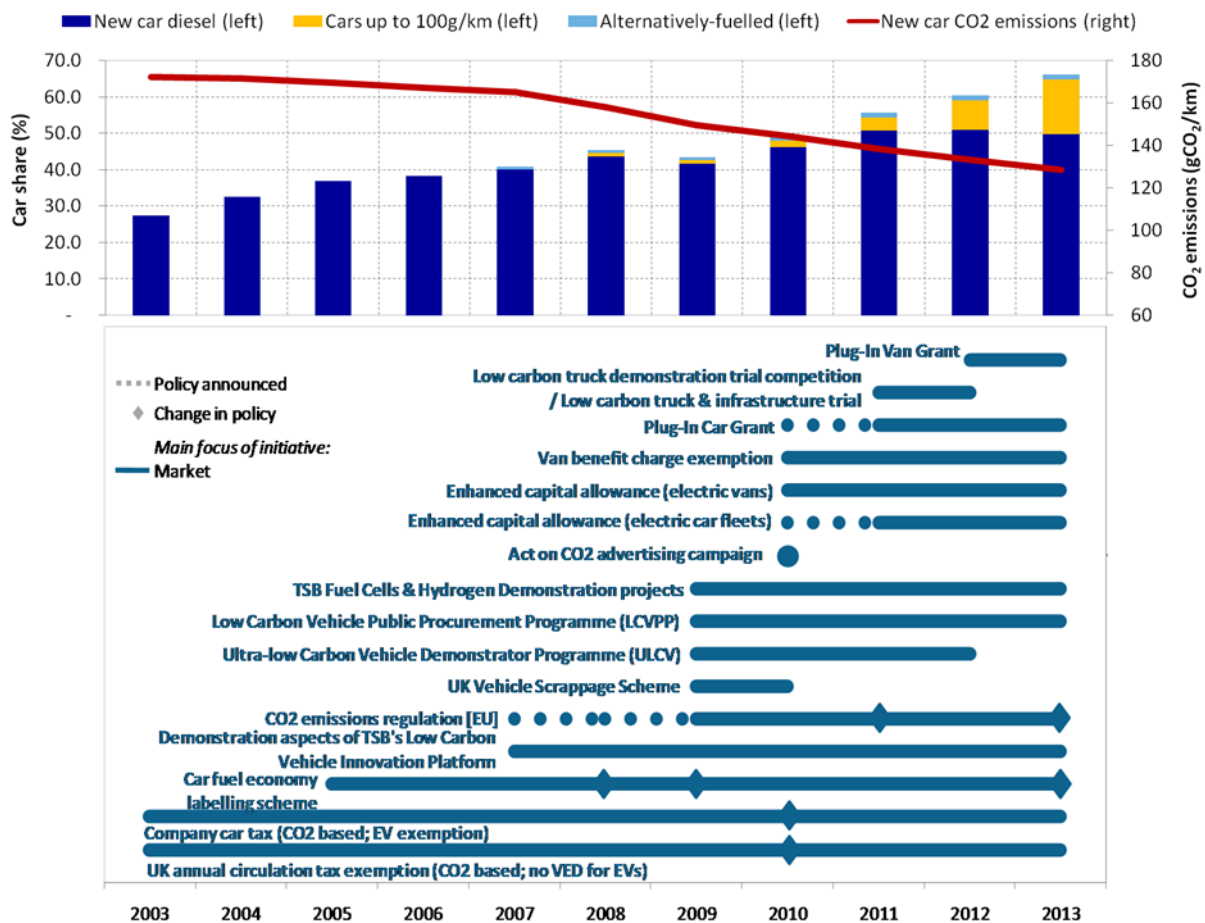


Figure 16: Pilot, trial and demonstration-focused policy and consumer-focused policy in the UK

Source: E4tech, ACEA 2013, SMMT 2012; 2013; 2014

The start of regulation and incentives for demonstration fleets are matched by a small increase in the vehicle parc for alternatively fuelled vehicles. While numbers remain small, the period from 2009 to 2013 shows growth of more than 100% on an annual basis. This is attributed not only to an expanding selection of vehicles from manufacturers, but also collectively to increasing public awareness stimulated by demonstration and pilot fleets, public policy support for these demonstration fleets, grant and tax incentives and public awareness campaigns. The Technology Strategy Board’s Ultra Low Carbon Vehicle Demonstrator programme, announced in June 2009, “set the pace for the UK as a world-leading test bed location. This ETI [Energy Technology Institute] project and the government’s £250million funding scheme for infrastructure investment and vehicle incentives are critical in maintaining and accelerating this momentum” (ETI, 2009), further Lord Drayson, then Science and Innovation Minister, said “we need to reduce our dependence on petrol- and diesel-based engines, and determine the best practical alternatives. But for electric cars to be a success we need to know how they perform in the real world. This project will help us do exactly that”.

This view was one shared by multiple survey participants throughout the supply chain. A prominent energy company noted that demonstration projects “allowed us to understand what was required to put a supply chain for procuring and installing recharging infrastructure in place and provided insight on customer behaviour and charging patterns which have influenced our customer offerings”, while

various OEMs commented that “the continued existence and expansion [of policy] is vital to persuading investors to support activity here rather than abroad”, “the information learned and interest in the project helped us and government better understand how to commercialise these vehicles in the UK and to understand the consumer journey, obstacles to overcome and behaviour expectations”, and “the general trend to low carbon commercial vehicles in the UK was the driving factor to introduce a trial/demonstration product”.

2.3.1.3 Low carbon public transport policy

“ Due to the cost premium to purchase hybrid buses we would not have invested in the buses we bought without Green Fund support. ”

Bus operator

“ Without positive public perception, aided by these structured long term campaigns which are clear and consistent, investment would be hard to justify. ”

Bus operator

Figure 17 reveals a gradual increase in annual carbon emissions for new buses until 2007 – perhaps due to emission control, rising weight and a rise in the number of (fossil-fuelled) buses. Correspondingly, the Bus Service Operators Grant (BSOG), known as the fuel duty rebate prior to 2000, was found to have stimulated a shift in public transport technologies. 2009 saw the introduction of a number of new policies to encourage low carbon public transport – including the Low Carbon Emission Bus (LCEB) certification scheme, the LCEB supplement to BSOG (6p/km for a certified LCEB) and the Green Bus Fund (GBF). These correspond with a significant annual increase in the number of hybrid buses in operation, and sustained carbon emissions reduction.

BSOG has been a crucial constituent of the reduction in operating costs and support for modal shift in public transport vehicles. In conjunction with the LCEB, bus operators and manufacturers have found BSOG useful for procurement citing: “BSOG allowance for low carbon certification drove our decision to procure low carbon certified micro-hybrid buses”, “a significant amount of investment has been generated as a result of programmes listed - BSOG is extremely important to bus operators”, and “changes in BSOG have made fuel saving technologies such as ours more valuable and credible as a means of saving money and demonstrating green credentials”. However, there is also criticism of the BSOG structure, in particular reference to technology bias. A prominent bus manufacturer noted that “with the current ‘yes/no’ definition of a LCEB, a technology that only just satisfies the requirement can attract as much funding as a technology that offers far greater benefit albeit at higher cost. The funding framework would in this situation tend to favour the lower performance products and gives little incentive to higher performance technologies”, while others stated that they “remain disappointed that a disproportionate share of this funding has gone to hybrid and electric buses”, and that “the effect of BSOG is very negative, as it subsidises the cost of diesel and elongates the payback time for fuel saving technologies”. The ‘subsidy of diesel’ through BSOG is actually a per-litre-of-fuel-consumed grant, but is perceived by some to reduce the competitiveness of fuel saving technology and alternative fuels. The BSOG LCEB supplement was introduced to compensate for this however.

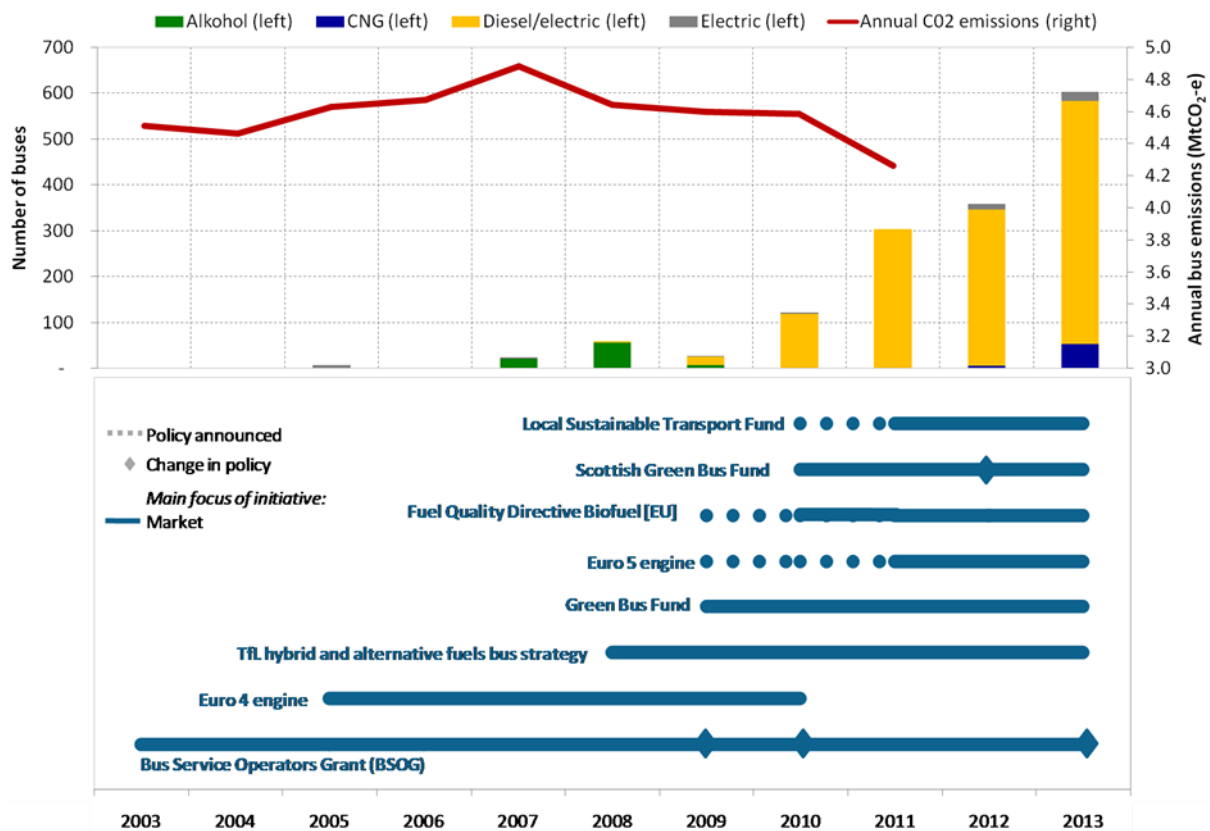


Figure 17: Low carbon public transport programmes in the UK

Source: E4tech 2014, SMMT 2014

Missing data points are not available

There is clear indication in the survey that the presence of both the LCEB supplement and, especially, the GBF have supported investment decisions. Respondents noted that: “the Green Bus Fund has been instrumental in providing the level of support to gain confidence in investment and help to develop the mass production market for cleaner vehicles”, “the various rounds of green bus funding have been very important in encouraging the update of low carbon technology”, “the Green Bus Fund in particular was the general driver towards us introducing a low carbon bus into the UK market”, and “Green Bus Fund has enabled the introduction of a considerable number of hybrid / low carbon vehicles ... with investment of over £7m as a result”. The Local Sustainable Transport Fund (LSTF) was also found to support investment, with one transport operator noting that “the availability of LSTF funding increased our investment in research and development”.

