Introduction

The global market for low and zero emission vehicles is estimated to reach between £1 and 2 trillion per year by 2030, rising to £7.6 trillion per year by 2050\textsuperscript{1}. The UK remains in a strong position to capitalise on this but there are still issues to deal with. As shown by the 2018 Automotive Sector Deal\textsuperscript{2} the industry faces major challenges in how cars are built, powered and driven.

The UK’s automotive industry needs to adapt to maintain its position as a global leader. The Department for Transport’s recently published ‘Road to Zero’ strategy plans to put the UK at the forefront of the design and manufacture of zero emission vehicles. It also aims for all new cars and vans to produce effectively zero emissions by 2040.

Research and development will play a critical role in driving forward advanced technologies and strengthening the UK’s automotive industry and supply chains. Innovate UK continues to work to meet the aspirations of government and industry in leading the way on low and zero emission vehicle technology.

Since 2007, Innovate UK, through its funders the Department for Business, Energy and Industrial Strategy (BEIS) and more recently the Office for Low Emission Vehicles (OLEV), has built a programme supporting mid Technology Readiness Level\textsuperscript{3} (TRL) research and development projects that meet the following 3 aims:

- contribute to the growth of the UK automotive sector
- increase and accelerate the introduction of low and zero emission vehicle-centric technologies
- help the UK reduce CO\textsubscript{2} and other emissions caused by road transport

Our work across the automotive sector continues to be industry-led and is influenced by a wide range of leading stakeholders and partners. We support leading-edge low and zero emission vehicle technologies developed in the UK for the benefit of the home market and beyond.

Find details of current funding opportunities and apply online: [gov.uk/apply-funding-innovation](https://gov.uk/apply-funding-innovation)
In 2015 the ‘Low carbon vehicles innovation platform impact review’ explored the innovations and successes of 77 projects.

This 2018 edition looks at the next 119 projects, completed between July 2014 and December 2017. In total this represents £99.5 million of grant funding from Innovate UK and our funders, split between 300 industry participants.

This report explores the economic gains, social benefit and additionality (how far new developments add to and strengthen existing ones) of innovations in low emission vehicles, as well as the wider benefits of Innovate UK support. These categories help us to assess the impact on the UK economy, the automotive industry and the aims of the low and zero emission vehicle programme.

A total of 93 project participants, 31% of all those funded, responded to our questionnaire. We’ve collected and analysed the data, keeping the responses confidential. With input from the Department for Transport and using best practice on evaluating impact, Innovate UK’s Economic and Evidence team has built on what we learned from 2015, improving our data gathering and the robustness of our results.

£99.5 million of grant funding, split between 300 industry participants.

Projected economic impact

Profitability of low or zero emission projects could reach £1.9 billion over the next 10 years.

6,000 jobs created within 10 years

11,000 jobs created within 15 years
Innovate UK supports organisations involved in low and zero emission projects, helping them and the UK economy as a whole.

We asked all project participants about their expected sales and profit, achievable or realised, over a 15-year horizon as a direct outcome of their projects. We’ve included those where a £0 value will be achieved and we’ve also adjusted the data to account for deadweight, displacement and leakage.

Using turnover sales forecasts we looked at the return on investment (RoI) for 56 project participants, representing a total grant value of £42 million.

For every £1 invested in low and zero emission projects, our 2018 survey responses show that companies expect between £6.70 and £8.40 will be gained in the medium term (5 to 10 years).

Over 10 to 15 years it increases to between £17.80 and £22.60 and with the supply chain multiplier applied, it’s £10.90 to £14.70 in the medium term and £29.40 to £39.50 over the long term.

These figures are representative of those reported back in 2015. We carried out a sensitivity analysis assuming that sales persist for 12 years (rather than 15) in the longer term to see its variability. With the longer-term estimate, a range of £7.62 to £9.69 was produced.

Based on the overall sample size and responses over a 5 to 10 year period, the cumulative RoI contribution that Innovate UK’s support could reach is £400 million, rising to £999 million over a 10 to 15 year horizon.

Two thirds of participants said that the support had helped with sales, profit, product development and/or created opportunities in new markets. Only 14% of respondents didn’t expect to bring a new product, service or process to market.

Economic gains

RoI projections for every £1 invested

- Up to £8.40 RoI over 5–10 yrs
- Up to £22.60 RoI over 10–15 yrs

Cumulative RoI projections

- 5–10 yrs: £400 million
- 10–15 yrs: £999 million

Find details of current funding opportunities and apply online: gov.uk/apply-funding-innovation
Low emission vehicles: over a decade of support

Since 2007 Innovate UK, along with the Department for Business, Energy and Industrial Strategy and more recently, the Office for Low Emission Vehicles, has invested in a series of funding opportunities to support low and zero emission vehicle technologies.

| **468** unique organisations |
| **303** projects supported |
| **1,157** project partners |
| **£568 million** Industry and Innovate UK support |
| **£321 million** Grant funding to industry |

Economic growth and its wider benefits continue to be a critical success factor for Innovate UK.