On the procurement side, the GBF has been positively viewed in general – especially in Scotland where incentives are higher than in England. Various bus operators noted the benefits, stating that “due to the cost premium to purchase hybrid buses we would not have invested in the buses we bought without Green Fund support”, “Green Bus Funding drove our purchase of hybrid double-deck vehicles, and we continue to monitor CBTF and other sustainable transport initiatives for relevant opportunity”, and “Green Bus Fund has allowed purchase of diesel electric vehicles to be undertaken, which otherwise would have been uneconomical”. Cumulative registrations of certified low carbon (mostly hybrid) buses reached 1,500 units by 2012 from a base of almost zero in 2009, a rapid rate of uptake. Operators noted that clarity on exemption of GBF from State Aid was welcomed

but took time, and that the rollout of the GBF in funding tranches makes it difficult to plan ahead. Another positive comment was: “The changes to BSOG (LCEB supplement) are helping bus companies to assess future lower cost alternatives of which low carbon options are amongst them. The Green Bus Fund has put some bus technology onto the roads which without grant funding would not have achieved that. It is evident by the fact that the UK is really the only place where hybrid buses operate.” (Consultant)

There is also seemingly a renewed interest in gas despite a strong opinion that there is little policy support for it. A number of gas-centric organisations noted in the survey that gas technology was somewhat excluded from the technology mix because “BSOG has made it almost impossible for alternative fuels to be competitive with subsidised diesel” and “at present the approach favours certain fuels over others and neglects the role that fuels like LPG can play”. However, another organisation noted that “the miniscule but growing recent DfT assistance for gas-powered vehicles (both natural gas and biomethane) has at last allowed a glimmer of work in UK on this option”.

R&D support has mostly been welcomed and appreciated by the UK bus operators and manufacturers, though with some significant provisos. Broadly, technology support from the Technology Strategy Board, and investment support from the relevant RDAs are most often cited as being beneficial, in some cases strongly so:

“These are excellent programmes that are well organised and well structured. We hope they continue.” (UK bus producer)

“The various rounds of Green Bus funding have been very important in encouraging the update of low carbon technology.” (UK bus producer)

“Without positive public perception, aided by these structured long term campaigns, which are clear and consistent, investment would be hard to justify.” (UK bus fleet operator)

The most significant reservations expressed in the bus sector concerned the problems of achieving comparability in technology assessments though there are also concerns over the way in which the GBF has been rolled out over time. However, recent developments by for example Wrightbus reveal the industry to be on the next stage of development beyond simple hybridisation and towards a more holistic approach to carbon reduction through systemic design changes. The GBF has arguably stimulated user interest in the potential of alternatives, and created an appetite for further improvement that could now be matched by new designs coming through.

2.3.2 Causal relationships between policy and investment

The crux of this study is a relationship between public policy and low carbon investment in the UK over the past decade. Figure 18, Figure 19 and Figure 20 summarise the call for evidence response over twelve different policy areas on the subjects of R&D investment; manufacturing, supply chain and skills development; and demonstration, rollout and uptake. Lessons can be drawn for the role that low carbon policies have played, as discussed subsequently.

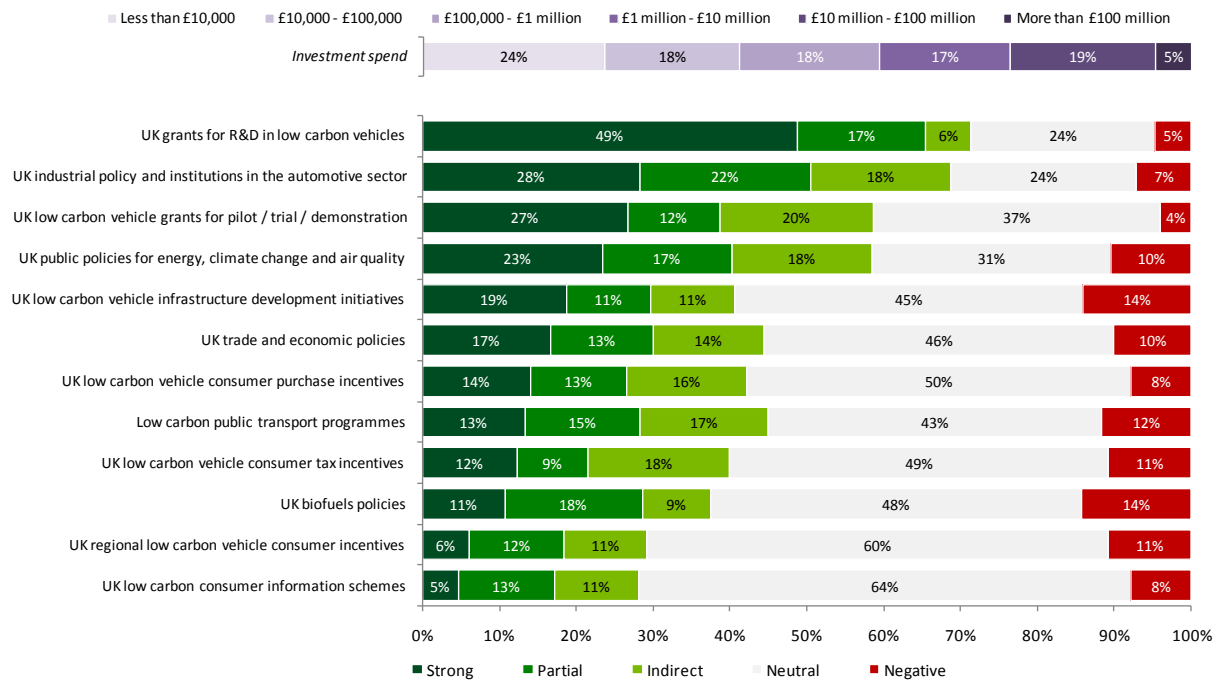


Figure 18: Influence of public policy on research and development investment

Source: E4tech industry survey, 2014

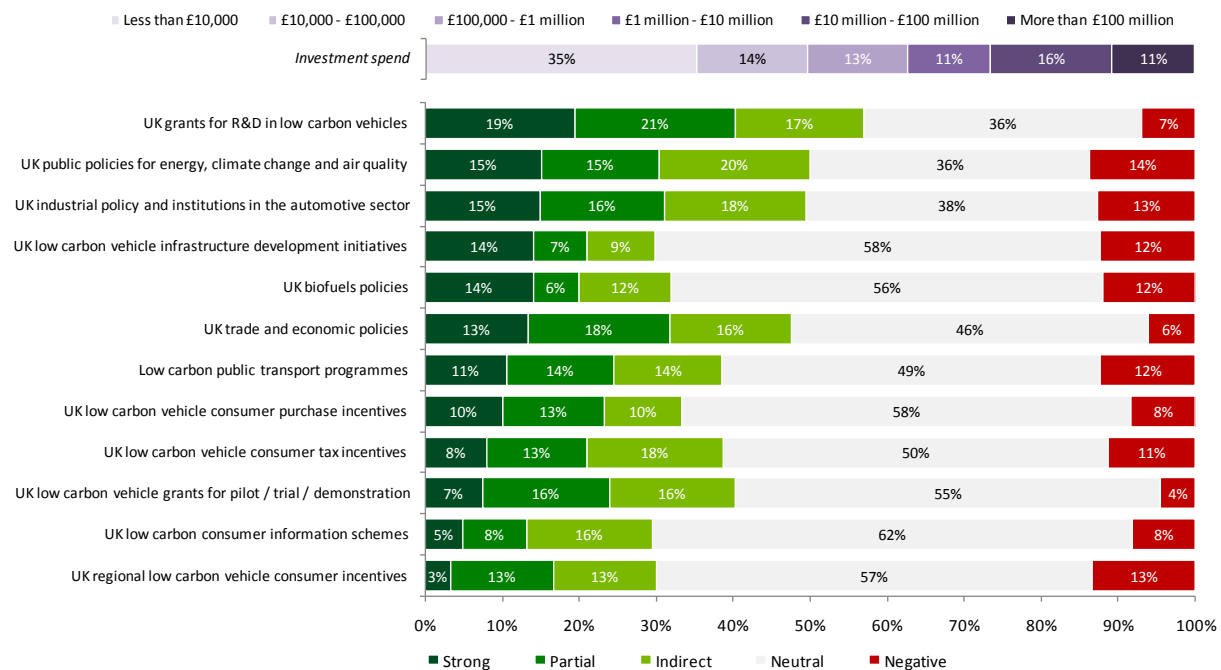


Figure 19: Influence of public policy on investment in manufacturing, supply chain and skills development

Source: E4tech industry survey, 2014

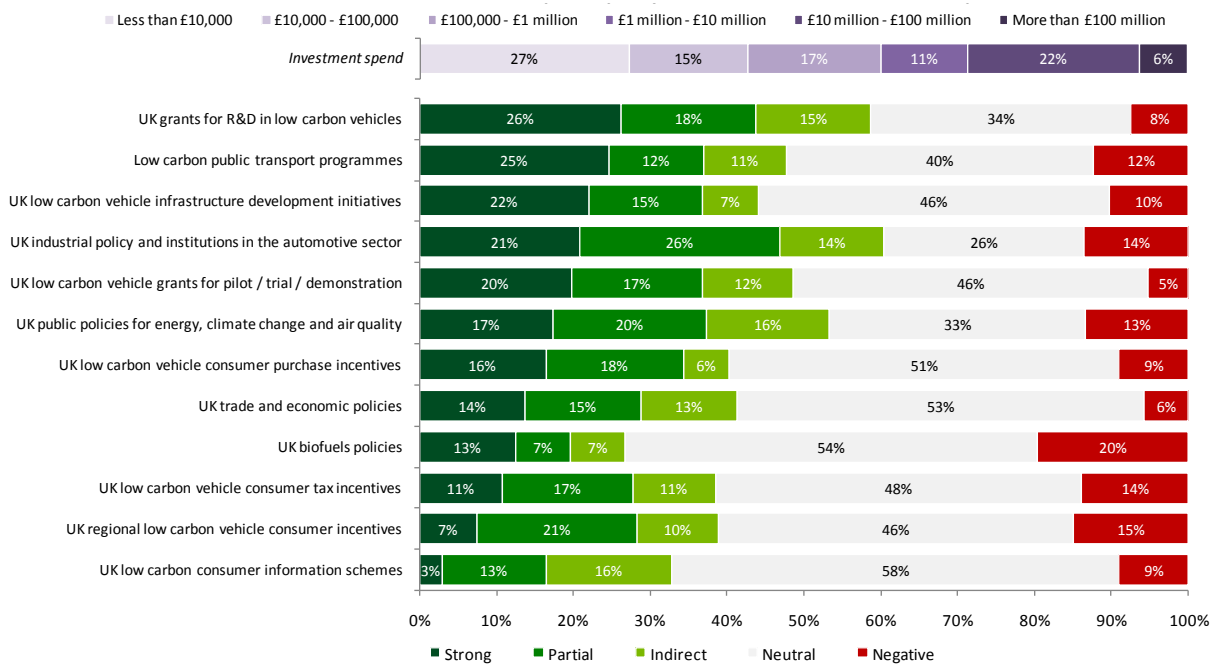


Figure 20: Influence of public policy on investment in demonstration, rollout and uptake

Source: E4tech industry survey, 2014

2.3.2.1 Research, Development & Demonstration policy

Overall, in R&D (Figure 18), each policy area saw positive impacts outweighing negative ones (combining indirect, partial, and strong positive together). The evidence also demonstrated an overwhelmingly positive response to the impact of low carbon R&D grants on R&D investment, with 49% of respondents reporting a strong positive influence, and a further 23% reporting an indirect or partial (positive) influence. Grants for low carbon pilot, trial and demonstration projects also scored clear positives with 27% of respondents reporting a strong positive influence, and a further 32% reporting an indirect or partial influence. In manufacturing, supply chain and skills development (Figure 19) this trend continues, with 19% ranking R&D grants as strong positive and 38% indirect or partial influence. Investment in demonstration, rollout and uptake (Figure 20) was again positively influenced by both R&D grants (26% strong positive, 33% indirect or partial positive) and pilot, trial and demonstration grants (20% strong positive, 29% indirect or partial positive).

The key messages relayed by the R&D and pilot/trial/demonstration scores are exceptionally positive. Respondents noted their appreciation for the coordinated and collaborative approach, valuing the partnership and networking opportunities as much as the grants. The Technology Strategy Board, its ancestors and relations like High Value Manufacturing Catapult and the Engineering & Physical Sciences Research Council, were repeatedly mentioned favourably as project enablers, although investor or self-funding remain key to activities and new funding models would be welcomed by academics. Respondents noted several examples of technology now in use, which would have not been possible without policy support. Further positives include R&D tax credits, and the opportunity for learning provided by trial or demonstration projects. Particularly with respect to bus operators, demo and trial support programmes were welcomed and seen as stimulating demand.

However, another key point was also availability of support not always being available when needed. The intermittency of funds was criticised by some, including larger players. A small number of SMEs also felt less supported or overlooked, particularly against larger players.

Whilst the evidence base for this study did not specifically focus on manufacturing, it is significant that the findings remain oriented towards R&D, product development, demonstration, and final assembly. The preparation for manufacture is a vital innovation step that was felt to be a critical UK challenge that will increase as innovation continues. The assumption that vehicle OEMs or Tier 1s will naturally address manufacturing challenges for newer technologies ignores the reality that most are headquartered outside UK, with the risk that technologies will be lost to the UK if they are acquired and readied for production in corporate R&D facilities.

It is likely that not all low carbon technologies will be refinements of ‘business as usual’ either in terms of the product / material technology involved or the manufacturing processes required. Some low carbon developments such as the latest generation Ford EcoBoost engines, although a significant advance in terms of carbon emissions, are not a great departure from existing engine manufacturing practice and to this extent the implementation of the technology into mass production is relatively unproblematic. Other low carbon developments such as battery electric drivetrains or carbon fibre vehicle structures are a major departure from mainstream contemporary industry practice, and thus the transition to mass production will inevitably entail higher uncertainty and risk. Industrial processes for these technologies may indeed exist, but in the particular context of the automotive industry with its unique cost reduction and high volume pressures there is much still to be learned and improved upon.

2.3.2.2 Industrial policy and general public policy

“ Government policy context and strategic goals and targets will have a role to play in the investment decision making environment. It may not be the determining factor - but it will be evaluated positively or negatively. ”

Major automotive manufacturer

Scrutinising the UK’s industrial policy and automotive sector-specific institutions (Figure 18), 28% of respondents reported a strong positive influence on R&D investment, with a further 40% citing a partial or indirect (positive) influence and 24% citing a neutral impact. Manufacturing, supply chain and skills development (Figure 19) showed a slightly lower strong positive influence (15%) but a higher indirect or partial influence (34%). There was also a notable negative influence (13%). This is primarily attributed to a generally negative perception of the transition from Regional Development Agencies (RDAs) to Local Enterprise Partnerships (LEPs). Respondents noted that “collaborative project investment... have diminished with the demise of the RDAs”, “the loss of a strong and focused RDA that has been replaced by a LEP that is struggling to find its way has led to a hiatus in funding and development”, and “replacement of RDAs with LEPs was highly negative to begin with because it took away momentum”. The transition is discussed further in section 3.1.1.

Demonstration, rollout and uptake (Figure 20) reported a strong positive influence of 21%, an indirect or partial influence of 40% and the highest negative influence of the three at 14%. In supporting their quantitative scores, respondents noted that consistency of government support,

including a strong policy framework and commitment to low carbon, had been vital – from R&D through to commercialisation. Notable support was obtained from the Technology Strategy Board, OLEV, Automotive Council and other funding sources. Respondents also highlighted that the UK provided a good rollout environment – with early market support. However, a number of SMEs also felt less supported or overlooked, particularly against larger players and if offering a technology not related to electric vehicles.

Comparing more generalised UK public policy, including that focused on energy and climate change, to vehicle-specific sector policy, there is a clear impact. R&D investment (Figure 18) was driven by positive or indirect influences totalling 58%, with positive or indirect influences on manufacturing, supply chain and skills development investment (Figure 19) totalling 50%, and a slight negative influence of 14%. Demonstration, rollout and uptake investment (Figure 20) showed positive or indirect influences totalling 53%, and a slight negative influence of 13%.

Respondents commented that in general, high level policies set the backdrop for investment. Although not always directly influential, they raised investor and buyer awareness, and set frameworks for more direct policy. Specific regulation was found to be very influential on reducing carbon emissions and improving air quality, though climate change and air quality showed potential for conflict. Several negative comments were made on increased dieselisation, which may have discouraged UK fuel investment – however ultra low emission vehicles (ULEVs) and zero emission vehicles (ZEVs) can meet both needs. The EU’s general focus on dieselisation as a route to efficiency has greater potential for conflict with air quality than that of other global markets such as Asia and US where gasoline hybrids are more favoured (offering huge combined volumes). A further issue which is felt to discourage investment is grid decarbonisation – where some respondents felt decreasing confidence, and a weakening of general climate change policy.

There was also a strong reaction to low carbon fuel policy, particularly biofuels which are discussed in section 3.2.

2.3.2.3 Consumer-centric policy

“ Consumers drive demand and manufacturers respond. This creates opportunities for research - it is indirect, but important. ”

Technology developer

When considering the impact of consumer-centric policy, including both national and regional initiatives, the majority of respondents in the call for evidence answered that across the board, investment due to these policies was neutral (Figure 21), though this may to some extent reflect the different position in the value chain of those respondents. For all policy categories the total positive responses also far outweighed the negatives. In all three investment areas, low carbon consumer purchase incentives showed the highest direct positive influence while consumer information schemes scored notably less. Both consumer tax incentives and regional consumer incentives were also showed to have comparably high negative influences on investment, despite being outweighed by the positives.

In support of the above, a number of interesting points emerged from the commentary. Various stakeholders noted that purchase grants and tax incentives have added to business cases and given

confidence to invest – in some cases attracting multinationals to UK investments. The positive impact of long-term policy was emphasised, “in order to develop a more mainstream market for low carbon products a package of financial measures and tax treatments... will continue to have an important role to play in the encouragement to the private and business consumer”. Further, the importance of consistency was also noted, “Frequent changes reduce incentives to invest. Investment requires consistency in support (for example 0% VED for EV guaranteed during the five year life of the vehicle)”, while another said that “Inconsistencies in Capital Allowance (e.g. exclusion of lease and hire vehicles) constrains adoption of ultralow emission vehicles. Aggressive increases in CCT [Company Car Tax] rates for ULEVs damage drivers' and operators' confidence in the long-term financial benefits of acquiring and running these vehicles”.

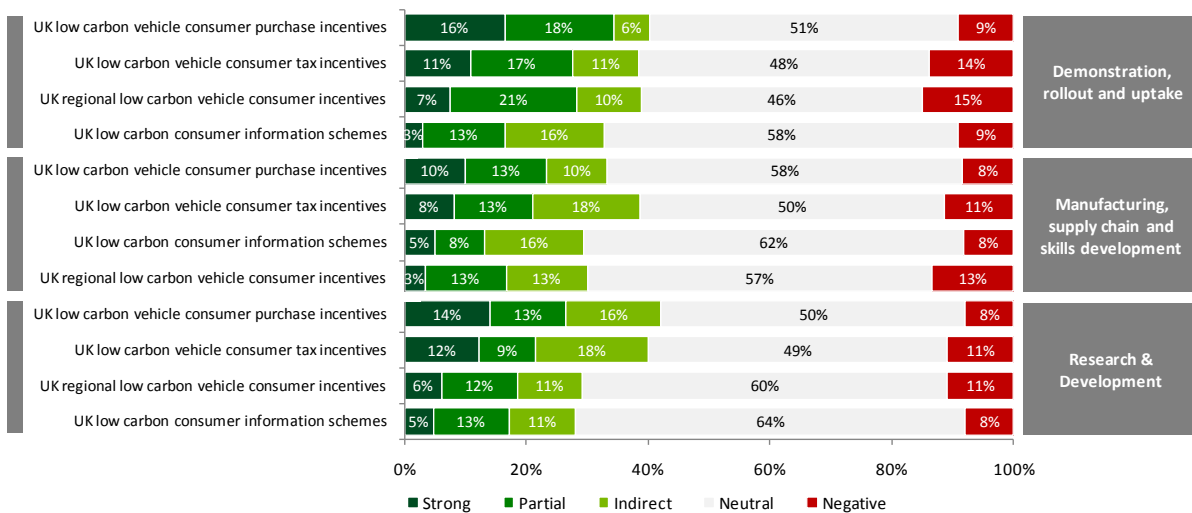


Figure 21: Influence of consumer-centric policy on low carbon investment

Source: E4tech industry survey, 2014

Concerns were raised with respect to consumer information – some commended this area for consistency and felt it was important to create consumer awareness, while others were unsure of its impact, and some felt that it supported moderate evolution rather than step changes. Government support for electrification was also criticised by some, arguing that it limited holistic, real impact and that money would be better spent on more universally applicable measures.

Regionally, respondents felt that while initiatives such as the London Congestion Charge and free parking for ULEVs strengthen the consumer’s purchase case and vehicle resale values, they were unhappy with the inconsistency in application and the lack of replication beyond London. Further inconsistency was noted in relation to infrastructure, for example charging standards and inconsistent implementation, although various multinational OEMs did cite this infrastructure as conducive to investment.

Overall, the policy bias towards light duty vehicles, in particular electric vehicles, and an absence of similar support for commercial vehicles, retrofit technology and alternatively-fuelled vehicles, was also strongly criticised.

2.3.2.4 EU policy

“ At the highest level, the creation of a level playing field by the EC was extremely helpful. ”

Automotive manufacturer

The focus of this study is the UK, considering the impact of UK public policy on local investment over the past decade. However, it is difficult to ignore the impact of EU policy at large on this investment as overarching EU Directives impact UK policy, but also as other European countries’ policies may create stimulus for a UK investment. Nevertheless, it is outside the scope of this research to consider these ramifications, save for a handful of policies which have had a definitive impact.

A particularly important EU policy to date has been the introduction of a binding CO₂emissionstarget for new passenger vehicles in 2009, and vans in 2011. Across EU this has led to a decrease in emissions of about 4% per year. As one commentator noted “at the highest level, the creation of a level playing field by the EC was extremely helpful”. Following these regulations was the introduction of a number of UK incentives, mainly via OLEV, aimed at promoting the purchase and use of lower emitting vehicles. The initiatives included changes to the vehicle excise duty (VED) and company car tax, awareness schemes, and grants for purchasing an electric vehicle. At a higher level, these regulations have stimulated the UK’s ambition to be a low carbon leader and catalysed the availability of funds from organisations such as the Technology Strategy Board for further investment within the UK. In 2013, after intense discussions, both EU regulations were extended to include binding targets for 2020.

2.3.2.5 Infrastructure

“ These (charging infrastructure) initiatives were important to our parent’s decision to make the UK one of our early markets for introduction of electric vehicles. ”

Major automotive manufacturer

The impact of initiatives related to low carbon infrastructure development within the UK has been perceived as a very positive contribution towards a low carbon transport environment. Between 19% and 22% of respondents reported a strong positive influence on investment across the board (Figure 22), particularly in demonstration, rollout and uptake. A negative influence was also felt by some, notably the gas fuels sector.