We’ve used Net Present Value (NPV) to determine the profitability of the low or zero emission projects in this impact review. Taking sales projections from respondents into account and after adjusting for deadweight, displacement and leakage, £1.9 billion in value in 10 years is forecast.

NPV in 5 and 15 years also showed significant benefits for the UK at £0.4 billion and £2.7 billion respectively. These figures are based on the average project duration of 3 years with impact starting after this point.

These figures build on those reported in 2015 and demonstrate the confidence and positive outlook of organisations delivering new and innovate automotive technologies. Although research and development (as well as forecasting) remain sensitive, commentary from respondents suggests that future value will be delivered.

Forecast profitability of low or zero emission projects is £1.9 billion in the next 10 years.
Case study: Hieta

At the leading edge of additive manufacturing globally, Hieta is a textbook example of a scalable business growing from a two-man operation to over 50 employees in just 7 years.

It plans to take what was once a high-end, often niche application, through industrialisation to manufacturing at scale.

Technical director, Simon Jones, highlights the role of Innovate UK in Hieta’s success, helping to make the design and manufacture of complex thin-walled structures possible. This improves efficiency and feeds into the time and cost of overall vehicle manufacture.

“We would not have achieved this level of growth without the technology that underpins it, technology developed because of Innovate UK funding.”

The next breakthrough came when Hieta acquired its own machines through a continuing relationship with Renishaw. This meant it could manufacture parts that could be incorporated into prototypes. Innovate UK projects such as Mitre were key here, helping Hieta on its way to securing contracts, including those in the Formula 1 and energy sectors.

Exploring the wider benefits

The UK, and Hieta especially, is strong on additive manufacturing, but further research and development is needed to understand the potentially wider reaching benefits that this technology could have. In the automotive sector, Hieta is looking to take existing knowledge around heat exchange and processing magnetic materials to realise huge benefits in battery cooling and electric motors.

For Hieta, volume manufacturing is the near-term destination. A pilot production line planned for 2019 will support a number of customers and by 2022 to 2023 it will be able to produce automotive volumes for a number of products. The technology continues to evolve rapidly with both manufacturing time and cost reducing significantly, allowing the technology to supply existing markets while opening others. Simon notes:

“The biggest change in the last 3-4 fours years is where we’ve transitioned from being 80 to 90% grant funded to being 90% commercially funded today.”

Find details of current funding opportunities and apply online: go\v.uk/apply-funding-innovation
Private sector investment and capital expenditure

Moving an innovative product, service or process to market takes time and money, even when demonstrations of the technology have already taken place.

Continued research and development is also a key part of the process, helping organisations to realise the commercial potential of their innovation.

The majority of respondents (68%) suggested that they undertook further research and development at the conclusion of their projects. Innovate UK support is also helping automotive organisations to pursue and secure follow-on private sector investment.

Nearly 60% of respondents said their projects have provided a moderate to transformative impact on their ability to attract future private finance.

The projects have also provided the evidence needed to secure private sector investment as routes to market and exploitation of the innovation become clear. Twelve projects that responded to the survey, with a combined grant of £6.8 million, have already secured a total of £33.7 million in private investment.

When taking account of the cumulative capital expenditure a total of £10.9 million was reported from 25 projects at a grant of only £21.2 million.

These figures are limited by time following the conclusion of projects and do not include major original equipment manufacturer (OEM) investment and capital spend as an outcome of the projects they’re involved in, which may increase these figures significantly.

Twelve responding projects have secured £33.7 million of private investment

68% of respondents undertook further research and development following their projects
Case study: Ashwoods Electric Motors

Ashwoods Electric Motors, established in 2008, is a UK-based tier 1 motor manufacturer on the outskirts of Exeter.

Ashwoods developed a hybrid retrofit kit for light commercial use, before developing its own axial flux motor technology with the help of Innovate UK.

Funding began in autumn 2012, in conjunction with GSK, Lotus and Bath University to develop a complete electric propulsion system incorporating a motor, controller and gearbox. Further funding in 2013 alongside Tata and Bath University developed an on-engine generator, which formed the basis of Ashwoods’ interior permanent magnet motor (IPM). In 2014, together with Curtis Instruments and Caterpillar, this technology was refined and the company moved from automotive to off-highway markets. Nowadays, its key focus areas are materials handling, golf and lawn care, construction and marine.

After a project to integrate Ashwoods technology into proven drive systems, in 2016 and 2017 the company became strategic investment partners with Curtis Instruments and Oerlikon Drive Systems, in a move towards producing thousands of electric motors. Ashwoods is now a leading electric motor supplier, bringing new technology to a market that previously saw little innovation.

Moving to ‘Innovation Valley’

Ashwoods has seen exponential growth over the decade, beginning with only 3 full-time employees and growing to 62, with a plan for 80 in 2019 and up to 200 in 2020. The company also recently moved into its brand new £3.5 million facility on the outskirts of Exeter, a custom-built motor manufacturing facility enabling Ashwoods to supply motors in high volume to off-highway original equipment manufacturers (OEM).