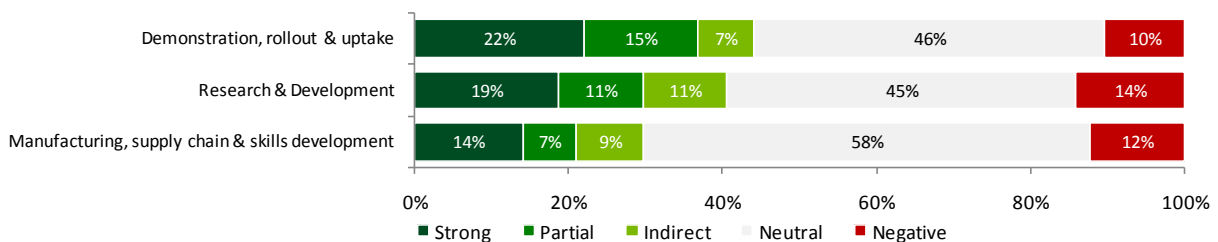


Figure 22: Influence of infrastructure development policy on low carbon investment

Source: E4tech industry survey, 2014

For electric vehicle charging infrastructure, the plugged-in-places scheme received positive responses all around, and was cited as having encouraged investment. One multinational OEM stated that “these (charging infrastructure) initiatives were important to our parent’s decision to make the UK one of our early markets for introduction of electric vehicles”, while another confirmed that “such schemes as UKH2Mobility and PiP [Plugged in Places] can have a demonstrable and important influence on vehicle rollout decisions in the early challenging phases”. Other residential charging schemes also received a positive affirmation, with one infrastructure developer noting that these not only allowed for a better understanding of recharging behaviour and retrofit challenges, but also that increased consumer demand served to bring costs down.

“ [UK H2Mobility] gave us improved confidence in solving the RD&D challenges and faith that the UK could establish a leading position. ”

Hydrogen technology developer

The UKH2Mobility scheme has also been positively received by the fuel cell and hydrogen sector. A prominent hydrogen technology developer noted that “its existence gave us improved confidence in solving the RD&D challenges and faith that the UK could establish a leading position”.

However, infrastructure schemes have not been without their teething problems. Inconsistency in electric vehicle charging standards and common technology has created a “patchwork system” and may present challenges in the long-term, “in several cases these initiatives are in early phases, but in some instances have over-sold and under-delivered. There is also uncertainty about the wider accessibility and future development of the charging infrastructure in London after the recent changes”. Separately, a criticism noted by the commercial vehicle industry in particular was the lack of infrastructure development support for gaseous fuels.

2.4 Confidence has been vital

2.4.1 Cumulative policy impacts

“ Investment decisions are always about more than incentives – policy and stability are vital. ”

Major vehicle manufacturer

Policy rarely acts in isolation, and the combined effect of several policies is often influential. A number of instances where cumulative policies have generated a positive impact were observed during this study. The first of these is R&D, in which growth was initiated by more joined-up and collaborative thinking, backed by consistent initiatives. This included the introduction of various bodies, notably the Technology Strategy Board, Automotive Council and OLEV. The Automotive Council roadmaps were arrived at through industry co-operation and were the basis of the Technology Strategy Board’s Integrated Delivery Programme of automotive research funding and latterly the funding calls of the Advanced Propulsion Centre. Confidence that an early stage

technology will have several opportunities to be supported through successive funding rounds, if compatible with the roadmaps and if viable, has been instrumental in encouraging UK low carbon R&D investments.

Another example of successful cumulative policy effects is in low carbon car uptake. Arguably there is still much room for growth, but a succession of measures with a clear low carbon message have promoted mainstream solutions and slowly seen the growth of alternatives in the market. The importance of long term consistency appears to have been recognised also by Treasury, since the launch of the Ultra Low Carbon Automotive Strategy in 2013 included a commitment to £500 million funding from 2015 to 2020 (for example allowing continuation of the £5,000 plugged in car grant until at least 2017).

There is a vital, yet subtle, positive feedback loop between inward investment and R&D, manufacturing and deployment policies. Some of the major manufacturing inward investment decisions have been influenced by “the right messages from government, for example Technology Strategy Board and OLEV” according one major company. This is not the same as a response to a request for government support since “lobbying has limited value, having an effect for 5 years at best”. Another commentator cited a major inward investment and their influential role of the UK’s “clear, consumer-led, technology agnostic pull for LowCVs thanks to vehicle taxation”. Similarly, a major vehicle company representative was asked if national R&D conditions influenced manufacturing location decisions—“there is not a direct causal link” he said“ but it does shift the odds significantly – a national technical presence loads the dice”. Given that the fortunes of the UK automotive industry are to a large extent determined by decisions taken in Japan, India, US and Germany (inter alia), this is an important message.

2.4.2 Government-industry dialogue

The interaction of government and industry is an important contributor to the success of any policy initiative. Whilst policymakers may be understandably nervous of ‘capture’ by an industry that is not aligned with the public interest, this should not be the case for industrial policy since the automotive industry is a major employer and provider of economic value. The economic crisis was a pivotal moment in the UK automotive sector, with both government and industry recognising the risk to jobs and the future of the industry, and ‘do nothing’ was not considered an option. The emergence of proactive industrial policy created a positive environment within which New Automotive Innovation and Growth Team and subsequently the Automotive Council could enable the industry to speak with one voice to government. It is telling that the Automotive Council has been emulated by several other automotive nations in recent years.

The Automotive Council survived a change of government in 2010 and its influence on investment continues to grow, inspiring confidence for the post-2015 election period. More recently, a number of structures, including the Advanced Propulsion Centre (APC) and the Automotive Investment Organisation (AIO) within UK Trade & Investment (UKTI), have been spawned to further support sector growth and attract inward investment. All have incorporated a collaborative structure.

2.4.3 Intellectual supply chain

A common theme that has emerged was the benefit of cooperation and collaboration between organisations, especially when the collaboration involved diversity of stakeholders throughout the

supply chain (as is typical in a consortium). It was noted that this type of interaction, by both small and large players alike, served to expand the knowledge base of all parties involved and also created more cohesive and successful project outcomes. One very experienced interviewee cited the skills that arise from such collaborations as more valuable than the R&D prototypes which are delivered.

2.4.4 UK position in Europe

“ A key challenge is to ensure that UK plays a strong role in Europe. ”

Industry body

The influence of UK trade and economic policy on investment showed a relatively high percentage of strong positive influence across the board (Figure 23). Further examination of the perceived impact of trade and economic policy in the UK showed that within the UK devolved assemblies and their support were found to be viewed positively. However, one of the most emphasised points across all sources of evidence was the critical importance of the UK's membership in the EU. In particular, access to valuable markets and skills. This is a view supported by other another recent study (commissioned by the SMMT), which showed that “92% of automotive companies said it was more beneficial to their business for the UK to stay in the EU” (KPMG, 2014).

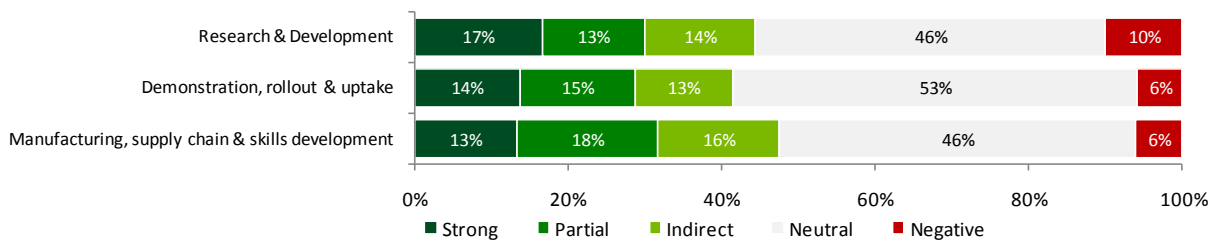


Figure 23: Influence of UK trade and economic policy on low carbon investment

Source: E4tech industry survey, 2014

Counter to this, less popular aspects of EU membership include exposure to the Euro, and perceived unfavourable employment law and work permits. Further, the negative impact of fragmented EU policy was also noted. This is particularly in relation to consumer policy, where products made popular in the UK due to incentives and grants may be less so elsewhere and vice versa.

3 Unclear signals – policy can also discourage investment

Despite the apparently upbeat message of the previous chapter, there is much to learn from situations where policy has not had successful results. Lack of clarity over the direction, duration and magnitude of policy can be a concern both for industry and consumers. Abrupt changes in policy such as the withdrawal of financial support or fiscal incentives can be particularly disruptive, while of course there must be changes of policy for many good reasons.

3.1 Not everything in automotive has gone smoothly

Policy-making is never a risk-free activity, and neither can policy outcomes always be as anticipated. External pressures or other factors can cause policy shifts that in turn undermine market confidence for consumers and suppliers alike. Nascent markets are often particularly sensitive to government policy; these markets may need to be nurtured through a transition phase to become self-sustaining, but the duration of that phase and the cost of underwriting it may be difficult to establish in advance.

The main potential problems with industrial support policies for low carbon vehicles are a) the technologies will not be sufficiently near to the market; b) efforts may be scattered over too broad a range of technologies and projects; c) there may be no parallel measures taken to nurture appropriate markets; or even d) the market incentives are in place but the technology programme is not. In the main, low carbon vehicle policies have thus far managed to avoid these problems, in no small part due to the way in which the Automotive Council, LowCVP and others have articulated industrial interests to government, and government has responded.

3.1.1 Abolition of the RDAs

Some concerns were expressed about the abolition of the RDAs and their subsequent replacement with LEPS. These concerns may be summarised by the view that there was no significant problem with the role RDAs played in the automotive sector, and in many cases there was a sense that they were doing a good job, while the replacement process was unnecessarily disruptive. As with other networks, the links between policy-makers at a regional level and their local industrial partners take time to establish, and the RDAs were clearly helping to fulfil a local need.

3.1.2 Bus sector concerns

Both the bus and the truck sectors had specific concerns with low carbon policies in the UK. Interestingly, there was some commonality in the perception of the operating environment in the UK. In particular, the prolonged period of comparatively high fuel prices in the UK had in turn stimulated greater interest in fuel economy than was evident from the large scale producers elsewhere in EU.

For the bus sector the Green Bus Fund has been important in helping to bring into use a large number of hybrid buses, and is restricted to 'Low Carbon Emission Buses' which are tested against a robust test procedure which allows comparison between different technologies. However, this is not the case for the whole bus market. There is no standardised duty cycle, designed around UK driving patterns and conditions applicable to all buses and technologies available to the bus market, on which vehicle emissions could be measured and compared, so it remains difficult to evaluate claims

for efficiency improvement for new technologies or components. Moreover, items such as hybrid systems are an issue where technologies have been added to vehicles that were not necessarily already optimised, particularly in terms of least possible weight. The bus sector, with some notable exceptions, uses mainly truck components to form the basis of a bus – and this might not be the most appropriate starting point. To illustrate, one major bus operator reported that it re-mapped the (truck) gearbox to suit their bus duty cycle, and readily obtained a 7-8% reduction in emissions. UK bus suppliers have been at the forefront of taking weight out of their designs, (e.g. Wrightbus launched their StreetLite Micro Hybrid with official Low Carbon Bus Emission Certification in September 2013). Volvo has also announced that in future all its urban buses will be using hybrid technology exclusively. The gradual removal of operational subsidies for EU operators would further stimulate interest in low carbon bus designs and technologies.

Similar concerns were expressed regarding the use of CNG in buses (and the use of electric vans), where there is no evidence base for systematic comparison of options to be made. As with the truck sector discussed briefly below, an important element in achieving low carbon performance in buses will be the operational practices adopted. For instance, the use of telematics to monitor driver performance can be a useful tool in identifying inefficient driving techniques and practices. Moreover, improving passenger miles per bus will make a genuine net contribution even when not captured by any certification process. On the other hand flywheels for buses were regarded as near ready for installation and with considerable low carbon potential.

Another difficulty in the UK is the fragmentation of bus operators, where few are large enough to venture into a new lower carbon technology alone. Funding and forward planning is a further concern, a prominent UK bus operator noting that “the funding framework tend(s) to favour the lower performance products and gives little incentive to higher performance technologies. The rollout of GBF as a series of individual fund announcements, without much forward visibility, has limitations in making it difficult for manufacturers to plan for investment in low carbon technologies and also for bus operators to align their fleet replacement programmes to GBF fund availability”.

3.1.3 Truck sector concerns

For the heavy truck sector the problems were rather different. One respondent pointed out that the funding was made available to develop hybrid truck engines through the Technology Strategy Board, but there was no market support mechanism put in place that would stimulate the uptake of the technology resulting in “a successful technology, but a commercial disaster”. For example, if hybrid trucks were given preferential access to central London it would have made a difference. As it is, technologies were successfully developed but the precise nature of the cost / complexity / emissions reduction equation meant that it was insufficiently attractive to fleet operators. Indeed, it was noted that the major carbon emissions reductions in the heavy truck sector are likely to come from operational changes to reduce empty running, heavier load limits (e.g. 60t) and reduced interruptions while driving on motorways.

The situation for heavy trucks was complicated by the Euro VI regulations and the need to meet the emissions limits without too high a penalty in terms of fuel consumption. Meeting the emissions targets was thus the main focus of truck engine development in recent years. In addition, truck operators have operational reliability as a primary concern, over and above the per-mile operating

cost. In this regard any novel technology introduction is viewed with some disdain by a conservative market, notwithstanding the occasional flagship project.

As a business-to-business industry, the truck industry has long been under pressure from its customers to improve fuel consumption and has therefore also been engaged for some time in effectively reducing carbon emissions. One respondent expanded, stating that “the biggest problem is the lack of set of tangible real life drive cycle tests for commercial vehicles....which would enable operators to clearly see which technologies deliver what for a set on-cost.” This is a question which needs to be addressed at EU level, as it has been for cars and vans, though it should also be noted that the accuracy of the test cycle is vital for its credibility. This is challenging in the context of commercial vehicles, whose configurations and duty cycles vary more widely than for light vehicles.

3.2 Biofuel investments have suffered from uncertainty

The study examined low carbon fuels as well as vehicles, though in practice the evidence base for many types of fuel was quite thin, but there was a good evidence base for biofuels. This section draws lessons from the UK experience of biofuels, looking more widely at other low carbon fuels where possible.

In contrast with the automotive sector, UK biofuel producers paint a gloomy picture of the influence that policy has played upon investments.

Figure 24 illustrates the timeline of biofuel-focused policy in the UK, along with liquid fuel consumption - petrol, diesel, together with gaseous fuel, and biofuel consumption (magnified by a factor of 10). Petrol and diesel have experienced broadly stable consumption over the past decade as efficiency gains have been offset by increased travel. Initially there was a steady growth in the use of LPG, which enjoyed short-term support, but this subsequently declined. Natural gas use has continued to fall over the past decade, though there is a recent renewed interest from the heavy duty sector. The introduction of the Renewable Transport Fuels Obligation (RTFO) in 2007 encouraged a steady, albeit small, increase in the use of biofuels. However, this was soon followed by a decline in biofuel (especially biodiesel) consumption.

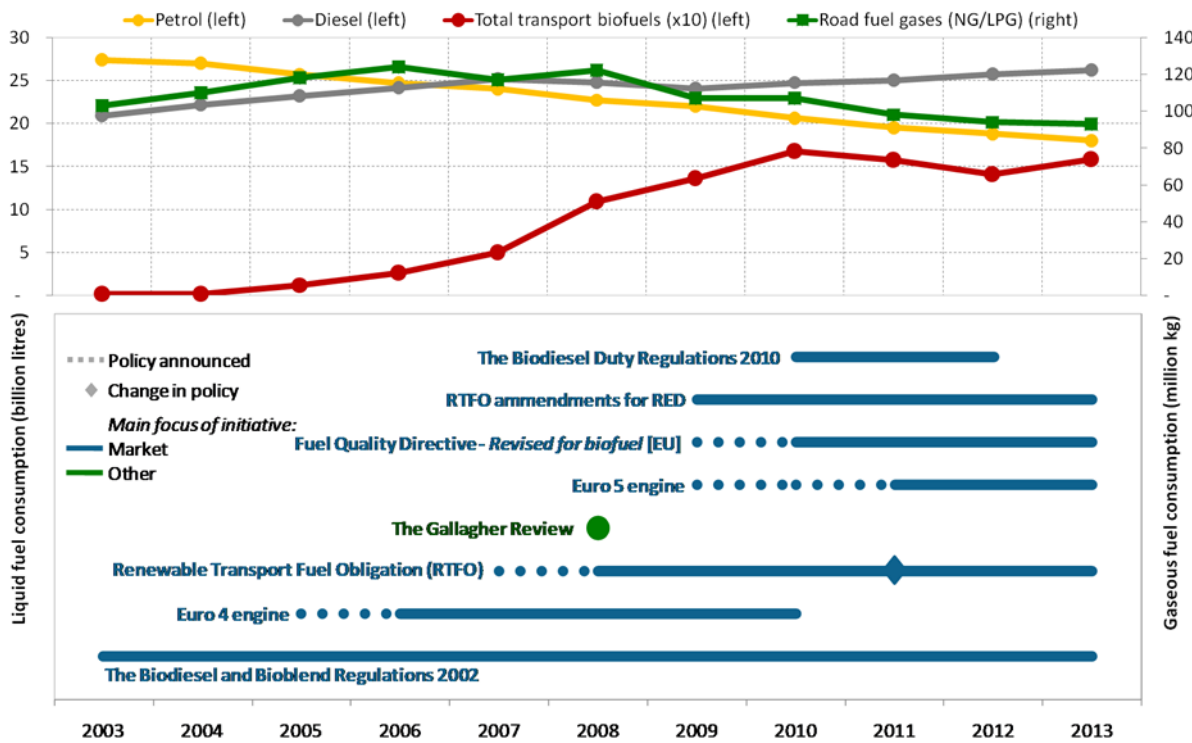


Figure 24: Biofuel-focused policy in the UK

Source: E4tech 2014, HMRC2014

3.2.1 Timeline of investment story

Out of a relatively mixed UK low carbon fuels picture in the early 2000s (featuring options such as hydrogen, electricity and gas fuels), biofuels emerged as the UK’s preferred option for the short to medium term. These were incentivised by the RTFO, which as one industry respondent expressed, “felt like progressive, sound regulation backed by sensible sustainability measures”. These initially positive signals encouraged investment: companies planned major investments based on a 2020 horizon, capital was committed, and production began.

However, the industry’s optimism was short-lived. According to respondents, several policy-related uncertainties emerged to damage investment. The first was the Gallagher Review in 2007, in response to concerns about the sustainability of biofuel feedstocks. These concerns led to a scaling back of the RTFO ambition and subsequently the Renewable Energy Directive (RED) at EU level, making the investment case for crop-based biofuels weaker. This situation remains effectively unchanged today, though recent EC announcements may improve the situation in the coming months. A second area of uncertainty arose as biofuel importers sought to exploit loopholes in the RTFO and RED, undermining the economics of domestic producers. The latter feel that these loopholes should have been addressed more rapidly by UK and EU policymakers than was eventually the case in 2009, which came too late to save some companies. A third uncertainty arose as the UK’s low carbon transport priorities appeared to shift towards electrification, with no clear vision for biofuels.

This uncertain investment climate, together with the removal of fuel duty rebates for liquid biofuels, had a “profound and negative effect on the economics of the liquid fuels sector”. Users and

operators suffered as a result. A fleet operator noted that “removal of biodiesel subsidies caused the market to effectively collapse overnight. Costs increased which in turn led to a major drop in demand and consequently the major suppliers to stop producing”.

3.2.2 Outlook for biofuels

The outlook remains negative for biofuels, as investors feel that there remains insufficient long-term support to justify the capital risks involved in biofuels. This contrasts with perceived positive support elsewhere, particularly in the USA – providing a more stable and investor-friendly environment. Also, no clear policy beyond 2020 creates uncertainty within the industry, “the absence of any indication on policy beyond 2020 is undermining the possibilities for investment, in particular for advanced biofuels”.

Interestingly, respondents disagreed on the subject of low-level mass blend biofuels compared with high-level niche blend biofuels, with vehicle companies tending to favour the former while operators seeking green solutions prefer the latter. However across the board, all parties criticised inconsistency and lack of long-term vision in biofuels policy as a show stopper for further investment.

Investors called for clarity on a range of factors, including whether the RED target would be enforced and what the UK’s position would be on E10 (10% ethanol blends) given the mixed experiences with introduction in other EU countries.

Going forward there is consensus that further government support, beyond just policy, is also required, “investment in new fuel types and low carbon vehicles has been fairly risky with no vision of long term support for implementation. Low carbon technologies will by their nature start out as low volume with a significant price tag compared to the conventional fuels and without stable implementation support either direct or via tax these become very risky. Therefore receiving R&D support de-risks some of the investment”.

3.2.3 General messages for fuels

“ We do not believe that the government’s support for other low carbon vehicles is misplaced and would not argue against support for emerging technologies and fuels, but believe that the government’s current silo approach to fuels policy is a key driver in any investment decision that we will take. ”

Gaseous fuel supplier

The general messages regarding consistency and certainty are common to vehicles and biofuels, so it is unsurprising that communities representing other fuels also made similar points. For example, biomethane sector respondents felt that current demonstration incentives favoured LNG, hybrid and electric propulsion to the disadvantage of biomethane, resulting in limited investment for this fuel. Certainty is needed for fuel infrastructure investments to take place ahead of vehicle market penetration– points that are central to the thinking behind EV charging infrastructure investments and the current H2Mobility initiative for hydrogen.

More broadly, there are several features of low carbon fuels which make a UK investment case particularly complex:

- The structure of the liquid fuels industry is very different to the automotive industry –this impacts both what stimulates UK investment and the consequences of UK investment. Today most fuels are blends of fuel components (mostly hydrocarbons with some biofuels). Not surprisingly the fuel industry (fuel manufacturers, blenders, distribution companies and retailers) will move quickly to optimise the cost of the blended fuel components sourced from both within and outside the UK. Thus UK Government policy actions can result in minor UK fuels manufacturing investment but significant imports (for example the large volumes of used cooking oil-derived biodiesel that are currently imported to the UK).
- Similarly, UK support for fuels innovation may lead to international spillovers since much of the fuels innovation community is outside the UK.
- Unlike automotive, the fuels industry is not labour-intensive. The fossil fuel refining and marketing industry is in structural decline due to generally increasing energy efficiency, yet the employment ‘crisis’ is more muted than was felt in automotive. Although the agricultural supply chain for biofuels is labour-intensive, this argument does not appear to be seen as a compelling justification for industrial policy in favour of UK biofuels.
- Fuel infrastructure investors face a first mover disadvantage due to underutilised assets, whilst automotive sector pioneers can build a market lead and charge a premium for early products.