Lloyd Ash, managing director of Ashwoods notes:

“Thanks to Innovate UK funded projects Ashwoods developed its IPM motor technology and transitioned from being a technology provider to a volume motor manufacturer.”

Find details of current funding opportunities and apply online: [gov.uk/apply-funding-innovation](http://gov.uk/apply-funding-innovation)
The government’s Industrial Strategy notes that “British businesses are good at creating jobs” and this is reflected in the impact of funding in the area of low and zero emission vehicles.

We asked project participants to forecast the number of jobs safeguarded and created as a direct result of their supported projects.

Taking leakage, displacement and deadweight into account, nearly 6,000 jobs could be created and safeguarded within 10 years. This increases to 11,000 within 15 years. When we include a multiplier to adjust for supply chain job creation this estimate rises to around 10,500 over 10 years and 18,900 over 15 years.

These 11,000 jobs by year 15 would be highly skilled, reflected in the nature of the work and the average salary reported – £50,000 in the medium term (10 years) and £66,000 in the long term (15 years).

Additional benefits will come in the form of development as an organisation and for the people who work there. Employee skills development and technical knowledge gained as an organisation was reported by 88% of respondents who experienced a moderate to transformative impact in these areas.
Innovate UK’s work across low and zero emission vehicles forms a key role in supporting technologies through the TRLs, with follow-on support available through the Advanced Propulsion Centre.

Funding is directed to innovations at levels 3–7, moving through proof of concept and demonstration. Project participants were asked to identify their TRL progression.

On average, an innovation developing through Innovate UK support moves up the TRL scale by 2.45 levels. A number of projects reported significant progression, including those that reach TRL 9 where the technology is being operationally used. The majority of innovations ended up at TRL 5 and 6.

Most of these innovations occurred as a result of Innovate UK funding – 73% of respondents indicated that their project would not have gone ahead without it. A further 20% said the project would still have happened, but more slowly and at a much smaller scale.

The outcomes of the projects would also be in doubt without the support provided. Sixty-four percent of respondents said that outcomes would probably or definitely not have been achieved. Ninety-two percent of respondents agreed that the support is not available anywhere else.

On average, an innovation developing through Innovate UK support moves up the TRL scale by 2.45 levels

92% agreed that the support is not available anywhere else

Find details of current funding opportunities and apply online: gov.uk/apply-funding-innovation
Lyra Electronics Ltd is a power electronics provider that customises its technology platforms for individual customers. A small, dynamic group of highly skilled engineers, Lyra focuses on building smaller, lighter and more efficient components, chargers and battery management systems.

Established in 2011, the company has grown from a one-man band to 12 full-time employees with a growth plan to reach 50 in the next 5 years. That’s a significant achievement given the shortage of highly skilled power electronics engineers in the UK. Peter James, co-founder of Lyra Electronics sits on a number of automotive board advisory committees and has led on helping local manufacturers gain skills in power electronics through research and development activities.

In 2014 to 2015, Lyra was awarded its first grant funding to develop a new active battery balancing system. The project goals were to increase the efficiency of battery balancing and maximise battery capacity. The project generated a pending patent and Lyra has since used the technology with several customers.

Build on its success so far

Lyra was further awarded grant funding for a full-electric aircraft baggage loader, a spin-off project that further developed its capability in battery management and battery pack design. Completed in January 2018, the next phase is to test, validate and move the technology into production.

Winning funding has helped increase both Lyra’s intellectual property portfolio and credibility with customers. It has created new opportunities with both existing and new customers, who are licensing Lyra’s technology in their products. Peter says:

“Innovate UK funding has significantly accelerated Lyra’s research and development capabilities. We now have new customers approaching us to license our technologies.”

Lyra is currently working on a range of customer projects as well as linking up with collaborative partners including universities for further research and development into power electronics technology.
Innovate UK drives productivity and economic growth by supporting businesses to develop and realise the potential of new ideas.

We connect businesses to the partners, customers and investors that can help them turn ideas into commercially successful products and services and business growth.

We fund business and research collaborations to accelerate innovation and drive business investment into R&D. Our support is available to businesses across all economic sectors, value chains and UK regions.

Innovate UK is part of UK Research and Innovation.

For more information visit innovateuk.ukri.org

References


3 Technology Readiness Levels - a tool to manage the progress of research and development activity within an organisation. There's more information at https://www.apcuk.co.uk/app/uploads/2018/05/TRL-levels-.pdf

4 Deadweight describes expenditure to promote an activity that would still have occurred without it. Displacement shows how far an increase in productive capacity promoted by government policy is offset by reductions in productive capacity elsewhere. Leakage means proportion of outputs that benefit those outside the intervention’s target area or group.

5 Multiplier effects relate to further economic activity (jobs, expenditure or income) associated with additional local income or local supplier purchases.


7 Figures exclude Integrated Delivery Programmes 3 and 5 as these competitions were completely funded by the Engineering and Physical Sciences Research Council.