Ultimately, the fuels and automotive industries are complementary parts of a single system – change often requires co-ordinated actions between sectors, taking consumers into careful consideration.

4 Recommendations for future policy

The UK automotive industry has performed remarkably well in a highly competitive international context. In part that performance can be attributed to the investments made by industry and government that have helped develop key new technologies and, as importantly, expand the scientific and technical capacity of the industry to face future challenges. There can be little doubt that the future of the industry in the UK, as with the rest of the EU, depends upon continuing productivity growth and the early deployment of new technologies (see Hill *et al.*, 2013). These factors in turn are strongly influenced by government policy. This section draws out key messages for policymakers in both low carbon automotive and fuels sectors, as summarised below and described in the sections that follow.

Stay on course:

- Automotive policy frameworks are mostly working well, in particular due to the sense of urgency as well as consistency of policy, which should not be allowed to diminish.
- There are other priorities but low carbon must remain a vital area of focus.
- Strong emphasis should be placed on the transition from low carbon technology development to manufacturing.

Address remaining automotive sector challenges:

- Attracting further inward investment, especially from component suppliers, would increase UK resilience.
- Future skills needs throughout the supply chain should be supported.
- Low carbon policies need closer alignment with air quality issues.
- A clear framework is required for commercial vehicle efficiency measurement and incentives.
- EU regulations play a key role in harmonising future vehicle CO₂ (and air quality) performance requirements and companies are keen to see the UK influencing this agenda.

Build confidence for the low carbon fuels sector:

- A collaborative approach is needed to define the outlook for automotive fuels.

4.1 Stay on course

There is always a balance to be struck between the need for consistency and the need to avoid the stagnation of ‘institutionalisation’ that can occur. The existing framework with the Automotive Council as the central pivot point of industry – government relations has clearly been working well and needs to be maintained. The automotive industry is one with long lead times and a necessarily conservative approach to product deployment, so policy longevity is an important prerequisite.

4.1.1 Maintain a sense of urgency

The unanimity of support for the Automotive Council and the anticipation over the role of the Automotive Propulsion Centre suggest that the overall policy-making framework is correctly structured resulting in policy that has been beneficial to the UK automotive sector. As with any institutional arrangements, however, it is important that self-critical renewal is important as a mechanism to guard against complacency and possibly the favouring of one possible trajectory over others in an unthinking manner. Above all it is vital to stress that the global automotive industry stands on the threshold of a far-reaching technological and business revolution in which the initial forays into low carbon vehicles are just the start. We are potentially witnessing not the demise of the automotive industry but its rebirth, and it is likely that the pace of technological and market change will accelerate further in the future.

On the one hand this means that the industry should not simply arrive at a long wish-list of support to request from government. What is needed is a precisely articulated strategy that builds on the success of the low carbon vehicle approach without unthinking resort to the next hype cycle (which the 2013 Automotive Industrial Strategy addresses). On the other hand it also means that government should not consider that the post-crisis era will be one of calm and prosperous serenity. On the contrary, as recovery gains momentum in the major competitor nations we can expect a renewed challenge over the trajectory that the industry globally will take in the future. The UK therefore must remain at the forefront of creating the market conditions that might support both innovative technologies (since no clear winner exist yet) and innovative business practices, alongside new forms of mobility, so that the global automotive industry will continue to regard the UK as being at the leading edge of change.

4.1.2 Keep a sharp focus on low carbon

A divergence of views emerged regarding the future direction of technology strategy for the UK automotive industry. Broadly views divided into the concern that low carbon remained a ‘work in progress’, and the concern not to be left behind in the next set of challenges facing the industry, for example, around the autonomous car concept. As the active participation of Google in autonomous cars has shown, this is a very different set of technology challenges compared with the powertrain and structures focus of contemporary low carbon initiatives, but one that could have profound implications for the future of the industry as a whole.

However the low carbon work is far from complete, given the long-term and highly demanding targets that the industry faces, including a virtual de-carbonisation of the UK fleet by 2050. The global market opportunities around low carbon technologies remain immense; while failure to capture these opportunities would be catastrophic for the long-term future of the automotive sector in the UK. Fundamentally the profitability of ultra-low carbon vehicles remains problematic, which is indicative of the work that remains to be done. In this context it is important to highlight the fact that government, in general, needs to take a longer term view than is customary in the automotive industry and carbon reduction will continue to be politically important for decades to come.

This work also extends to the technology diversification aspect of low carbon vehicles. A key theme to emerge during this study was the perceived preference for one type of technology above all others –electric vehicles. While not necessarily a negative, there is validity in the request for

consideration of the potential for other (currently less-supported) technologies – especially at an early research stage - throughout the supply chain of a technology. For example, one organisation remarked that they “make hydrogen refuellers and in the past had to develop the vehicles ourselves too (to demonstrate refuelling/mobility). So it's helpful that grants have existed for others to develop various types of EV and that grants exist for consumers at the points of purchasing. We now need something similar for [hydrogen] FCEVs”.

Several respondents noted the need for greater funding for the Technology Strategy Board, because many good quality low carbon R&D projects remain unfunded. Mention was also made, however, of the need to ensure Technology Strategy Board has a clear long-term vision and focus. As one industry respondent noted a key concern is: “...uncertainty over the size and long-term strategy for future funding.”

4.1.3 Pursue the journey through to manufacturing

While major investment has been made in low carbon vehicles in production, much remains to be done. The application of lightweight vehicle structures is still in its infancy outside of the motorsport and high performance cars segments for example, with multi-material structures likely to be a viable intermediary route. The championing of aluminium use by Jaguar Land Rover is recognised, but so too is the long lead time for the current position to be attained. A greater understanding is needed of the issues that prevent a transition to manufacturing, to establish where the risks are and how they might be mitigated. The work of entities like The Proving Factory and High Value Manufacturing Catapult are important in aiding the journey through to manufacturing.

Powertrain investments appear to be more ‘comfortable’ for most automotive industry participants, while the remaining aspects of vehicle design, production and assembly are less closely addressed. Investments so far by the Technology Strategy Board and related bodies have not addressed issues such as innovative business models as mechanisms to enable a rather different transition to market, for example.

4.2 Address automotive sector challenges

As is clear from the Automotive Council (2013), there is an understanding that the automotive industry is embarking on an unprecedented change in core technologies in a process that is far from complete. Building on the successes of the low carbon vehicle policies, and on government–industry collaboration, is therefore a priority that has already been recognised. The idea of sector focus, with the automotive industry as a primary example, has also been endorsed by the Confederation of British Industries (CBI, 2013).

One key step is the creation of the Advanced Propulsion Centre in which government and industry will invest around £1 billion over ten years from 2013. The intention is to reinforce and safeguard the UK expertise in engine design and production. Additionally the Automotive Council and the UK EPSRC (Engineering and Physical Sciences Research Council) will seek to align funding and research initiatives. Some interviewees highlighted the need for stronger ‘horizontal’ integration of efforts in this manner.

More broadly uncertain is the question of linkages to other sectors, notably rail, marine and aerospace. There is a recognition of potential synergies and overlaps in low carbon technologies, but also that these are rather different sectors in terms of their economic and business dynamics. Certainly some of the policy structures successfully applied to the automotive sector could be applied to others, and vice versa, but it is notable that previous efforts to nurture an automotive telematics R&D programme in the UK have not fared so well.

Also uncertain, and a potential area of concern, are the differing levels of interest between the SMEs in the automotive sector, and the major OEMs. One industry respondent observed that SMEs were more assisted by demonstration projects and transition funding that recognised the long lead times in the sector, whereas the major OEMs were more assisted by enduring regulatory and fiscal frameworks. In a related manner, there was some concern expressed that the Advanced Propulsion Centre should avoid being dominated by the major OEMs alone.

4.2.1 UK supply chain is incomplete

The concerns over the UK supply chain are hardly new, and despite a long history of initiatives they remain to a large extent. For those few companies that are UK-based the national market is relatively modest compared with their international profile: In the case of GKN, for example, some 94% of their market is outside the UK.

The establishment of the Automotive Investment Organisation in July 2013 as a component of the UKTI operation is the latest step in the attempts to bolster the automotive supply chain in the UK. It seeks to build on the gap in the UK industrial base that meant an estimated £3bn in unfulfilled demand for UK-sourced automotive components (Automotive Council, 2013; BIS, 2013). The Automotive Investment Organisation is supported with £3m in funding for the first two years.

The benefits of UK policy consistency for inward investment were highlighted in 2.4.1, resulting in vehicle manufacturers being prepared, over time, to place confidence in the UK as a manufacturing location. This should, in turn, provide a pull for supply chain businesses seeking to locate close to manufacturing. This is relevant for all areas of automotive, including low carbon, and a tight linkage between these messages should be promoted by Automotive Investment Organisation and others.

4.2.2 Skills are becoming a challenge

The value of the UK university sector as a source of educated and talented people has already been acknowledged in this report. It is important not to let this advantage be eroded. Additionally however there remain concerns over the future supply of skilled workers via various 'apprenticeship' type schemes. As one industry respondent observed, "The whole intellectual supply chain – academic talent-pool and its research - needs to be more strategically focused."

Skills shortages remain a key concern therefore. This general message also has a low carbon dimension, as the vehicles and fuels that decarbonisation will bring imply different types of capabilities: a shift from mechanical to electrical engineering; from liquid to gaseous fuel handling; from steel and plastics to aluminium and composites repair; from ownership to use-based selling; and so on.

4.2.3 Air quality - low carbon interaction is unclear

The contribution of low carbon policies to relieving air quality concerns has been underplayed. Urban air quality is a growing area of concern for many cities across Europe, with many episodes in which 'safe' levels of pollutants are exceeded. In some instances the balance between CO₂ and air quality needs to be better managed, and some products can be beneficial on both fronts. Noise is another feature that should be considered alongside CO₂ and, again, there may be synergies as well as trade-offs.

Looking ahead, greater clarity is required about the relative importance of air quality and CO₂ emissions, at national and local levels. This also relates to commercial vehicle and fuels policies, discussed below.

4.2.4 Commercial vehicle efficiency lacks incentives

On the commercial vehicle side, the requirements of recent Euro VI pollution emission standards were extremely demanding in terms of engine design, particularly if fuel economy were not to be unduly sacrificed. Some refer to a degree of perverse impact with Euro standards resulting in higher CO₂ emissions than would otherwise have been the case. The EC's framework for measuring and comparing commercial vehicle efficiency (the Vehicle Energy Consumption Simulation Tool, which is currently in development) is required. This in turn will provide a basis upon which fuel efficiency can be incentivised or enforced - an intention to regulate has been indicated by the EC. This will affect UK heavy vehicle manufacturers, including bus and coach makers, so close engagement is advisable. This should be taken forward with UK oversight from OLEV, the DfT Low Emission HGV Task Force and the LowCVP.

At a UK level, support for heavy vehicle low carbon innovation has not been followed by incentives for deployment. This should be remedied by congestion charge exemptions or fiscal incentives.

4.2.5 EU participation is important

As has been noted in this report and other research, there is a strong level of support for a continued and active UK role in the EU. In areas such as regulation (especially CO₂ emissions), R&D, single market type approval, cross-border movements and many other issues, the EU provides industry with a strong platform on which to plan and invest (see KPMG, 2014). In practice, with other key aspects of the business changing so quickly, the addition of another layer of complexity while the structures and rules of the EU (and the relation of the UK to the EU) are being renegotiated are an added risk industry would rather forego. More prosaically, the EU has also helped fund much of the research base (particularly in universities) that ultimately contributes to the intellectual capacity needed for the future automotive industry.

4.3 Build confidence for the low carbon fuels sector

Low carbon fuels have not been as rapidly adopted as more efficient versions of ICE vehicles, including diesels and hybrids. As the scope for viable efficiency gains of this nature diminish, the potential role of alternative powertrains and energy vectors (i.e. fuels and electricity) increases. However, the communities favouring different options are diverse and the options are for the most

part only compared objectively at OEM level. This is further complicated by the intersecting objectives of air quality improvement, energy security, the needs of other energy use sectors, and EU interests.

Given the plethora of options and the market failures inherent in low carbon fuels, there is a role for government as well as industry and other stakeholders in comparing and mapping out UK energy vector options for the future. Low carbon fuels currently do not benefit from the same clarity of outlook that automotive players enjoy thanks to the Automotive Council roadmaps. A partnership between government and stakeholders, ideally with an EU perspective, to define the outlook for fuels would be valued by the fuels and vehicles industries. More specifically, there is a strong appetite amongst the UK biofuels industry for greater clarity with regard to the role of biofuels with regard to the RED and also beyond 2020, which is an EU debate which the UK Government could usefully contribute to.

5 Outlook

This report identifies many things that have gone right, as well as some that have gone wrong. However, it is not a manifesto for complacency as the journey has really only just begun. The challenges of decarbonising road transport are enormous, especially as the UK seeks to capture a growing share of the industrial opportunities that this presents. Much work is still required to develop low carbon vehicles, fuels and technologies, and especially to manufacture them in the UK and deliver them to market. Through collaboration government and industry, along with other stakeholders, have made an important start on the journey. Continuing dialogue, support and action are required to ensure that UK industry can deliver upon future targets and build both a vibrant and sustainable industry and vehicle fleet.

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7 The Low Carbon Vehicle Partnership and authors

Low Carbon Vehicle Partnership

The LowCVP, which was established in 2003, is a public-private partnership working to accelerate a sustainable shift to lower carbon vehicles and fuels and create opportunities for UK business. Around 170 organisations are engaged from diverse backgrounds including automotive and fuel supply chains, vehicle users, academics, environment groups and others. The Partnership became a not-for-profit company limited by guarantee in April 2009.

The LowCVP plays a key role in helping government to deliver its low carbon transport strategy. The objective of the strategy is to ensure that the UK takes a leading role in the global shift towards low carbon transport. The activities of the Partnership are governed through a Memorandum and Articles of Association. The multi-stakeholder Board of Directors is responsible for the direction and outputs of the Partnership.

The Members Council, comprising a cross-section of stakeholders oversees the work programme and supports the Secretariat.

Five Working Groups focus on the main areas of activity and establish project teams for specific tasks.

The Partnership's work is coordinated by a permanent Secretariat headed by the LowCVP Managing Director, Andy Eastlake.

Disclaimer

This report was commissioned by the LowCVP and prepared jointly by E4tech and Cardiff Business School Centre for Automotive Industry Research (CAIR). E4tech and CAIR are internationally leading organisations with extensive expertise in sustainable energy technology, strategy, and policy. The work is the output of these organisations and does not necessarily represent the views of the LowCVP or its members. This report represents the two organisations' best judgment in the light of information made available.

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8 List of Acronyms

AFV	Alternatively-fuelled vehicle
AGT	Automotive Innovation and Growth Team
AIO	Automotive Investment Organisation
APC	Advanced Propulsion Centre
BERR	Business Enterprise and Regulatory Reform
BEV	Battery Electric Vehicle
BIS	Department for Business, Innovation and Skills
BSOG	Bus Service Operators Grant
CBI	Confederation of British Industry
CCT	Company Car Tax
CNG	Compressed Natural Gas
CO ₂	Carbon Dioxide
CPT	Confederation of Passenger Transport
DECC	Department of Energy and Climate Change
DfT	Department for Transport
EC	European Commission
EPSRC	Engineering and Physical Sciences Research Council
EU	European Union
EV	Electric Vehicle
F1	Formula 1
GBF	Green Bus Fund
ICE	Internal Combustion Engine
LCEB	Low Carbon Emission Bus
LowCV	Low Carbon Vehicle
LowCVP	Low Carbon Vehicle Partnership
LEP	Local Enterprise Partnership
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas

MPG	Miles per gallon
NAIGT	New Automotive Innovation and Growth Team
NG	Natural Gas
NGO	Non-Governmental Organisation
OEM	Original Equipment Manufacturer
OLEV	Office for Low Emission Vehicles
PHEV	Plug-in Hybrid Electric Vehicle
PiP	Plugged-in-Places
R&D	Research and Development
RD&D	Research, Development and Demonstration
RDA	Regional Development Agency
RED	Renewable Energy Directive
RTFO	Renewable Transport Fuels Obligation
SME	Small and Medium Enterprises
SMMT	Society of Motor Manufacturers & Traders
TfL	Transport for London
UK	United Kingdom
UKTI	UK Trade and Investment
ULEV	Ultra Low Emission Vehicle
VED	Vehicle Excise Duty
ZEV	Zero Emission Vehicle

Appendix 1: Call for evidence questionnaire



Investing in the low carbon journey: Lessons from the first decade of UK policy on the road to 2050

Call for Evidence

Thank you for your participation. The aim of this questionnaire is to gather evidence of how various aspects of public policy have impacted investment in low carbon vehicles and fuels in the UK. This will be used to inform recommendations for future policymaking in the UK. The results will also be published and presented at the annual LowCVP conference.

You will be asked to provide answers on:

- What kind of stakeholder you represent
- Your view on the impact of various public policies on your organisation's decision to invest (from 2003-2013)
- The type of activity that investment was directed at
- Areas where you feel that a type of policy was strongly influential

The questionnaire should take you about 15 minutes to complete. *Some of the questions will not apply to you and may be left as N/A.*

You may choose to remain anonymous, and we will not attribute any response to you without your approval. For further FAQs please [click here](#).

For further information on the study that this call supports, please [click here](#).

To download a basic PDF copy of the questionnaire, please [click here](#).

My response to this survey is:

- Official (on behalf on my organisation)
 Unofficial (in my personal capacity)

Please select the type of organisation you are from:

- Academic / education
 Engineering services & commercial research
 Fleet operator
 OEM / final integrator
 Public / government
 Supplier of components & systems
 Supplier / distributor of fuels
 Other: _____

What is the name of your organisation?

Are you currently employed by this organisation?

- Yes
 No

What is / was your job title in this organisation (as applicable to your answers in the survey)?

Please select the sector in which your organisation operates (select all that apply):

- Passenger cars
 Motorcycles, 3-wheelers & quadricycles
 Vans
 Trucks
 Buses
 Off highway vehicles
 Liquid fuels
 Gaseous fuels
 Electricity
 Refuelling / recharging infrastructure
 Other: _____

Please indicate the magnitude of your organisation's cumulative investment in the UK for each investment area from 2003 to 2013:

	Less than £10,000	£10,000 - £100,000	£100,000 - £1m	£1m - £10 m	£10m - £100m	£100m +
Research & development	()	()	()	()	()	()
Manufacturing, supply chain & skills	()	()	()	()	()	()
Demonstration, rollout & uptake	()	()	()	()	()	()

Definitions

There are a number of definitions that may be useful for accurately answering the questions in the survey. These cover:

- **Public policy** (what we mean by a policy)
- **Level of influence** (the level of influence that we will ask you to assess each policy against)
- **Investment** (what the investment was targeted at)

Please consider those investments in particular that have taken place between 2003 and 2013, and have been directed within the UK.

For a list of definitions, please click [here](#). This will open the definitions in a new window, so you will be able to refer to them throughout the questionnaire (please ensure pop-ups are enabled).

After reading the definitions please proceed to the next section where we will ask you to rate various policy types for their influence on your UK low carbon vehicle & fuel investment decisions. For each policy type, we have grouped together some illustrative policies or their manifestation as actions, but this is not an exhaustive list. You will have the opportunity to say more about each policy type if you wish.

Support to UK business

Please assess how influential each of these policy areas has been in terms of your decisions to make low carbon vehicle or fuel investments in the UK from 2003 to 2013.

For a popup list of definitions please click [here](#). For a quick reminder of definitions for policy?, investment?, level of influence?, low carbon vehicle?, and low carbon fuel? please hover over the ?next to each term.

1. Supporting the UK automotive sector

Please rate (on a scale of 1-5) how *UK industrial policy and institutions in the automotive sector* have impacted your investment in the UK in each investment area.

UK industrial policy and institutions in the automotive sector include:

- Foresight Vehicle Programme
- New Automotive Innovation and Growth Team (NAIGT)
- Automotive Council
- Office for Low Emission Vehicles (OLEV)
- Support to industry from Regional Development Agencies and Local Enterprise Partnerships
- Replacement of RDAs with LEPs

	1. Negative	2. Neutral	3. Indirect	4. Partial	5. Strong	N/A
Research & development	()	()	()	()	()	()
Manufacturing, supply chain & skills	()	()	()	()	()	()
Demonstration, rollout & uptake	()	()	()	()	()	()

Please elaborate on why UK industrial policy and institutions in the automotive sector were influential on your investment? Please mention any particularly important aspects of policies, and the magnitude of investment.

2. General public policy on business, trade and the economy

Please rate (on a scale of 1-5) how *UK trade and economic policy* has impacted your investment in the UK in each investment area.

UK trade and economic policies include:

- Employment law
- EU membership
- Euro non-membership

	1. Negative	2. Neutral	3. Indirect	4. Partial	5. Strong	N/A
Research & development	()	()	()	()	()	()
Manufacturing, supply	()	()	()	()	()	()

chain & skills						
Demonstration, rollout & uptake	()	()	()	()	()	()

Please elaborate on why UK trade and economic policy was influential on your investment? Please mention any particularly important aspects of policies, and the magnitude of investment.

Support to new technology

Please assess how influential each of these policy areas has been in terms of your decisions to make low carbon vehicle or fuel investments in the UK from 2003 to 2013.

For a popup list of definitions please click [here](#). For a quick reminder of definitions for policy?, investment?, level of influence?, low carbon vehicle?, and low carbon fuel? please hover over the ? next to each term.

3. Promoting research and development in low carbon vehicles and fuels

Please rate (on a scale of 1-5) how the UK's grants for R&D in low carbon vehicles have impacted your investment in the UK in each investment area.

UK grants for R&D in low carbon vehicles include:

- BIS (formerly DTI) Innovation Programme
- Technology Strategy Board Integrated Delivery Programme for low carbon vehicles / Low Carbon Vehicle Innovation Platform (LCVIP)
- RDA initiatives, e.g. Low Carbon Vehicles Technology (LCVT) programme and Premium Automotive R&D program (PARD) from Advantage West Midlands
- Energy Saving Trust
- EPSRC research
- ETI Transport programme
- Niche Vehicle Research and Development programme

	1. Negative	2. Neutral	3. Indirect	4. Partial	5. Strong	N/A
Research & development	()	()	()	()	()	()
Manufacturing, supply chain & skills	()	()	()	()	()	()
Demonstration, rollout & uptake	()	()	()	()	()	()

Please elaborate on why the UK's grants for R&D in low carbon vehicles were influential on your investment? Please mention any particularly important aspects of policies, and the magnitude of investment.

4. Promoting pilot, trial and demonstration programmes

Please rate (on a scale of 1-5) how the UK's low carbon vehicle grants for pilot, trial or demonstration projects have impacted your investment in the UK in each investment area.

UK low carbon vehicle grants for pilot / trial / demonstration include:

- Ultra-low Carbon Vehicle Demonstrator Programme (ULCV)
- Low Carbon Vehicle Public Procurement Programme (LCVPP)
- Demonstration aspects of Technology Strategy Board's Low Carbon Vehicle Innovation Platform and Integrated Delivery Programme
- BIS / Technology Strategy Board Fuel Cells and Hydrogen Demonstration Programme

	1. Negative	2. Neutral	3. Indirect	4. Partial	5. Strong	N/A
Research & development	()	()	()	()	()	()
Manufacturing, supply chain & skills	()	()	()	()	()	()
Demonstration, rollout & uptake	()	()	()	()	()	()

Please elaborate on why the UK's low carbon vehicle grants for pilot, trial or demonstration projects were influential on your investment? Please mention any particularly important aspects of policies, and the magnitude of investment.

5. Promoting low carbon technologies in public transport

Please rate (on a scale of 1-5) how the UK's low carbon public transport programmes have impacted your investment in the UK in each investment area.

Low carbon public transport programmes include:

- Bus Service Operators Grant (BSOG)
- Green Bus Fund
- Local Sustainable Transport Fund
- Clean Bus Technology Fund

	1. Negative	2. Neutral	3. Indirect	4. Partial	5. Strong	N/A

Research & development	()	()	()	()	()	()
Manufacturing, supply chain & skills	()	()	()	()	()	()
Demonstration, rollout & uptake	()	()	()	()	()	()

Please elaborate on why the UK's low carbon public transport grant programmes were influential on your investment? Please mention any particularly important aspects of policies, and the magnitude of investment.

Consumer and user uptake

Please assess how influential each of these policy areas has been in terms of your decisions to make low carbon vehicle or fuel investments in the UK from 2003 to 2013.

For a popup list of definitions please click [here](#). For a quick reminder of definitions for policy?, investment?, level of influence?, low carbon vehicle?, and low carbon fuel? please hover over the ? next to each term.

6. Promoting consumer and user awareness

Please rate (on a scale of 1-5) how the UK's low carbon consumer information schemes have impacted your investment in the UK in each investment area.

UK low carbon consumer information schemes include:

- Car fuel economy labelling scheme
- Act on CO₂ advertising campaign
- Go Ultra Low campaign

	1. Negative	2. Neutral	3. Indirect	4. Partial	5. Strong	N/A
Research & development	()	()	()	()	()	()
Manufacturing, supply chain & skills	()	()	()	()	()	()
Demonstration, rollout & uptake	()	()	()	()	()	()

Please elaborate on why the UK's low carbon consumer information schemes were influential on your investment? Please mention any particularly important aspects of policies, and the magnitude of investment.

7. Incentivising low carbon vehicle purchases through grants

Please rate (on a scale of 1-5) how the UK's low carbon vehicle consumer purchase incentives have impacted your investment in the UK in each investment area.

UK low carbon vehicle consumer purchase incentives include:

- Plug-In Car Grant
- Plug-In Van Grant
- Scrappage Incentive Scheme

	1. Negative	2. Neutral	3. Indirect	4. Partial	5. Strong	N/A
Research & development	()	()	()	()	()	()
Manufacturing, supply chain & skills	()	()	()	()	()	()
Demonstration, rollout & uptake	()	()	()	()	()	()

Please elaborate on why the UK's low carbon vehicle consumer purchase incentives were influential on your investment? Please mention any particularly important aspects of policies, and the magnitude of investment.

8. Incentivising low carbon vehicle purchases through taxation

Please rate (on a scale of 1-5) how the UK's low carbon vehicle consumer tax incentives have impacted your investment in the UK in each investment area.

UK low carbon vehicle consumer tax incentives include:

- UK annual circulation tax exemption (no VED for electric vehicles)
- Company car tax exemption (electric vehicles)
- Enhanced capital allowance (electric car fleets)
- Enhanced capital allowance (electric vans)
- Van benefit charge exemption

	1. Negative	2. Neutral	3. Indirect	4. Partial	5. Strong	N/A
Research & development	()	()	()	()	()	()
Manufacturing, supply chain & skills	()	()	()	()	()	()
Demonstration & rollout	()	()	()	()	()	()

Please elaborate on why the UK's low carbon vehicle consumer tax incentives were influential on your investment? Please mention any particularly important aspects of policies, and the magnitude of investment.

9. Regional / local incentives for low carbon vehicle choice and use

Please rate (on a scale of 1-5) how the UK's regional low carbon vehicle consumer incentives have impacted your investment in the UK in each investment area.

UK regional low carbon vehicle consumer incentives include:

- Exemption from central London congestion charge
- Free EV parking in various cities

	1. Negative	2. Neutral	3. Indirect	4. Partial	5. Strong	N/A
Research & development	()	()	()	()	()	()
Manufacturing, supply chain & skills	()	()	()	()	()	()
Demonstration, rollout & uptake	()	()	()	()	()	()

Please elaborate on why the UK's regional low carbon vehicle consumer incentives were influential on your investment? Please mention any particularly important aspects of policies, and the magnitude of investment.

Fuel, infrastructure and energy

Please assess how influential each of these policy areas has been in terms of your decisions to make low carbon vehicle or fuel investments in the UK from 2003 to 2013.

For a popup list of definitions [please click here](#). For a quick reminder of definitions for policy?, investment?, level of influence?, low carbon vehicle?, and low carbon fuel? please hover over the ? next to each term.

10. Promoting low carbon refuelling / charging infrastructure

Please rate (on a scale of 1-5) how the *UK's low carbon vehicle infrastructure development initiatives* have impacted your investment in the UK in each investment area.

UK low carbon vehicle infrastructure development initiatives include:

- Plugged-in Places
- H2Mobility
- ETI Transport programme
- London Electric Delivery Plan

	1. Negative	2. Neutral	3. Indirect	4. Partial	5. Strong	N/A
Research & development	()	()	()	()	()	()
Manufacturing, supply chain & skills	()	()	()	()	()	()
Demonstration, rollout & uptake	()	()	()	()	()	()

Please elaborate on why the *UK's low carbon vehicle infrastructure development initiatives* were influential on your investment? Please mention any particularly important aspects of policies, and the magnitude of investment.

11. Promoting biofuels

Please rate (on a scale of 1-5) how the *UK's biofuels policies* have impacted your investment in the UK in each investment area.

UK biofuels policies include:

- Renewable Transport Fuel Obligation (RTFO)
- The Biodiesel Duty Regulations 2010
- The Biodiesel and Bioblend Regulations 2002
- Government funding for biofuels demonstrators and manufacturing

	1. Negative	2. Neutral	3. Indirect	4. Partial	5. Strong	N/A
Research & development	()	()	()	()	()	()
Manufacturing, supply chain & skills	()	()	()	()	()	()
Demonstration, rollout & uptake	()	()	()	()	()	()

Please elaborate on why the UK's biofuels policies were influential on your investment? Please mention any particularly important aspects of policies, and the magnitude of investment.

12. UK policies on energy, climate change and air quality

Please rate (on a scale of 1-5) how the UK's public policies on energy, climate change and air quality have impacted your investment in the UK in each investment area.

UK public policies for energy, climate change and air quality include:

- Climate Change Act 2008 (80% reduction in greenhouse gases by 2050)
- Energy Act
- Congestion charging
- Other local air quality regulations and incentives

	1. Negative	2. Neutral	3. Indirect	4. Partial	5. Strong	N/A
Research & development	()	()	()	()	()	()
Manufacturing, supply chain & skills	()	()	()	()	()	()
Demonstration, rollout & uptake	()	()	()	()	()	()

Please elaborate on why the UK's public policies on energy, climate change and air quality were influential on your investment? Please mention any particularly important aspects of policies, and the magnitude of investment.

Miscellaneous

Other public policy

Please assess how influential this policy area has been in terms of your decisions to make low carbon vehicle or fuel investments in the UK from 2003 to 2013.

For a popup list of definitions please click [here](#). For a quick reminder of definitions for policy?, investment?, level of influence?, low carbon vehicle?, and low carbon fuel? please hover over the ? next to each term.

13. Other influential policies

Are there any other policies (not already covered) that have influenced your investment in low carbon vehicles or fuels in the UK?

Yes

No

Please specify the policy (name and/or description):

Please rate (on a scale of 1-5) how this policy has impacted your investment in the UK in each investment area.

	1. Negative	2. Neutral	3. Indirect	4. Partial	5. Strong	N/A
Research & development	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Manufacturing, supply chain & skills	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Demonstration, rollout & uptake	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Please elaborate on why this public policy was influential on your investment? Please mention any particularly important aspects of policies, and the magnitude of investment.

Please add any further information which describes the link between public policies and the UK low carbon automotive investments in the past 10 years?

Do you wish to remain anonymous during this survey?

- Yes
- No
- Maybe (information may be used with my prior permission)

Please indicate if a researcher may contact you to follow up on any answers you have provided in the questionnaire?

- Yes
- No

Please provide your name and contact details:

You may choose to remain anonymous. In any case no response will be attributed to any individual without approval.

Thank you for your valuable time in responding!

A summary of the study's findings will be presented at the LowCVP Annual Conference in July 2014.
Please see www.lowcvp.org.uk for further details about the event.



Appendix 2: List of respondents and interviewees

Organisation	Organisation
Abellio UK	John Lewis
Admeasure Technologies Ltd	JouleVert Limited
Aeristech Ltd	KeeResources Ltd
Alexander Dennis Ltd	Leyland Trucks
Arval	Liberty Electric Cars
Aston University	Libralato Ltd.
Autogas Ltd	London Borough of Hackney
AVL Powertrain UK Ltd.	Loughborough University
BAE Systems Hybridrive Solutions	Low Carbon Vehicle Technologies (LCVT)
BartCar	MAN Truck and Bus UK Ltd
BIS*	McLaren Automotive Limited
BiS Henderson Academy	Michelin
BP Alternative Energy*	Michelin Tyre PLC
BP International Ltd	Modec Ltd
BP / Vivergo	Motorcycle Industry Association
BRC (GB) Ltd	MTC
British Sugar*	National Express Bus
British Vehicle Rental and Leasing Association	Nissan*
Cardiff University	Oaktec
CAVT Ltd	Office for Low Emission Vehicles
Cenex	Optare plc
Center for Automotive Engineering, University of Brighton	Parliamentary Advisory Council for Transport Safety (PACTS)
Centro	Petrol Retailers Association
CNGServices Ltd	Productiv*
Commercial	Reading Buses
Controlled Power Technologies Ltd	Renewable Energy Association
DAF Trucks Ltd/ Leyland Trucks Ltd	Revolve Technologies Ltd

* A representative of the organisation was interviewed

Dearman Engine Company Ltd	Ricardo*
EDF Energy	Riversimple Ltd
Energenics Europe Ltd	Road Haulage Association
Energy Saving Trust Ltd	RouteMonkey Ltd
Expansion Energy Ltd	Scania GB
Far-UK	Smith Electric Vehicles Europe Ltd
First Group UK Bus*	SMMT*
Flybrid Automotive Limited	Stephen Plowden
Ford Motor Company	Sutherland Campbell International
FredStarr Ltd	Swansea University
Gas Alliance	Technology Strategy Board
Gasrec Ltd	The Green Liberal Democrats
General Motors UK Ltd	Toyota Motor Europe
GKN*	Transport for Greater Manchester
Go Ahead Group	TRL
Gordon Murray Design*	Tyndall Centre for Climate Change Research
Greenergy Fuels Ltd.	University of Birmingham
Greenwatt Technology	University of South Wales
Hardstaff Group	Vivergo Fuels
High Speed Sustainable Manufacturing Institute	Volkswagen Group United Kingdom Limited
ICDP	Warranty Direct
Impact Global Emission Solutions Ltd	We are Futureproof
Imperial College London	Weald Technology Ltd
Independent retired from Shell	Wellglade Limited
ITM Power	Which? Ltd
Iveco	Wrightbus Ltd.
Jaguar Land Rover	Zero-m Ltd

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